KOÇ UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES AND HUMANITIES

Developing a Customizable Arm-worn Wearable Device Based on Gestural Controls for Pen-and-Paper Role-Playing Games

By

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

in

Design, Technology and Society Interdisciplinary Program

(Specialized in Interaction Design)

Koç University

August 2017

KOÇ UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES AND HUMANITIES

This is to certify that I have examined this copy of a PhD dissertation by Oğuz Turan Buruk and have found that it is complete and satisfactory in all respects, and that any and all revisions required by the final examining committee have been made.

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STATEMENT OF AUTHORSHIP

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ABSTRACT

With the integration of tangible and touchable surface technologies to gaming, a new game genre called "computer augmented tabletop games" emerged. These games combine the analog and digital and thereby augment tabletop games with computational power allowing new possibilities in gameplay and game experience while maintaining the tangible aspects of tabletop games. Tabletop Role-Playing Games (TTRPG) are also among the popular genres which were benefited from this augmentation movement. On the other hand, movement-based game play became another trending modality in game research. Development of the embodied interaction methods led to the commercialization of movement-based game play with the invention of game devices such as Wii, Playstation Move or Kinect. Research on this modality put forth that it engages player more in the digital games. Upon this, wearable devices, which can support movement base game-play seamlessly, attracted attention in game research and researchers speculated that these devices can boost the connectedness to imaginary worlds of games. Therefore, both these concepts are claimed to increase immersion and player/character relationship experience, yet they have been never considered as part of TTRPG where these two concepts are critical for an ideal game experience.

To fill this gap, we developed a *game system,* WEARPG, which incorporates *movement-based game play* supported by *arm-worn devices* and an augmented die. We believe that TTRPG provides an appropriate environment to test the effects of both wearables and movement-based gameplay on the immersion and player/character relationship. Moreover, TTRPG opens a new exploration area for movement-based gameplay, which is mostly focused on short-term and action-based games, in implementing it into the narrative-based long-term gameplay. Similarly, how to incorporate wearable devices in a way that can increase the immersion or player/character relationship is underexplored and TTRPG environment is promising to dig this subject deeper.

While developing WEARPG, we administer a research through design method comprised of participatory design workshop as a formative research phase to design an artifact and series of user tests in different states of the design process to understand the effects of arm-worn device and movement-based gameplay on player experience. To summarize our research process, we first *(a) organized a participatory design workshop with 25 participants including TTRPG players and game masters, cosplayers, interaction designers and jewelry designers, (b) extracted preliminary design implications with the data collected from the workshop, (c) designed a role-playing game system that can incorporate movement based gameplay and arm-worn devices, (d) test this system with Wizard-of-Oz method and experience prototypes, (e) extracted preliminary game design implications with the data collected from user tests, (f) improved the game system and developed a working prototype of arm-worn device and an additional device which will replace the dice, (g) tested this system in order to understand the effects of these concepts on the player experience, (h) created design themes about incorporating wearable devices and movement-based gameplay for narrative-based long-term games by satisfying user expectations.*

As a result of our study, we obtained design knowledge in different levels that can help designers about integrating wearables and movement-based gameplay to tabletop games. Moreover, we tested out these concepts with players to understand their effects on immersion and player/character relationship. Our feedback from participants shows that wearables and movement-based gameplay can really add up to player experience in terms of player/character relationship and immersion. As we anticipated, players reported that carrying a part of their character helped them to get into the role of the fictional character. Movement-based gameplay also provided a similar effect as most of the players identified their movements and effort in the real life with the effort of the character in the imaginary world. Still, a possible mismatch between player and character abilities can be problematic. Moreover, in long-term engagement, correct design for the placement of the movement-based play in the game is important for keeping players engaged. Our design themes highlight possible ways of overcoming these problems.

TEZ ÖZETİ

Dokunulabilir/tutulabilir ve masaüstü dokunmatik etkileşim modellerinin oyunlara entegrasyonu “bilgisayarla artırılmış masaüstü oyunlar” isimli bir oyun türünün ortaya çıkmasına öne ayak oldu. Bu tür oyunlar analog ve dijitali birleştirerek, bilgisayar gücü sayesinde yeni oyun stillerine ve deneyimlerine gebe olurken, masaüstü oyunların dokunulabilir doğasını da korumayı başaran bir tür olarak literatürde yer aldı. Masaüstü Rol-Yapma Oyunları (MRYO) da bu “artırma” tredinden yararlanan masaüstü oyun türleri arasında yer aldı. Masaüstü oyunlar tarafında bu gelişmeler yaşanırken, bir taraftan da hareket-tabanlı oyunlar, dijital oyun dünyasında popüler araştırma konularından biri haline geldi. Bedensel etkileşim modellerinin gelişimi, Wii, Microsoft Kinect ya da Playstation Move gibi araçların ortaya çıkmasını sağladı ve bu da hareket tabanlı oyunların ticarileşmesinin önünü açtı. Hareket-tabanlı oyunlar üzerine çalışan araştırmacılar, bu tür oyunların, dijital oyunlara karşı olan angajman/bağlılığı artırdığını ortaya koydu. Bununla birlikte, hareket-tabanlı oyun oynanmasını, oyun deneyimini bölmeden sağlayan giyilebilir cihazlara olan ilgi arttı ve araştırmacılar giyilebilir cihazların oyunun hayali dünyasına olan bağlılık deneyimini artırabileceğini öne sürdüler. Dolayısıyla, hem giyilebilir cihazların hem de hareket-tabanlı oyunun, MRYO için çok önemli olan içine çekme (immersion) ve oyuncu/karakter ilişkisini artırabileceği iddia edilirken, bu konseptleri MRYO ile bir araya getirmek daha önce hiç denenmedi.

Bu eksikliği doldurmak adına, masaüstü rol-yapma oyunlarında kullanılmak üzere, *hareket-tabanlı oyunu* destekleyen bir *kola giyilebilir cihazlar* ve *artırılmış bir zar* geliştirdik ve *yeni bir oyun sistemi (WEARPG)* tasarladık. Bu yeni MRYO ortamının, hareket-tabanlı oyun ve giyilebilir cihazların, içine çekme ve oyuncu/karakter ilişkisi üzerindeki etkileri gözlemlemek için uygun bir ortam yarattığını düşünüyoruz. Bunun yanında MRYO, daha önce genellikle kısa süreli ve aksiyon-tabanlı oyunlara yoğunlaşan hareket-tabanlı oyunu, uzun süreli ve hikaye-tabanlı oyunlarda kullanmak için de yeni bir keşif alanı ortaya çıkarttığına inanıyoruz. Benzer olarak, giyilebilir cihazların içine çekme etkisini ve oyuncu/karakter ilişkisini nasıl artırabileceği de yeterince bir araştırma alanı olmadığı gibi, MRYO bu konuyu da derinlemsine araştırmak adına uygun bir ortam sunuyor.

WEARPG oyun sistemini tasarlarken, öncül çalışma olarak katılımcı tasarım atölyesini içeren tasarım odaklı araştırma (research through design) yöntemi izledik. Bunun üzerine ise, masaüstü rol-yapma oyunlarında giyilebilir cihazların ve hareket-tabanlı oyunun etkilerini anlayabilmek için, çalışmanın farklı noktalarında, farklı niteliklerde kullanıcı testleri düzenledik. Araştırma sürecimizi özetlemek gerekirse, öncelikle (a) MRYO oyuncuları, oyun yöneticileri, cosplayerlar, etkileşim ve takı tasarımcılarından oluşan 25 kişilik bir ekiple bir katılımcı tasarım çalıştayı düzenledik, (b) bu çalıştaydan elde ettiğimiz bilgilerle öncül tasarım yönelimleri ortaya çıkardık, (c) bu yönelimlerden yararlanarak, hareket-tabanlı oyunu destekleyen giyilebilir cihazları içeren yeni bir MRYO sistemi tasarladık, (d) bu oyun sistemini öncelikli olarak deneyim prototipleri ve Oz Büyücüsü (Wizard-of-Oz) yöntemini kullanarak test ettik, (e) bu çalışmadan elde edilen bilgilerle öncül oyun tasarımı yönelimleri ortaya çıkardık, (f) bu bilgilerden yararlanarak oyun sistemimizi geliştirdik ve kola-takılabilir cihazları ve bununla beraber klasik MRYO’daki zar yerine geçecek bir cihazı implemente ettik, (g) bu sistemin oyuncu deneyimi üzerindeki etkisini anlayabilmek için 24 oyuncu ile oyun testleri düzenledik ve (h) hareket-tabanlı oyunların ve giyilebilir cihazların hikaye-tabanlı, uzun soluklu oyunlarda kullanımı ile ilgili tasarım temaları ortaya çıkarttık.

Yapılan bu çalışmalar sonucunda, farklı seviyelerde, MRYO’lar için giyilebilir cihaz ve hareket tabanlı oyun tasarlayacak tasarımcılara yol gösterecek tasarım bilgileri ortaya çıkarttık. Bunun yanında, bu konseptleri, oyun deneyimi üzerindeki etkisini anlayabilmek için oyuncularla test ettik. Oyunculardan aldığımız geribildirimler, giyilebilir cihazların ve hareket-tabanlı oyunun içine çekme etkisi ve oyuncu/karakter ilişkisine katkı yaptığını gördük. Beklediğimiz üzere, oyuncular karakterlerinin bir parçasını taşıyor olmanın, o karakterin rolüne girmeyi kolaylaştırdığını ifade ettiler. Hareket tabanlı oyun da benzer bir etki yarattı. Oyuncuların birçoğu, gerçek dünyada yaptıkları hareketler ve ortaya koydukları eforu, kurgusal karakterlerinin hayali oyun dünyasında yaptığı hareketler ve koyduğu eforla özdeşleştirdi. Yine de hayali karakter ve oyuncuların yetenekleri arasında oluşabilecek bir dengesizlik MRYO için problem yaratabileceğini gözlemledik. Ayrıca ortaya çıkardığımız sonuçlara göre, birden fazla oyun seansından oluşan uzun süreli oyunlarda, hareket-tabanlı oyunun oyun içine yerleşimi ile ilgili doğru tasarımı uygulamak, oyuncuları oyuna karşı ilgili tutmak açısından önemli bir nokta olduğu ortaya çıtkı. Oluşturduğumuz tasarım temaları, bu problemlerin üstesinden gelmek için uygulanabilecek yöntemleri de ortaya koydu.

ACKNOWLEDGEMENTS

I express my most sincere thanks to my advisor Oğuzhan Özcan for his every kind of support during my PhD Studies. He did not only guide me in writing this thesis and conducting research but also in every other imaginable way which makes my five-year PhD process worth-remembering. Other than my advisor, I also thank my dissertation jury members for their very useful critics and comments that helped me to bring this thesis to its final form. I also have to express my gratitude to staff and faculty members of Koç University, especially Tuğçe Şatana and Zeynep Aycan, who supported me and solved every kind of problems occurred during my research process.

This project is undertaken by a team and each of the members has important contributions in the final state of WEARPG which is the game system developed in the scope of this thesis. I am very grateful for the efforts of İsmet Melih Özbeyli who helped me with his great technical knowledge during the development of devices and the interface. He also showed a great competency in helping and supervising our interns. I also want to express my thanks to my interns Sanchit Bansal and Hira Shahzad Sardar, who helped us to take our first steps towards the development of the wearable devices.

Aside from the effort spent in the development of the game, we also put a lot effort in testing it. During these tests, İhsan Uygur moderated game sessions with his great story and story-telling abilities. Each game session lasted around 8 hours and İhsan was together with us in total of 80 hours. I thank him for this extreme effort and also for making our test sessions fun and exciting. Other than that, I thank all volunteers who participated in the process during our user tests and participatory design workshop. I especially thank Fatih Tepgeç, Atilla Filinta Abuşoğlu and Bulut Asutay for gathering teams and moderating game sessions.

Another extensive process in this project was the analysis of interviews. We had almost a 100-page interview data to be read and coded. I appreciate the works of Gizem Filiz and Alp Kahvecioğlu who undertook this work very swiftly and made the process very smooth for me. I also thank to Pınar Aldan who provided every kind of help in supervising the process and came up with magical methods and software which helped us to finish this part of the project quickly.

Other than all these great people who contributed to my thesis, I also thank all my colleagues in Koç University – Arçelik Research Center for Creative Industries for making my last five years a memorable one and providing the motivation for finishing this work.

DEDICATION

I dedicate this thesis to my fairy and wife Seda Suman. Seda was my great helper, supporter and many other kinds of -er which is very hard to express here. This five-year process was a very extensive and a tiring one and I am sure that it would not be so smooth without the existence of her. She did everything to remove the other burdens of life from my shoulders and undertook many things that was in my responsibility. She even kept my connection with my friends which let me to focus on my work but at the same time having a decent social life. Therefore, my last five-years was great due to her and I am very thankful for her to be here.

I am also very thankful to my parents Sevim Buruk and Mustafa Buruk for their supports and presence. They helped me to keep a calm state in all phases of this work and became my invisible security all the time. I also thank to my aunt and uncle, Fatma Aktepe and Orhan Aktepe, since they shared my happiness in my academic successes and supported me in every kinds of ways.

LIST OF PUBLICATIONS

Papers included in the PhD Dissertation

Paper 1: Oğuz Turan Buruk and Oğuzhan Özcan. 2017. User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games. Design, user experience, and usability. Theory, methods, tools and practice, 636–655.

Paper 2: Oğuz Turan Buruk and Oğuzhan Özcan. 2016. WEARPG: Game Design Implications for Movement-Based Play in Table-Top Role-Playing Games with Arm-Worn Devices. Proceedings of the 20th International Academic Mindtrek Conference, 403–412.

Paper 3: Oğuz Turan Buruk, İsmet Melih Özbeyli, and Oğuzhan Özcan. 2017. Augmented Tabletop Role-Playing Game with Movement-Based Gameplay and Arm-Worn Devices. Proceedings of the 2017 companion publication on Designing interactive systems: 289–292.

Paper 4: 1. Oğuz Turan Buruk, İsmet Melih Özbeyli, and Oğuzhan Özcan. 2017. WEARPG: Movement-Based Tabletop Role-Playing Game with Arm-Worn Devices and an Augmented Die. Proceedings of the ACM SIGCHI annual symposium on Computer-human interaction in play.

Paper 5 (Submitted): 1. Oğuz Turan Buruk, Pınar Aldan, İsmet Melih Özbeyli, Alp Kahvecioğlu, Gizem Filiz, and Oğuzhan Özcan. 2018. Wearing and Moving in Imaginary Play: Effects of Wearables and Movement on Tabletop Role-Playing Game Experience. Proceedings of the International Conference on Tangible, Embedded, and Embodied Interaction.

Related publications not included in the PhD Dissertation

Paper 6: Zachary Toups, Nicolas LaLone, Oğuz Turan Buruk, Joshua Tanenbaum, Aaron Trammell, Jessica Hammer, and Ansgar Depping. Augmented Tabletop Games Workshop. Proceedings of the 2017 ACM SIGCHI annual symposium on Computer-human interaction in play Companion - CHI PLAY '17 Companion.

Paper 7: Çağlar Genç, Oğuz Turan Buruk, Sejda İnal Yılmaz, Kemal Can, and Oğuzhan Özcan. 2017. Forming Visual Expressions with Augmented Fashion. Visual Communication. (In Press)

Paper 8 (Under Revision): Çağlar Genç, Oğuz Turan Buruk, Sejda İnal Yılmaz, Kemal Can, and Oğuzhan Özcan. 2017. Exploring Computational Materials as Fashion Materials: Recommendations for Design Process of Fashionable Wearables. International Journal of Design.

Side publications for research training

Paper 9: Oğuz Turan Buruk and Oğuzhan Özcan. 2014. DubTouch: exploring human to human touch interaction for gaming in double sided displays. Proceedings of the 8th Nordic Conference on Human-Computer Interaction, 333–342.

Paper 10: Mert Canat, Mustafa Ozan Tezcan, Celalettin Yurdakul, Eran Tiza, Buğra Can Sefercik, Idil Bostan, Oğuz Turan Buruk, Tilbe Göksun, and Oğuzhan Özcan. 2016. Sensation: Measuring the Effects of a Human-to-Human Social Touch Based Controller on the Player Experience. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems: 3944–3955.

Paper 11: Mert Canat, Mustafa Ozan Tezcan, Celalettin Yurdakul, Oğuz Turan Buruk, and Oğuzhan Özcan. 2016. Experiencing Human-to-Human Touch in Digital Games. Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems., 3655–3658.

Paper 12: Oğuz Turan Buruk and Oğuzhan Özcan. 2017. GestAnalytics: Experiment and Analysis Tool for Gesture-Elicitation Studies. Proceedings of the 2017 companion publication on Designing interactive systems: 34–38.

Paper 13: İdil Bostan, Oğuz Turan Buruk, Mert Canat, Mustafa Tezcan, Celalettin Yurdakul, Tilbe Göksun, and Oğuzhan Oguzhan Özcan. 2017. Hands as a Controller: User Preferences for Hand Specific On-Skin Gestures. Proceedings of the 2017 ACM International Conference on Designing Interactive Systems Conference, 1123–1134.

Paper 14: Hayati Havlucu, Mehmet Yarkın Ergin, İdil Bostan, Oğuz Turan Buruk, Tilbe Göksun, and Oğuzhan Özcan. 2017. It Made More Sense: Comparison of User-elicited On-Skin Touch and Freehand Gesture Sets. Distributed, Ambient and Pervasive Interactions: 5th International Conference, DAPI 2017, Held as Part of HCI International 2017, 159.

Paper 15: Eric P S Baumer, June Ahn, Mei Bie, Elizabeth M Bonsignore, Ahmet Börütecene, Oğuz Turan Buruk, Tamara Clegg, Allison Druin, Florian Echtler, Daniel Gruen, Mona Leigh Guha, Chelsea Hordatt, Antonio Kru, Shachar Maidenbaum, Meethu Malu, Brenna Mcnally, Michael Muller, Leyla Norooz, Juliet Norton, Oğuzhan Özcan, Donald J Patterson, Andreas Riener, Steven I Ross, Karen Rust, M Six Silberman, Bill Tomlinson, and Jason Yip. 2014. CHI 2039: Speculative Research Visions. Proceedings of the 2014 CHI Conference Extended Abstracts on Human Factors in Computing Systems, 761–769.

Paper 16: Oğuz Turan Buruk and Oğuzhan Özcan. 2013. Anything Left to Borrow From Cinema? Guidelines for Game Narrative. CONFIA: International Conference on Illustration & Animation

Paper 17: Adviye Ayça Ünlüer, Mehmet Aydın Baytaş, Oğuz Turan Buruk, Zeynep Cemalcilar, Yücel Yemez, and Oğuzhan Özcan. 2017. The Effectiveness of Mime-Based Creative Drama Education for Exploring Gesture Based User Interfaces. International Journal of Art & Design Education.

TERMINOLOGY

Tabletop Role-Playing Game: Tabletop role-playing games are played in a table top setting that relies on the social communication of the players. A tabletop role-playingr group usually consists of a game master and players (usually at least two). Game master is the moderator of the game and apart from that he is in the role of a story teller who creates the fictional world. Players assume the role of the fictional characters and guide them in this fictional world and perform some actions. Results of these character actions are usually determined via randomizers such as dice or cards.

Randomizers: Randomizer means the objects which are used for determining chance related factors. Cards or dice can be examples for randomizers.

Wearable Device: Wearable device refers to electronic gadgets which are worn or attached to different parts of the body. Smart watches or VR glasses can be examples of wearable devices. However, in this study it mostly refers to the Elemental Gauntlet, which is an "arm-worn" device developed for table-top role-playing games. Therefore, in this thesis, although some of our results can be applicable for other kinds of wearables, we refer to arm-worn devices by articulating "wearable devices".

Gameplay: The state that the game is played and elements which are related to ludic part of the game rather than the other parts such as narrative.

Immersion: Immersion means to be absorbed by the game's virtual world and to get unresponsive to the surroundings in real world. It is commonly associated with the player experience and its increase is seen as a positive effect for the experience.

Player/Character Relationship: It represents the link between the fictional character and the player. In other words, it is the level of player's identifying themselves as their characters.

Elemental Gauntlet: It is the arm-worn device which is developed in the scope of this thesis. It is designed to be worn during the tabletop role-playing gameplay.

Luck Stone: It is the randomizer designed in the scope of this thesis. Different from conventional randomizers it is augmented with computers and thereby has different properties due to its computational power.

Movement -Based Gameplay: Movement-based gameplay refers to a game state where players need to use parts of their bodies in order to play this game. This movement may refer to running around a game field as it is in hide and seek or only use a part of the body as it is in clapping games. In our thesis, movement-based gameplay refers to the games which are played by using the Elemental Gauntlet and the Luck Stone. Other than that, games in this thesis only require the movement of the upper body.

WEARPG: A new tabletop role-playing game system which is designed in the scope of this thesis. It incorporates movement-based gameplay, wearable (Elemental Gauntlet) and tangible (Luck Stone) devices.

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I
DISSERTATION

1. Introduction

With the development and the commercialization of embodied and tangible interaction systems in games, augmenting analog tabletop games became a trending topic in game research. These games, in the scope of Computer Augmented Games (CAG), led researchers to explore different modalities that can be used to augment tabletop games. Tabletop Role-Playing Games (TTRPG) are also among the popular games for augmentation and they also offer more distinctive characteristics by being narrative-oriented and requiring long-term engagement. There are many examples aiming at enhancing TTRPG experience in several aspects like improved sensory feedback, speeding up uncaptivating game processes and implementing new mechanics with opportunities granted by the computational power [4,10,16,18]. These improvements also work for leaving more space for role-playing by debilitating the conditions interfering with it. Moreover, increasing sensory experiences fosters the atmosphere, again resulting in a better experience [17]. Still, how to incorporate wearable devices and movement-based play in TTRPG was not studied in a deeper level although previous studies suggest that these concepts may perfectly fit to TTRPG environment since 1) wearables can be designed in a way that do not directly interfere with players' concentration, 2) can increase the connectedness to imaginary worlds by perceived as costumes [13,23] and 3) movement-based play can let players enact their characters with their bodies [23].

We believe, to test these arguments, we need to incorporate a research through design method where we include users in the design process from the very beginning to design and produce an artifact that integrates wearables and movement-based play into TTRPG in a *right* way. Therefore, we executed a seven-pillared research process which includes a (a) participatory design workshop, (b) design of a new games system (WEARPG), (c) preliminary user testing of WEARPG with experience prototypes [6] and Wizard-of-Oz method [3], (d) design and implementation of wearable and tangible devices included in WEARPG system, (e) user testing of the working prototype to understand its effect on immersion and player/character relationship and (f) forming design themes drawing upon our experience in this research process. In the following parts of this introduction, we will go into more detail about each part of our process.

The beginning point, participatory design workshop (Work Package 1), included 25 participants from 5 different stakeholders which are TTRPG players, game masters, cosplayers, jewelry designers and interaction designers. In this study, we wanted to (1) see users' reactions on positive and hindering parts of the wearable idea, (2) learn their preferences about the game actions to perform with this device, (3) understand their desires about the interaction techniques which refers to input and output methods (4) see their visual design decisions and (5) understand Game Master's role in controlling these devices. Upon this phase, we obtained design implications which can lead us in the design process of a new game system and the wearable devices. Although this study did not include the exploration of movement-based gameplay, we saw that gestures and movement can be adopted by players as two projects in the workshop speculated using them in the gameplay.

We evaluated the design implications which are related to game design and designed a new game system which can incorporate movement-based gameplay and arm-worn devices in TTRPG (WP2). We named the new game system as WEARPG and created a quick start guide which introduce the basic rules of it. We also produced experience prototypes [6] which would let us to test our new system by using Wizard-of-Oz method [11]. We executed preliminary tests with this phase by including 15 participants in the process (WP3). This part resulted in new design implications which are related to game research. It also gave us clues about how to improve the system before beginning to implement a working prototype.

After this phase, considering the design implications obtained from our first and second studies, we designed an arm-worn device called Elemental Gantlet (WP4). We also designed another tangible device which is called Luck Stone which can replace the dice in TTRPG since our previous studies indicated that dice constitutes a very important part of the TTRPG experience. We demonstrated this version of the device in DIS'17 and took positive feedbacks mostly.

After the production of our artifacts, we tested them with 24 players (WP5). In these tests, players played the game, half without wearables and movement-based gameplay system and half with wearables and movement-based gameplay system. They filled questionnaires aiming at measuring their immersion and player/character relationship level after each condition. Moreover, we made an in-depth semi-structured interview with each player to understand their opinions and experience about the game with open-ended questions.

Our research encapsulated formative and summative user inclusion for the production and the test of a new game system and artifacts. In total, 61 participants contributed to this project in different states. The amount of work invested in developing this system, artifacts and the feedbacks of our users provided design implications and themes for designing movement-based gameplay and wearable devices for TTRPG. We believe that, these implications and themes can also be used by the designers of interactive devices for narrative-oriented and long-term engagement requiring tabletop games. They can also be expanded to narrative-based digital game genres.

Each phase mentioned in this introduction section is explained in detail in the "included papers" section of this dissertation which is in the collection-of-papers format.

1.1. Motivation

Utilization of wearables as a component of games attracted the attention of researchers recently. Previous work on this subject speculates that wearables can be perceived as costumes of imaginary characters and boost the connectedness of players to imaginary worlds [2,22]. We believe that these statements may address an increased immersion and player/character relationship when wearables are used. Other than that, previous studies on movement element in games showed that more movement can add to the engagement of players in digital games [5].

Player/character relationship and immersion is critical concepts for an ideal TTRPG experience. Although they are critical, only assets that can support these experiences are the imagination of players and the performance of the game master. Therefore, these two experiences are very dependent on the player motivation, independent from any outside effects such as sensory stimulators that exists in computer role-playing games. This creates an ideal environment to test the arguments about wearables and movement-based gameplay and understand if they increase the motivation for games in which these experiences are more important than any other game genre. Moreover, it also provides an environment where we can understand how to use movement-based gameplay in more narrative-oriented, long-term games.

1.2. Dissertation Outline

This dissertation is comprised of three sections. The first part summarizes our research motivation, questions and methods. Second part consists of published and submitted papers which opens the first part into its details. Third part of the dissertation puts forth our contributions to human-computer interaction and game research field along with the lessons learnt from our research process and future directions. Moreover, this section also includes related papers and research training papers which were not included in the thesis flow and other research materials produces in the scope of this thesis.

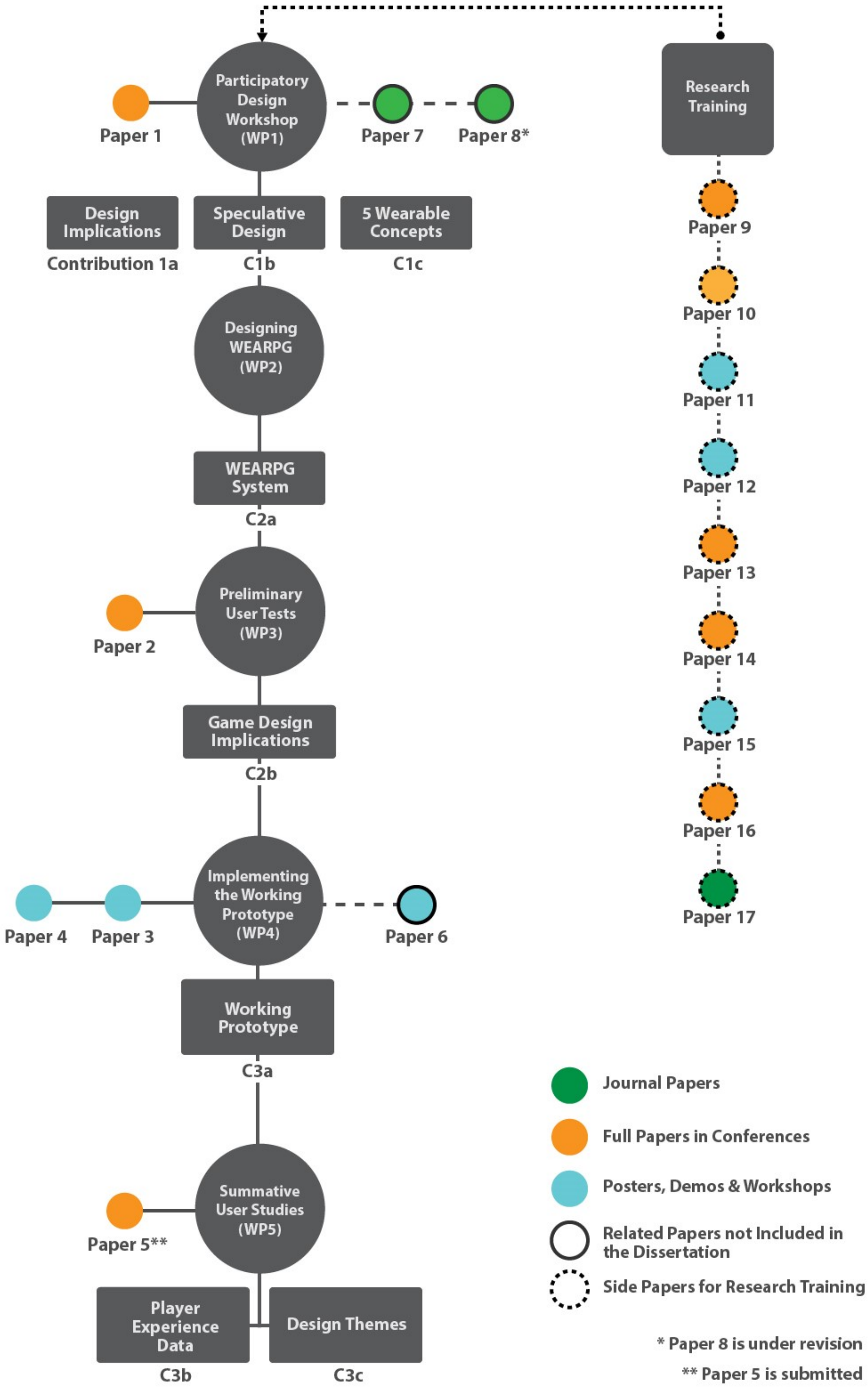

Figure 1: Structure of the Dissertation

2. Research Description

2.1. Research Questions

Wearables are speculated to increase the connectedness to imaginary words. Other than that, movement-based play boosts the engagement to digital games. Still, we cannot encounter any work which put forth the effects of wearables on the player experience of tabletop role-playing games. Moreover, movement-based play mostly examined in the scope of digital games or exertion games [5,19] which do not include narrative or long-term gameplay. As a result, possible effects of wearables and movement on the TTRPG experience is unknown. Moreover, previous studies do not present design knowledge about the effective ways of integrating these concepts into tabletop games.

RQ1: What is the effect of movement and wearables on the tabletop role-playing game experience in terms of immersion and player/character relationship?

This question led us to design a new game system which is based on movement and wearables, namely WEARPG (Paper 2, 3 and 4). We conducted gameplay sessions with 24 players by incorporating this new system. In these studies, we divided sessions into two phases. In the first phase, players played the game without WEARPG system by utilizing conventional d20 (dice with a 20 side). In the second phase, they used wearables, an augmented die and movement based gameplay. We make participants fill questionnaires in these two different conditions and conducted in-depth semi-structured interviews with 24 (we only could use the interview data of 16 participants due to the technical problems in recording and procedure change) participants to understand their experience and opinions about this new system. Most of the participants reported that they felt a boost in their player/character relationship and immersion. (see Paper 5).

RQ2: What design practices should be applied while integrating wearables and movement-based gameplay into TTRPG to affect player experience in a positive way?

We intend to answer this question by drawing upon the all design process of our artifact (see Design Process of WEARPG section). We extracted design implications about the product properties of wearables in the participatory design workshop (Paper 1). These implications led us to create a speculative design which turned into a working prototype in the last phases of this study. After, we also designed a game and tested it with 15 players to obtain knowledge about designing a role-playing game around wearables and movement-based gameplay (Paper 2). Finally, our experience in production process and the feedback from users allowed us to generate design themes about how these concepts may affect the gameplay experience, what may be the practices for overcoming possible short-comings and how it can be expanded further for a better player experience (Paper 5).

2.2. Research Phases (Figure 1)

2.2.1. WP1: Participatory Design Workshop

Procedure

For examining the use of wearables in TTRPG, we integrated users in the design process from the very beginning with a participatory design (PD) workshop. Our aim was to engage users with this underexplored topic to elicit better constructed opinions and ideas. PD is a widely adopted method for eliciting design ideas from the users, understanding them and producing design implications which will serve to the broad-range of fields [8,14,15]. Participatory Design Workshop is conducted in two consecutive days and participants worked on the subject for 18 hours. The first day of the study focused on the generation of the concepts which was about the possible ways of using a wearable device in tabletop role-playing games. In the second day participants worked on the visual design by building non-working prototypes and detailed the interface and the interaction styles by role-playing a game session with these prototypes. They also prepared Video Sketches to easily communicate their concepts and their usage during the gameplay. After the hands-on work, we also initiated a brief discussion about their opinions about the system which we like to design. Our expectations from the workshop were to (1) see users' reactions on positive and hindering parts of the wearable idea, (2) learn their preferences about the game actions to perform with this device, (3) understand their desires about the interaction techniques which refers to input and output methods (4) see their visual design decisions and (5) understand GM's role in controlling these devices.

Participants

25 participants which are *TTRPG players, game masters, cosplayers, interaction designers and jewelry designers* took part in the workshop. TTRPG players and GMs were our main users. We included cosplayers due to their knowledge in making costumes of fictional characters. Interaction designers were to assist projects in terms of interaction techniques while the jewelry designers helped in the visual design. We included jewelry designers since the wearable device design were mostly related also with smart jewelry.

Outcomes

a. Design implications about designing a wearable device for tabletop role-playing games.
b. Speculative Design proposed by us drawing upon the design implications we obtained from the workshop
c. Five design concepts which are proposed by RPG players in the design workshop

Papers

a. **Paper 1:** *User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games.*

   This paper explains the procedure of the participatory design workshop and demonstrates the five conceptual designs proposed by participants, design implications extracted from the data obtained from the workshop and the speculative design that we proposed by benefiting from the design implications.

b. **Paper 7:** *Forming Visual Expressions with Augmented Fashion.*

   This paper is not included in the flow of the thesis but added to the related papers section. Although it is not directly related to the participatory design workshop, this paper is generated with the purpose of generating design recommendations about designing fashionable wearables by undertaking a very similar research process. Our aim was to incorporate the knowledge we got about the fashionable wearables with the wearable device which was developed for tabletop role-playing games, however our recommendations for fashionable wearables revealed that they can be used in such work only in the further studies. This paper is a visual essay which includes the design themes extracted upon our analysis the artifacts designed by fashion design students in the design workshop.

c. **Paper 8:** Exploring *Computational Materials as Fashion Materials: Recommendations for Design Process of Fashionable Wearables.*

   This paper is the successor of the Paper 7 and communicates the design recommendations that can be used in the design process of fashionable wearables. Different from the Paper 7, this paper includes the report of interviews with leading experts who work on wearable device design.

2.2.2. WP2: Designing WEARPG

Procedure

Participatory Design workshop granted us the knowledge about how to integrate wearables into the game. Moreover, workshop results indicated that movement-based gameplay can be a novel addition that can also be favored by players. Drawing upon these implications, we designed WEARPG game system. WEARPG aims to provide a more narrative-oriented experience by leaving calculation side to computers and encouraging players to act their characters with their bodies. WEARPG is based on a fictional world where five elements of water, air, earth, fire and electric grant powers to the fictional characters. Players choose two of these elements for defining the main attributes of their characters. The game play session, different from many conventional role-playing gamess, is operated by 7 different movement-based games. Players play these games with the help of *Elemental Gauntlet,* which is an arm-worn device with capabilities of motion tracking, haptic and visual feedback and wireless communication. This device also supported by a tangible prop called Luck

Stone, which is similar to the dice in conventional role-playing game systems. The detailed design process of WEARPG is explained in *"Design Process of WEARPG"* section.

Outcomes

a. Novel role-playing game system which is based on movement-based gameplay provided by arm-worn devices (Research Material-2)

2.2.3. WP3: Preliminary tests with Wizard-of-Oz and Experience Prototypes

Procedure

We conducted player experience tests with 15 players to understand how new game system with movement-based play via wearable devices would change the experience of players. We organized game play sessions with three different TTRPG groups of players and game masters. Each game session lasted around 4 hours and was moderated by the game masters. We used the Wizard-of-Oz (WoZ) method in these game sessions. Players wore experience prototypes [6] made out of sponge. These props did not function at all, yet the participants conducted the elemental stone integration ritual by attaching token props to their devices (without any feedbacks). Moreover, we explained the possible interaction method which will work after the implementation. In our pilot studies, the Luck Stone was not also functional similar to wearables. However, the lack of feedback after the activation moves hindered the experience of the players. Therefore, we used a Sphero[1] which is a programmable ball and printed a dice shell for it with a 3D Printer. Sphero has a simple programming interface and by this we were able to program some of the activation moves. The ones that we could not program like power move which requires squeezing, controlled by us during the gameplay. These moves, as expected from the WoZ, did not function as precise as they should be, yet the applications were enough to facilitate the movement-based play. Each game session concluded with a semi-structured interview which aims to get players' opinions about the overall game setup, contribution of movement-based play and the wearable prop, the game system and the adaptation of this setting to other role-playing game systems. The purpose of the interviews was to gain insights about (1) hindering parts of the game environment, (2) benefits and (3) detriments of the new game mechanics, rules and interaction style on the player experience.

Participants

15 participants (14 male, 1 female, Age_m=26.6, Age_{std}=5,46) took part in the study as three groups. Groups consisted of five, four and three players respectively. Each group has one game master. Detailed information about the participants can be seen in **Paper 2/** Error! Reference source not found.**.**

The game masters were chosen among the participants of the PD workshop. Therefore, they knew the aim of the project however, we wanted them not to inform players about the purpose of the study. We wanted them to choose players from their gaming groups. Therefore, players were chosen by the game masters among the players who they regularly play with. As the game master is an important aspect of the role-playing game experience we preferred this setting in order to provide ideal experience for each player in terms of game moderation and storytelling in their accustomed environment.

Outcomes

a. Game design implications about the integration of movement-based play and wearables drawing upon the user feedback.

Papers

a. **Paper 2:** *WEARPG: Game Design Implications for Movement-Based Play in Table-Top Role-Playing Games with Arm-Worn Devices*

This paper explains our design motivations for WEARPG game system which was produced in WP2 and informs the field about the design implications we got after testing the early version of our game system with experience prototypes and Wizard-of-Oz method.

[1] http://sphero.com

2.2.4. WP4: Implementing the Working Prototype

Procedure

Upon our user studies with the preliminary version of WEARPG, we were motivated to implement a working prototype to understand the effects of our new design on the player experience. We implemented four arm-worn devices (Elemental Gauntlets) and an augmented die (Luck Stone). We also developed a Game Master interface which can be operated from a computer for controlling the Elemental Gauntlets and the Luck Stone. Elemental Gauntlet is made of 4 modules. These modules respectively include (1) main processor, sensors and batteries. (2) LED lights and the socket for elemental stones and (3-4) haptic motors. As a main processor, we used Arduino Lilypad. Pololu Altimu V4 was the motion sensor while the wireless communication was provided by NRF24L01+. For the light feedback Adafruit Neopixel ring and strip LEDs used for their convenience in easy programming. Two generic haptic motors were used for haptic feedback. Elemental Stone ritual socket is built with a basic circuit logic. We created a circuit between analog pins of Arduino and manipulate it with different resistances. Each elemental stone has a different resistance which can be separately recognized by the device. GM console creates a mesh network with the use of RF24 mesh library for Arduino, for other all Elemental Gauntlets and Luck Stone to connect. We used an NRF24L01+ which is connected to Arduino Uno. The software of the GM Console was developed using Unity3D and it communicates with Arduino Uno over the serial port. More details about the design process of Elemental Gauntlets, Luck Stone and Game Master Console can be found in the *"Design Process of WEARPG"* section.

Outcomes

a. Working prototype of the Elemental Gauntlets and Luck Stone

Papers

a. **Paper 3:** *Augmented Tabletop Role-Playing Game with Movement-Based Gameplay and Arm-Worn Device*

Paper 3 explains the basics of the WEARPG, Elemental Gauntlet and the Luck Stone. This is an extended abstract for our demonstration in DIS '17.

b. **Paper 4:** *WEARPG: Movement-Based Tabletop Role-Playing Game with Arm-Worn Devices and an Augmented Die*

Paper 4 adds up to Paper 3 by providing detailed explanations of movement-based mini games. This is an extended abstract for the CHI Play '17 Student Game Design Competition. WEARPG is qualified as a finalist to the game design competition.

c. Paper 6: *Augmented Tabletop Games Workshop*

Paper 6 is not included in the thesis flow but added to the *Related Papers* section. This is a workshop paper which is written in collaboration with an international committee. Although it is about the augmented tabletop games to which is the genre WEARPG belongs, contents of the paper is not directly related with the outcomes of this thesis.

2.2.5. WP5: Summative User Studies with Players

Procedure

For understanding the effects of wearables and movement-based gameplay in order to answer RQ1, we organized gameplay sessions with 24 participants. In this study, we aim to understand how gameplay experience will be affected by wearables supporting movement-based play. Therefore, we conducted a within-subject study where players play the game without WEARPG in the first phase and with WEARPG in the second phase. Same *game master* with 13 years of experience told the stories throughout the whole testing with the purpose of standardizing the story-telling quality which is quite important for the role-playing game experience. We made participants fill immersive experience questionnaires in the first and the second phase of the sessions. We also conducted in-depth semi-structured interviews with each participant. Detailed explanation of the procedure and the results of the study are reported in Paper 5. An example of coded interviews (in Turkish) can be seen in Research Material-4.

Participants

Twenty-four participants (4 female, ages ranged between 19 and 45, *M*age = 26.63, *SD* = 7.22) were included in the analysis. Participants varied in their experiences from 1-year experience to 10+ years of experience. Therefore, we were able to collect feedback from players with various experiences.

Outcomes

a. Evaluation results regarding to effects of wearables and movement-based gameplay on the player experience
b. Design themes that highlight the properties of the WEARPG which affected the player experience. These themes also pointed out the possible solutions to the hindering parts.

Papers

a. Paper 5: *Wearing and Moving in Imaginary Play: Effects of Wearables and Movement on Tabletop Role-Playing Game Experience.*

This paper describes the summative user studies which was conducted in order to understand the effect of wearables and movement-based gameplay on the player experience in terms of immersion and player/character relationship. We report the results of the summative user study and articulate design themes which are constructed upon our analysis of the user feedback we got.

2.2.6. Research Training

Other than the research efforts which remain in the flow of this dissertation, research training that we got from the side projects also has an important impact on the research outcomes of the phases in this dissertation. Below, we indicate the role of each paper in my research training.

Papers

a. **Paper 9:** *DubTouch: exploring human to human touch interaction for gaming in double sided displays*

This paper is the first paper which is published in a peer-reviewed ACM conference. This paper presents the preliminary study about human-to-human touch in games. In this project, we conducted user-elicitation studies and an expert workshop which earned me the knowledge about coding video recordings and extracting user information from them and organizing a workshop for eliciting ideas from users and experts. This knowledge provided us the experience which we effectively used in our considerably large participatory design workshop with 25 participants.

b. **Paper 10:** *Sensation: Measuring the Effects of a Human-to-Human Social Touch Based Controller on the Player Experience.*

This paper is the first paper that we published in a top-tier conference (CHI '16). This paper is important in two terms. (1) We involved undergrad students for technical development and the writing of the paper. I supervised all the development and the writing process which adds up to my experience about leading research students. (2) In this project, we undertook player experience testes to understand immersion experience difference between when players played a game by human touch and a conventional controller. The method applied here gained me the experience which helped me greatly while conducting summative user tests which are explained in Paper 5.

c. **Paper 11:** *Experiencing Human-to-Human Touch in Digital Games*

This paper presents the demonstration of the Sensation which is a device detecting different types of touch patterns between two players. This is the first time that we demonstrated a working prototype of a project in our lab. With this demonstration, we gained experience in writing a demo paper, setting up a demonstration area in an overseas country and handling a great number of participants in a conference. This experience contributed to our demonstration of WEARPG in DIS '17.

d. **Paper 12:** *GestAnalytics: Experiment and Analysis Tool for Gesture-Elicitation Studies*

Gestanalytics is an experiment and an analysis tool that I designed and developed for gesture-elicitation studies. This is the first work-in-progress/poster paper that we published. With this project, I improved myself in programming which helped me both during prototype development of WEARPG and when I need to communicate with engineers about the technical restrictions of a concept.

e. **Paper 13:** *Hands as a Controller: User Preferences for Hand Specific On-Skin Gestures*

This paper presents a user-elicitation study about hand-specific on-skin gestures. As a result of this project, we extracted two different gesture sets for this modality. This project improved me as a design researcher as we ideate on how to overcome legacy bias, how to code and extract gesture sets and analyze the mental models of users.

f. **Paper 14:** *It Made More Sense: Comparison of User-elicited On-Skin Touch and Freehand Gesture Sets*

We conducted this study as a follow up to Paper 13 to understand what advantages and disadvantages on-skin gestures have compared to the mid-air gestures. In this study, I supervised a team with research psychologists and a newcomer PhD student. Therefore, it helped my development as a researcher who is likely to supervise masters and PhD students in the future.

g. **Paper 15:** *CHI 2039: Speculative Research Visions*

This is an international crowd-sourced paper which I contributed to with the future version of human-to-human touch interaction in double-sided displays. This project provided us to opportunity to ideate on a future utopia and take place among an international committee from very diverse disciplines and backgrounds.

h. **Paper 16:** *Anything Left to Borrow from Cinema? Guidelines for Game Narrative*

This is the first paper I published in an international conference. Therefore, this is almost the beginning of my research career as I learnt how to frame a subject in a 10-paper article and present it in front of a crowd.

i. **Paper 17:** *The Effectiveness of Mime-Based Creative Drama Education for Exploring Gesture Based User Interfaces.*

This is the first journal paper I contributed to. I was not in a critical role in this project and my main role was to conduct literature research about learning styles and create the connection between this research and the rationale of this project. Still, this experience provided me the opportunity to see a journal submission and the acceptance process. Therefore, in Paper 7 and 8, we were experienced about how to frame a research for a journal article and what to expect in terms of reviewing process and the timing.

2.3. Design Process of WEARPG

In each phase of our design process, we involved users to get their opinions and to have an understanding of their mindset to design a product which will work towards their expectations. Therefore, it was a dynamic process and in each phase, we made changes in our game system and devices after examining the user data and extracting design implications. In this section, we will explain the design process of each component in our research project. These components are WEARPG Game System which includes movement-based games, Elemental Gauntlets, Luck Stone and the Game Master Console.

2.3.1. WEARPG Game System and Setting

The main component of this project is the game system. Game system represents the set of rules and mechanics in which the other components become meaningful. Although this is a preliminary game system, it still covers a character creation phase, three levels to progress for characters, skills that can be chosen for each level for different types of characters and a setting which gives the shape to the wearable devices and the imaginary world of the game. With these properties, it can provide a role-playing game session up to 15 hours (this number is the maximum gameplay time we conducted in our user tests). Game system is the most important component since all the other components reach their meanings depending on it. Game system determines the relationship between components, how they are connected to game rules and the meanings of the actions in the imaginary world of the game.

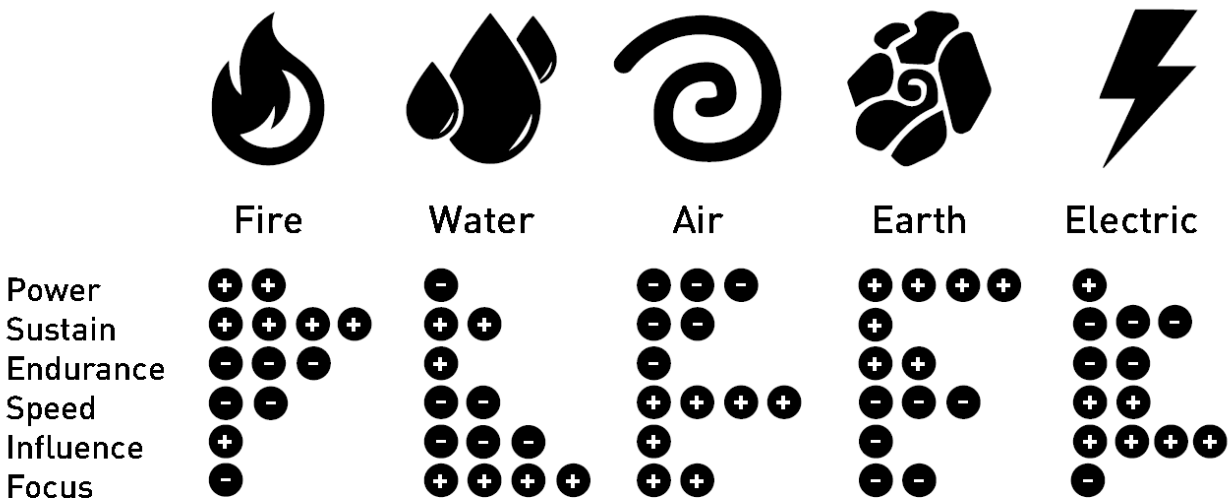

Figure 2: Ability Chart for Elements[2]

WEARPG game system evolved into its current state after several iterations. These iterations were made upon the user feedback during the tests which were conducted with experience prototypes and Wizard-of-Oz method. We can divide our game system into three as the character creation system, action system which encapsulates the movement-based games and skills that can be used during the level up. In this section, we mention what these three elements are and how they evolved to their current version.

Character Creation System

Incorporated Design Implications: Customization of the device can serve as an upgrade to character properties. (WP1, Paper 1), Automatization of Uncaptivating Processes (WP1, Paper 1).

Character Creation was basically based on elemental powers. Our initial intent was to create a system where we can easily create a visual and physical connection to the imaginary world through elemental stone props which will be attached to Elemental Gauntlet (arm-worn device). Contrary to more abstract concepts such as the race (elf, dwarf, orc etc.) or the class (fighter, assassin, ranger etc.) we created a system which affects the appearance and the physical abilities of the fictional character at the same time. In this system, players choose a primary and a secondary element stone which determines the physical abilities as can be seen in Figure 2.

[2] References for element icons: Fire [21], Water [9], Air [20], Earth [12], Electric[1]

Moreover, the primary element also determines the overall look of the character as described in the quick-start guide (Research Material-2). We designed this system in favor of forming an easy way to create visual props that will build a bridge between the real world and the imaginary world. For instance, instead of dealing with props which should connect players to both their race and class which can be reflected in many different ways and styles, we can directly connect them to their character by only making them to choose their elemental stones. Several implications from the *participatory design workshop (WP1)* led us to make this design decision. First, as many participants proposed concepts which can be customized in a way that can reflect the “character”, we tried to find a feasible way to make this reflection possible. Our other aim was to speed up the math calculations in the character creation process as it was done almost all groups in the workshop. Therefore, we created a system which provides an easy way for players to relate their wearables to their fictional character’s equipment and narrows the character creation process down only to attaching elemental stones to the wearable device. During our user tests, one of the game masters felt the need for constructing a background story for each player which reflects their previous life before becoming wearers. Therefore, we improved our character creation system in a way that players can start playing by choosing their professions, manners and age. In this version, they play a story piece where they practice their jobs with a role suitable to their ages and manner. They become wearers after wearing the Elemental Gauntlets in one part of the story. This also helped us to integrate Elemental Gauntlets to the story in a meaningful way and helped players to form a relation between the powers they gained and the Elemental Gauntlet. This type of character creation which involves the background story in the game mechanics were found innovative by most of the players, yet it also created inappropriate character development for professions such as a *farmer*. Some of the players who chose the farmer profession complained that their character would not want to wear a technological device such as Elemental Gauntlet. In the future versions of WEARPG, these situations can be overcome by creating appropriate story line proposals for such characters.

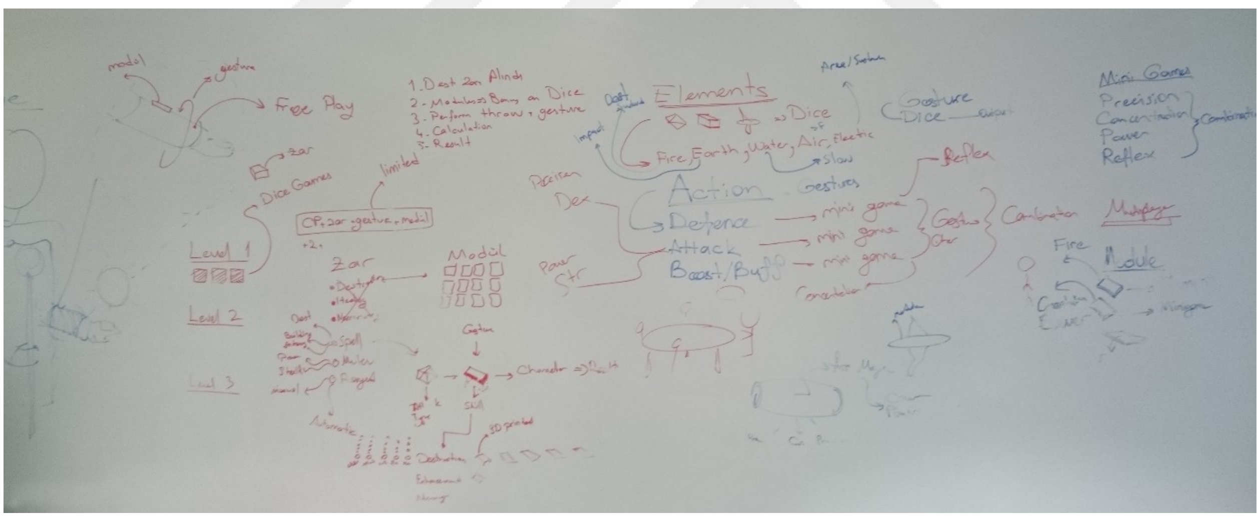

Figure 3: Ideation Process Board which forms the relations between characters, elements, devices and the movement-based games

Movement-Based Games

Incorporated Design Implications: Assigned in-game actions should be adaptable to narrative (WP1, Paper 1), Exploring new gameplay styles (WP1, Paper 1), Providing non-repetitive performances (WP3, Paper 2), Player specific outcomes of movements (WP3, Paper 2).

Another important aspect of the game system is the introduction of the movement-based games. These games are the most distinctive elements which differentiate the WEARPG from other role-playing game systems. We were also encouraged to implement this concept due to the implication from WP1 suggesting that players are open to *exploration new gameplay styles*. While designing these games we inspired from a genre what is called dexterity games. Dexterity games are physical games which rely on the physical abilities of the players. However, as can be understood from the name, they rely on only specific skills which can be counted as precision and reflex. However, role-playing games can yield many different scenarios as the only restriction is imagination. Therefore, our aim was to create a game set which can be applicable to many different scenarios.

To satisfy this condition, we designed 7 different mini games which can adapt to different types of scenarios which would require power, concentration, precision and reflex moves of the fictional character. With our team members, we ideate on different types of games and chose eight which can successfully represent the experiences of using strength, concentrating, moving quickly and precisely (Figure 3). The first versions of movement-based games which were designed without considering technical restrictions can be seen in Research Material-1. After designing these, we produced very basic props which can be used for testing these games. We organized an internal game session with our colleagues to understand if these games can work towards our intentions with these basic props. Although we got positive feedback in terms of movement-based games, our colleagues who were experts in interaction design suggested that these games need more clear feedbacks for understanding their outcomes. Therefore, we designed a new prop which can facilitate movement-based gameplay with more visible feedback (Figure 4). We named the prop which is expected to replace the dice as Luck Globe (which is turned into Luck Stone in the further parts of the design process). In our preliminary tests, Luck Globe was the main component that facilitates the movement-based gameplay as we could not find to way to create a fast and dirty prototype for wearables. We created this prototype by using a programmable ball called Sphero. Sphero has embedded electronic components such as motion sensor, LEDs and motors which are programmable. During this transition from conceptual phase to the application phase, we had to make revisions in games due to technical restrictions and understandability and playability of games. After these revisions, we obtained the final versions (Research Material-2, p.2) of these games to be tested in preliminary user studies which were conducted via experience prototypes and the Wizard-of-Oz (WoZ) method. Upon the tests, we observed that WoZ can fall short in terms of transferring the experiences that we intend to create because of its slow nature. Although participants expressed their positive feedbacks towards the movement-based gameplay concept, we started to the implementation of the working prototype to have a clear understanding of the experiences which will be facilitated by the devices.

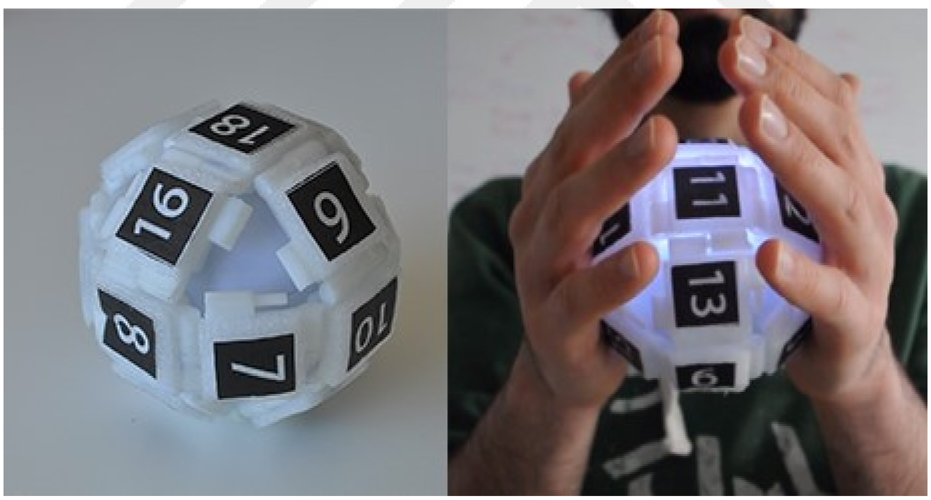

Figure 4: Early version of the Luck Stone (it was named as Luck Globe at that time)

While designing these movement-based games, we prioritize the implication which indicated that *all actions should be adaptable to narrative* which were obtained from the *participatory design workshop (WP1)*. We tried to satisfy this implication by introducing two concepts. The first one of these concepts was *adaptable movements.* In this concept, we were attentive to design movements which can be altered by players according to their role-playing scenes. During our preliminary user studies (WP3), we only partially provide this with some of the games such as power games. This study revealed that adaptable movements were favorable by players and seen as a requirement also by them. Upon this implication which suggests that *providing non-repetitive performances* is important for role-playing, we tried to satisfy this conditions in all movement-based mini games. For example, as seen in Figure 5, concentration game can be played with different body postures. In this example, one of the players are playing the game by using larger movements while the other one only uses his hands. The second concept was occurred after the preliminary tests (WP3) with the implication *player specific outcomes*. Players expressed that these games should not allow to power-play which means that players should not be advantageous because of their physical skills and the character skills should be more important than the players' own physical abilities. Therefore, we designed the difficulty system which does not allow players' physical skills to overwhelm the characters' skills. For example, with this system, power games will be much easier for players with a powerful character compared to players with a weak character. Thus, even if players who role-play a strong character are not strong enough, they will not perform bad in power game as it will be considerably easy for them.

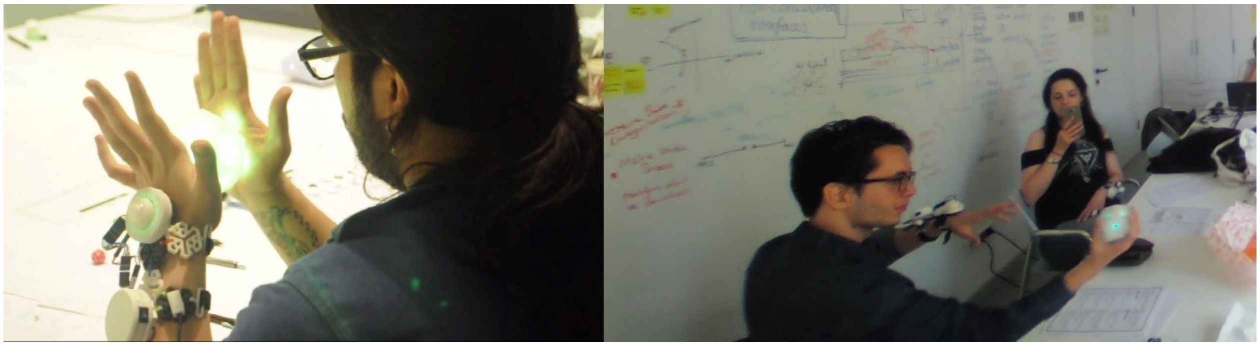

Figure 5: Two different ways for playing the Concentration Game

Skills

Incorporated Design Implications: We did not have design implications about how to design skills. Yet, we integrated skills in the game system as they are a very common part of role-playing game systems.

The last part of the game system includes 3 levels of skills for each different element combinations (see Research Material-2, p.7). We designed two skills for each level of main elements and element combinations. Each skill also has an assigned movement-based game(s) to be activated in the imaginary world. We decided to have this kind of a skill-set since they are common in most of the role-playing game systems and they render having elemental powers more meaningful and related to movement-based games. Still, our final tests revealed that dictating an activation move for each skill can turn playing movement-based games into a mundane act. Moreover, during the play sessions, these skills were perceived as guidelines rather than pre-determined character abilities. For example, a skill called "lightning strike" means to send an electrical bolt to an imaginary target. However, instead applying this directly, one player wanted to explore their abilities and tried if she can form a continuous electric arc between themselves and the target. Our game master allowed her to do so. This shows that similar to the placement of the movement-based games, these skills also can be considered more vague concepts that can be freely used according to the consensus between the game master and the player. In the further development of these skill, we consider creating a system which allows players to devise new creative abilities by using them as guidelines.

2.3.2. Elemental Gauntlet

Elemental Gauntlet represents the arm-worn device of WEARPG. It is actually a part of the game system or even if it is a separate entity, it becomes meaningful with the rules and the mechanics of the game system. Our design process for the Elemental Gauntlet was mainly affected by the design implications which we got from the participatory design workshop (WP1) at the beginning. We can divide the Elemental Gauntlet into three as the base, elemental stone socket and the interface part.

Base

Incorporated Design Implications: Customization of the device can serve as an upgrade to character properties. (WP1, Paper 1), Participatory customization space (WP1, Paper 1)

For forming the base of the Elemental Gauntlet, we designed hexagonal parts that can be brought together in many different ways. Our design was directed by especially two implications which suggest that the wearable device should be upgradable as the character progress and the expandable customization space that can be enhanced by outer parts should be provided. The first implication indicates that aside from being customizable, wearable devices should also be upgraded along the way as the character improves by gaining experience points and leveling up. In our design, a player can upgrade their base as much as they want if they have extra hexagons. We also considered adding this as a game mechanic where players gain new hexagons as they level up.

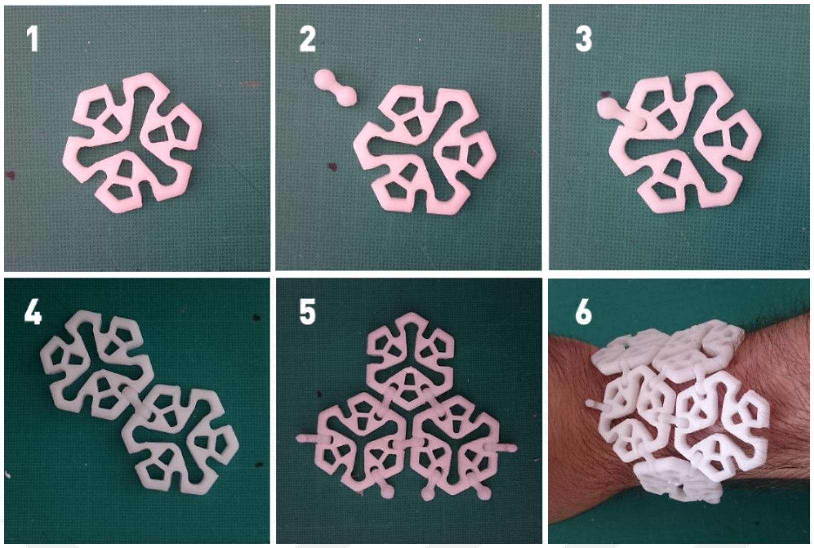

Figure 6: Process of designing a wearable base by using hexagonal parts

Other implication proposes that the customization space for such device should be a hybrid which comes with pre-designed parts but at the same time encourage players to enhance the base with outer parts that can be suitable. For example, after players formed the main shape with hexagons they can also add leather parts to add a more authentic look to their creation. To provide this, we designed different types of connectors which can be used for attaching parts such as fabrics. For creating a customization space which can yield to different results, we analyzed conventional jewelry and extracted parameters about limb, material, grip, fastener, decoration, decoration placement and form. We obtained these parameters by examining more than 270 different non-smart jewelry over Pinterest.com (samples can be reached from bitly.com/wearthefun). Detailed explanations of these parameters can be found below.

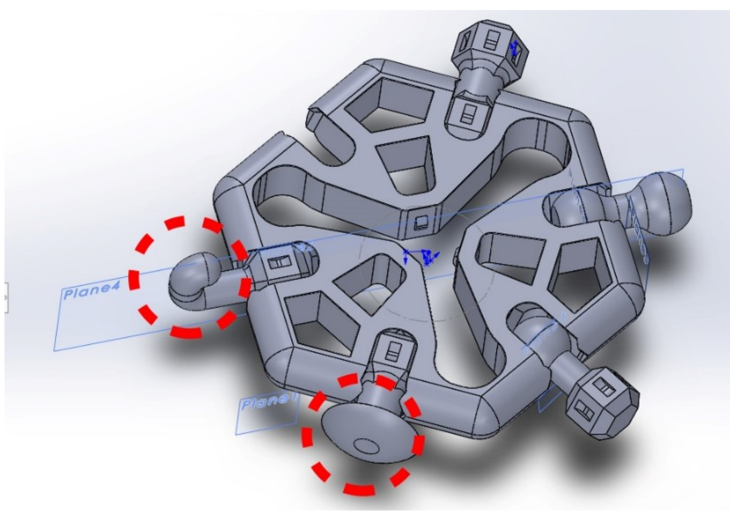

Figure 7: Different types of connectors which are designed for adding outside materials

- *Limbs* parameter is concerned with which limb the accessory is worn on.
- *Materials* parameter is used to categorize accessories according to their materials like gold, silver, leather, rope, wood etc.
- *Grip* parameter refers to the fit of the accessory. It can be categorized as tight if it fits snugly around the limb or loose if it has a more relaxed fit.

Figure 8: Form Parameters (images taken from Pinterest.com)

- *Fastener* parameter classifies jewelry according to different fastener types. Subcategories of this parameter are buttons, clips, ties, finger rings and flexing of the accessory itself in order to fit around the limb.
- *Decoration* parameter refers to the material and form of decoration that is on the accessory. Its categories are non-precious, semi-precious and precious stones, pearls, seashells, metal pieces, metal figures, strings, cloth figures, glass figures, plastic figures, feathers, chains and embedded shapes.
- *Decoration Placement* parameter stands for the position and the arrangement of decoration pieces on the jewelry. *Static* refers to fixed objects while the *Dynamic* represents moving objects such as dangling parts.
- *Form* parameter (Figure 9) categorizes the form of traditional jewelry into 7 different categories. These categories are lines, chain, eclectic, imitation,
    - Lines: Adornments that have continuous lines in their forms
    - Chain: Adornments having a chain assembly as a main body
    - Eclectic: Consisting of distinct pieces as a base structure,
    - Imitation: If the form of the adornment is a direct transfer from a real-world object like a flower, sword, etc.
    - Patterned: Adornments that are consisted of patterns
    - Bulk: Adornments which are designed with pieces brought together as a mass
    - Geometric: Geometric shapes like squares or hexagons are used in the jewelry multiple times
    - Irregular: If the lines which form the shape are not in regular pattern, it is classified as irregular form.

Figure 9: Early ideation sketches for a modular concept

We ideated on modular customizable concepts which can yield to variety of designs that incorporate different parameters (Figure 9). We designed our hexagonal base by considering these parameters and tried to create a modular system that can build wearables satisfying the diversity especially in the *"forms"* parameter. In Figure 10, we exemplify three different designs which matches with the following parameters: A) Arm, plastic, flex, electronic and geometric shapes, static, bulk, (B) Arm, plastic, finger ring, electronic and geometric shapes, static, chain, (C) Arm, plastic, flex, electronic and geometric shapes, dynamic, lines.

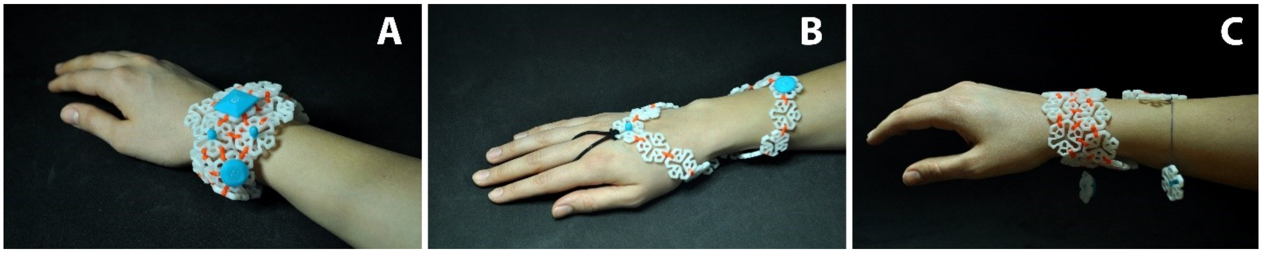

Figure 10: Different types of designs that can be created with hexagons

Elemental Ritual Socket

Incorporated Design Implications: Customization of the device can serve as an upgrade to character properties. (WP1, Paper 1), Setting and its relation to the visual customization (WP3, Paper 2), *Device belongs to the fictional world* (WP3, Paper 2).

Other property of the Elemental Gauntlet is the socket (Figure 11) where the elemental stone ritual is executed. This part can detect different elemental stones and react to them by illuminating in the color of the attached element stone. This feature is connected with the character creation part of the game system. Implication which suggests that the wearable device should reflect the character properties from WP1 led us to this decision. By making players attach their elemental stones to the gauntlet, game system creates their characters according to different characteristics of these stones. We wanted to create the impression that elemental stones are powerful props that activates the elemental gauntlet and make it ready for the utilization of players. Moreover, since these stones determine the character properties, we see them as a direct visual and tangible connection to the fictional characters in the imaginary world of the game. Our main aim was to make players experience that they obtain the powers of these stones after connecting them to the gauntlet. The game design implication which was obtained from our preliminary user tests (WP3) indicates that the adoption of wearables by players are more likely if they have a meaningful role in the game story. By adding this kind of ritual, we wanted to strengthen its place in the imaginary world of the game.

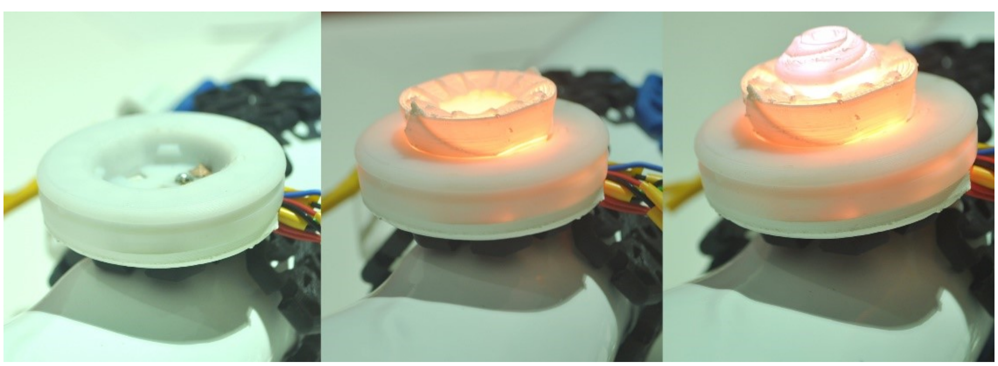

Figure 11: Attaching Fire and Air Stones to the Element Stone Socket

Interface

Incorporated Design Implications: Non-Distracting Interaction Techniques (WP1, Paper 1), *Enhancing Communication Between Players* (WP1, Paper 1), Other than these more experience based properties, the Elemental Gauntlet also functions as an interface of the game system. It is an input device which detects the movements of the player and the output device which provides haptic and visual feedback. Our design decisions mainly affected by the design implication from WP1 which suggests that non-distracting interaction techniques should be incorporated. Firstly, we designed a LED indicator around the elemental socket. This part indicates different kinds of light feedback according to the characteristic of the game. For example, it turns into a targeting game where players need to move a single led to left or right to aim at an imaginary target in the precision game. In another game which is the reflex game, it flashed in red or green after the player makes the move to indicate the success of the action. Other than the games, it is also used to give information about character properties such as the health or mana level of the character. Moreover, game master can send any kinds of light or haptic feedback to the device. We added this availability in case game master wants to incorporate the Elemental Gauntlet in the story in different ways or decides to communicate with player by sending haptic feedbacks for partially supporting the design implication indicating that these devices can serve to increased communication between players and game master. We did not define any rules or meanings for different kinds of haptic or light feedbacks, however these can be decided as in-house rules by players or can be added to the game system in the further studies. All in all, the input and the outputs used in the Elemental Gauntlet do not require a direct attention during the game and are usually perceptual by also being supported by the haptic feedback. Moreover, interaction with the device is limited and only possible when game master allows player to do so. We gave all these design decisions in order to maintain the interest of the player in the game and prevent them to be distracted because of the devices.

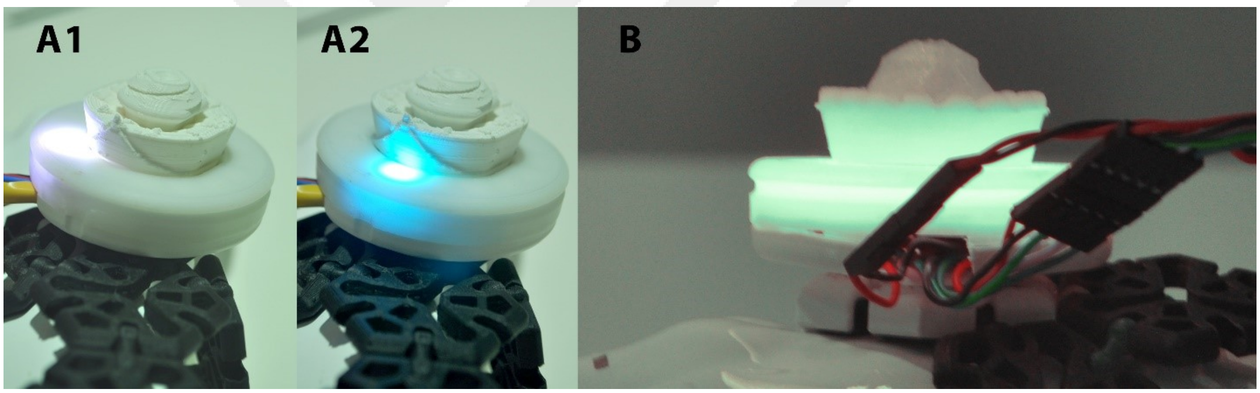

Figure 12: (A) Interface for Precision Game - (A1) Out of target, (A2) On the target, (B) Interface for Reflex Game

2.3.3. Luck Stone

Incorporated Design Implications: Designing devices in interaction with the auxiliary objects (WP1, Paper 1),

Luck Stone is a randomizer which replaces the dice in the conventional role-playing games. At the beginning of this study, we did not speculate a tangible device which is a companion to the arm-worn devices. However, our implications from WP1 indicated that players tend to keep tangible objects such as figures or boards in the game system. Among all tangibles, dice is the most crucial one as it also can be seen as a collection item. Upon these observations, we decided to add a supportive device which will provide randomization in a tangible way. Chance is a part of every game and among the elements which forms up the game mechanics even if it operates in the background. For example, in a first-person shooter game which is basically about shooting enemies and dodging their attacks, chance is an important part of the game mechanics which determines if you are hit by a bullet or not. Game mechanics which facilitates the enemy bullets is usually based on chance instead of a physical modeling of an accurate shooter. If the enemy shooter is a talented one, then its chance of hitting you gets higher. In the light of this information, the design decision here could have been a programming a randomizer which functions in the background. However, drawing upon our design implications, we implemented a hybrid randomizer which takes advantage of both tangible aspects of a die and the computational power provided by the augmentation. Moreover, since the design implication indicated that the relation between the interactive system and the auxiliary device should be formed in the design process, we designed several different interactions between the wearables and the Luck Stone such as communication during the movement-based games or chance manipulation according to the result of the movement-based game.

Figure 13: Evolution of the Luck Stone, (A) Luck Globe with Sphero, (B) Luck Stone without the silicone cover, (C) Luck Stone with the silicone cover

The first version of the Luck Stone is produced with the purpose of facilitating the preliminary user tests which were conducted with Wizard-of-Oz method. This version was full of production errors and did not have any connection with wearables since we did not have functional wearables at that time. The name of it was also Luck Globe since it was a globe instead of a dodecahedron. We prototyped the first version of the Luck Stone by programming a Sphero, which is a programmable ball that have a motion sensor, LEDs and the motors inside. We also designed a cover and 3D printed it to make the Sphero function as a die (Figure 4). With this early version, we were able to get a preliminary idea about the movement-based games. However, this version was only giving feedback about the success of the game and the dice outcome was manually calculated by the game master which were quite similar to the conventional role-playing game systems. One of the aims for augmenting the tabletop role-playing games is removing the uncaptivating processes such as these calculations. Our design implication from WP2 suggests that addition of electronics can render new uncaptivating processes while removing the some other which should not be the case in a right design. Therefore, we aimed for designing an object which will ease all calculation process to a second, which is connected to the Elemental Gauntlet in a meaningful way and still provides the tangible feeling of using a randomizer.

With these intentions, we designed the last version of the Luck Stone. This version is produced in the form of a dodecahedron which is much more suitable for becoming a randomizer. Dodecahedron geometry is also an accustomed shape in conventional role-playing game systems with a name d12. In this version of the Luck Stone, we created the concept of "chance manipulation". Compared to the previous version where the success of the movement-based games and the result of the dice is two different entity, in this version, the success of the movement-based games affect the result of the dice. For example, if a player succeeds the power game, then the Luck Stone will get more green (stands for success) and purple (stands for epic success) sides. With this method, we came up with a more holistic method which blends the Elemental Gauntlet and the movement-based gameplay into the game mechanics with a seamless way. Chance manipulation was also appreciated by users since, different from their previous experience, they felt that they have a control upon their decisions and the results do not depend on the pure chance.

The latest alteration in the design process of the Luck Stone was about its material properties. In our design process, we 3D printed the outer part of the luck stone and placed the electronic components inside. Our internal tests revealed that the outer material should be altered since it should be more protective for the internal electronic parts and should create a similar feeling to the bouncy nature of the dice that creates the excitement while players are waiting for the results to be revealed. Therefore, we designed a dice cover with a silicon material (Figure 13). To produce this material, we 3D Printed a mold and casted moldable silicone in it (Figure 14). End-result satisfied our expectation by making the Luck Stone more durable for impact and bouncier for rolling.

Figure 14: Molding process of the silicone cover of the Luck Stone

At the end of the design process of the Luck Stone, we succeed to create a product which fulfills the expectations of players about keeping dice while bringing novel mechanics to the randomization process.

2.3.4. Game Master Console

Incorporated Design Implications: Immediate control ability of Game Master (WP1, Paper 1)

Game Master console (Figure 15) was the last component produced in the design process. Its function is providing capability to Game Master for controlling the Elemental Gauntlet and the Luck Stone. Although we focus on the player experiences in this study, we still got several implications about the role of the game master in this kind of game system. We especially followed the implications which proposes that the game master should have an immediate control ability over almost everything about the game. Therefore, we designed the GM Console in a way that allows game master to manipulate the Elemental Gauntlet, the Luck Stone and even the results in case she/he wants to alter them according to his/her story. Moreover, GM Console stores all the character information in the character sheet (Research Material-3) which existed in the early version of the WEARPG game system. Therefore, GM is always in the reach of all character information which eases him to devise the story accordingly.

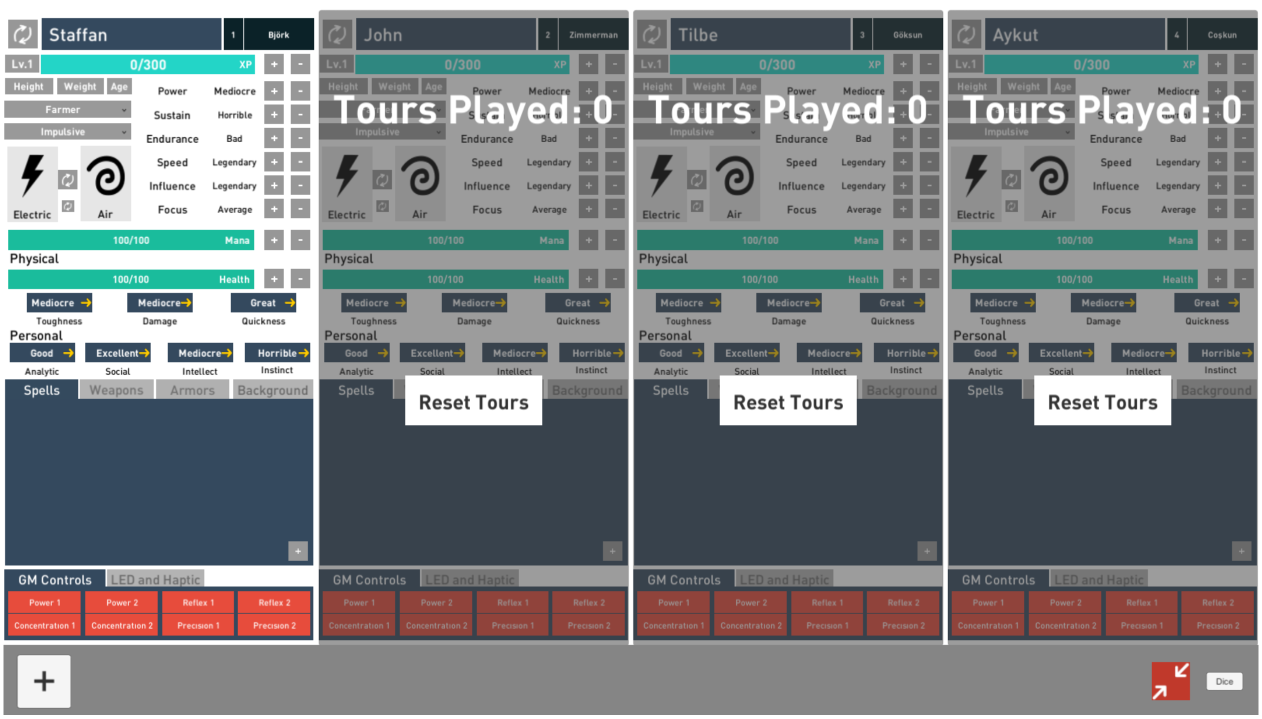

Figure 15: Interface of the Game Master Console

In this section, we explained our design process and explicitly indicated how our design decisions are affected by the design implications which we got from the participatory design workshop (WP1, Paper 1) and preliminary play tests (WP3, Paper 2). After we implemented the working prototype, we tested it with 24 players. User feedback from these tests led us to design themes which are explained in Paper 5.

2.3.5. Articulating the study as a research through design process

Research through design as an interaction design method put forth three different types of contributions which are expected from the interaction design researchers: (1) laying down opportunities for new technologies or improvements in existing technologies, (2) artifacts as embodiments of theories and (3) and the comprehensive understanding of the problem framing and the intersecting and conflicting approaches [24]. This approach proposes four lenses for evaluating a research through design process and in this section, we will articulate how our design research process corroborates with this mentioned four lenses.

Process: Research through design method for interaction design does not look for the reproducibility of the results but the reproducibility of the design process. Our design process is expressed in the "Design Process of WEARPG" part while the methods that we chose during this process is mentioned briefly in "Research Phases" and in a more detailed way in included papers 1,2 and 5. In that sense, we present our research process in two different angles. (1) Methods chosen for facilitating the design process and the rationales behind these methods, (2) Design process of the artifacts and the game system, the motivation behind our design decisions and how these decisions are related to the results we obtained from our research methods.

Invention: Our research proposes a novel table-top role-playing game system which incorporates movement-based games and wearables in gameplay. In this sense, this study opened an area where wearables which supports movement-based game are explored as a gaming apparatus for narrative-based and long-term computer augmented games for the first time. Moreover, we also proposed implications about how to integrate these components in the right way and what might be the possible design themes which are open for further exploration.

Relevance: We started this project suggesting that the tabletop role-playing game experience can be rendered more immersive and we claim that this can be the preferred state as immersion is one of the most crucial experiences in game research. When players experienced the tabletop role-playing game with our artifacts and the game system, most of them articulated that their experience in terms of player/character relationship and immersion was better compared to their previous experience. Still, although we articulated the ways of designing artifacts which may help researchers to reach this preferred state, the current form of our product, game rules and mechanics behind the game system is just one embodiment of what might be the right design. Five concepts which were proposed by players in our participatory design workshop is a concrete example of this as all proposed concepts focused on a very different aspect although their main aim is to improve the gameplay experience of tabletop role-playing games. We believe that the design implications which are extracted in the different stages of our research can yield to many different designs that can serve to the same preferred state.

Extensibility: Research through design process should either inform a design process that can be adopted in the further research for other problems or design knowledge that can guide other researchers upon a produced artifact. We believe that our research process is a good example for investigating unexplored areas such as utilization of wearables in tabletop games. We believe that organizing a participatory design workshop is essential for this kind of this process since it makes players of such games think on the subject with hands-on experience in an interdisciplinary group which includes the other stakeholders and the experts in the area. Although we kept it short after the workshop, we experienced that a focus group study after the workshop was quite productive since the participants had an experience about thinking in what ways a wearable device can contribute to the role-playing game experience. We believe that basing the design of our artifacts and the game system on the design implications which we got from the early user feedback helped considerably for designing the right thing at the end. Other than that, rapid production of low-fidelity or experience prototypes and testing them with methods such as Wizard-of-Oz which do not require a serious technical implementation was also very helpful for understanding the potential of our design. Therefore, a similar design process which are explained in "Research Phases" section and in included papers 1,2 and 5 can be followed for similar research topics.

Other than that, our research also put forth design themes which was generated upon the creation of the artifact. In each state of this design process, we generated design implications and themes which form a base for opening new exploration areas and show directions about the utilization of wearables and movement-based gameplay in narrative-based long-term games such as tabletop role-playing games.

Design researchers can have different roles in a research project. In this project, my main role was to (1) construct the research structure that can lead our team to produce the right design, (2) produce generalizable design knowledge and communicate it to the other researchers and designers for helping them to reach the right design, (3) lead the production of artifacts and the game system. The first one was a dynamic process in which the structure of the research changes in a considerable way depending on the results of the previous study. Since it is an iterative process which we ideate along the way according to the user dat, my aim was to pivot the process to the right direction in a way which helps to produce design implications and to improve the design of our game system and artifacts. As my second role, I undertook the analysis of the produced artifacts and the user feedback for extracting directions for other researchers and designers of such products. My third role was the manage and apply the design decisions for producing a usable product that will provide an enhanced gameplay experience for role-playing games. Other than these roles, another role that a design researcher can take is a critical one [24]. However, in our process, I did not take the role as a critic. Still, we believe that our results showed that several parts of this project can be altered in the reverse way to have a better understanding about the right design. For example, in our design themes, we revealed that the placement of movement-based games is quite important. However, we do not exactly know what should be the frequency or the pattern of this placement. Our insights suggest that dictating it to be played before every move may be problematic, yet we can understand this subject better by designing a unpreferable version of it. Similarly, we also proposed that the interaction with such device should be limited for maintaining the social interaction and the concentration to game. Thereby, designing a very distractive version of this kind of device can be an interesting approach to understand until what extend the players should be allowed to interact with such device.

2.4. Expected Results

Design Knowledge (ER1): We expect to produce design implications, themes and guidelines which will cast light on the design of wearables and integration of movement-based play in a way which can satisfy players. We expect this result since we adopted a methodology which includes user-oriented formative design research during the design process and a deep summative analysis upon the production of our artifact. We expect these design implications and themes will help and guide designers of such products for tabletop games. We also expect to understand if these implications work in the intended way (in our case it is affecting the player experience in a positive way) by incorporating this knowledge in the design process of the artifact and the game system.

Artifact and game system (ER2): This project incorporates a research through design method which examines the research questions (RQ1, RQ2) through the design process of an artifact and a game system. Therefore, along with the knowledge about designing wearables and movement-based gameplay for tabletop role-playing games, we also expect to obtain working prototypes of arm-worn devices and a game system.

Effects on player experience (ER3): We expect that additions of wearables and the movement-based gameplay will affect the player experience in a positive way. To articulate in more detail, as a result of our user tests with the wearables and the new game system developed, we expect users to express that these additions affected their immersion and player/character relationship experience in a positive way.

3. Easy-Reading Guide

Since this thesis is in the form of collection-of-papers, many of the parts in the papers can be repetitive such as introduction, background and related work. Moreover, some of the papers were already seen by the jury members. Therefore, we grayed out the repetitive parts and also summarized each paper below to articulate the main focus of the paper. Structure of this thesis and the relation of papers with each work package can be seen in Figure 1.

Paper 1

Title: User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games.

Subject: This paper presents the design implications derived from the Participatory Design Workshop and a speculative design based on these implications.

Easy-Reading Guide: For having a broader knowledge about the field you can consult the **related-work section** of this paper. Related work sections on all other papers are quite similar to this one. Most important parts of this taper are the sections of **Device Concepts, Design Implications** and **Design Speculation.**

Paper 2

Title: WEARPG: Game Design Implications for Movement-Based Play in Table-Top Role-Playing Games with Arm-Worn Devices

Subject: This paper presents the first version of WEARPG game system, design motivations behind it and the game design implications extracted depending on the user feedback from the preliminary game tests.

Easy-Reading Guide: Most important sections of this Paper are **Game Design: WEARPG, User Experience Test** and **Game Design Implications.** These implications helped us during the development of the working prototype.

Paper 3

Title: Augmented Tabletop Role-Playing Game with Movement-Based Gameplay and Arm-Worn Devices

Subject: This paper presents the detailed introduction of the Arm-Worn Devices and the Game System

Easy-Reading Guide: This is an extended abstract for the demonstration that we made in DIS'17. **Game System** part is important to understand the functions of Elemental Gauntlet (arm-worn device) and the Luck Stone (augmented die). In this part, you can also see several different alternatives of the customization opportunities with the hexagonal base parts.

Paper 4

Title: WEARPG: Movement-Based Tabletop Role-Playing Game with Arm-Worn Devices and an Augmented Die

Subject: This Paper 16resents the WEARPG in detail and submitted for participating in student game design competition in CHIPlay '17.

Easy Read Guide: This is an extended abstract as we qualified to the the finals of Student Game Design Competition in CHI Play'17. Different from the Paper 3, in this Paper **Game Design/Movement – Based Mini Games** explains the last versions of the mini-games in detail. Moreover, **Game Design/Materials** part gives technical information about the working prototype.

Paper 5

Title: Wearing and Moving in Imaginary Play: Effects of Wearables and Movement on Tabletop Role-Playing Game Experience

Subject: This paper presents the results of our evaluation on the player experience and the design themes extracted from the feedback that we got from the participants.

Easy Read Guide: Method, Results, Design Themes and **General Discussion Parts** of this paper should be read to have an understanding of the effects of wearables and movement-based gameplay on the player experience.

Related papers which are not included in the dissertation

From the beginning of this project, we were curious about the fashionable ways of designing wearables. Therefore, we also initiated another branch of work exploring this area. We conducted design workshops with fashion design and engineering students. Other than that, we conducted interviews with experts all around the world to discuss if our findings can inform the design process of fashionable wearables. These efforts yielded into two journal papers (Paper 7 and 8). Yet, we did not include these two papers in the flow of the dissertation since results obtained from these studies were not used in our working prototype. Still, we believe that design recommendations about fashionable wearables can blend into the artifacts of WEARPG in further studies. These papers are included in the *Related Papers* section.

Additionally, Paper 6 which is about the workshop that will be organized in CHIPLAY'17 is directly related to augmented table-top games. Still, it is not focused on wearables and movement-based gameplay and do not inform our design process and results. Therefore, it is also not included in this dissertation flow, yet added to the *Related Papers* section.

Side Papers for Research Training

Other than papers which are included in the dissertation flow and related papers which are added as an addition, side papers which served to my research training also presented at *"Side Papers for Research Training"* section. Most of these papers are generated from other projects whose concepts are created by me. These research efforts helped me greatly in my training as a researcher and most of the design methods such as user elicitation studies, design workshops or summative user studies for understanding the immersion experience were first applied and trained in these papers. Moreover, they contemplate my experience of writing different levels of papers such as demonstrations, posters, competitions or alternative formats such as alt.Chi. Additionally, in some of these projects, I participated in the technical development side which added to my knowledge in programming. My roles in each paper are expressed in the *"Side Papers for Research Training"* section.

II
INCLUDED PAPERS

Paper 1: User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games.

Co-Authors: Oğuzhan Özcan (Advisor)

Conference: DUXU 2017: Design, User Experience, and Usability: Designing Pleasurable Experiences, Held as Part of HCI International 2017 [h5-index: 20]

Role: Concept Creator, Main Author, Design Researcher

Year: 2017

Type: Full Paper

User Oriented Design Speculation and Implications for an Arm-Worn Wearable Device for Table-Top Role-Playing Games

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Abstract. Augmenting table-top role-playing games (TTRPG) with computers is an extensive research area. Nevertheless, wearable devices were not considered a part of TTRPG before. Previous studies speculate that wearables may be valuable additions for games by altering many aspects some of which can address TTRPG such as character identification. Still, we did not encounter a player oriented exploratory study which suggests possible utilization ways for these devices. Therefore, we organized a participatory design workshop with 25 participants aiming at eliciting ideas from users to produce design knowledge about the interaction techniques, actions, visual properties and the GM's role. We also wanted to understand users' overall reactions to the idea of wearables in TTRPG. The workshop resulted in 5 conceptual device designs which led to design implications that can guide designers in this unexplored area. Moreover, we proposed a speculative arm-worn device drawing upon these implications.

Keywords: Wearables · Role-playing · Games · Game research · Game design · Movement-based game-play · Participatory design · Design workshop · User centered design · Design speculation

1 Introduction

Table-top Role Playing Games (TTRPG) are games in which players assume the role of their fictional characters. Game consists two types of actors which are players and the game master (GM). Players role-play their characters in an imaginary world written and moderated by the GM. TTRPG can have ancillary objects such as dice, character sheets, boards or figures. Conventional setting of TTRPG (Fig. 1), however, does not include digital artifacts. Nevertheless, recent studies integrate computer assisted devices such as notebook computers, interactive boards or surrounding systems like interactive rooms into role-playing games for altering especially narrative, ludic and functional properties [6, 14, 21]. However, previous studies did not consider wearable devices as a part of TTRPG. Thus, design knowledge regarding to user preferences for wearable devices do not exist in the field.

There are many studies aiming at augmenting the table-top games. [5, 14, 21, 23]. These studies aimed to enhance the table-top gaming experience by speeding up the

A. Marcus and W. Wang (Eds.): DUXU 2017, Part II, LNCS 10289, pp. 636–655, 2017.
DOI: 10.1007/978-3-319-58637-3_50

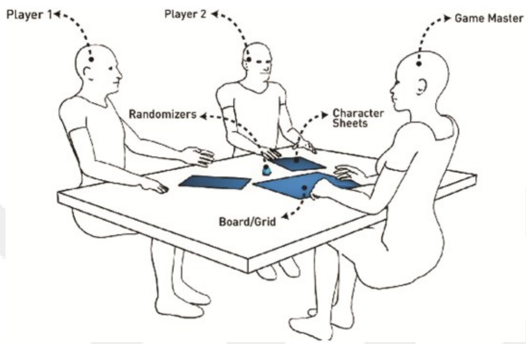

Fig. 1. Setting of conventional PnPRPG

calculation processes, improving communication abilities, bolstering sensory experiences and adding novel mechanics. In case of TTRPG, these additions left more space for role-playing by debilitating the conditions interfering with acting process. Drawing upon the previous studies, we believe that exploration of these devices in TTRPG context is valuable since wearable devices are claimed to enhance game experience with introduction of new interfaces and modalities [1], utilization of body as a controller [1, 2] and strengthen the feeling of character identification [3]. Still, we did not encounter a player oriented exploratory study which suggests possible utilization ways for these devices.

In the direction of these arguments, we believe that an arm-worn device may enhance the TTRPG experience. However, providing the ideal experience to players can only be possible with a ready-to hand device and such device can be designed with user-oriented design knowledge which was not covered by previous studies. In order produce this design knowledge, we organized a participatory design workshop with 25 participants including TTRPG players, game masters, cosplayers, jewelry designers and interaction designers. In this workshop, we asked participants to design non-working arm-worn device prototypes and "role-play" using them in a game scenario. Our expectations from the workshop were to (1) see users' reactions on positive and hindering parts of the wearable idea, (2) learn their preferences about the game actions to perform with this device, (3) understand their desires about the interaction techniques which refers to input and output methods (4) see their visual design decisions and (5) understand GM's role in controlling these devices. We especially focus on arm-worn devices, since they are easy to reach and control, attached to the upper part of the body which is visible in a table-top setting. Moreover, we wanted to narrow down to scope to have a more fertile workshop process. Upon the workshop, we discussed the design implications and proposed a speculative design with the design knowledge gained from the workshop.

2 Related Work

Augmenting table-top games with computers is a well-adopted practice in game design field [4–8]. However, we did not encounter any example which specifically proposes augmenting the TTRPG with arm-worn devices. Nevertheless, utilization of wearable devices is common in games which have similar characteristics [9–14]. Pervasive games, physical games and live-action role playing games (LARP) were considered suitable environments for the integration of the wearable devices.

Before referring to wearables, we should examine the work on computer augmented games (CAG). STARS Platform [7] is a remarkable example which was designed to be adaptable for different kinds of games with a room-sized interactive environment. This is one of the first and noteworthy examples of a working CAG system. Other than implemented systems, a recent work by Bergström and Björk pointed out 6 different CAG cases and extracted 8 dimensions which define the game design space for CAG [4]. These dimensions form constructive insights and define the design space of CAG in a convenient way. A similar study puts the primary aim of the CAG to decrease uncaptivating game processes, integrate game mechanics which can only work with computational power and maintain the social interaction level [6]. Another project, Undercurrents is a software which will remove undesired gaming processes like complex calculations and add enhanced properties like private communication by also emphasizing the importance of calm technology [5].

Another domain which is more related with TTRPG is Live-Action Role Playing Games (LARP). Lindley and Eladhari coined the Trans-Reality RPG concept which combines LARP, TTRPG and computer RPG (CRPG) using the advantages of each game modalities [15]. Proposed design does not include wearables, yet the concept of bringing together CRPG, TTRPG and LARP also corroborates with our concept of creating sensory experiences and costuming properties which is essential for LARP [16]. We may exemplify usage of wearables in LARP with the projects of Thumin Glove [13] and Gauntlet [12]. Both of these devices were developed for enhancing the game experience with new game mechanics generated by the computational power. Both studies draw conclusions from the user remarks.

Previous studies also suggest that wearables can strengthen the bond between player and the imaginary world which is an essential quality for TTRPG. Lightning Bug [3] examines wearables as costumes and question how they can foster the connectedness to imaginary worlds. Tanenbaum et al. also claimed that wearable devices can mediate one to feel as another character [2]. Supported by these projects we believe that connectedness to fictional world and characters in TTRPG can be bolstered by wearables.

The studies are indicators of how computers may be sources that can foster the tabletop games by shortening undesired processes, introducing new game mechanics and fostering the sensory aspects. Moreover, previous studies indicate that wearable devices can bolster the game experience by increasing the connectedness to imaginary worlds. Wearables also were speculated to support calm technology which has been coined as an important aspect for CAG [5]. However, these projects did not investigate wearable devices for TTRPG. Moreover, they do not focus on presenting user-oriented design knowledge which can inspire designers. Therefore, in our study we aimed at exploring this unvisited field by involving users in the design process, understanding their reactions and eliciting ideas.

3 Method

For examining the use of wearables in TTRPG, we integrated users in the design process from the very beginning with a participatory design (PD) workshop. PD is a widely adopted method for eliciting design ideas from the users, understanding them and producing design knowledge which will serve to the broad-range of fields [17–19].

3.1 Participants

25 participants which are *TTRPG players, game masters, cosplayers, interaction designers and jewelry designers* took part in the workshop. TTRPG players and GMs were our main users. We included cosplayers due to their knowledge in making costumes of fictional characters. Interaction designers were to assist projects in terms of interaction techniques while the jewelry designers helped in the visual design. We included jewelry designers since the wearable device design were mostly related also with smart jewelry. Table 1 demonstrates users' backgrounds, experiences and relation with the field. For acquiring participants, we posted a call to social media pages and e-mail groups related to RPG, cosplay, games and design. This call included a brief explanation of the workshop and a visual prepared by us to attract attention. We chose participants among 143 applicants according to their backgrounds and experience in related fields. We provided breakfast, lunch and transportation for the participants, yet we did not offer a payment. We believe that the TTRPG players, GMs and cosplayers wanted to participated in the workshop since they are usually enthusiastic for alternative culture events. Jewelry and interaction designers may also be motivated by the novel topic (wearable devices) of the workshop.

3.2 Procedure

We motivated the workshop by stating that we investigate the usage of wearable devices in TTRPG and did not disclose the arguments of previous work about costume properties, embodiment of characters and unobstructed interaction in order not to direct participants towards our opinions and to elicit objective ideas which are not affected by a certain point of view. The workshop lasted two consecutive days, in total 16 h.

The first day of the workshop focused on creating use case scenarios for devices. It started with a brief presentation about the utilization of wearables in HCI, in role-playing games and the schedule of the workshop. After the presentation, participants were divided into five groups. Each group incorporated one participant from all audiences. Then, in a brainstorming session which lasted about two hours, each group generated several ideas about the employment of the arm-worn device in the game. Jewelry and interaction designers led this brainstorming process. Each group presented their ideas with sketches, notes and mind-maps after the brainstorming session. All the participants watched the presentations and made their comments on the ideas. After presentations, we wanted each group to choose one of the alternatives and prepare detailed use case scenarios for the wearables. First day of the workshop concluded with final PowerPoint presentations which explains the preliminary use cases.

Table 1. Breakdown of participants (CP: Cosplayer, IxD: Interaction Designer, JD: Jewelry Designer, RP: RPG Player, GM: Game Master, XP: Experience in Years)

Part.	Age	Sex	XP	Notes
CP1	28	F	5–10	Masqueraded more than 10 characters
CP2	24	F	2–5	Masqueraded more than 10 characters
CP3	21	F	2–5	Masqueraded more than 10 characters
CP4	31	F	2–5	Masqueraded more than 10 characters
CP5	20	M	0–2	Masqueraded 3 characters
IxD1	24	F	3	Designer in a web-design company
IxD2	30	M	2	Musician working on wearable devices
IxD3	22	M	2–5	IxD student worked in prof. projects
IxD4	25	M	2–5	Industrial designer working on electronic devices and interfaces
IxD4	26	F	5–10	IxD in a game studio
JD1	27	F	0–2	Industrial designer with the fashion accessories master degree
JD2	29	F	>10	Jewelry designer and seller
JD3	34	F	5–10	Fashion design researcher with a master degree in fashion in game design
JD4	25	F	2–5	Industrial designer who designs and sells jewelry
JD5	24	F	0–2	Industrial designer with a jewelry design related work background
RP1	23	F	4–6	Knowledgeable D&D and custom RPG systems
RP2	24	M	4–6	More than 5 different RPG systems
RP3	21	F	4–6	More than 5 different RPG systems
RP4	21	M	>6	4 different RPG systems
RP5	21	M	0–2	More than 5 different RPG systems
GM1	27	M	>6	Knowledgeable in moderating 5 different RPG systems
GM2	33	M	>6	3 different RPG systems
GM3	25	M	>6	More than 5 different RPG systems
GM4	26	M	4–6	3 different RPG systems
GM5	25	M	>6	More than 5 different RPG systems and the co-founder of a RPG community

The second day of the workshop aimed at defining the form factor, visual properties, making the visual (non-working) prototypes and "role-playing" the use cases, which were designed in the first day, in a real game scenario. First, participants designed and produced visual prototypes with the materials we provided such as leather strips, beads, jewelry accessories, model clay, cardboard and cloth pieces. Groups also used the materials which the cosplayers and jewelry designers brought along to the workshop. After the visual prototypes were created, they wore them and played a short (about an hour and half) session of TTRPG by "role-playing" as if the devices were working (Fig. 2). Forming user scenarios with role playing and making users explore the design space by creating prototypes was claimed to be effective also by previous research [20]. The game systems and the scenarios in these sessions were decided by GMs in each group. We also wanted participants to document this process with photos. These photos were turned into video sketches [21] to be presented at the end of the second day. We specifically facilitated video sketches, as they are useful expressing the ideas quickly and finding hindering parts of the use cases. After the presentations, we made a semi-structured group interview to understand participants' opinions on the possible contribution of the device. Questions were about the main contribution of the device, effects on the game, visual properties, ways of integration, GM's Role and the possible interaction techniques.

Fig. 2. Gameplay session in the second part of the workshop

We analyzed the workshop results drawing upon the visual prototypes, video sketches, video records of presentations and voice record of the group interview.

4 Device Concepts

In this section, we explained all projects in detail by commentating the concepts, interaction techniques, game actions, visual factors and GM's Role since a product is comprised of form, material, function, cultural aspects, interaction and environmental design dealing with the mental models of users [22]. We encapsulate the form (visual aspects), function (actions), interaction (interaction technique). We also examine the

Fig. 3. Some of the visual non-working prototypes from the workshop

GM's role as a separate entity, since it is a special case for TTRPG. Material, cultural aspects and mental models of players can only be examined in production level and upon long-term engagement with the product. Figure 3 shows visual non-working prototypes and Table 2 demonstrates the main properties of designs.

Table 2. The properties of the device concepts – C (Combat), NC (Non-Combat), PC (Private Communication), DR (Dice-Rolling), MF (Move Figure), FC (Fully Customizable), PDC (Pre-designed Customizable)

	Interaction techniques		Game actions		Visual styles		GM Control
	Input	Output	In-game	Out-of-game	Feature	Appearance	
Group1	Tangible, auxiliary	Visual, haptic	C, NC, PC	–	FC	–	Separate console
Group2	Gestures, body sensors, touch	Visual	C, NC, PC	–	FC	–	Separate console
Group3	Gestures, voice, touch	Audial, visual, haptic	PC	DR, MF	PDC	Daily Use	Enhanced wearable
Group4	Tangible, touch	Visual, haptic	C, PC	DR	PDC	Character	Enhanced wearable
Group5	Voice, auxiliary, tangible	Audial	C, NC, PC	DR	PDC	Character	Enhanced wearable

4.1 Group 1 – RPGear (Fig. 4)

RPGear is focused on increasing the spatial awareness of the player about the fictional world. The concept adapts a gameplay similar to role-playing games which includes boards and figures. RPGear has auxiliary parts, called "beacons", which are used for defining the game area/map as if there is a board. Moreover, beacons are also used for defining the character figures, their locations and their connection with the wearable device. As the game progress, the information about the environment is transferred to the device and the players can react to the events according to their skills. For examples, if a player come across with a cliff, she/he can use Climb command if she/he has the ability. Similarly, during the combat, players can select the skills they had when the turn is theirs. The success of the moves is shown with LEDs which are visible to all players. Private information like private messages, character properties, intractable objects or available skills are demonstrated with a private display which remains under the front-arm.

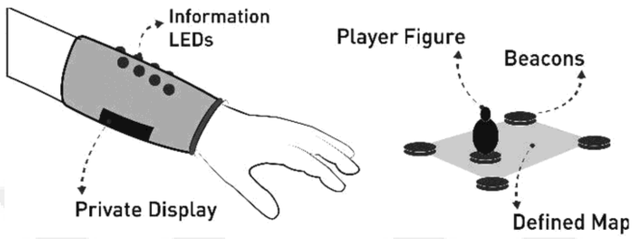

Fig. 4. Group 1 - RPGear device instructions

4.2 Group 2 – Nameless One (Fig. 5)

Nameless one focused on encouraging players enact their characters by making use of gestures and body conditions. Mid-air arm gestures and player's body conditions detected by body sensors like galvanic skin sensors are the primary inputs. Instead of expressing the command verbally and rolling the dice for calculating the outcome, players perform mid-air gestures. For example, when encountered to foes, on should swing her/his arm for performing a sword attack. After the gesture is performed, body conditions detected by sensors also affect the outcome.

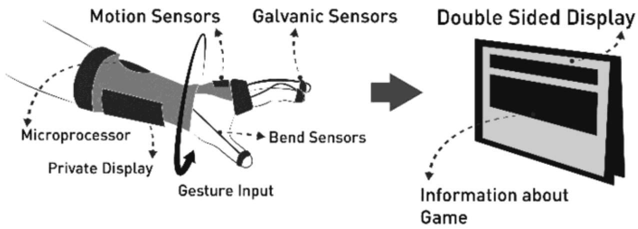

Fig. 5. Group 2 - the nameless one device instructions

Different than other projects, primary output is provided via a separate double sided display one side of which is visible to all players. Game events are to be monitored from this display. Information which should not be available to public is shown by small displays on wearables. The group also added a small device which emits scents to the environment in order to increase sensory experiences.

Other side of the double-sided display was faced to GM and functions as GM console. GM can manipulate the environment, alter the difficulty of the game and decide the outcomes of the moves.

4.3 Group 3 – RProp (Fig. 6)

The primary goal of the RProp is to provide private communication capability to players by using directional speakers. The device is consisted of two parts. One part includes

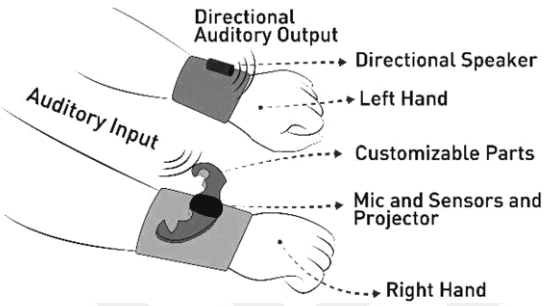

Fig. 6. Group 3 – RProp device instructions

the main module comprised of a projector and a microphone. Other part hosts the directional speaker. Players speak the messages directly to microphone and point their arms to the player who should hear the message.

As a secondary function, RProp simulates dice-rolling when a player performs the dice-rolling gesture. When the dice is rolled, device calculates the outcome by the virtue of character information loaded in its memory. The outcome can be seen from the projected display which is formed via the projector embedded the main module. This display can also be used as an alternative for getting private messages. Moreover, figures on the grid can be controlled through this display.

RProp provides a playful engagement for GM. GM device can be linked with the objects in the gaming environment. For example, when GM says "It's getting dark" while telling the story, the lights of the room dim.

Both parts of RProp are customizable and players can customize them with pre-designed parts. Group 3 expressed that, they aimed at designing a minimal device which can be worn also in their daily life.

4.4 Group 4 – RPGear (Fig. 7)

RPGear aims at speeding up the dice rolling process and encouraging players to express their character's progress with visual cues. Group 4's prototype stores the character information and lets players attach badges to device which shows their character achievements and history.

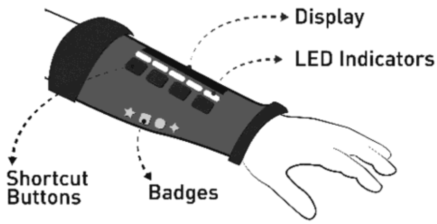

Fig. 7. Group 4 – RPGear device instructions

RPGear has buttons, a display, LED indicators and badge sockets. Buttons are for performing various dice-rolls and specific attacks. The LED indicators show the mana or health level of the players. When the move type is chosen and the dice are rolled by the device, the display shows a solid color depending on the success of this move. Although device can manage all kind of dice-rolling, Group 4 decided to keep dice in the game. They are not functional but they expressed that dice should not be removed completely as they were a symbolic part of TTRPG.

GM device differentiates from other players by its size and look. Its design is more flamboyant compared to the player devices. RPGear adds physical interaction to game. GM should touch other players' devices to make the outcome affect them when s/he performs a move.

Players can add badges to the device which reflects the characters' properties and achievements. These badges also activate the achievements in an online platform which functions as a social network between players who has a RPGear.

4.5 Group 5 – Gauntlet of Fate (Fig. 8)

The main purpose of Gauntlet of Fate (GoF) is reflecting the fictional character by using nano-technological clothes which can morph into different shapes. Therefore, every player may turn their devices into something which is related to their character properties.

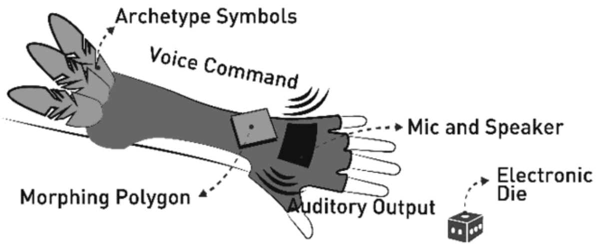

Fig. 8. Group 5 - gauntlet of fate device instructions

As a primary input, Group 5 used voice commands. For example, when a player says "Fireball", the device executes that move. Dice is also a part of the input system. When the dice is rolled, the outcome is transferred to the device for calculating the value of the move. The output of the move is also announced by device via speech. Group 5 indicated that this interaction technique provides non-distracting gameplay. Additionally, device has a part which has a shape of a polygon. The edge number of the polygon is determined according to the number of players. If there are 4 players, this polygon-shaped part morphs into a square and each corner represents a player. GM can select specific players by touching the specific corners.

GM device, different from the players' devices, is two part and worn to both arms. Therefore, it is more radiant than others. The device of the GM has several enhanced properties. For example, GM can attach some figures to the devices which show the number of the fictional characters who passed away during the games that he moderated.

Moreover, GM can send a “whisper of GM” which includes private information by talking towards his palm. Players can listen these messages via speakers of the device. Furthermore, device is able to change the voice of the GM during the storytelling according to characters she/he enacted.

GoF can also be upgraded with new parts as the fictional character levels up. Therefore, players can represent their fictional characters with their device’s appearance.

5 Discussion

We evaluated the visual prototypes, presentation videos, workshop notes and the voice record of the semi-structured group interview for analyzing the outcomes of the workshop. According to the evaluation, players’ opinions indicate that arm-worn devices may contribute to the RPG environment by (1) adding new game play styles, (2) automatizing the undesired game process, (3) enhancing the sensory experiences. Apart from these positive additions, participants expressed their concerns about the distraction possibility which may be caused by the interaction with the device. In this section, we commented on how the results corroborate with previous studies and how our implications may hint to design of wearables for TTRPG. We believe that these implications are important since they provide the design knowledge which is open to interpretation [23] that can lead to many different designs.

5.1 New Gameplay Styles

Previous research on CAG indicates that integration of new game play styles as a result of the computational power is an expected result [6]. Our study also shows that this also reflects the TTRPG players’ mind as four of the groups proposed changing the game play style slightly or radically.

The most radical change was proposed by Group 2 with the introduction of movement-based play and the effects of body conditions. Previous research in games indicates that movement is a phenomenon which may result in an increased engagement [24–26]. Yet, movement-based play was not investigated in the context of long-term games with rich narrative. As RPGs may have limitless in-game actions, assigning different movement patterns to each action can be mentally or physically fatiguing. Substantiated with this statement, Group2 assigned gestures only to main actions like attack, defense or spell-casting instead of all actions. This way, players do not have to memorize different gestures, for different spells. To exemplify, they can use the same gesture for all ranged attack spells, yet imagine different results. In this way, the system becomes more scalable and usable for players. This new addition to game, turned the game into a real-time game where players need to react events in real time instead of the turn-based structure of conventional RPGs. For instance, players may have to attack to a certain enemy by swinging their arms for attacking with a sword. In the conventional structure, dice should be rolled for the player and for the enemy to conclude this encounter. However, new structure proposes players to swing their arms in a right timing and reduces the process into just one move. If player can have a good timing, than she/he can take out the enemy successfully. Still, each player performs their moves in the turn-based system and rest until the turn is theirs which bypasses the physical fatigue.

Group1 also radically changed game play style by removing dice and the board completely. They used beacons for digitally defining the map and instead of using dice, implemented CRPG-like system in which players can choose skills to perform on the wearable device's display. Moreover, device can provide sensory feedback like visual and haptic easing the spatial comprehension for the imaginary environment. The approach of this group put the game into a space between CRPG and TTRPG by adopting sensory and scripted nature of CRPG and social, limitless and imaginary environment of TTRPG. Other groups also made slight additions to gameplay like tangible inventory system (Group5), global achievement system (Group4).

Although changes in game-mechanics were acceptable, players expressed that RPG elements like character properties should not be overwhelmed by new additions. For example, during our discussion in the group interview, challenge-based game mechanics were taken skeptically. One of the players said that "I am a tiny person, however I always role-play a barbarian character. How will I overcome the physical challenges which will be faced by my character with my tiny body?" This indicates that imaginary characters' properties and similar role playing elements always should be the primary concern and their emphasis should not be reduced by new additions.

Players preferences and opinions indicate that wearable devices can conceive new game play styles, interactions and mechanics which may bring the TTRPG closer to CRPG and LARP. Still, new game mechanics should be implemented carefully by not overwhelming the RPG elements like character skills.

5.2 Transforming the Undesired Game Properties

RPGs are based on impersonating a character and acting it. However, most of the RPG systems have game rules which require long and complex calculation processes. These calculation processes can be considered uncaptivating [6]. Participants showed an inevitable consensus on automatizing these processes. Similar features also were introduced in previous CAG [5].

First, the common point for all groups was assigning character information and dice calculation to devices. However, they followed different approaches. Group1 and Group2 replaced the conventional dice rolling system with new game mechanics, whereas other groups decided to keep the conventional game play. Group4 and Group5 kept the dice physically in the game while the Group3 replaced it with a dice-rolling gesture. Moreover except for Group2, all groups kept the tangible props like figures or a game board in the game. Previous research also suggests that the tangible props, and especially dice [27], have an important effect in table-top gaming experience. The moment when the dice is rolled, the excitement occurred until the result is revealed and the materiality [28] of it stand as important properties of TTRPG experience. Even, one of the players said "Dice is like the treasure for role playing gamers and I am attentive not to lose any of them".

Another common point was the private communication feature. In a conventional TTRPG setting, private communication is only possible with note papers or whispering to the ear of players. However, this process does not create the ideal experience since all the players are aware that a secret message is delivered to a specific player. With wearable devices, participants emphasized the opportunity which improves transmitting secret and private messages.

Our observations showed that removing and automatizing the processes which intervenes with role-playing process and entertainment such as calculating dice outcomes should be done by devices. Still, we saw that, as also previous work suggests [27, 28], player may keep the dices or other tangible props in the game system even if their functionality are replaced by devices. Therefore, how these kinds of props will be integrated to the game system supported by wearable devices should be scrutinized by designers. Other than this, wearables can transform and enhance the communication between players by providing features such as secret or private messaging.

5.3 Sensory Experiences and Character Identification

TTRPG is built on the imagination of players and visual support is usually provided by miniature figures and boards. However, players took the opportunity of using more dynamic visual, audial and haptic feedback to foster the sensory aspects of the TTRPG with wearables. Previous studies also remark the advantages of computers in enhancing the sensory experiences [29]. Group1 used LED and Haptic indicators, Group2 coined the idea of a scent emitter, Group3 gave the proposal of GM's ability to manipulate environmental conditions, Group4 and Group5 came up with visually customizable devices enhancing the identification experience with fictional characters.

Still, participants also expressed the worry for the distraction that can be caused by the excessive visual feedback. Therefore, peripheral interaction methods were proposed which are not visually distracting and captivating like gestures, voice commands, tangible buttons, haptic and audial feedback. Moreover, visual feedback is mostly used as sole colors, simplified information and mostly for calculation results and character information. At group interview, one of the participants also said "If we are stuck to the device, this may break our concentration to game."

Designers should acknowledge that although players consider that an arm-worn device may enhance the game, the interaction techniques should not be distracting and prevent social communication. Wearables can more advantageous then other types of devices in that sense, since they are speculated to support "calm technology" by remaining at the periphery of users [30]. The maintenance of social aspects was also asserted as an important property by previous research [6]. Moreover, especially haptic feedback come forward as specific to wearables as they are attached to the body. Similarly, identification with characters through customization, as also indicated by previous research [2, 3, 14], is wearable specific.

5.4 GM's Role

Previous studies in augmenting TTRPG explored the possible functions for GM's in CAG which also corroborates with many of the features proposed by participants like immediate control availability, map and story preparation [5]. However, different from the previous work, our study put forth interaction, game-play, visual style and feature preferences of GMs for arm-worn devices in TTRPG.

First of all, while two groups proposed a separate console, other groups preferred a wearable device for GM. A separate console is advantageous in administering a detailed interface which may let GM control the players' wearables and the game with much force. On the other hand, a wearable for GM can be more desirable as it can include GM in the game not only as a moderator but a player. One of the GMs expressed that "Game Masters should also be considered as a "player", as moderation and story-telling get boring if you cannot participate in the game."

The enhanced features for GMs were environment control, voice changing, private communication, manipulating game environment, creating NPCs and controlling other devices. Moreover, wearable GM consoles were visually different than the player devices. Group3 preferred a different color, Group4 expressed that GM has a more flamboyant device and Group5 proposed devices which can be worn to both arms different from the single-arm devices of players.

Participants preferences in the workshop showed that GM's can either have a separate console or a wearable device for controlling the game. Independent from the version they have, GMs should be able to manipulate many aspects of the game. Some of the abilities they have even may make them feel as if they are super-powered players of the game. Corroborating with this, in case they have wearable devices, these devices should be different and even more flamboyant and superior than player devices.

6 Design Implications

User reactions and device concepts lead us to extract design implications which may guide the designers of such devices. Moreover, we believe that these implications will also be constructive for other kinds of wearable and personal gadgets which may be used in computer games, pervasive games, serious games or gamification projects.

Non-Distracting Interaction Techniques. All groups preferred interaction techniques which remains in the perceptual area of the players. For example, haptic or audial feedback which does not require a direct attention to be perceived preferred more than other techniques. Visual feedbacks were mostly solid colors or LED lights at which can be perceived without directly looking. Likewise, gestural, voice or tangible inputs preferred which does not require a direct look, browsing and such. This is important for maintaining the social interaction and satisfies our motivation about the calm interaction [28].

Designing devices in interaction with the auxiliary objects. Four of the groups decided to keep the supportive objects like dice, grids, and figures. Therefore, instead of assigning the roles of these objects to wearable by removing them from the game, designers should scrutinize to form an interaction between this objects and the wearable. This finding is also supported by previous research suggests that use tangible objects like dice increase the table top gaming experience [5].

Automatization of Uncaptivating Processes. By design, out of game moments like calculation after dice rolling occur repeatedly during the gameplay of TTRPG. All of the groups assigned processes like dice-rolling or storing character information to device. Thus, device has to speed up all of the out-of-game processes. Previous research on CAG role-playing games also suggest the advantage of electronic devices in this manner [18, 19].

Different information levels. As explained in the descriptions of "Device Concepts", the information needed by players were classified into two as public and private information. Therefore, designers should consider how to place information which is relevant to other players and which is private to the wearer. Private displays or audial feedback were preferable for private information while LED's or public displays were used for public information.

Enhancing the communication between players. Another function used by all groups was private communication between players via auditory output or via displays. GM or other players need to communicate with each other secretly time to time. This property also was reported preferable by users in a previous study [3]. Therefore, easing the communication between players should be considered as an important property of the device.

Assigned in-game actions should be adaptable to narrative. All actions assigned to the devices have to be simple actions like attacks, or skills which are liable to success check, details of which can be expressed by game master according to the narrative. Otherwise assigning commands to each action is not scalable. Therefore, no action should be precluded because the device does not support them.

Exploring new gameplay styles. All the groups proposed new interaction techniques both for players and GMs via use of embedded sensors or electronic auxiliary objects. Moreover, Group1 transferred mechanics from CRPG while Group2 introduce a whole new approach with movement-based gameplay. Therefore, designers should not ignore that novel interaction techniques and gameplay mechanics are welcome by players in an integration of such device.

Customization of the device can serve as an upgrade to character properties. As Group 4 and Group 5 suggested devices may be a part of an environment where the fictional characters' skills are developing as the device is visually upgraded with different parts in real life. This also supported the claim of Isbister suggesting that costumes may increase the connectedness to imaginary world [11] as players consider them as a part of their fictional characters.

Participatory customization space. While three of the groups proposed a customization space with pre-designed parts, two of them proposed customizing the device from the scratch. We believe that a customization space for such device should form an environment which guides players to design their devices easily with pre-designed parts while letting them to modify it with outer parts.

GM as a player. Game masters can be considered as god-like beings in the fictional world of the game while granted with improved skills for their devices. One of the participants expressed that "Game Masters should also be considered as a "player", as moderation and story-telling get boring if you cannot participate in the game." Therefore, while designing a wearable device for PnPRPG, game masters should not be considered referees or moderators only as they also devote themselves to the game voluntarily and for enjoyment.

Enhanced visual appearance for GM Device. Visual properties of the devices also showed differences from the players' devices. Group 3 favored a color change in modules, Group 4 and Group 5 designed a bigger, more flamboyant and multiple-module device. Therefore, GM device should be different than the other players' devices and its visual properties should express the GM's superior status.

Immediate control ability of GM. As in the GM consoles of Group 1 and Group 2, game master should be able to step in the decision mechanism of devices whenever she/he wants and manipulate the outcomes according to the story. For example, if a dice calculation or a result of a challenge based attack is more than what is meant to be according to story, GM should be able to change the output.

7 Design Speculation

Upon our analysis and design implications extracted from the user preferences, we designed a speculative arm-worn device which may satisfy the TTRPG Players (Fig. 9). Design speculations contribute to the field by informing the community about the possible future designs about a specific topic [31–33]. Still, this is only a one type of interpretation of the design knowledge we presented and it may lead to many more different proposals. Among our many implications we extracted following design motivations for our speculative design. We only focus on player device, thereby our implications about GM device are not in the scope of the following speculation. Our motivation for this speculative design is based on (Design Motivation 1) automatization for uncaptivating process, (DM2) introduction of new game mechanics with movement-based play, (DM3) support by auxiliary objects, (DM4) customization depending on the

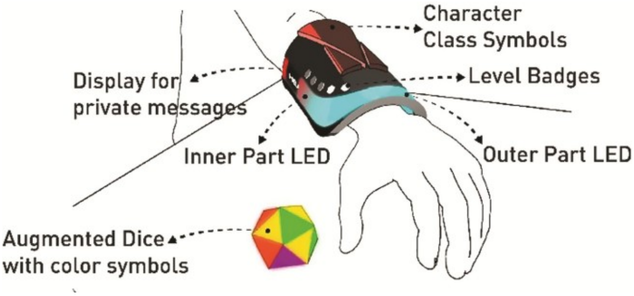

Fig. 9. Speculative arm-worn device design for TTRPG

fictional character, (DM5) non-distracting interaction techniques, (DM6) introducing actions adaptable to narrative. We also conducted a preliminary user test with an experience prototype which encapsulates some of these design motivations as a successor of this project [34].

Concept. This device aims at encouraging the players to act their characters by performing the actions with body movements and visually customizing the device for reflecting the fictional character. Moreover, the device works for automatizing the dice calculations and private communication between players.

Interaction Technique. WeaRPG is mainly operated with gestures (DM2, DM5). Gestures are only assigned for actions which may define the essence of the movement like power, concentration, reflex and precision (DM6). In this way, these actions can be adapted to many different scenarios in the narrative of the game. For example, an attack with sword requires power gesture which needs swinging the arm as strong as possible while dodging requires rapid movements of arm in the right timing. However, gestures do not affect the outcome directly, yet affect the augmented dice. If the gesture is successful, the green sides of the dice increase compared to red sides (DM3). Output is provided with a LED stripe inner part of which reflects the private information like a secret notification from GM while the outer part demonstrates the public information like a success of the move performed (DM5). There is also a small display which only shows private messages from the GM (DM5).

Actions. Combat and Non-combat actions can be performed with WeaRPG thanks to the global gesture system which may be adapted to a wide range of actions in the game. Moreover, it also calculates dice-rolls and provides private communication (DM1). In an example scenario, a player encounters with an enemy and performs concentration and power gestures for activating a fireball spell. The gesture performance is fairly good, so the green parts of the dice increase. When the dice is rolled, luckily, green side comes which result in the elimination of the foe.

Visual Factors. The device includes a component which allows magnetic parts to be attached. As seen in Fig. 9, players can attach different figures which can reflect their factions, races or classes depending on the different game systems (DM4). Moreover, badges define the levels of the character (DM4). Other than the customization properties, a LED strip surrounds the device. Moreover, a display is embedded to the inner part of the device enabling only the player who wears it see.

8 Conclusion

As a result of our study we presented detailed explanation of all projects in our participatory design workshop with 25 participants. We also reflected our designerly comments on the devices, extracted design implications drawing upon the proposed designs, participants' comments, ideas, presentations and made a design speculation for a wearable device which can be used in TTRPG. Our findings demonstrated that an arm-worn device may contribute to augmentation of table-top games in terms of adding new gameplay styles, removing the undesired game processes and fostering the sensory experiences which lacks in conventional table top setting. Moreover, we conclude that non-distracting interaction techniques like gestures, tangible buttons, voice commands, simple visuals and audial feedback should be preferred in order to maintain the social environment without capturing players' attention to devices.

The speculative design we proposed should be tested with further user tests to understand its effect on player experience. However, a product which would works towards enhancing the gameplay experience with a better character identification can only be possible with a ready-to-hand product. Our study proposes the detailed explanation of conceptual projects, design implications and a speculative concept which adds to the field with user-oriented design knowledge on wearable device design for TTRPG and forms the path which goes to such ready-to-hand design.

Acknowledgements. We thank all volunteer participants of our workshop. We also thank our colleagues at KUAR for their detailed review in this paper.

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Paper 2: WEARPG: Game design implications for movement-based play in table-top role-playing games with arm-worn devices

Co-Authors: Oğuzhan Özcan (Advisor)

Conference: 20th International Academic Mindtrek Conference [acceptance rate: %52, h5-index: 11]

Role: Concept Creator, Game Designer, Main Author

Year: 2016

Type: Full Paper

WEARPG: Game Design Implications for Movement-Based Play in Table-Top Role-Playing Games with Arm-Worn Devices

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1. ABSTRACT

Combining the physical and the digital is one of the most trending topics in game research in HCI. Augmenting the table-top role-playing games (TTRPG) by adding electronic devices is a growing research area, yet the introduction of new play styles is still open for exploration. We believe that integration of wearable devices and movement-based play, which are also prominent research areas for gaming, hold potential for increasing the TTRPG experience since these are observed to increase the connectedness of players to imaginary world of games by previous studies. However, such augmentation will also bring changes in game design and these changes were not investigated thorougly in previous studies. To understand how game design of such games may change due to the usage of wearables and movement-based play, we conducted a participatory design workshop with (1) 25 participants, (2) designed a new game system according to our findings and (3) evaluated it with iterative tests with 15 participants in TTRPG sessions. Our study resulted in 8 player-centered game design implications for the use of arm-worn devices and movment-based play in narrative based long-term games like TTRPG. The implications present clues about *forming the narrative, regulating the rules and the functional use of the device in game mechanics.*

CSS CONCEPTS

• Human-centered computing~User studies • Human-centered computing~Gestural input • Human-centered computing~Ubiquitous and mobile computing • Software and its engineering~Interactive games

Author Keywords

Wearable Computing, Role Playing Games, Participatory Design, PnPRPG, Guidelines, Player Experience, Play Test, Table-Top, Augmented Games, Exertion Games, Game Design.

AcademicMindtrek'16, October 17 - 18, 2016, Tampere, Finland

ACM 978-1-4503-4367-1/16/10 $15.00

DOI: http://dx.doi.org/10.1145/2994310.2994315

2. INTRODUCTION

TTRPG is played in a table top setting (Figure 1) that relies on the social communication of the players. A TTRPG player group usually consists of a game master and players (usually at least two). Game master is the moderator of the game and apart from that he is in the role of a story teller who creates the fictional world. Players assume the role of the fictional characters and guide them in this fictional world and perform some actions. Results of these character actions are usually determined via randomizers such as dice or cards. Therefore, TTRPG environment is filled up with non-digital props like dice, figures or a game board. Still, recent studies investigates the integration of computer assisted devices to such table top games [2,18,20]. These works contribute to the table-top gaming by enhancing different aspects of the games.

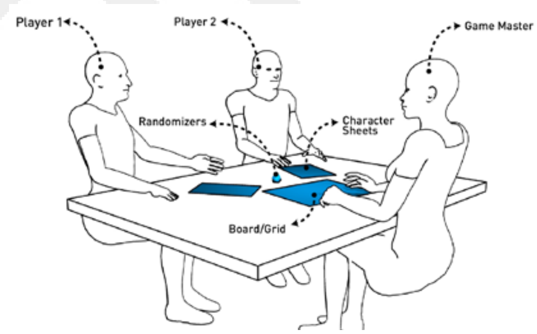

Figure 1: Setting of conventional TTRPG

One part of the former studies in this area focus on shortening the out of game process by transferring processes like dice calculations to the electronic devices [3,19,20]. Several other research made use of audio-visual content which will increase the sensory experience of the players as in computer games [18]. These studies also put forth new rules and mechanics which were raised due to the use of computational power [19]. Previous studies also indicate that, utilization of movement-based play and wearable devices has a potential for increasing one's connectedness to imaginary worlds and ease them to identify with the fictional characters [1,26], which are essential parts of TTRPG. However, we did not encounter the utilization of wearables and movement-based play in TTRPGs.

We believe that movement-based play via arm-worn devices (as the table-top setting renders visible only upper part of the body, we preferred to use arm-worn devices which is attached to the arm, most accessible part of the body [28]) may be a promising new gameplay style which may foster the game-play experience in TTRPG. First of all, movement is claimed to be an activity which increases the engagement with the game by previous studies [5,10,15]. Yet, how movement will affect such narrative oriented table-top game atmosphere is still an unknown question. We believe that our exploration in this area may provide answers for how to use movement based interaction with narrative involved games. Secondly, previous research suggests that embodied play and modification of body with wearables can increase immersiveness by fostering the identification with the fictional character [1,9,26]. Nevertheless, we believe that complex character creation system and rules of role-playing games need to be reshaped in order to get a holistic feeling of embodied play experience. Therefore, we consider the computer augmentation as a source for new game play and interaction styles instead of considering it a mere implementation for only speeding up and automatize the game process. For creating a computer augmented TTRPG in that sense, we need to go under an extensive user centered design process.

In the direction of above statement, we aimed to understand the player needs and design a TTRPG environment which provides embodied play via wearables. We followed a three pillared design method. First, we conducted a participatory design (PD) workshop to understand players' approach to arm-worn device idea and to elicit further ideas. Workshop consisted of 25 participants from 5 audiences which are *TTRPG players, game masters, cosplayers, jewelry designers and interaction designers*. Second, we designed a preliminary game system, based on movement-based play with wearables drawing upon the insights we got from the workshop. Lastly we tested the game system with 15 participants. Our extensive player centered design process resulted in game design implications which propose insights for the design of embodied games especially for narrative oriented table-top games.

3. BACKGROUND

3.1 Role Playing Game Systems

There are many role playing systems which focus on different aspects of role playing. Dungeons & Dragons [8], the first role playing game system, has quite complex rules and a play system. Nevertheless, the last version, 5th ed., is much more simplified, emphasizing the role playing over the game rules. Vampire: The Masquerade [21] is based on a system called Storyteller/Storytelling which utilizes multiple dice rolling at the same time and put less emphasis on mathematical calculations by highlighting character customization in the system.

Since they came out, role playing games got more and more narrative inclined encouraging free form game play [17]. Everway [27] is a great example of narrative based game system which make players draw cards during character creation and progress on this card drawing system. RPG of Star Wars [16] which was published in 2012 also put storytelling and role playing to priority by simplifying the dice numbers by transforming them into symbols which has a simple rock-scissors-paper logic.

Although dice rolling or cards are common ways of randomizing the play, some role-playing games follow different approaches. Mist-Robed Gate (MRG) [24] is one of these examples which facilitates the play with rules without any randomizers. What is interesting about MRG is the use of a "real knife" for symbolizing the attacks and threats. This role-playing game is designed to be cinematic and all the explanations during the play needs to include also camera angles.

The role-playing systems are too many, yet we discussed several different approaches which put emphasis on different aspects like operational rules, storytelling or role-playing (acting). Throughout the years, game systems give more importance to role-play elements than the operational rules [17]. We believe that computer augmentation via arm-worn devices will also a step forward in this manner by also providing chance to act their characters.

3.2 Related Work

Extensive research has been conducted on computer augmented table-top games. The use of computer assisted devices such as mobile, head mounted devices and wearable devices aims at different goals such as increasing the physicality of games, shortening the calculation processes in tabletop games and introducing different mechanics which includes physical environment embodiment.

Stars Platform [19] is one of the computer augmented systems which was designed specifically for computer augmented table top games. Stars Platform is available to be adapted to different games, therefore it lets designers investigate the adaptations of conventional table top games to computer augmented environments. Two games – an adaptation of Monopoly and a RPG called KnightMage – were developed for this platform. Although this research mentioned new game mechanics, rules and interaction styles during the adaptation process, it was not solely focused on TTRPG. Moreover, these changes were not investigated in a way that may guide to the design implications. Another research, Undercurrents [3], specifically aims at augmenting the TTRPG setting and introduces an environment comprises of notebook computers for each player and a software which provides private communication, audio-visual support and real-time documentation. Nevertheless, this study too, did not focus on game design issues occurred during the adaptation of games. In another study, Bergström and Björk investigated 6 different computer augmented games and defined a design space of such games [2]. However, this study presents a broader conceptual space in terms of design instead of focusing on game mechanics or rules. Moreover, none of these studies has implications on movement-based play and wearables.

The usage of wearable devices in physical games may be advantageous in the aspects of mobility or accessibility, nevertheless one of our motivations behind using them is their costume properties which is claimed to foster the bond to the imaginary game worlds. Previous studies by Isbister investigate the utilization of wearables as game controllers and examines the effects on connectedness to virtual worlds [1,9,26]. Bertelsmeyer et al. discusses the game design challenges when wearable devices integrated into the games by conducting a research through the design of a real time strategy game in which the players are involved using their bodies [4]. Although these projects give strong insights about how wearable devices may contribute to the game experience, they do not present user feedbacks about these hypotheses.

Other than these, there are many work which examines the role of the movement in games. Previous research indicates that movement can increase the engagement with the game [5,11]. Moreover, Mueller and Isbister put forth design guidelines for movement-based games, yet the games they examined were mostly casual and did not include long-term gameplay times or were not narrative based [22]. Nevertheless, none of these projects focused on a table-top setting. Furthermore, they do not consider integration of wearables and movement-based play in progressive games with a dynamic story telling.

Our research showed that extensive work has been done for augmentation of non-technological games with computers, usage of wearable devices and movement in games. However, wearable devices and the effects of movement-based play through arm-worn devices were not investigated in the domain of TTRPG. Furthermore, although design guidelines for movement-based games were present, the role of movement were not examined in the context of long-term narrative based games like TTRPG and a discussion about game design implications has not been raised. In this study, we aim at generating knowledge about the game design characteristics of such adaptation.

4. PARTICIPATORY DESIGN WORKSHOP

4.1 Participants

The workshop included 25 participants which are *TTRPG players, game masters, cosplayers, interaction designers and jewelry designers* (5 participants from each audience). The information regarding to participants' backgrounds can be found in **Table 1** .

TTRPG players and game masters were our main user base. Cosplayers are hobbyists who design and wear costumes for fictional characters. We included them since their knowledge on producing costumes for fictional characters may contribute to the process. Interaction designers and jewelry designers were the professional participants whose duty was aiding users in design decisions for interaction design and wearable design as arm-worn wearables can also be considered as smart jewelry. For choosing participants, we posted a call to social media pages and e-mail groups related to RPG, games and design. We chose participants among 143 applicants according to their backgrounds and experience in related fields. Participants' breakfasts and lunches during the workshop were reimbursed. Yet, we did not offer any other payment and the main motivation behind their participation was being part of such work for their hobbies. Professional participants which were jewelry and interaction designers may have been motivated by the novel character of the study.

Figure 2: Some of the non-working prototypes from the participatory design workshop

4.2 Procedure

In order to involve users in the design process from the very beginning, we conducted a participatory design (PD) workshop. PD is a widely adopted method for eliciting design ideas from users and understanding their needs [13]. The workshop lasted two consecutive days, in total 16 hours. In the first day, we wanted participants to create use cases and define the features of the device. Other day, we wanted them to build non-working visual prototypes and test them in game scenarios created and moderated by Game Master participants. They played the game with these non-working prototypes by role playing as if the device is working. Forming user scenarios by the use of role playing and making users explore the design space by creating prototypes was also proposed as an effective method by previous research [25]. At the end of the workshop, participants presented their work with video sketches, since video sketching is an effective and fast method for explaining use cases. Presentations were followed by a semi-structured group interview in order to learn what participants think about the contribution of the devices.

Table 1: Breakdown of Participants (CP: Cosplayer, IxD: Interaction Designer, JD: Jewelry Designer, RP: RPG Player, GM: Game Master ,S: Sex, XP: Experience in years)

Part.	*Age*	*S.*	*XP*	*Background*
CP1	28	F	5-10	Masqueraded more than 10 characters
CP2	24	F	2-5	Masqueraded more than 10 characters
CP3	21	F	2-5	Masqueraded more than 10 characters
CP4	31	F	2-5	Masqueraded more than 10 characters
CP5	20	M	0-2	Masqueraded 3 characters
IxD1	24	F	3	Designer in a web-design company.
IxD2	30	M	2	Musician working on wearable devices.
IxD3	22	M	2-5	IxD student worked in prof. projects.
IxD4	25	M	2-5	Industrial designer working on electronic devices and interfaces
IxD4	26	F	5-10	IxD in a game studio
JD1	27	F	0-2	Industrial Designer with the Fashion Accessories Master Degree
JD2	29	F	>10	Jewelry designer and seller
JD3	34	F	5-10	Fashion Design Researcher with a Master degree in fashion in game design
JD4	25	F	2-5	Industrial designer who designs and sells jewelry
JD5	24	F	0-2	Industrial designer with a jewelry design related work background
RP1	23	F	4-6	Knowledgeable D&D and Custom RPG Systems
RP2	24	M	4-6	More than 5 different RPG Systems
RP3	21	F	4-6	More than 5 different RPG Systems
RP4	21	M	>6	4 different RPG Systems
RP5	21	M	0-2	More than 5 different RPG Systems
GM1	27	M	>6	Knowledgeable in moderating 5 different RPG systems
GM2	33	M	>6	3 different RPG systems
GM3	25	M	>6	More than 5 different RPG systems
GM4	26	M	4-6	3 different RPG systems
GM5	25	M	>6	More than 5 different RPG systems and the co-founder of a RPG

We facilitated workshop only by making a brief presentation about the usage of wearables in HCI and role-playing games. We did not disclose the idea of using embodied interaction since we wanted them to act on their works free from our mindset.

4.3 Outcomes

As a result of the workshop five device concepts were designed by the participants (Figure 2 and Figure 3). Other than that, the user remarks procured from the semi-structured interview and our observations earned us strong insights about their approach to the idea of using wearable device. The players' found wearable devices effective in several aspects. All of the players and GMs agreed that such device has potential to unveil novel interaction methods and increase the fun factor. Only concern was the distraction that can be caused by the devices. Therefore, players preferred non-distracting interaction techniques.

We will not analyze every project in detail because of the limited space yet we will explain the observed mutual points by referring each project briefly. We will discuss the outcomes under six main themes.

4.3.1 Peripheral Interaction Modalities

We observed that participants decided to use peripheral interaction modalities such as gestures, tangible buttons, voice commands as an input. Outputs were mainly in the form of haptic feedback, simple visual and sound feedbacks. We believe that this decision was originated from the concern of possible distractions which will be caused by devices. Peripheral interaction modalities do not distract player by remaining at the periphery and not requiring direct attention. Among all, embodied interaction methods like gestures were also one of these peripheral interaction modalities.

One of the projects called *Nameless One – Group2* (Figure 3b) operates with gestures and body conditions. For instance, if players want to attack to an enemy with a sword, they need to swing their arms instead of just rolling dice. The other project *RProp - Group3* (Figure 3c) made use of gestures which replaces the dice rolling action. Other than that, Group5 with their project *Gauntlet of Fate (GoF* - Figure 3e*)* used augmented dice and voice commands as input and sound feedback as output. *RPGear – Group4* (Figure 3d) introduced an input modality which includes touching other players. Game Master has to touch a specific player to make her/him affected by the outcome of the move.

We observed that gestural interaction and movement-based game play also may meet with player expectations as two groups decided to use this modality. In workshop, while Group 2 proposed a game play which is solely based on movement, Group 3 used gestures for replacing the dice rolls. Other than that, we observed that participants put emphasis on using peripheral interaction modalities in order to prevent distraction during the game.

4.3.2 Auxiliary Props as Interactive Elements

We observed that other than the wearable devices, all concepts had another auxiliary prop in the game environment like dice, figure, grid or other interactive devices. *RPGear – Group1* (Figure 3a) used beacons which are interactive tags for defining the game map and builds a communication between character figures and the device. Group 2 included a double-sided public display as an extension while the Group 3 had interactive figures and a grid. Group 4 did not want to remove dice from the game although the device could perform dice rolls automatically. Group5 integrated augmented dice which sends the rolled value to the wearable device.

Depending on these results, we believe that augmented or not, auxiliary props are important for forming the public information ground of the game which informs all players at the same time. Apart from letting these props be a part of the game, the interaction between these props and the arm-worn device should be designed as in Group1,2,3 and 5's projects. Among all other elements, dice seem as the most valuable for TTRPG players. One of the players explained the motivation behind keeping the dice in game by saying "Dice is like the treasure for role playing gamers and I am attentive not to lose any of them." Dice was also proven to be an important elements of gameplay experience in board games by previous research [7].

4.3.3 Speeding Up the Calculation Process

By design, out of game moments like dice calculations occur repeatedly during the gameplay of TTRPG. All of the groups assigned processes like dice-rolling or storing character information to device. Thus, device has to speed up all of the out-of-game processes. Previous research on CAG role playing games also suggest the advantage of electronic devices in this manner [18,23]. Therefore, the device needs to have all information about the environment, the character properties and the calculation processes. As designers of these kinds of devices we need to think the work flow of setting up the device with all this information. This workflow also should enhance the concentration and role-playing performance of the players without distraction.

4.3.4 Becoming the Character

Group4 and Group5 considered devices as a visual representations of the characters. Each device for different character archetypes had specific looks and devices can also be upgraded as the fictional character gains achievements and levels up. RPGear (Group4) had slots for achievement tokens to be placed while the GoF (Group5) is made of a shape changing cloth which will turn into different forms according to the character properties. Other than that, in all projects, devices included character information and they all refer to customizability although not as structured as in Group4 and 5. We can state that besides facilitating the gameplay, as suggested also by previous work [26], players were tend to see wearables as a part of their fictional character. Therefore, for an increased immersion, relation between device and the characters should be scrutinized by designers.

4.3.5 Gameplay Characteristics

A note to mention here was about the change of the gameplay characteristics. Although participants did not raise objections for real-time gameplay, another different characteristic which was the physical challenge-based gameplay was not favored by players. We

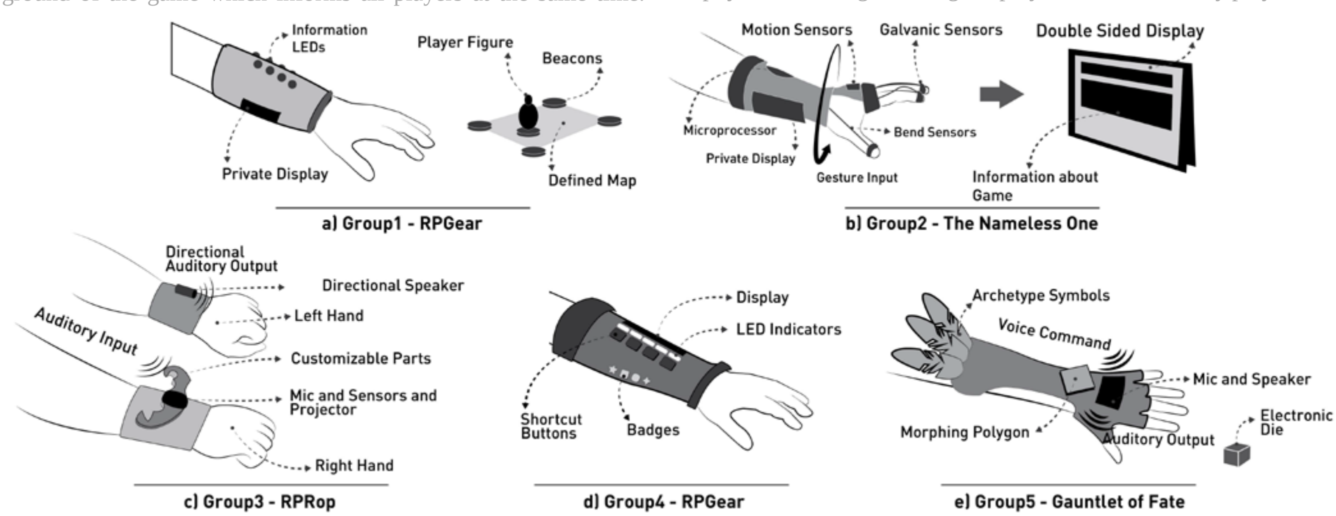

Figure 3: Device instructions for each group

discussed this during the semi-structured interview to understand players' side for this kind of change. One of the players said that "I am a tiny person, however I always role play a barbarian character. How will I overcome the physical challenges which will be faced by my character with my tiny body?" These reactions show that new gameplay or interaction styles may conflict with role-playing elements. Therefore, elements like the fictional character's levels, players' imaginary skills, decisions of GM and role playing abilities of the players should not be overwhelmed by new game mechanics

4.3.6 Scalable Actions

In RPGs, there are vast amount of actions. Therefore, in case of movement-based play, assigning different gestures for every possible action does not seem possible both technically and ergonomically. In conventional RPGs, dice rolls are usually assigned to simple actions which are liable to success check, details of which can be expressed by GM according to the narrative. Participants also followed a similar approach by assigning these kinds of general actions to moves even if they change the gameplay style. Commenting on this approach, we can state that assigning commands to each action is not scalable. Therefore, no action should be precluded because the device does not support them.

This condition drove participants to stick with existing game systems by integrating the technology on top of it. Only Group 1 and Group 2 went with distinct approaches. Players can choose which action (skills, moves etc.) to perform from the *RPGear's* (Group1) private display. Group2 used gestures for different types of attacks like ranged, spell and melee. Moreover, they also considered adding bonus moves like finishing an enemy who is about to die. Although these groups were able to break the routine of RPGs about using dice/randomizers, Group2 kept up with the overall logic of assigning main actions to moves. Group 1 transferred the system from the CRPGs. These two different approaches show that players may be open to new interaction styles with the introduction of the technology yet these new styles should correspond with the limitlessness of role-playing actions.

As a result of the workshop we gained strong insights which will guide us in the game design process. We explained how these insights affected the game design in the following section.

5. GAME DESIGN: WEARPG

The workshop resulted in five dimensions we need to satisfy which are (PD1[1]) movement-based play without limiting the role-play elements, (PD2) interaction with auxiliary props, (PD3) speeding up the calculation process, (PD4) ability to reflect fictional characters' properties on devices and (PD5) introducing the new gameplay characteristics without overwhelming the role-play elements. We aimed to satisfy all of the above during the game design process. The game system is still in a preliminary state but it provides a gameplay of 4-5 hours to understand how the embodied gameplay via wearables may affect the player experience. We also exanşbed six different role-playing systems which are D&D 3,5th and 5th ed. [8], Vampire: the Masquerade [21], Shadowrun 5th ed [29]. , Dragon Age RPG [30], Everway [27] to understand if any of them would fit to our requirements, yet for exploring the effects of new mechanics in a more controlled environment, we decided to continue with a new game system.

WEARPG[2] is a table-top role-playing game with an environment supported by wearable devices (one for each player) and a luck globe (an augmented dice for the preliminary version). This augmented environment aims to inspire players for new ways of role playing by embodying their fictional characters.

The wearable device can be considered the character sheet which will be carried in the arm. Players can customize the look of the device and creation of the fictional character will be mostly done during this customization. The level of the character, her/his interaction with the environment, skills and moves will all be provided via device. As the character strengthens and levels up it is need to be upgraded accordingly. The other part of this interactive setting is the *luck globe*. Luck Globe is an interactive dice which is also used to perform some of the movement-based tasks.

5.1 Fictional Setting and Character Creation

WEARPG's fictional world is a realm where the five elements – fire, water, air, earth and electric- prevail the nature and all the living creatures. Every breathing has a penchant for one or more elements and has to live their lives with the weakness and the strength bestowed by these elements.

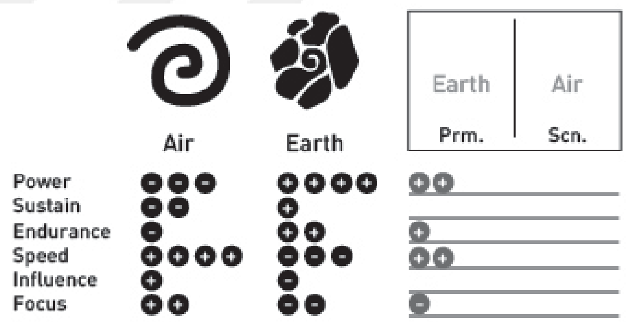

Figure 4: Example character of Earth/Air Combination

The character creation of the game is based on these elements. Each character can choose two elements which is a primary and a secondary. Character attributes are assigned automatically according to their element choices. For example, Earth element is strong in "power", however lacks the "speed" and "focus" which is required for concentration related actions. Air element at the same time is very capable in "speed", good at "focus" however weak in "power". Combination of these two elements creates a character which is not too strong and hasty but balanced in every manner (Figure 4). Players need to attach their *elemental stones* (tangible props) to their devices for choosing their elements.

5.2 How to Play?

WEARPG aims to leave more space to players for role-playing by loading the burden of the calculation to the device. Therefore, most of the character creation is done as players attach their elemental stones to the devices. There are three pillars of the game play session of WEARPG which are (1) activation moves, (2) rolling the luck globe, (3) character skills.

The second and the third pillar are known steps from conventional RPGs. However, WEARPG has another pillar which is the Activation Moves. Activation moves (Figure 5) can be explained as embodied mini games played just before the globe is rolled. These moves can grant the character bonuses or penalties according to the success of the player. After the move is performed, player will roll the luck globe and the outcome will be calculated depending on the

[1] These codes will be referred in the other parts of the paper as the outcomes of the Participatory Design Workshop.

[2] Quick Start Guide can be downloaded from: http://bit.ly/1TgseVx

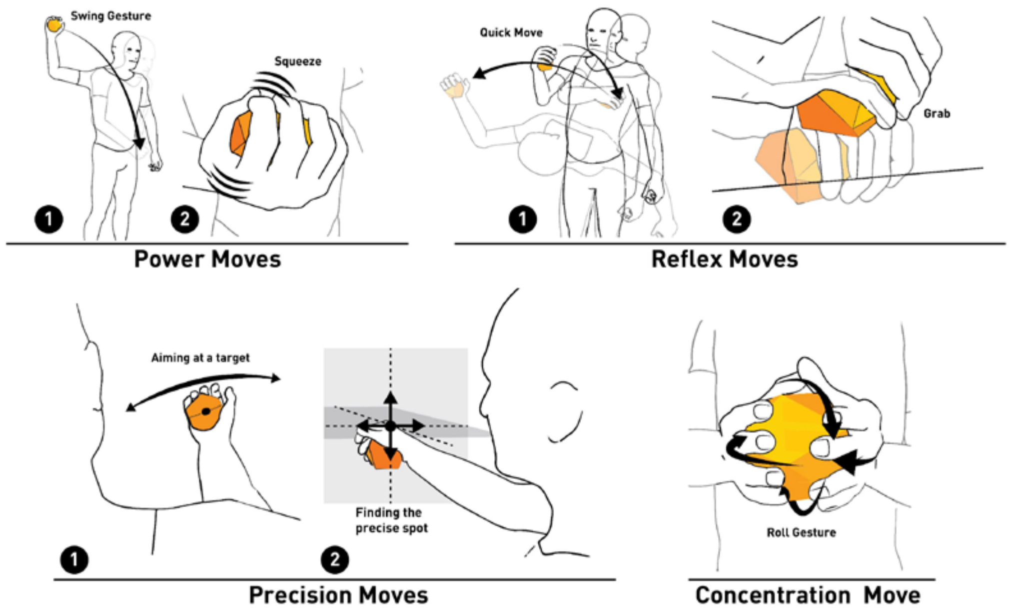

Figure 5: Activation Moves

moves' success, luck globe result and character skills. There are 4 different types of activation moves which are *Power, Reflex, Concentration and Precision.* Power moves requires to squeeze or swing the luck globe as strong as possible before rolling. *Reflex moves* require to move quickly by moving the arm after a haptic feedback or grabbing the luck globe quickly from the table after a visual feedback. *Precision moves* refers to aiming at a target presumably far away by moving the arm according to LED indicators on the wearable device or moving in a precise and delicate way to be able to find an open spot at the target following the haptic feedbacks. *Concentration move* requires to roll the luck globe by finding and maintaining the right rolling speed for a certain period of time or match the right rolling direction according to the haptic feedback from the globe and from the wearable device.

User studies were conducted with experience prototypes and only the luck globe had interactive abilities due to the prototyping issues. Therefore, Figure 5 demonstrates the activation moves as if they are all performed based on the luck globe. In the final implementation of the game wearable device will also take part in activation moves. Activation moves can be combined together. Some of the skills may require more than one activation moves. Therefore, more than one move can be performed at the same time or sequentially.

5.3 Motivations behind the Game System Design

5.3.1 Luck Globe

Luck globe is the ancillary interactive device in the WEARPG environment. We believe that addition of the Luck Globe to the game system will work towards satisfying players' needs for *keeping the dice/auxiliary props* in the game system. (PD2).

Luck Globe is basically an augmented die which can detect movements of players and give visual and haptic feedback. Form factor of the Luck Globe is not defined yet. Therefore, in the final version it may look different from a dice. Luck Globe, together with the Wearable Device will be responsible for calculations of the moves. The success of the activation moves, outcome of the dice and character skills will all be calculated automatically and *speed up the out of game process (PD3).*

5.3.2 Element Based Character Creation

In game system, players need to augment their devices with elemental stones (modules with different looks for each elements) in order to gain their power and define their base character properties. After players are united with their elemental stones, they become *Wearers* according to the game lore. We believe that this kind of direct reference to the fictional characters will be easy to interpret for players and strengthen their bonds by giving them the *capability of reflecting their characters* on the device (PD4). These elemental stones can be upgraded as the character's level raises.

The preliminary version of the game only consists background customization like age, occupation and manner of the character apart from the elements. However, we plan to add more customization availabilities like religious beliefs, alignment, race etc. In this way, while we were able to keep the elemental features as a core property which is easy to relate with characters, side customization opportunities can work as an extra for increasing the belongingness of the devices to the fictional characters.

5.3.3 Movement-Based Mini Games

We gathered activation moves under four categories for the sake of scalability. We thought that these four moves can encapsulate all of the actions in the game related with character attributes which are *Power, Sustain, Endurance, Speed, Social and Focus*. These moves do not rely on discrete gesture recognition but simple data which will be got from sensors. This method is also supported by previous work which proposes guidelines for movement based games [22]. For example, in *Power Move* players can swing their arms in any direction they want. The only important data is their swinging speed. Therefore, we tried to provide players with the opportunity to perform embodied acting without limiting their role-playing space (PD1). Mapping the movements in an imaginative way was also recommended by previous work [22].

Other than being non-discrete, these moves are also adaptable to each player. There are two conditions for the outcome of the moves. First is the character properties. For instance, if the fictional character's "power" attribute is high, *power move* will be easier to perform meaning that she/he/it will have a better chance of getting high scores. The second parameter is the calibration. The globe and the device will be calibrated for each player only for once. For instance, a physically strong player needs to apply much more force compared to a physically weak player. Our aim with these two design decisions is to preserve role-playing experience for each player independent from their physical conditions but dependent on their fictional characters' conditions (PD5).

6. USER EXPERIENCE TEST

6.1 Procedure

We conducted player experience tests to understand how new game system with movement-based play via wearable devices would change the experience of players. We conducted game play sessions with three different TTRPG groups of players and game masters. Each game session lasted around 4 hours and was moderated by the game masters. Quick Start guide was sent to players and game masters prior to test via e-mail. In the player version of the quick start, we censored the parts which may cause biased opinions.

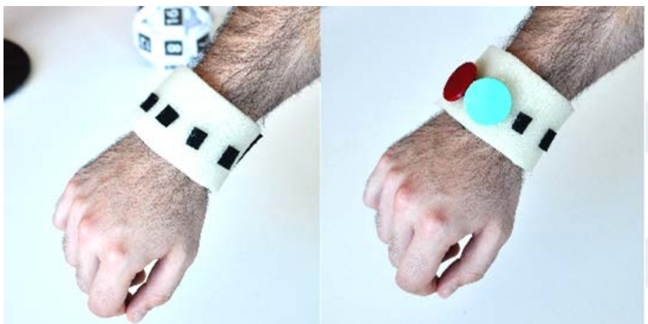

Figure 6: Experience Prototype of the Arm-Worn Device. (Left) Before Elemental Stone Ritual (Right) After Ritual

We used the Wizard of Oz (WoZ) method in game sessions. Players wore experience prototypes [6] made out of sponge (Figure 6). These props did not function at all yet the participants conducted the elemental stone integration ritual. Moreover, we explained users the possible interaction methods which will work after implementation. In our plot studies, the Luck Globe was also non-functional. However, the lack of feedback after activation moves hindered the experience of the players. Therefore, we used a Sphero[3] which is a programmable ball and 3D Printed a dice shell for it (Figure 7). Sphero has a simple programming interface and by this we were able to program some of the activation moves. The ones that we could not program like power move which requires squeezing, controlled by us during the gameplay. These moves, as expected from the WoZ, did not function as precise as they should be, yet the applications were enough to facilitate the embodied play.

All of the sessions took place in different locations. One study was in a café, one is in the lab condition and the other one was in a convention area (Figure 8). We especially administered this due to the exploratory nature of the study.

Each game session concluded with a semi-structured interview which aims to get players' opinion for overall game setup, contribution of movement-based play and wearable device, the game system and the adaptation of this setting to other role-playing game systems. The purpose of the interviews was to gain insights about (1) hindering parts of the game environment, (2) benefits and (3) detriments of the new game mechanics, rules and interaction style on the player experience.

[3] http://sphero.com

Figure 7: Luck Globe prototype with Sphero

6.2 Participants

15 participants (14 male, 1 female, Age_m=26.6, Age_{std}=5,46) took part in the study as three groups. Groups consisted of five, four and three players respectively. Each group has one game master. More information about the participants can be seen from **Table 2**.

The game masters were chosen among the participants of the PD workshop. Therefore, they knew the aim of the project however, we wanted them not to tell players about the purpose of the study. We wanted them to choose players from their gaming groups. Therefore, players were chosen by the game masters among the players who they regularly play with. As the game master is an important aspect of the RPG experience we preferred this setting in order to provide ideal experience for each player in terms of game moderation and storytelling in their accustomed environment.

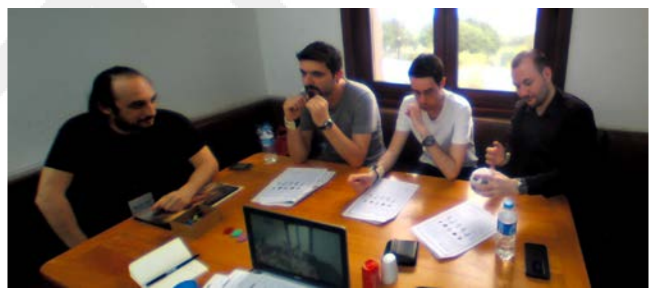

Figure 8: User Experience Test from the Convention Setting

7. OUTCOMES AND DISCUSSION

Overall the user study encouraged us about the embodied play since the players' reactions towards it was quite positive. Still, there are parts that we need to consider for further improvement and some negative points which should be overcome by revisions.

7.1 Movement-Based Play

The participants' reaction to the movement-based play was overtly positive. One of the Game Masters said "Although I did not love how the game system works, I really liked the embodied play part. If this type of play could have been implemented to D&D $3,5^{th}$ ed, I would not play it in the regular way anymore." Another player expressed that he already acted the characters with his body during the game play and a system that rewards the embodied play was quite pleasing for him. Towards the end of the game session one player said "I want to play more with the ball (referring the luck globe)." We observed that the embodied play increased the engagement of the players. One of the players who also moderates other games as a Game Master told that this kind of play can increase the motivation of the players who lost interest to game when the turn is theirs.

The ambiguity of the activation moves was favored by players. We observed that players were able to perform their moves in different ways according to the story. Moreover, some players expressed that they especially liked the freedom in that sense. The positive feedbacks on this feature corroborates with previous research [22].

Table 2: Breakdown of Participants (GM: Game Master, XP: Experience in Years)

Participant	Age	Sex	XP	Session
Player 1	22	M	6	#1
Player 2	32	M	15	#1
Player 3	34	M	20	#1
Player 4	37	M	19	#1
Player 5	24	M	14	#1
GM1	26	M	12	#1
Player 1	21	M	12	#2
Player 2	19	M	1	#2
Player 3	20	F	1	#2
Player 4	21	M	2	#2
GM2	26	M	10	#2
Player 1	27	M	4	#3
Player 2	28	M	3	#3
Player 3	29	M	13	#3
GM3	34	M	20	#3

As we hypothesized before, players also mentioned that embodied play worked towards increasing the connection between them and the character. One of the players said "It helped me to identify myself with my character."

An interesting remark from one of the players indicated that the game is something between TTRPG and LARP (Live-action Role-Playing Game). LARPs are played in an open field where people act and move around instead of sitting around a table. A previous study named a similar conceptual setting as Trans-Reality Role-Playing Game [14].

7.1.1 Considerations

The first negative point for embodied play was about GM's contribution to the game. In combat position GM had to act all enemies. Therefore, he had to make a lot more activation moves compared to players. When it gets that intense, fatigue can be an issue for GMs. We believe that with exceptional rules about the movement-based play for GM, we can overcome this issue.

One other negative point they expressed was the possible campaign duration. Several players expressed that this play style may not be appropriate for long term engagement and get boring. One player told "I would lose my interest in this type of play soon." While this may be a disadvantage for experienced players, some players expressed that this may be a good start for casual players too.

We believe that players were concerned with the possibility of repetitive feeling which may be caused by activation moves. Previous research on user experience claims that properties which look fancy and supposed to work towards a better experience may not work as expected in the long term [12]. Yet, in the game context *designing for the self* is a dominant issue since it is a domain where people willingly spare their time and eager to perform tasks outside of their daily routine. Although, activation moves kept players engaged with the game, they took a bit more time than the dice roll and required more effort. We did not observe any fatigue because of the turn-based system, still if players lose their interest on doing the same activation moves it may become dull in long campaigns. Therefore, game design should be shaped in a way that renders the activation moves less repetitive. This can be either done by increasing the variety or providing flexibility on the use of actions.

This negative feedback may be the result of the slow nature of WoZ. In every move, we had to activate the specific code set which created some hassle in the long combat scenes. This effect may be removed when the system is implemented as a working prototype.

7.2 Wearable Prop

In our test environment, wearable devices were not interactive and focus was more on the luck globe. We could only explain how the device was expected to work. Moreover, players attached their elemental stones during the character creation process (Figure 6). Although, we could not provide the expected interaction techniques for the devices, we could still get valuable insights about the integration of wearables.

Our observations and participants' comments showed that wearable props helped players to identify themselves with their fictional character. During the interview one player indicated that the wearable prop helped him to identify himself with the fictional character. One of the players shouted, "I attached my stones, now I got the power" after he stuck the elemental props to the wearable. During the interview, we asked the question "Would it be any difference if the device was not wearable but something on the table?" Players agreed that, it would make a difference. One of the players indicated that wearing the device personalizes the experience. One other players expressed "To identify myself with the character, wearing the device is important."

7.2.1 Considerations

Still some of the players consider the wearable as only a visual prop. One player said "I would wear it only for it is fancy". This comment was made in the first test session. In this session, although wearable devices should be worn in the middle of the game according to the story, GM got them worn in the beginning. We considered this condition may affect how players perceive the wearable device. In the second and the third test, we asked GM to make players wear the devices when it is told according to the story. In the second and the third tests we took positive feedbacks about wearable device's effect on player/character relationship.

One other concern about the wearable device was the replay condition. Our design facilitates reflecting the character on the device. However, role-playing gamers can have more than one character for the same game system. When this is the case, will players need to have another device? Or should they rebuild the device from the beginning with different element stones and other possible modules? These questions also should be considered by designers for designing devices which can be customized not digitally but physically.

7.3 Game System

Majority of the participants expressed positive opinions on how game system works. One of the participants said "We have played for 4 hours, yet we did not encounter with any serious problems which interrupts the gameplay." One of the players appreciated how wearing the device is blended into the lore with the "Wearer" concept. In each session, participants agreed that testing the new play style with a game specifically designed for it better since the established games systems have complicated rules which may be hard to adapt and compromise the test purposes.

The game system is still in a preliminary state and even during the tests it is revised according to the feedbacks from players. In the last game session, we took much less feedback which require revision in the game system. Still we observed some fallbacks which should be investigated in further development.

7.3.1 Considerations

Although we predicted that our activation moves can encapsulate all the actions, we observed that GMs used other dice for abstract concepts like luck or initiative. We also observed that they rolled the Luck Globe without performing activation moves for a few times. Although this was not a condition that we wanted to prevent, we should scrutinize the rules for further concepts which require success check. We also observed that actions of diplomacy and social interaction with the NPCs in the imaginary world was performed with the *Concentration Move.* We did not consider any activation move for social interaction since it was not kinesthetic but verbal. However, tests showed that we need to regulate the rules for social interaction without extending the current activation moves or define new activation moves for social interactions.

Another consideration is that the game system should be acknowledged by the GMs for a better moderation. In our first test, GM expressed that he would moderate the game in a better way if he had a chance to manage it once more. During our first tests, GMs only watched while players were performing the acts. From time to time we interrupted the story by narrating the activation moves. For instance, while a player was performing the *Reflex Move,* we narrated the process by adding a story like "You evaded the first sword swing, wow it really hit hard in the second, fortunately you saved yourself in the last minute." The difference of this narrative piece was that it was told *during* the activation move performance rather than *after* the dice roll. Although we could not observe such performance from the GM, when the game is completely designed this recommendation should be in the Game Master Guide.

7.4 Other RPG Systems

Although players found that designing a new game system for testing purposes is favorable, they agreed that, after a solid implementation, especially the movement-based play part of the system can be applied to the other game systems. They expressed that rules can be easily programmed if the props are open source.

Still, especially the visual adaptation would be much harder. The first idea coined by the participants was that it may have several different styles according to melee, ranged and magic using characters. However, this may require a major visual redesign or addition to the devices. Moreover, they also expressed some conditions where characters should fake their appearance. Therefore, for the implementation of other kinds of systems more scalable customization properties should be introduced.

As a result of our user study we have seen that movement-based play was enjoyed by players and it works towards a better character identification. Wearable prop also showed that, if it is implemented as working prototype, it has the potential of adding up to the identification feeling with the perception of a character costume. Also the game system was not met with negative critiques, however it should be improved for deeper character customization and activation moves should be regulated or advanced for matching with a broader pack of actions. The most significant concern in the current state is the long term game play conditions which may be hindered by the repetitive structure of the activation moves. These problems can be overcome by regulations in the rules about the activation moves or devising more various ways of using the them.

8. GAME DESIGN IMPLICATIONS

Our study which is comprised of a participatory design workshop, design process and a user study gained us valuable game design implications for the design a role-playing game which supports embodied play via wearable devices. We believe that our implications may help the design of both embodied game play in narrative based games and the interactive devices which aims to enhance the gameplay with new interaction styles.

1. Device belongs to the fictional world: In case of augmenting the game with interactive devices, they should be treated as the part of the fictional world. Players expressed that they experienced a better identification with their fictional characters in the session in which the devices were fully integrated with the story.

2. Providing non-repetitive performances: Movement should be designed in a way which let players perform actions in different ways. Still, we observed that as long as the nature of the move is the same this may create boredom in players. Therefore, these movements may be flourished either by creating combinations or introducing different versions with different characteristics.

3. Setting and its relation with the visual customization: Players expressed that, being able to relate their elemental stones to the fictional world increased their feeling of immersion. However, our discussion with players put forth that the adaptation of such visual connection should separately be considered for other RPG systems. Therefore, if the devices introduced to the game have a place in the lore of the game, players can have a better connection to the fictional world.

4. Narrating the body moves: When the activation moves are considered as a part of the game frame instead of the performative frame [17], they may increase the out-of-game moments unintentionally. The nature of the moves should let the GM/Storyteller narrate them during the motion. Therefore, there should be enough time to GM improvise story pieces on them. Other than that, GMs should also be trained for such narrative.

5. Replay availability of the devices: RPG players can use different characters in the same game system. The only thing that they need is a different character sheet. In cases where devices represent the fictional character players should be able to switch between characters without much effort. Therefore, visual customization should also be adapted to it.

6. Increased speed of the game: When electronic devices are the case, the biggest expectation of the players is to speed up the process. While the devices bring the advantages of the computational power, they also carry requirements like calibration for each player. While designing such games, designers should make sure that new processes does not slow down the process.

7. Player specific outcomes of movements: While movements can increase the engagement of the game, they raise the question of how players' real physical condition would affect the gameplay. In role-playing games outcomes of these moves should change and depend on the abilities of fictional characters. Moreover, actions like squeezing, swinging which depends on power or like evade depending on the reflexes should be calibrated for each player.

8.Different roles, different play: Although the GM's duty is to moderate the game session and to tell the story, we should not forget that they also play the game. However, in embodied RPG, the same rules which applies to players may create fatigue for GM since they had to perform them more frequently. Therefore, exceptions should be defined for the GMs. In movement-based games, designers should consider the movement frequency of different parties.

9. CONCLUSION

In this study we tested the embodied play in TTRPG via wearable devices. We applied a design process comprised of a participatory design workshop, game design process and a user experience test.

Participatory design workshop included 25 participants from *TTRPG players, game masters, cosplayers, jewelry and interaction designers*. We designed a new game system according to the outcomes of PD workshop and evaluate the game with explorative user tests with 15 participants.

As a result of our study, most of the players expressed and agreed that their engagement to game and connectedness to fictional character was higher with movement-based game play and wearable props. However, long-term engagement which refers to more than one game session should be treated as a design challenge which should be overcome by regulating the body movements in the game. Moreover, designers should consider ways of integrating the wearable device by forming a connection with the story and scrutinizing the replay conditions with different characters.

Research on movement-based games is growing [22] yet the research is mostly done on casual games which has short gameplay times. Moreover, previous research did not put forth design guidelines about how to integrate wearable devices into games. Our extensive user centered design process gained us valuable insights and let us put forth 8 game design implications *about forming the narrative, regulating the rules and the functional use of the device for game mechanics* which can guide the game designers in the means of movement-based games' and wearable devices' integration to long-term narrative based non-digital games like TTRPG. The implications can also be applied to other kinds of personal gadgets that can be integrated to such games.

10. ACKNOWLEDGEMENTS

We want to thank İsmet Melih Özbeyli for his contribution to the game design process. Moreover, we thank all volunteer workshop and user test participants. Among all, we specifically thank İhsan Uygur, Atilla Filinta Abuşoğlu and Fatih Tepgeç for sparing time to moderate the games during the user experience tests.

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Paper 3: Augmented Table-Top Role-Playing Game with Movement-Based Gameplay and Arm-Worn Devices

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Conference: ACM Conference Companion Publication on Designing Interactive Systems [h5-index: 31]

Role: Concept Creator, Game Designer, Product Designer, Hardware and Software Developer, Main Author

Type: Extended Abstract (Demo)

Date: 2017

Augmented Tabletop Role-Playing Game with Movement-Based Gameplay and Arm-Worn Devices

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DIS'17 Companion, June 10-14, 2017, Edinburgh, United Kingdom

ACM ISBN 978-1-4503-4991-8/17/06.
http://dx.doi.org/10.1145/3064857.3079176

Abstract

Augmenting table-top role-playing games (TTRPG) is a trending subject in game research. Different objects and interaction modalities such as surface displays, tangible devices or interactive rooms are used for the augmentation of TTRPG. Still, usage of wearable devices and movement-based gameplay in such games is a rather underexplored area although they have a potential for enhancing the player experience according to the previous studies. To delve into this area, we developed a new interactive environment comprised of arm-worn devices and an augmented die. These devices, together with a new role-playing game system, facilitate movement-based gameplay which encourage players to enact their characters with their bodies. In this paper, we explained the specifications of this gaming environment and our demonstration setting.

Author Keywords

Wearable Computing; Role-Playing Games; TTRPG, PnPRPG, Pen-and-Paper, Tabletop Games, Board Games, Tangible Interaction, Augmented Games

ACM Classification Keywords

H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles

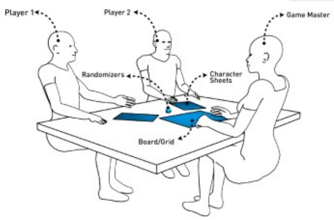

Figure 1: Tabletop role-playing setting

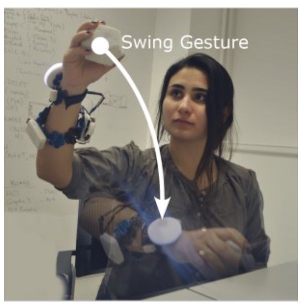

Figure 2: Power Mini-Game

Introduction

Tabletop Role-Playing Games (TTRPG) are games in which players assume the role of their fictional character. Game consists two types of actors which are players and the game master (Figure 1). Players role-play their characters by controlling them according to the game events which takes place in an imaginary world written and moderated by the game master. TTRPG can include supportive objects like dice, character sheets, boards or figures. Conventional setting of TTRPG does not include digital artifacts. Nevertheless, recent studies integrate computer assisted devices such as notebook computers, interactive boards or surrounding systems like interactive rooms into role-playing games for altering especially narrative, ludic and functional properties [1,8]. However, a gaming environment comprised of wearable devices in the context of TTRPG was not investigated before.

Although wearable devices were not used in TTRPG before, this technology was adopted by live-action role-playing (LARP), pervasive and physical games. They are considered useful for such gaming environments [7], since wearables were speculated to be devices to which "calm technology" principles can be applied [13]. Remaining in the periphery, wearables do not distract players, allowing them to focus on the game and maintain their social interaction. These two qualities are important aspects of TTRPG. Previous studies also indicate that wearable devices increase the connectedness to fictional worlds -which is critical for TTRPG- by being perceived as costumes [6,11]. Apart from these, sensors embedded into wearables may create opportunities for embodied interaction where players freely interact with the game by using their whole bodies instead of focusing on displays or controllers [9]. Previous studies indicate that movement-based gameplay may increase players' motivation and identification feelings towards the imaginary characters in role-playing games [2]. Still, although user-oriented design implications for such gaming environments are present in the field [2,3], how these implications may turn into a working prototype was not explored.

In the direction of these arguments, we believe that an environment comprised of wearable devices and movement-based gameplay may enhance the TTRPG experience. Therefore, we developed a table-top gaming environment which facilitates embodied interaction with the help of arm-worn devices and an augmented die based on the previous work in the field. In this paper, we explain our gaming environment and our design motivations behind it.

Game System

Recent studies about TTRPG and wearables indicate that (Concept1*) tangible interaction*, (C2*) automatization of uncaptivating processes*, (C3) *non-distracting interaction techniques*, (C4) *customization depending on the fictional character* and (C5) *movement-based gameplay* can be preferable by players [2].

In the light of this information, we designed a new RPG system. This system is based on a fictional world where five elements of water, air, earth, fire and electric grant powers to the fictional characters. Players choose two of these elements to define the main attributes of their characters. The game play session, different from many conventional RPGs, is operated by seven different

Figure 3: Fire and Water stones are attached to the device

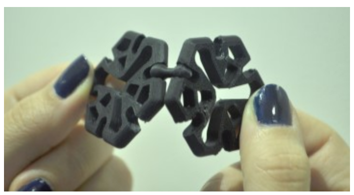

Figure 5: Hexagonal Parts and Two Different Design Alternatives

movement-based mini games (C5). For example, in power mini-game (Figure 4), players must swing their arms as strong as possible if they want to perform a strength-related move. Players play these games with *Elemental Gauntlet* (EG) which is an arm-worn device with capabilities of motion tracking, haptic and visual feedback and wireless communication (Figure 6 and 7). Game is also supported by a tangible prop called *Luck Stone(LS)* (Figure 7), which is similar to the dice in conventional RPG systems.

EG supports the gameplay of TTPRG in several aspects. The first advancement provided by EG is the automatization of the character creation process (C2). The character creation takes effect as the players attach their elemental stones to the EG (Figure 3). This also slightly differentiates each device depending on the character properties and creates customizability (C3). Players also can customize the body part of the EG according to their preferences by using the hexagonal parts (Figure 5). By customizability, we wanted to create the perception that each device belong to the unique characters of players in imaginary worlds and are actually costumes/equipment of fictional character's that can lead to increased immersion and better identification with the fictional character according to previous studies [6,12].

Furthermore, EG enhances the sensory part of the game with simple light and haptic feedback without using distracting elements such as displays (C3). These feedbacks, other than indicating the success of the mini games, can be used by GM to warn players about specific cases like spell-affected areas. This functionality lets GM covertly warn players when needed. Moreover, most of the mini-games are

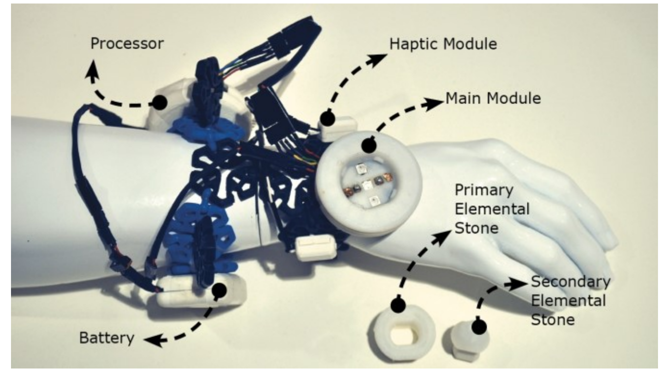

Figure 6: Parts of the Elemental Gauntlet

facilitated by EG and the results are calculated and transferred to GM panel by eliminating the need for uncaptivating dice calculation process [5].

While each player has an EG, LS is a mutual and a tangible (C1) object which can be used by all players. Previous research indicates that, auxiliary props are important for players and the interaction between electronic devices and these props should be considered by designers of augmented table-top games

Figure 7: Elemental Gauntlet (EG) and Luck Stone (LS)

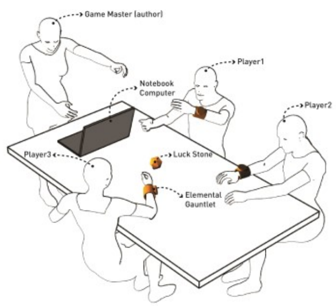

Figure 8: Demo Setting

[2]. Moreover, another research indicates that dice are an important part of table-top gaming experience [4] and materiality of board games is an essential element for players [10]. Therefore, LS is designed as a randomizer in the shape of a dodecahedron to provide similar experiences. When it is a player's turn, this player will interact with LS and roll it like dice after she/he completes the mini game. LS, aside from being used in some of the mini-games, has color changing surfaces. If the player is successful, number of green sides increases, boosting the chance of getting a better result from the dice-roll.

Demo Setting

Game will take place around the table which will be dedicated to this project in the demonstration area (Figure 8). During the demo session, we will allow players to attach elemental stones to their devices and play in speed-scenarios where they can try several moves to understand the essence of our game environment.

Conclusion

Our pilot studies with experience prototypes and the previous work in the field indicate that embodied interaction and wearable devices can enhance identification feeling and player motivation. To explore this topic deeper, we developed a novel game environment comprised of arm-worn devices, a tangible device and movement-based gameplay. We believe that this new concept will be favored by DIS audience which will grant us valuable insights to improve this work further.

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Paper 4: WEARPG: Movement-Based Tabletop Role-Playing Game with Arm-Worn Devices and an Augmented Die

Co-Authors: İsmet Melih Özbeyli, Oğuzhan Özcan (Advisor)

Conference: Proceedings of the ACM SIGCHI annual symposium on Computer-human interaction in play [h5-index: 11]

Role: Concept Creator, Game Designer, Product Designer, Hardware and Software Developer, Main Author

Type: Extended Abstract (Student Game Design Competition Finalist)

Date: 2017

WEARPG: Movement-Based Tabletop Role-Playing Game with Arm-Worn Devices and an Augmented Die

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Abstract

Augmenting tabletop role-playing games (TTRPG) with computers took much attention of researchers recently. Nevertheless, these efforts mostly remained as functional augmentations. We believe that integrating new gameplay styles to this genre is still an underexplored area. Drawing upon the previous studies, we believe that wearables which support movement-based gameplay can be a good step taken in this direction as previous studies claim that wearables can strengthen the link to the imaginary worlds which is critical for TTRPG experience while the movement-based play can increase the player engagement. However, previous studies did not investigate these concepts with an implemented technology. Therefore, to get a better understanding of how wearables can alter the TTRPG experience, we designed a new RPG game system and developed the Elemental Gauntlet and the Luck Stone which enables movement-based game play in TTRPG context. Our preliminary results showed that, movement-based play and wearable props strengthen the identification feeling with the fictional character and resulted in a better immersion to the imaginary world of the game.

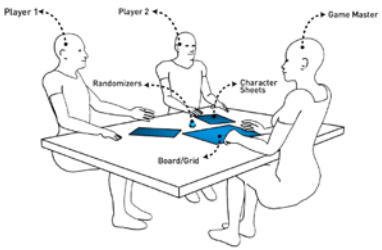

Figure 1: Setting for TTRPG

Author Keywords

Wearable Computing; Role Playing Games; Participatory Design; PnPRPG; Guidelines; TTRPG; Tabletop.

ACM Classification Keywords

H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles - User Centered Design.

Introduction

Augmenting table-top games is a trending topic and table-top role-playing games (TTRPG) is among the popular table-top game forms to be augmented. There are many examples aiming at enhancing TTRPG experience in several aspects such as improved sensory feedback, speeding up uncaptivating game processes and implementing new mechanics with opportunities granted by computational power [1,10,13,15]. These improvements work towards leaving more space for role-playing by debilitating the conditions interfering with it. Moreover, empowering sensory experiences intensifies the atmosphere, again resulting in a better experience [14]. Still, previous studies do not offer any radical improvements for the gameplay of TTRPG (Figure 1). We believe that wearable devices which support movement-based gameplay can be a step forward in terms of gameplay innovation for this game genre. We believe that they would suit very well to TTRPG environment since 1) they can be designed in a way which do not directly interfere with players' concentration, 2) can increase the connectedness to imaginary worlds by perceived as costumes [11,22] and 3) let players enact their characters with their bodies by providing embodied interaction techniques [22]. Previous user studies also concluded that these properties may contribute to the TTRPG environment [4,5], yet never tested these arguments with an implemented device.

In the direction of these arguments, we designed a new game system called WEARPG [3]. The distinctive feature of WEARPG is that it includes four arm-worn devices named as *"Elemental Gauntlet"* and an augmented die called *"Luck Stone"*. These devices augment the game by encouraging players to participate in the game by using their bodies. In this sense, we also contribute to an uncharted area by testing movement-based gameplay in narrative-oriented and long-term play where character identification is very important. We tested WEARPG with 19 participants to understand if (1) arm-worn devices add to the player/character relationship and immersion by being perceived as costumes and (2) movement-based gameplay helped players to identify themselves with their fictional characters and make them feel more into the imaginary world.

Related Work

Augmenting table-top games with computers is a well-adopted practice in game design field [1]. However, we did not encounter any example which specifically proposes augmenting the TTRPG with wearable devices. Nevertheless, utilization of wearable devices is common in games which have similar characteristics. Pervasive games, physical games and live-action role playing games (LARP) were considered suitable environments for the integration of the wearable devices.

Augmented wearables were used in Live-Action Role Playing Games (LARP) which are relatives to the TTRPG. Costuming is an essential quality in LARP [8]. Therefore, we may state that *Thumin Glove* [24] and *Gauntlet* [16] are a result of this tendency. Both of

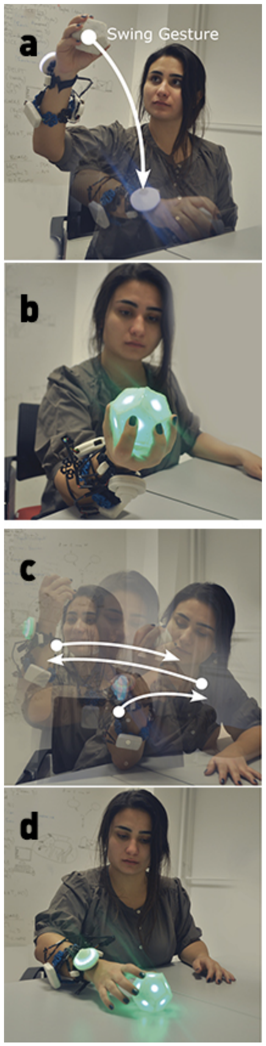

Figure 2: Power (a,b) and Reflex (c,d) Games

these devices were developed for enhancing the game experience with new game mechanics generated by the computational power of the devices. Both research draw conclusions from the user remarks, yet they were not presented in a way that can guide designers.

Lightning Bug [11] is a project which forms a sound background for our project. It investigates how wearables alter the user perception for better costumes. Isbister et.al. also defined interdependent wearables as a strong concept [12] which was also mentioned in Mueller et.al.'s definitions about social exertion games [17]. Moreover Tanenbaum et al. supports that the wearables affect the experience of being another character as it does in theater [21,22]. Magia Transformo [20] is another recent example of how costuming can create the feeling of transforming to another character by blending costumes into gameplay. Supported by these projects we believe that connectedness to fictional world and characters in TTRPG can be bolstered along with the immersion with the inclusion of wearables and movement-based play.

The studies mentioned in this section are indicators of how wearables may foster the gaming experience. However, these projects do not target TTRPG and did not put clear user feedback about how the utilization of wearables and movement-based gameplay affect the player/character relationship and immersion level in a tabletop setting where all of the game world is visible only in players' minds.

Game Design

There are many RPG systems which drive the different aspects forwards. For example, while D&D 3.5 [9] or Pathfinder [2] is operated on complex and detailed game rules, Everway [23] or World of Darkness [25]

Figure 3: Elemental Gauntlet and Luck Stone

follows a more simplified approach emphasizing the acting and role-playing of the character. Other than these classic systems, some systems try to include the players physical skills in the game in a way that can affect the outcomes such as in the Dread by the [7] Impossible Dream. In Dread, players are pulling blocks of a Jenga Tower if they want to perform critical moves.

WEARPG game system aims to provide a more narrative-oriented experience by leaving calculation side to computers and encouraging players to act their characters with their bodies. WEARPG is based on a fictional world where five elements of water, air, earth, fire and electric grant powers to the fictional characters. Players choose two of these elements for defining the main attributes of their characters. The game play session, different from many conventional RPGs, is operated by 7 different movement-based games. Players play these games with the help of *Elemental Gauntlet* (Figure 3), which is an arm-worn device with capabilities of motion tracking, haptic and visual feedback and wireless communication. This device also supported by a tangible prop called Luck

Figure 4: Concentration (a) and Precision (b,c) Games

Stone *(*Figure 3*)*, which is similar to the dice in conventional RPG systems.

Movement - Based Mini Games
Mini games refer to several movement characteristics in RPG environments. These characteristics are *power, reflex, precision and concentration.*

Power games includes two types one of which is swinging the arm as strong as possible (Figure 2 – a) while the other requires squeezing the luck stone (Figure 2 – b). This game is to be played when a character need to perform strength related tasks like hitting or attacking with sword.

Reflex games encapsulate two versions. In one of them, players need to move their device after they feel a haptic feedback (Figure 2 – c). In the other type, they had to grab the luck stone as soon as the luck stone flashes in the same color of their elements (Figure 2 – d). These games are for situations where the fictional characters had to move quickly in situations like dodging or catching.

In *Concentration* game players need to roll the luck globe in a specific pace and maintain it for a certain period of time (Figure 4 - a). This game is designed to be used in focus demanding tasks like casting spells.

Precision games also have two versions. One of these is trying to aim towards the light in the Elemental Gauntlet which can be used for ranged attacks (Figure 4 - b). The other one is used for precisely detecting a place by rotating their arms slowly (Figure 4 - c) in situations like lock picking or finding the weakest part of the foe when attacking.

Figure 5: Fire and Electric Stones are attached to Elemental Gauntlet

Elemental Gauntlet
Elemental Gauntlet (EG) is an interactive wearable device which is designed to support the game play of TTPRG in several aspects. The first advancement provided by EG is the atomization of the character creation process. The properties of fictional character are immediately transferred to GM console as the players attach their elemental stones to the EG (Figure 5). After this, most of the character traits and properties like *power, sustain, endurance, speed, influence and focus* are calculated by GM Console.

Furthermore, EG also enhances the sensory part of the game with light and haptic feedback. These feedbacks, other than indicating the success of the mini games, can be used by GM to warn players about specific cases like spell-affected areas. This functionality is especially beneficial to covertly warn players whose skills are enough to sense this kind of spell while others cannot. It also lets GM to undertake these kinds of actions without interrupting flow of the game.

During the gameplay, EG also automatize the dice calculation process. Therefore, players and GM do not have to put effort for uncaptivating processes [18].

Luck Stone

Previous research indicates that, auxiliary props are important for players and the interaction between electronic devices and these props should be considered by designers [4]. Moreover, another research indicate that dice is an important part of table-top gaming experience [6] and materiality of board games is an essential element for players [19]. Therefore, Luck Stone (LS) is designed as an auxiliary prop for complementing the EG. While each player in the game has an EG, LS is a mutual object which can be used by all players. LS is a randomizer in the shape of a dodecahedron. When a turn is one players', this player will interact with LS and roll it like dice after she/he completes the mini game. LS, aside from being used in some of the mini games, has color changing faces according to the success of the mini game. If the player is successful, amount of green sides increases, boosting the chance of getting a better result.

GM Console (Figure 6)

GM Console is a computer software. GM has power to control all the devices from this console. She/he can activate mini games, change the colors and patterns of LEDs or send vibration notifications. Moreover, GMs can create enemies for the story and observe how much damage they took from players. Other than that, during the character creation process, GMs should enter the properties of character which are age, manner, weapon, armor and skills of the players. Element selections are transmitted to GM console directly from devices. After these, GM console calculates all traits like *hit point, quickness, damage, quickness, analytic, social, intellect and instinct.*

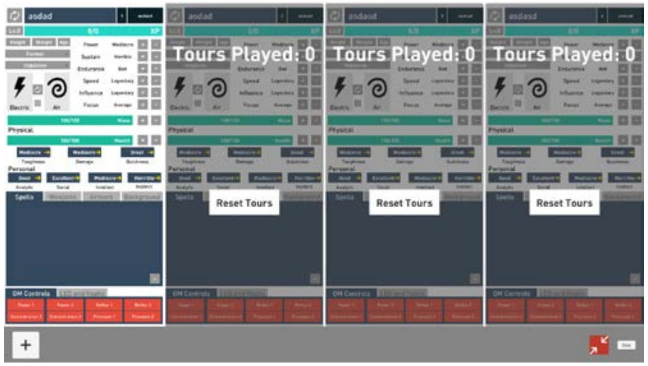

Figure 6: GM Console

MATERIALS

EG is made of 5 modules. These modules respectively include (1) main processor and sensors. (2) LED lights and the socket for elemental stones, (3) batteries and (3-4) haptic motors. As a main processor we used Arduino Lilypad. Pololu Altimu V4 was the motion sensor while the wireless communication was provided by NRF24L01+. For light feedback Adafruit Neopixel ring and strip LEDs used for their convenience in easy programming. Two generic haptic motors were used for haptic feedback. Elemental Stone ritual socket is built with a basic circuit logic. We created a circuit between analog pins of Arduino and manipulate it with different resistances. Each elemental stone has a different resistance which can be separately recognized by the device. GM console creates a mesh network with the use of RF24 mesh library for Arduino, for other all Elemental Gauntlets and Luck Stone to connect. We used an NRF24L01+ which is connected to Arduino Uno. The software of the GM Console was developed using Unity3D and it communicates with Arduino Uno over the serial port.

Table 1: Questions of the semi-structured interview

No.	Question
1	What is your overall opinion about the system?
2	How do you think EG affected the game play?
3	How do you think EG affected your connectedness to your fictional character?
4	How do you think EG affected your connectedness to fictional world of the game?
5	How do you think movement-based play affected your connectedness to your fictional character?
6	How do you think movement-based play affected your connectedness to your fictional character?
7	How do you think movement-based play affected your connectedness to fictional world of the game?
8	What's your opinions on the luck stone?
9	Which one was your favorite mini game?
10	Do you think that using and learning the devices and mini games hard?
11	What do think the main difference is before and after the EG and LS were introduced?
12	In what conditions, EG and LS can be used in other popular game systems?

Demonstration Setting

Although WEARPG is designed for long term gameplays such as 3-4 hours, jury members and visitors most probably will not have this much of time. Therefore, we will present the game to our audience with our story cards. Each card will include a speed scenario which makes players experience at least one of the mini games. We also make them choose their element cards to create their characters. We predict that each player will need 5-10 minutes to get the essence of our game.

Discussion and Conclusion

We tested WEARPG system with 19 players (16 M, 3F, M_{age} = 26,4, SD_{age}= 7.14) and made a preliminary analysis over the semi-structured interviews (Table 1) which were done after each game session with each player. We saw that our system worked in the intended way as most of the players articulated that wearable props and movement-based game play both increased their identification to character and their immersion to world. One player said, "I felt as if my arm is in another universe". They pointed out that wearing a prop which belongs to their fictional character eases their embodiment process. Moreover, most of the participants expressed that it is important that Elemental Gauntlet is functional in the game and not just a prop. They indicated that if it was just a prop without any interaction abilities, then it will be no different than cosplaying.

In terms of movement-based gameplay several things increased their motivation. First, they enjoyed acting their characters not only with their mental skills but also body skills. Other thing they found positive was that they could affect the outcomes of their moves. Although, we still have the chance component, they could manipulate the chances on Luck Stone which made them feel they are more in control. Several of them also indicated, it become more comfortable to act their character also with their bodies since this game system provided a seamless transformation to this mood by encouraging all players to bodily play.

Although many players found this new way of play positive, several players expressed concerns. One player was worried that this may weaken the game mechanics of role-playing games which is based on mental skills. He was concerned that shift towards the physical skills may hinder the required mental skills which are important for role-playing. Still, this concern is expressed only by minority of players, yet it gives a valuable lesson about balancing the mental and physical skills in such games. Another concern, which was even raised by the participants who was positive towards the new system, was the long-term engagement. Participants were not sure if movement-based play can keep its attraction in a long-campaign setting. We started to test this condition by organizing user tests which will last long for 3-game campaigns.

We believe that, WEARPG is a valuable first step to understand the effects of wearable devices and movement-based gameplay on the player/character relationship and the immersion in a tabletop setting where these two notions are quite important. Our study aims to put forth a detailed analysis of the user feedback to extract design guidelines for designing wearables and movement-based games for narrative-oriented, long-term game settings. After finishing our long-term user tests, we plan to contribute to field with a user-oriented design knowledge which can inspire the designers and developers of such games.

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Paper 5: Wearing and Moving in Imaginary Play: Effects of Wearables and Movement on Tabletop Role-Playing Game Experience

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Conference: Proceedings of the International Conference on Tangible, Embedded, and Embodied Interaction [h5-index: 23]

Role: Concept Creator, Game Designer, Product Designer, Hardware and Software Developer, Design Researcher, Main Author

Type: Full Paper

Date: 2018 (Submitted)

Wearing and Moving in Imaginary Play: Effects of Wearables and Movement on Tabletop Role-Playing Game Experience

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ABSTRACT

Player/Character Relationship (PCR) and *Immersion Level* are important aspects of *Table-Top Role-Playing Game (TTRPG)* experience. Role-playing abilities and the motivation of player are critical in increasing these qualities. However, except than the game master and the players' incentive, there is not enough motivators encouraging the enactment. We believe that an arm-worn device which *introduces movement-base play* can foster the player experience by (1) encouraging players to enact their characters with their bodies and (2) being perceived as a costume piece belonging to the fictional character. These two factors can increase the immersion and PCR level. For testing our hypotheses, we developed a role-playing game system based on movement-based play with interactive wearable and tangible props. Then, we conducted a user study with 24 players to understand the effects of wearing and moving on the player experience. Most participants reported that both wearables and movement-based gameplay increased immersion and PCR experience.

Author Keywords

Wearable Computing, Role-Playing Games, TTRPG, Guidelines, Movement-Based Gameplay, Game Design

ACM Classification Keywords

H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles - User Centered Design

INTRODUCTION

Tabletop Role-Playing Game (TTRPG) experience is grounded on assuming the role of a fictional character and enacting it. The more players are able to role-play their characters, the more immersive the game gets [36]. Therefore, Player/Character Relationship (PCR) and Immersion Level which are considered critical aspects of player experience mostly rely on the character enactment. However, being in-character is a volunteer state which can be left easily [20] and there is not external facilitators except for the game master and players' own intention. Although, special environments like theme parks are chosen as a game environment to create the enactment motivation [36], in-game objects which can provide such motivation are missing. We believe that introducing arm-worn devices that provide movement-based game play can fill this gap.

Computer augmentation in TTRPG aims to enhance the game play experience in various aspects. Several projects [5,37,38,40] aims at augmenting the environment both by shortening the out of game processes and by providing sensory experiences. Other few projects investigated the utilization of wearable devices in physical games and live-action role-playing games (LARP) [2,14,26,56]. However, none of these projects addressed additions which will encourage players to act their characters bodily and they do not aim at enhancing the gameplay in terms of character identification and immersion.

Previous studies claim that, although player/character relationship is superior in TTRPG, Computer Role-Playing Games (CRPG) can provide better focused immersion [55]. A study claims that, In TTRPG, *out-of-game conversations* and *functional language use* are encountered %20 more than *in-game character conversations* and *dramatic language use* [15]. We believe that these studies indicate that there can be room for facilitating the character enactment in a better Parallel with this, research on wearables claims that wearing props which are related to game can result in better character identification and connectedness to the imaginary worlds [1,8,53]. Moreover, many alternative studies claim that increased body motion can boost the engagement with the game [6,28,34]. Besides, according to the Calleja's player involvement model, kinesthetic involvement is one aspect which affects the perceived immersion by players [10]. Thus, an interactive game system which is based on wearable devices and movement-based play can increase the player experience in TTRPG.

In the direction of these information, we developed a new game system which incorporates arm-worn devices supporting movement-based play in TTRPG. We believe that this system will both increase the immersion of players [12] and PCR by encouraging players to involve in the game with their bodies. Furthermore, we assume that the device will be perceived as an object/costume piece belonging to the fictional character which will strengthen the bond between player and the character [26]. In this paper, we present the results of player experience evaluation conducted with 24 participants to understand the effects of our new system on the player experience in TTRPG. Moreover, we also created four design themes for highlighting the important points which work towards the player expectations.

RELATED WORK

Computer Augmented Games

Combining digital and physical to create augmented tabletop game experiences is a popular research topic in game design field [4,5,37,38,45]. However, empowering tabletop games with wearable devices was not studied before. Still, pervasive and physical games which are mostly played in open areas made use of wearables [1,2,14,39,43,56]. Among these, live-action role-playing (LARP) games incorporate wearable devices and costumes. Yet, research on LARP do not give clues about how these can be adopted in a tabletop setting.

There are plenty of studies about augmenting tabletop games with electronic devices. Some of these studies also focus on Tabletop Role-Playing Games (TTRPG). STARS Platform [37] is one of the first examples of such augmented environment which is adaptable to different games with many different interactive devices in a specifically designed room. Another research by Bergström and Björk pointed out 6 different computer-augmented game (CAG) cases and formed 8 dimensions to define the game design space for CAG [4]. These dimensions put forth valuable insights for CAG designers while forming their games. A similar study points out that computers can enhance the tabletop game experiences by decreasing uncaptivating game processes, introducing new game mechanics which made possible with computational power and maintaining or increasing the social interaction level [45]. Different from these projects which focus on a theoretical framework, Undercurrents [5] aim to integrate computers into TTRPG. Its focus is speeding up uncaptivating processes such as dice calculation and enhancing communication abilities between players by adding features such as private communication.

Another related domain which captivates costumes and bodily play is Live-Action Role Playing Games (LARP). In LARP, players mostly come together in a designated area with their costumes suiting to theme and role-play a scenario. However, organizing such games requires many preparations such as arranging a roomy area, collecting many players and creating the thematic environment. Therefore, participating in LARP is much harder than organizing a TTRPG game session. Still, examining this genre is important for getting inspirations for TTRPG. In this direction, Lindley and Eladhari coined the Trans-Reality Role-Playing idea which combines LARP, TTRPG and computer RPG (CRPG) using the advantages of each game modalities [33]. Proposed design does not include wearables, yet the concept of bringing together CRPG, TTRPG and LARP also corroborates with our concept of creating sensory experiences and costuming properties which is essential for LARP [18]. We may exemplify usage of wearables in LARP with the projects of *Thumin Glove* [56] and *Gauntlet* [39]. Both devices were developed to add new game mechanics to LARP generated by the computational power. Both studies also reported user feedback about the experience of wearing devices during LARP. Most participants found it positive, yet these studies did not provide a detailed analysis about how they affected immersion and player/character relationship.

Previous studies also suggest that wearables can strengthen the bond between player and the imaginary world which is an essential quality for TTRPG. *Hotaru* [1] examines wearables as costumes and question how they can foster the connectedness to imaginary worlds. Moreover, Isbister coined the term interdependent wearables and defined it as a strong concept for play [27]. Tanenbaum et al. also claimed that wearable devices can mediate one to feel as another character [53]. In this direction, they also developed a game called Magia Transformo [50] where players wear costumes and perform bodily play for generating spells. Supported by these projects we believe that connectedness to fictional world and characters in TTRPG can be bolstered by wearables.

The studies are indicators of how computers can foster the table-top games by shortening undesired processes, introducing new game mechanics and fostering the sensory aspects. Moreover, previous studies indicate that wearable devices can bolster the game experience by increasing the connectedness to imaginary worlds. Wearables also were speculated to support calm technology which has been coined as an important aspect for CAG [5]. However, these projects did not investigate wearable devices for TTRPG. Moreover, they did not put forth knowledge about how these concepts affect the immersion and player/character relationship in games.

Measuring the Player Experience in Tabletop Games

We refer to immersion and player/character relationship (PCR) as player experience. Immersion has many different classifications [7,10,17] yet generally it means to be absorbed by the game's virtual world and to get unresponsive to the surroundings in real world [7]. PCR [55] represents the link between the fictional character and the player.

Game Experience Questionnaire [25] is one of the common questionnaires used in measuring the player experience. Another questionnaire is designed by Ermi and Mäyrä measured the player experience around their conceptualization of immersion [17]. Brockmyer et al. developed another questionnaire called Game Engagement Questionnaire whose focus is on negative behavior resulting from game engagement. Herrewijn et al. [24] combined many different questionnaires by categorizing them according to player involvement model [11].

Mentioned methods are developed for measuring the experience in digital games and not in the tabletop game settings. However, previous research used similar approaches for comparing computer and tabletop games. The research conducted by Tychsen et al. used FUN construct and SYMPA construct to compare the differences in experience between TTRPG and CRPG [55]. Other than that, Barbara pointed out that Game Experience Questionnaire is reliable to be used across game formats, therefore it can be used for measuring experience in board games too [3].

Player Experience in Movement-Based Games

There are many studies on games which are played with body movements [30–32,42]. The appropriate gestures for such games, guidelines and possible problems are also addressed by several research [42,44,49]. Games which include embodied game play are related with our research even if they are not in the TTRPG context. Previous studies have exposed findings which concretely support our argument on movement in games. Isbister et al. found that movement increases the player experience [28]. Another study compared conventional game pad with the guitar props in guitar hero to investigate the effect of bodily interaction on player experience and concluded that embodied interaction significantly raise the immersion level [6].

However, different from the previous work, our aim is to understand the effect of movement-based game play TTRPG context which differentiates by not having displays or controllers and is played in the imaginary plane. Moreover, most of the previous work draw conclusions on arcade games with short-term gameplay. In this sense, our explorations give insight about the integration and effects of movement-based play in long-term, narrative-based play.

WEARPG: NEW GAME ENVIRONMENT DESIGN

WEARPG is a RPG system, which relies on wearable and tangible props that provide movement-based game play. Although, there are many RPG systems which are popular among players and emphasize different aspects [22,35,48,54,58,59], we designed a new game system to have a controllable environment for further modifications and break the bias of players towards their previous game knowledge in our user tests. WEARPG is based on a tesla and steampunk hybrid fantasy world where five elements of air, water, fire, earth and electric dominates the life.

Figure 1: Elemental Gauntlet and Luck Stone

Characters in this word can use these elements to gain powers. Each character can choose two of these elements as the primary and the secondary. Based on this setting, WEARPG is constructed on four pillars. These pillars are: (1) Movement-Based mini games (2) Elemental Gauntlet, (3) Luck Stone, (4) Game Master Console.

Elemental Gauntlet (EG) is the arm-worn device *(Figure 1)*. It is comprised of three modules which are LED Module and Elemental Stone Socket, Processor Module, and two Haptic Modules. It accounts for automatization of calculations and character creation. With EG, one can perform the elemental ritual by attaching elemental stones to device to define their character properties. Moreover, it also measures the motion and facilitate the movement-based play. It is also the main interface which leads players during mini-games and shows information such as mana level. It can also be used by GM by lighting up different colors or sending haptic feedback.

Luck Stone (LS) is an assistive device for randomization *(Figure 1)*. Previous work in this area puts forth the importance of such auxiliary objects [13,47] and one another work claims that designers of augmented TTRPGs should consider how to incorporate valuable items such as dice in relation with the interactive devices [9]. Therefore, we introduce the LS into the game which has a role in some of the mini games and in the randomization. Still, different from a conventional die, LS has a dynamic chance adjustment system. Your success in the movement-based mini games affects the outcome of the LS. For instance, if a player is successful at playing a *power* game, than the Luck Stone will have more green (standing for "success") and purple (standing for "epic success") sides.

Movement-Based mini games encapsulate seven different games which refer to basic movements in the game which are *power, reflex, precision* and *concentration. Power* games are required when the fictional character perform a physically demanding task like swinging a sword. It has two different versions. First requires swinging the arm as strong as possible while the second one works by squeezing the Luck Stone, which is the augmented die, as hard as possible. *Reflex* games are to be played in situations where the pace is essential. Dodging from an attack or catching something thrown can be the examples. First reflex game is about moving the Elemental Gauntlet in the right timing just after a haptic feedback is gotten. Other one requires grabbing and lifting the Luck Stone as soon as it turns into the players' main element color. *Precision* moves were designed for situations like shooting an arrow or lock picking where hefty hands are essential. First version of precision games is aiming by using the LEDs on Elemental Gauntlet, while the other is rotating the hand really slow to find the right spot for several times. The last game type, *Concentration* game, is for where focus is needed. Examples can be casting a spell or focusing on something for remembering it. This type has only one game and it requires rolling the Luck Stone in hands in a certain speed and maintaining that speed. Each game has

P/C Relationship (PCR)	1	It was difficult for me to engage in my character
	2	I experienced the emotions of my character during play
	3	My character was easy to enact/play
	4	I mostly made decisions/took actions in the game according to my understanding of my character
	5*	I felt in the shoes of my character
	6*	I felt I was in the role of my character
General involvement and Immersion	7	I felt completely absorbed
	8	I forgot everything around me
	9	I lost track of time
	10	I had the feeling as if I was present in the game environment
Shared Involvement	11	I empathized with other players
	12	My actions depended on the others actions
	13	I felt connected to other players
	14	The other players paid close attention to me
	15	I paid close attention to other players
Competence	16	I felt skillful
Tension	17	I felt tense
	18	I felt restless
Challenge	19	I felt that I was learning
	20	I thought it was hard
	21	I had to put a lot of effort into it
Negative Affect	22	I found it tiresome
	23	I felt bored
	24	I was distracted
	25	I could have done more useful things
Positive Affect	26	I felt happy
	27	I thought it was fun
	28	It felt like a rich experience
	29	I felt energised

Table 1: Questionnaire Items for IEQ

5 difficulty levels from easiest to hardest. GM decides which difficulty level will be played depending on the character skills and condition (injured, crimpled etc.)

GM Console is a functional part of the game. It is a software for GMs to manipulate the game environment and Elemental Gauntlets. GM can assign any mini game to these devices or control them according to his will by lighting different colors in LEDs, or sending different patterns of haptic feedback. Moreover, it can see all character information, change it and create enemies in the game environment by entering their names, hit point, and power.

METHOD

Participants

Twenty-four participants (4 female, ages ranged between 19 and 45, *M*age = 26.63, *SD* = 7.22) were included in the analysis. Participants varied in their experiences from 1-year experience to 10+ years of experience. Therefore, we were able to collect feedback from players with various experiences.

Questionnaires

We used the immersion test based on Player Involvement Model (**Table 1**) which is prepared by Herrejiwn et al. [24] for measuring the immersion level. This questionnaire is built by combining several questionnaires such as Presence Questionnaire [57], Immersion Scale [29], Narrative Engagement Scale [21] and Game Experience Questionnaire [46]. Moreover, we added questions from SYMPA test [55] for understanding the player/character relationship. Q5 and Q6 are added by us to refer to the character identification. Overall, questionnaire is designed to measure the perceived PCR, general involvement, positive and negative affect, shared involvement, competence, tension and challenge.

Procedure

In this study, we aim to understand how gameplay experience will be affected by wearables supporting movement-based play. Therefore, we conducted a within-subject study where players play the game without WEARPG in the first phase and with WEARPG in the second phase. Same game master (GM) with 13-year experience told the stories throughout the whole test for standardizing the story-telling quality which is quite important for the RPG experience.

First, game groups were welcomed in the experiment room. Each group consisted of two to four players. They were introduced to the GM. We told them that the aim of the study is testing a new RPG system and did not mention the interactive devices which are Elemental Gauntlet (EG) and Luck Stone (LS). We followed this step, since we do not want to create a bias and an expectation towards them at the beginning.

After the introduction, GM facilitated the game by asking players their preferences of age, height, weight, profession and manner for their characters. In the first part, players played a scenario piece where they somehow taken to a research facility which is in a future time and where the EG are tested (players learnt these details in the second part of the test). This part was more role-play oriented rather than combat-oriented. We facilitated the process in this way since we wanted players to get used to their characters in the first part. The story was mainly the same except for the parts that differed according to profession choices of players. The process until here took about two hours. After characters reached the centre, we stopped the game and made participants fill the first questionnaire which measures their immersion and PCR level. Upon filling the questionnaires, we took a coffee break for 10 minutes for participants to rest.

In the second phase (Figure 2), story continued from the research facility where characters learned that they were chosen for testing the elemental powers. But the only way to use

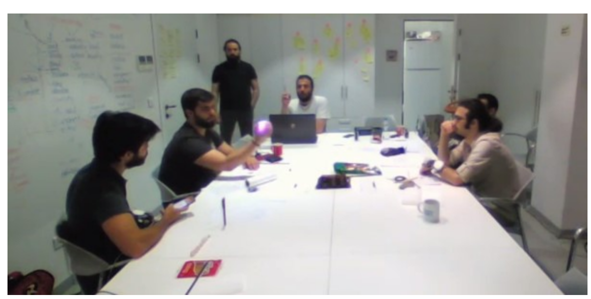

Figure 2: A scene from the second phase of a game session

No.	Question
1	What is your overall opinion about the system?
2	How do you think EG affected the game play?
3	How do you think EG affected your connectedness to your fictional character?
4	How do you think EG affected your connectedness to fictional world of the game?
5	How do you think movement-based play affected your connectedness to your fictional character?
6	How do you think movement-based play affected your connectedness to your fictional character?
7	How do you think movement-based play affected your connectedness to fictional world of the game?
8	What's your opinions on the luck stone?
9	Which one was your favorite mini game?
10	Do you think that using and learning the devices and mini games hard?
11	What do think the main difference is before and after the EG and LS were introduced?
12	In what conditions, EG and LS can be used in other popular game systems?

Table 2: Questions of Semi-Structured Interview

them was to wear EG and attach the elemental stones they chose. At that point, one of the authors stepped into the story and introduced the EG and the LS. The researcher acted as a fictional character who was a mentor for newcomers and introduced the devices in the context of both the real and fictional world. By applying these steps, we aimed to introduce these props as a part of narrative and game sphere at the same time. Previous studies show that, integrating props in the fictional world may increase the chance of their acceptance as the part of the imaginary world [8,56]. Second part of the scenario was more combat-oriented in which players learned to use their elemental skills and fought against a foe by using EG, LS and movement-based game-play. This part of the scenario also lasted around 2 hours. When the scenario ends, we made players fill the same questionnaire for the second time for the evaluation of their experience in the second part of the game. We also conducted semi-structured interviews with each player with the questions in **Table 2**. Each game session lasted around 8 hours with questionnaires, breaks, gameplay and the interview.

Analysis

Players' character empathy, general involvement, shared involvement, competence, perceived challenge, perceived tension, negative affect, positive affect and character resemblance scores taken after each two parts of the game session (1st phase: before the introduction of the devices 2nd phase: after the introduction of the devices) were compared with Repeated Measured ANOVA's.

We also transcribed all interviews and coded the answers of each questions to quantify our qualitative data. Data was coded by two independent coders. Each answer was coded in terms of the subject (lore, elemental gauntlet, luck stone, etc.), the effect (immersion, effects on player/character relationship, boredom, fun, etc.) and the valence (positive or negative). In addition, participants' concerns and advices regarding to the new game was coded. These category codes were formed after the discussions following the cooperative coding of 4 interviews for coders' training. Additional categories emerged from the remaining interviews were also included into coding scheme. In the independent coding of the remaining 14 interviews the agreement between the coders was %70. Most of the parts that did not match were the parts where the participants do not explicitly mention if they were talking about the LS, EG or movement-based gameplay. Disagreements were overcome with repeated discussions on the data before starting the analysis. While we tested the system with 24 players, we only used the interview data from 16 participants since in first two games we conducted a group interview instead of an individual one. We also lost 3 interviews due to the technical problems in the recording.

RESULTS

Semi-Structured Interviews

Positive Remarks

11 out of 16 participants reported that Elemental Gauntlet (EG), which is the arm-worn device, affected player/character relationship (PCR) in a positive way. Sample quotes included *(P16) "I felt what my character felt more", (P15) "It helped me to reflect my feelings while I am in the role", (P11) "I could get into my character more easily", (P8) "When I wear it, I am no longer myself but my character".*

EG boosted immersion according to 12 participants. *((P4) "It is an incredible object to put you into the game. When you wear it, you feel the power, (P15) "I direct my interest towards the game", (P11) "It is like cosplay, you feel a little bit more immersive")*

When it comes to movement-based gameplay, 13 out of 16 participants reported positive remarks in terms of PCR. *((P3) "It felt as if I am really casting a spell", (P4) "You are experiencing the same thing that your character is experiencing in the imaginary world", (P6) "It helped me to feel the tension that my character experienced", (P8) "As myself, I cannot swing a huge sword. But with this device, my character can swing it. You became your character while doing this [swinging the arm]", (P9) "This device puts you closer to your character since your own skills affect your character skills. You add something more than the pure chance.")*

11 participants indicated that movement-based gameplay increased the immersion feeling. *((P11) "Since you are putting an effort, it connects you more [to the game]", (P13) "It helped me to visualize the world in my imagination", (P16) "It's not only the dice, what you do affects the game. This loads more responsibility on you and puts you into the game", (P3) "I realized that I can do better if I concentrate more. Then, I literally concentrated")*

We also wanted to learn participants' opinions about the Luck Stone. 11 out of 16 participants asserted positive remarks indicating that the new system granted them autonomy about their decisions. *((P4) "It is very good that you can affect the dice. In each time, you have effect on every outcome but it can always surprise you. There is an autonomy and the chance factor at the same time. You affect and are affected.")*

5 Participants asserted that Luck Stone helped overcoming the uncaptivating processes such as dice calculations *((P8) In Degenesis (another RPG system), I roll eight 6-sided dice and add 4-modifier to result. Same can be done with Luck Stone only with one roll).*

Negative Remarks

1 participant said that EG damaged her/his PCR since her/his character do not normally wear such technologic device. 1 participants expressed that EG did not affect her/his immersion feeling. 1 participant expressed that it affected immersion negatively since some players started to examine the device out-game by getting distracted from in-game. 5 players said that EG was uncomfortable and should be improved that way. 1 of the players exerted that the EG is a redundancy and all the functionality should be transferred to LS.

3 players indicated that movement-based play did not affect their PCR at all. 1 player asserted that it did not have any effect on immersion.

One concern expressed by 6 players was a possible mismatch between player and character skills *((P14) I have to play with a character which will match with my physical skills. For example, if my hands are shaking, it would be hard to play precision games*, *(P15) I wish I chose a more sociable character to play games like reflex or precision rather than power*) Another concern raised by 4 players was that it may not be as fun in long-term play. *((P16) After several sessions will the games give the same feeling? After learning the games, will they be easier? I do not know how it will feel yet).*

Questionnaire Analysis (Table 3)

Results indicated that compared to 1st phase (without WEARPG), there was an increase in 2nd phase (with WEARPG) in terms of PCR (1st phase : $M = 5.81$, $SD = .68$, 2nd phase : $M = 6.15$, $SD = .67$, $F(1, 23) = 4.3$, $p = .05$, $\eta 2 = .16$), general involvement and immersion (1st phase: $M = 5.09$, $SD = 1.28$, 2nd phase: $M = 6.11$, $SD = .92$, $F(1, 23) = 26.93$, $p < .001$, $\eta 2 = .54$), shared involvement, (1st phase: $M = 3.88$, $SD = 1.33$, 2nd phase: $M = 5.75$, $SD = .97$, $F(1, 23) = 50.97$, $p < .001$, $\eta 2 = .69$), positive affect (1st phase: $M = 5.33$, $SD = 1.07$, 2nd phase: $M = 6.41$, $SD = .79$, $F(1, 23) = 30.72$, $p < .001$, $\eta 2 = .57$), competence (1st. phase: $M = 5.13$, $SD = 1.36$, 2nd phase: $M = 6$, $SD = 1.02$, $F(1, 23) = 7.21$, $p < .05$, $\eta 2 = .24$), and perceived challenge (1st phase: $M = 2.94$, $SD = .82$, 2nd phase: $M = 3.69$, $SD = .9$, $F(1, 23) = 9.82$, $p < .01$, $\eta 2 = .3$) scores. There was a decline in negative affect (1st phase: $M = 2.05$, $SD = .81$, 2nd phase: $M = 1.72$, $SD = .78$, $F(1, 23) = 5.$, $p < .05$, $\eta 2 = .22$).

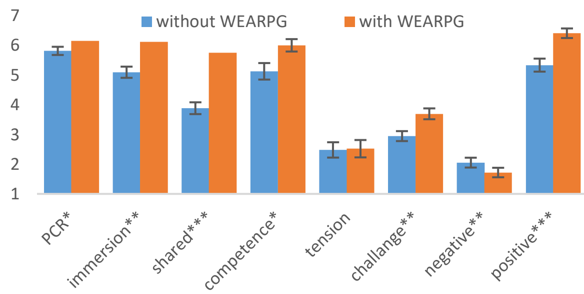

Table 3: Results of Immersive Experience Questionnaire N = 24 (* = p < .001, ** = p < .01, *= p < .05)**

Perceived tension (1st. phase: $M = 2.48$, $SD = 1.26$, for time 2: $M = 2.52$, $SD = 1.43$, $F(1, 23) = .02$, $p > .05$, $\eta 2 = .001$) did not changed from first phase to second.

DISCUSSION

Our feedback from participants shows that wearables and movement-based gameplay can add up to player experience in terms of player/character relationship and immersion. As we anticipated, players reported that carrying a part of their character helped them to get into the role of the fictional character. Movement-based gameplay also provided a similar effect as most players identified their movements and effort in the real life with the effort of the character in the imaginary world. Questionnaire data also supported our interview data by indicating an increase in terms of both concepts. Still, a possible mismatch between player and character abilities can be problematic. Moreover, in long-term engagement, correct design for placing the movement-based play in the game is important for keeping players engaged.

Other than supporting our hypotheses, we also generated four design themes. These themes provide valuable design knowledge in terms of incorporating wearables and movement-based gameplay in the design process of narrative-based games. Previous work speculated that wearables can increase the connectedness to imaginary worlds by being perceived as costumes [53], however we improved this knowledge by collecting feedback from users and suggesting ways that can provide such connectedness. Moreover, although there are studies in the field about the integration of movement-based play [41], how it should be used in narrative-based long-term games is still underexplored. Design themes provide many insights about how and with what properties movement-based play should be placed in such games. They also highlight the parts of WEARPG which work towards player expectations and point out the shortcomings by proposing possible solutions to overcome them.

DESIGN THEMES

Materialization

We saw that wearable prop became a device which is perceived as the materialization of the imaginary world. Previous studies claim that wearable controller may increase the connectedness of players to imaginary worlds [51,53]. This hypothesis corroborates with our results. Our outcomes add up to this hypothesis by casting light on how this connectedness is provided. In the game literature, one aspect of the immersion is referred as players' presence in the imaginary world [17]. In our case, we saw that both wearables and movement-based gameplay brought the imaginary world to the real game environment. Therefore, we believe that these two concepts can create a bi-directional transitive state where players are immersed in the game while the game also expands from the imaginary world to real world. These two quotes exemplify how the game world and the real world became related: "*(P2) It connected me to my character in a better way since I wore something from the world of my character ... While examining the gauntlet physically, I felt that I can role-play my character better. Because, I could show it to the player next to me and talk about it by referring to the cables or circuits."* Another participant said, "*(P3) I was aiming and there was one of the team members on the way. While I was trying to aim, I kind of experienced as if the target goes forth and back towards my team mate."*

In this direction, we believe that materializing the game world in terms of both wearables and movement-based gameplay is important. In terms of wearables, 10 participants pointed out that it is important to introduce them as the part of the imaginary world. Previous studies also suggest placing tangible objects diegetically can add up to storytelling experience [23,52,56]. Additionally, we also think that it is also important to integrate these objects as a functional part of the game as 3 participants indicated that if EG was just a prop in the game it would not be as effective. Therefore, we believe that functionality can be another aspect for rendering the wearable device active and effective in the game world.

When it comes to movement-based gameplay, 8 players indicated that they liked the mini-games which make them feel like they were performing the move that their character was performing in the imaginary plane. Mueller and Isbister indicated that movements should allow for imaginative mapping instead of a precise one [41]. Our games were also designed in the same way and they could also adapt the different body movements of the players. Still, for increasing the immersion it is important to transfer the essence of that motion which players think that their characters are experiencing in the game world. For example, (P11) said *"When you try to dodge something that falls on you, reflex game overlaps with this feeling since you have to move quickly in the game too."* Although reflex game requires only to move the arm, it can still transfer the experience of the fictional character who must move fast for dodging the falling object.

Autonomy

Previous studies suggest that computer-augmentation can bring new mechanics which would not be possible in the absence of computational power [16]. Parallel to this, we added a system where players can affect their chance before rolling the dice. With this, players gained an autonomy over the game compared to the conventional RPG systems where most of the results are dependent on luck. 11 out of 16 players articulated appreciation towards this new mechanic. We believe that this is a good example of utilization of computational power in terms of incorporating engaging mechanics.

Still, this new mechanic comes with a disadvantage. As indicated before, 6 players expressed their concerns about a possible gap between players' own physical abilities and characters' abilities. 5 of these players indicated that it can be a problem for other players rather than for themselves. Since we started developing WEARPG, a possible mismatch between player and character skills was the number-one concern as nothing is more important than to role-play your character in TTRPG. Therefore, we designed the difficulty system which does not allow players' physical skills to overwhelm the characters' skills. For example, power games will be much easier for players with a powerful character compared to players with a weak character. One player who came to realization about this system said *"(P12) It looks like there is an ability testing in the game but actually there is not… You can perform the precision task easily when the gaps are wider* (mentioning the easy version of the game) ... *Since, there is a difficulty system, I could experience a 100-year-old woman since it would not allow me to perform good in power test although I am more powerful than a 100-year-old woman."* Thus, we believe that although players may assume that a weak player may struggle in the power game while a strong player would possibly be successful, this is not the case due to the difficulty system.

Although the game dynamics were designed to not to allow skill-challenge imbalance, a struggle can still be possible for players with physical impairments. For instance, we had a colour-blind participant in the study. He could not play the reflex game where he should catch the LS when it flashes in the colour of his element. Precision game can also be problematic for people with shaking hands no matter how easy it is. In this sense, having more than one version of a game helped us. Therefore, by increasing the variety, some players may be exempted from playing some games which may be too hard for them. As a result, new mechanics can be appreciated by players, yet it is important to apply game design solutions which will keep role-playing elements as a priority.

Movement-Based Gameplay Placement

The biggest concern coined by our participants was the condition of movement-based mini games in long-term usage. This condition should be tested with further user tests which last more than one game. However, we will discuss what may be the possible ways that can prevent movement-based gameplay become a burden overtime.

Although, uncaptivating processes such as dice calculations are sped up by Luck Stone, movement-based game play can cause some deceleration in the game flow if not placed in the correct way. Our participants proposed that the times when mini-games are played should be adjusted by GM. In our game sessions, GM decided to apply long-term effects to mini-games. For example, if a player successfully played a concentration game, its effect on the Luck Stone lasted for the following three rounds. Similarly, one participant proposed that these mini-games can be played in critical situations where players may want to boost their chances. Fortunately, our system does not dictate these mini games to be played all the time and leave this decision to GM and players. Different combinations and rules should be tested in long-term play to understand how to reach to the ideal experience.

Dependent on this subject, in a turn-based game such as TTRPG, what other players are doing other than the active one should also be scrutinized. Waiting for each player to finish their moves can be boring unless it is worth-watching. 1 participant expressed that *"(P8) In conventional FRP, I get bored while all these dice are rolled. Here, it was fun to watch if he could succeed the mini-game."* Drawing upon this, we can say that it is possible to liven up these uncaptivating moments with movement-based game play. Still, making it mandatory for each move can slow down the game no different than dice-rolling.

Another concern about mini games was that their number may not be enough when players learn and become experts in playing them. While designing mini games, we thought that it may be overwhelming for players to have too many of them. This may be true for the first session but our players exerted that in long-term play the variety of the games can be increased. This variety can either be more than two variations for action characteristics (power, reflex etc.) or introducing different levels of mini games as the game progress. For instance, a player can unlock a new level of a mini game which is harder but brings more bonus when used. Another idea was creating different mini-games for different characteristics of fictional avatars.

Shift Between Genres

Six participants mentioned that what we do shifts the tabletop RPG towards Live Action Role-Playing (LARP) in several terms. 1 player pointed out the resemblance between EG and the costumes in LARP by saying *"(P16) It is like wearing an armor in LARP".* 2 other players said that movement-based gameplay is similar to the performances in LARP, yet less tiring and reachable with a system like WEARPG. *((P8) "I always aspired to play LARP, but I did not want to move that much. It was ridiculous for me to run around with a character sheet in your hand. Yet here, you do not have to both put that much of an effort or play with your imagination all day!")* Other than LARP, one player compared it to computer RPGs (CRPG) in terms of autonomy.

Bringing LARP, TTRPG and CRPG together is not a new concept. It is mentioned by Lindley and Eladhari with the name of Trans-Reality RPG [33]. In this concept, all these genres are played in their own medium by having mechanics which can affect each other. For example, a LARP player with a camera can become a figure in TTRPG with the help of a tangible display on the table. However, we present a game system which blends elements from each genre in the same game and the transition between imaginary game plane and the real game plane is provided via wearables. We believe that this blend shows that we can improve WEARPG by analysing other properties of LARP and CRPG and transfer the appropriate ones. Still, we should not forget that we actually augment TTRPG and mind the essence of it. For instance, one of our players said that *"(P14) If these are on a screen, it may restrict our imagination since you cannot put everything to a screen. There is no limit for the imagination."* Thus, transferring screens from CRPG to boost the sensory experiences may not suit to TTRPG.

CONCLUSION

In this paper, we explained the WEARPG which is a new role-playing games system based on movement-based gameplay with arm-worn devices. We tested this system with 24 players. Our results indicate that wearables and movement-based gameplay add up to immersion and player/character relationship level in tabletop role-playing games (TTRPG). Still, concerns such as mismatch between player and character abilities and condition in the long-term engagement should be scrutinized. We highlighted four design themes around these issues and about how to integrate movement and wearables into narrative-based games such as TTRPG. We proposed solutions for problematic areas drawing upon our user feedback, our observations and experience during the design process. We believe that this knowledge can also be useful for game designers of other narrative-based genres such as walking simulations in computer and console games in case of integration of wearables and movement.

LIMITATIONS AND FUTURE WORK

To concretize our results, a control group study should be conducted. However, because of time constraints, we could not finalize these control studies and hence, cannot present the results yet. Our initial Mixed Measured ANOVA (2: control vs experimental group x 2: questionnaire data from 1st phase vs 2nd phase) comparisons with 10 control participants that we tested thus far and 10 participants from the experimental group, who were equal to the controls in terms of game experience, indicated that there is a trend showing PCR and general involvement increases more in the experimental group compared to the control group with effect sizes $\eta 2$ = .26 and $\eta 2$ = .21, respectively. Upon these initial indicators of statistical power, we conducted a priori analyses to compute the sample size required to reach meaningful results using G-Power statistics [19], with power (1 - β) set at 0.80 and α = 05, two-tailed. This analysis indicated that with an N= 40 (20 in the control and 20 in the experimental group), there is .8 chance of correctly rejecting the null hypothesis of no significant effect of the interaction (i.e. the amount of the increase from time1 to time2 was the same for the control and the experimental group) for PCR and general involvement.

ACKNOWLEDGEMENTS

We thank all players who participated in our tests and helped us in finding new participants. Moreover, we thank our game master anonymus for his effort in narrating 8 game sessions and for the great story he created for our test.

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III
CONCLUSION

9. Research Contributions

9.1. Contribution 1: Design Implications about designing a wearable device for role-playing games

As a result of our first study, participatory design workshop, we presented five different device concepts which are proposed by participants of the workshop. We reflected our designerly comments on these devices and extracted design implications drawing upon the proposed designs, participants' comments, ideas, presentations. Other than these design implications we also proposed a speculative design for a wearable device which can be used in TTRPG. We speculated this design in order to see how these implications can inform the design of such device. Our findings demonstrated that an arm-worn device may contribute to augmentation of table-top games in terms of adding new gameplay styles, removing the undesired game processes and fostering the sensory experiences which lacks in conventional table top setting. Moreover, we conclude that non-distracting interaction techniques like gestures, tangible buttons, voice commands, simple visuals and audial feedback should be preferred in order to maintain the social environment without capturing players' attention to devices.

Specific Contributions:

d. Design implications about designing a wearable device for tabletop role-playing games.
e. Speculative Design proposed by us drawing upon the design implications we obtained from the workshop
f. Five design concepts which are proposed by RPG players in the design workshop

9.2. Contribution 2: Design Implications about integrating wearables and movement-based gameplay to tabletop role-playing games

As we got the knowledge about what might be the properties of a wearable device and the possible ways of using it during the gameplay, we started the design process of a new role-playing game system based on movement-based gameplay which is facilitated by arm-worn devices. We also conducted explorative user tests with 15 participants by using Wizard-of-Oz method and experience prototypes. These tests resulted in valuable feedback from user allowing us to improve the game system and implement a working prototype.

Specific Contributions:

b. Novel role-playing game system which is based on movement-based gameplay provided by arm-worn devices
c. Game design implications about the integration of movement-based play and wearables drawing upon the user feedback.

9.3. Contribution 3: Knowledge about the effects of wearables and movement-based gameplay on tabletop role-playing game experience

From the beginning of this work, our aim was to understand the effects of wearables and movement-based gameplay on the immersion and player/character relationship experience. Still, to make this exploration we had to obtain the right design (at least as right as possible), therefore we underwent long formative design research process. With the design implications we got from WP1 and WP3, we designed the final version of WEARPG (at least in the scope of this PhD thesis). In this version, we had four working arm-worn devices and an augmented die. Both these objects facilitate the movement-based gameplay which is based on 7 different mini-games. Upon the implementation, we tested the prototype with 24 participants with questionnaires measuring their experiences and in-depth interviews. As a result, we obtained results regarding to effects of both movement-based gameplay and wearables on the tabletop role-playing game experience.

Specific Contributions:

j. Working prototype of the arm-worn devices and the augmented die.
k. Evaluation results regarding to effects of wearables and movement-based gameplay on the player experience

l. Design Themes that highlight the properties of the WEARPG which affected the player experience. These themes also pointed out the possible solutions to the hindering parts.

10. Conclusion

Our design process yielded design knowledge in several forms in the different phases of the project. In the beginning of this study, we organized a participatory design workshop with 25 participants from different audiences such as role-playing gamers, game masters, cosplayers, interaction designers and jewelry designers. Our intention was to obtain design implications which would help us to explore this subject and lead us in the following design process. From these implications, we incorporated many of them such as, *non-distracting interaction techniques, designing devices with auxiliary objects* etc. (Expected Result 1).

Other than this, in the second phase of the project, we also produced another set of implications which was oriented towards the game design by developing a new game system and conducting preliminary user tests with Wizard-of-Oz and experience prototypes. Again, we used implications such as d*evice belongs to the fictional world* or *providing non-repetitive performances* in the final version of our game system. These implications really helped us since we do not come across to problems such as distraction from the game or character/skill imbalance during the gameplay (ER1).

Upon these formative studies, we developed the working prototype of our speculative design (ER2). We conducted user tests with 24 players. We made these players play the game without the WEARPG in the first half and play it with the WEARPG in the second part. To understand the effects of wearables and movement-based gameplay, we made participants fill questionnaires for measuring the immersion and player/character relationship level in both parts. Moreover, we conducted a semi-structured in-depth interview with each player to understand their experience better. Most of the participants articulated that movement-based gameplay increased their immersion (11 out of 16) and player/character relationship (13 out of 16). They also expressed that wearable device boosted their immersion (12 out of 16) and player/character relationship (11 out of 16). Our questionnaire data also supports these results by indicating a significant increase in both these concepts when we compare the second half to the first half (ER3).

Research activities in the scope of this thesis was also supported by the research activities in the side projects. We believe that these side efforts have impact on the outcomes of this thesis since these projects was in the role of pre-studies of the research methods conducted in this thesis. As a result of all our research efforts, we produced 17 publications, several different prototypes and design concepts for further explorations.

11. Further Work

As a result of this project, we satisfied our expected results as we designed and produced the speculated artifact, got design implications and themes along the process and incorporate the ones which are in the scope of our projects and observed an increase in the player experience in terms of immersion and player/character relationship. Still, our research yielded in new directions which should be addressed in the future studies. First, to concretize the results of our user study, a control group study should be conducted. We actually started to conduct control group experiments. So far, we conducted it with 10 players, however this number is not enough to inform a meaningful result. Our initial Mixed Measured ANOVA (2: control vs experimental group x 2: questionnaire data from time 1 vs time 2) comparisons with 10 control participants that we tested thus far and 10 participants from the experimental group, who were equal to the controls in terms of game experience, indicated that there is a trend showing PCR and general involvement increases more in the experimental group compared to the control group with effect sizes $\eta 2 = .26$ and $\eta 2 = .21$, respectively. Upon these initial indicators of statistical power, we conducted a priori analyses to compute the sample size required to reach meaningful results using G-Power statistics [7], with power ($1 - \beta$) set at 0.80 and $\alpha = 05$, two-tailed. This analysis indicated that with an N= 40 (20 in the control and 20 in the experimental group), there is .8 chance of correctly rejecting the null hypothesis of no significant effect of the interaction (i.e. the amount of the increase from time1 to time2 was the same for the control and the experimental group) for PCR and general involvement/immersion. The trend analysis graphs can be seen in Research Material-5.

Other than that, our results were obtained in a one-shot game which is lasted about 6 hours. Still, role-playing games are also played in long-term campaigns that can last more than one game and even for a year. Therefore, our design knowledge should be extended with long-term studies. We also conducted preliminary studies with two players by making them play a long-term story which lasted for three games. These players did not express a boredom for three games and indicated that they enjoyed the movement-based gameplay and wearables with the same level in each gameplay sessions. Still, similar tests should be conducted with more players to obtain and confirm our implications about implementing movement-based gameplay and wearables in the long-term gameplay.

These studies can be undertaken for concretizing our results and adding to the design knowledge generated. Still, by also revisiting our design implications, different functions that can be granted by the Elemental Gauntlet can be studied. Some of the functions can be private communication or notification, placement of these devices in the narrative by GM or providing information about character properties. Our work mostly focused on how these devices may add up to the player experience, yet a follow-up study which focuses on the functional aspects can be conducted.

Other than that, we also think that another follow-up study can be executed by shifting our approach from wearables to the tangibles. Although our work focused on wearables and movement-based gameplay, another important part of our game is Luck Stone. Luck Stone is a tangible device which works as a mediator between the imaginary world of the game and the game mechanics. Therefore, while wearable devices were mostly lean on the tangible representation of the imaginary world, Luck Stone stands as the physical abstraction which represents the game mechanics and render the Elemental Gauntlet meaningful in the game by connecting it to mechanics and rules. Moreover, while tangible interfaces are mostly the physical representations of the digital in the real world, Luck Stone is a physical object which is meaningful both for its digital and physical properties. Therefore, a follow up work can be done about how tangibles change the role of the other components such as wearables in games. Other than that, by studying on the Luck Stone, what can tangible objects for game can inform to the areas of HCI can be studied.

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13.Related Publications

13.1. Paper 6: Augmented Tabletop Games Workshop

Co-Authors: Zachary Toups, Nicolas LaLone, Joshua Tanenbaum, Aaron Trammell, Jessica Hammer, and Ansgar Depping.

Conference: Proceedings of the 2017 ACM SIGCHI annual symposium on Computer-human interaction in play Companion - CHI PLAY ‘17 Companion [h5-index: 12]

Role: Co-Author

Year: 2017

Type: Workshop

Augmented Tabletop Games Workshop

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CHI PLAY'17 Extended Abstracts, October 15–18, 2017, Amsterdam, Netherlands.

ACM ISBN 978-1-4503-5111-9/17/10.
https://doi.org/10.1145/3130859.3131443

Abstract
This workshop gathers researchers and practitioners interested in augmented tabletop games: physical games that include digital augmentation. Participants will compile ways of knowing for this unique research space and share their methods of research, demonstrating, where possible, through a research gaming and prototyping session. Post-workshop, we will assemble an online compendium for findings, which will include video sketches recorded during the workshop and an annotated bibliography.

Author Keywords
Tabletop games; digital augmentation; tangible interaction.

ACM Classification Keywords
K.8.0 [Personal Computing]: Games

Introduction
Much of the pleasure of tabletop games derives from their physicality [14]. Wooden cubes, cardboard chits, dice, miniatures, and social rituals keep these games firmly inside a physical space that cannot be fully replicated by a computer. This lack of replicability rests within a simple premise: rules are not codified by computation and are thus open to wildly varying interpretation and change [15]. We believe that there is a space between computationally mediated games and the tabletop that offers designers a

range of new opportunities (e.g., Figure 1). Through this workshop, we will explore the means through which designers can augment physical gameplay, without sacrificing the pleasures that players experience at the tabletop [18].

Augmented tabletop games (ATGs) have long been a staple of the analog design environment, though augmentations were limited. Throughout the 1980s, board games controlled by video recordings included on a VHS cassette created new ways to interact between players and the board. More recently, in *Space Alert!*, players respond in real time to problems aboard a spaceship provided by audio files included with the game; in *Golem Arcana*, players use a Bluetooth stylus to play a physical miniatures game using a mobile app; in *Live Game Board* players can enhance the interactive abilities of a paper board with augmented reality.

Extensive research has looked at ATGs [3–5, 8, 11, 22]. The use of computer-assisted devices such as mobile devices, head-mounted displays, and wearable computers aim at different goals, such as increasing physicality, shortening calculations, introducing new mechanics, and increasing sensory experiences.

Social interaction and immersion in gameworlds have been key components of more recent work in this space. Based on the game *i-dentity* [7], *Department of Hidden Stories* [20] examined play as a lens that may transform our perception of each other and the space [19]. Moreover, *Musical Embrace* [9], *Shape Destroy* [6], *Balance of Power*, and *Bundle* [12] are games that emphasize co-presence and physical touch as game mechanics. Tanenbaum et al. considered wearable devices as an important element for fostering the experience of character identification and bond to the imaginary worlds [16].

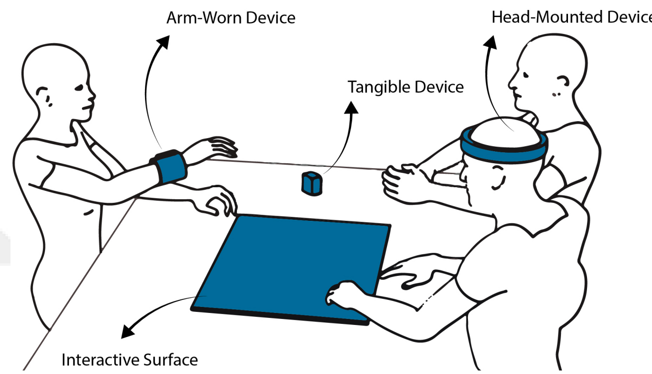

Figure 1: One vision of an augmented tabletop gaming setup for a board game including an interactive surface and sensor-equipped tangible devices and wearables. Image ©2016 Oğuz Turan Buruk.

Beyond improved player experience, some projects have combined the physical and the digital experiences in commercial products. We observe that many products use the reverse approach by increasing the materiality of smart devices like touch-screen tablets or game consoles instead of enhancing the conventional tabletop environment (e.g., *Skylanders* [17], *Zombie Burbz* [21]).

There is also substantial conceptual and pragmatic overlap in this area with research into tangible and embedded/embodied interfaces (TUIs). Starting with the work of Ishii and Ulmer [10] the field of TUIs has devoted almost 20 years to solving the interactional problems of hybrid physical/digital environments. Systems like Tangible Viewpoints [13], *Futura* [1], and EventTable [2] are especially relevant as tabletop TUIs. Many technical challenges involved in creating ATGs have been tackled in the TUI community, albeit towards different ends.

Objectives and Expected Outcomes

The major components of the proposed workshop begin with an opening discussion, followed by participant presentations to get a sense of the scope of work being undertaken in this research space. We follow with a discussion of ways of knowing: how to evaluate ATGs. After lunch, a novel two-hour research gaming and prototyping session will enable participants to experience and discuss research within this space and facilitate collecting video sketches. We close the workshop with a discussion of practicalities.

Planned Activities & Schedule

09:00–09:30: Opening discussion by the organizers.

09:30–11:00: Introductions and presentations by participants.

11:00–12:00: Ways of knowing session.

12:00–13:30: Break for lunch.

13:30–15:30: Research gaming and prototyping session.

15:30–16:00: Brief presentations of observations from research gaming sessions.

16:00–17:00: Practicalities of research session.

18:30: Dinner.

Participant Presentations. A set of participant presentations will identify areas of research. The length of the presentations will be short (dependent on workshop attendance and set in advance). The goal of this session is to establish a sense of the existing work in the space of augmented tabletop games and point the way forward.

Ways of Knowing Session. Research in augmented tabletop gaming is interdisciplinary, including game studies, anthropology, human-computer interaction, psychology, sociology, etc. Each field brings its own ways of knowing: techniques for studying systems, play, experience; data sources; analysis methods; etc. We expressly frame this session as "ways of knowing" to be inclusive when it comes to generating knowledge. This open-floor discussion will enable participants to identify the ways of knowing that have worked for their research (and those that have not). This session will be recorded and used to establish best practices in our online compendium.

Research Gaming and Prototyping Session. The research gaming and prototyping session will offer participants an opportunity to undertake and/or participate in ATG research at the workshop. We design this part of the workshop to be open to a number of activities, including, but not limited to, participatory design sessions, prototyping, research on gameplay activities with tabletop games, and/or miniature workshops (within a workshop).

Although it will not be a requirement, we request that potential participants propose their own projects for the research gaming session. We are open to a range of entries, from nascent and/or exploratory projects for which a small group of experts is ideal, to established projects in need of data collection. In the session, participants will split into small groups that will play together.

As part of organizing the workshop, we will curate entries for the research gaming session based on the number of submissions and interest from participants. In addition, the organizers will bring a sample of their own work, as well as materials to facilitate prototyping in the session. Materials will include commercial board games and pieces (e.g., miniatures, dice), cardboard, and pens, ensuring there is sufficient material for the event.

Participants who bring games will be able to use this session for data collection and the workshop organizers will use it as a time to collect video sketches [23]. Video sketches will be recorded from participants while they are playing games and will focus on identifying new means for designing and evaluating augmented tabletop games. The resulting videos will be included in the online compendium.

At the conclusion of the research gaming session, we will discuss observations and findings.

Practicalities of Research Session. The final session will be an open-floor discussion of the practicalities of undertaking augmented tabletop games research. Participants will share experiences publishing and seeking funding. We expect this session to produce a list of high-quality venues for publication, and a framing for how best to seek funding.

This session will be audio-recorded and used to develop the online compendium.

Outcomes. This workshop will build an ATG-research community and provide source data for an online compendium consisting of ATG ways of knowing, practical considerations, video sketches, and an annotated bibliography.

Organizers' Backgrounds

The organizers are interested in research in the field of augmented tabletop games and include a mix of junior faculty and senior students. All have expertise in game and interface design, as well as research interests in the value of play in design; wearables, augmentation, and physicality and how they influence immersion; identity transformation through games; the historical connections of games and the military-industrial complex; and facilitating social bonds through play.

Planned Solicitation and Expected Attendance

We will develop a website at https://pixl.nmsu.edu/atgworkshop to promote the workshop and maintain materials. To participate in the workshop, potential participants will send whitepapers that address research interests in augmented tabletop gaming and what materials they will bring to the workshop. We will coordinate with authors to arrange the research gaming and prototyping session, which will include the set of games to be played and which participants will be assigned to each session, based on interest and availability. We expect there to be at least 15–20 participants, although fewer of those will bring systems.

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13.2. Paper 7: Forming Visual Expressions with Augmented Fashion

Co-Authors: Çağlar Genç, Sejda İnal Yılmaz, Kemal Can, and Oğuzhan Özcan (Advisor).

Journal: Visual Communication [h5-index: 16]

Role: Main Co-Author, Design Researcher

Year: 2017

Type: Practitioner's Essay

FORMING VISUAL EXPRESSIONS WITH AUGMENTED FASHION

VISUAL ESSAY

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Visual Communication 2017
Vol. 16(4) xx-xx

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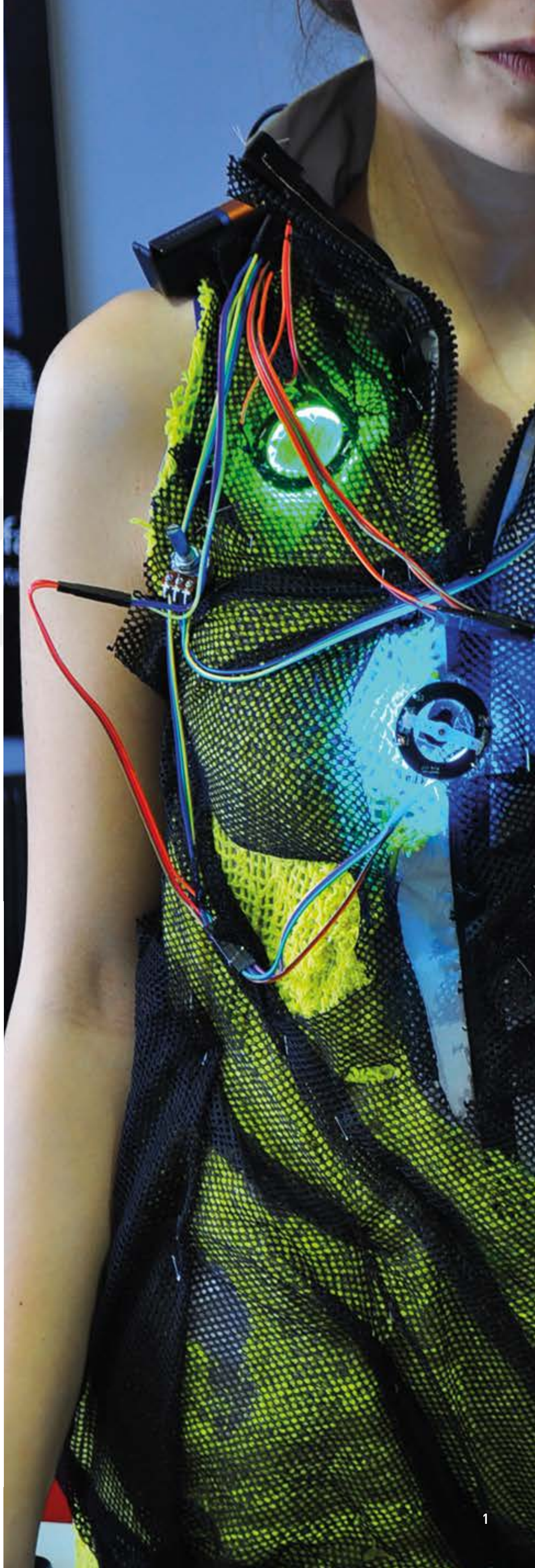
Permissions.nav
DOI: 10.1177/1470357217714652KEY WORDS

Fashion • wearable • design • workshop • fiber art

ABSTRACT

Wearable devices have a crucial impact on our bodies since they directly affect our appearance. However, wearable design practitioners focus more on the practical functionalities of the technology, leaving more investigation needed on what kind of visual expressions the technology might enable on wearable devices. With a critical approach on this functional perspective, the authors conducted a design workshop with fashion design and engineering students in which they first created art expressions and then wearable devices by using technological components. This practitioner's essay reflects on the resulting hands-on design experiences in new visual expressions that would not have been possible with just traditional materials.



1

1 While a participant was sketching their ideas.

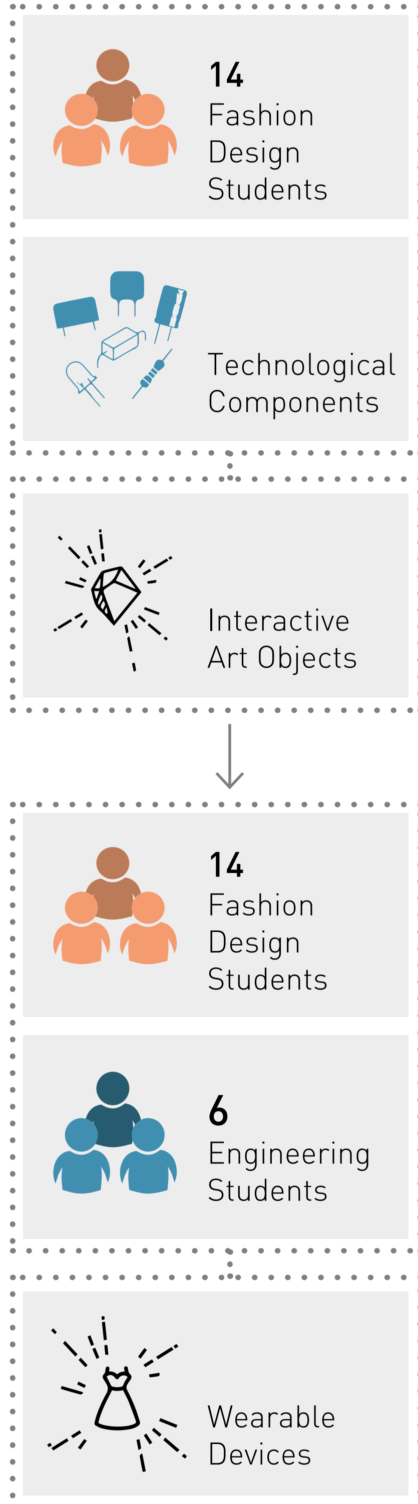
INTRODUCTION

Almost every morning, we wake up to a new world with new technological achievements that affect our lives in different ways. Among them, the evolution of wearable devices is giving birth to a common ground where the two notions, technology and fashion, coincide with each other. With the recent explosion in the use of smart bracelets, smart watches and wearable gadgets, we witness the evidence of this fusion more than ever in our daily life. Yet, from the first appearance of wearable technologies, they are mostly defined by the practical functionalities from a perspective where the formal and expressive qualities are underrated. This is apparent on the first theoretical underpinnings in which these kinds of devices are defined (Mann, 1996; Weiser, 1991). This can be said to be the output of 'the ideological legitimization of the technology' where the development of technology is seen as a rational problem-solving process that increases the efficiency of people beyond workplaces (Dunne, 2008: 2).

However, wearable technologies are sensitive in terms of their impact directly on our body and our appearance. Therefore, similar to our conventional clothes, expressiveness is also an important aspect for wearable devices (Seymour, 2009). This situation creates a need to examine approaches that see wearable development as a technical problem-solving process and raises the question: 'What kind of new visual expressions might technology enable on the body?'

Although there are many examples of technological garments that focus on expressive qualities, we have not found any analyses of possible visual expressions originating from technological components. Therefore, in this practitioner's essay, we explore the relationship between experimenting with technological components and the creation of visual expressions that the technology might enable on interactive garments. To investigate this from the critical point of view from the functional perspective of technology development, we conducted a design workshop with fashion design and engineering students in which we encouraged them to explore the expressive qualities of technological components (see Figure 1). By presenting the process and the outcomes of the workshop, which are in contrast to previous work on wearable fashion, this practitioner's essay provides a thorough analysis of how utilizing technological components helps fashion designers to form visual expressions that would not have been possible to obtain without the existence of these technological materials.

The workshop was conducted with 14 fashion design students studying on the Fibre Art Course at İstanbul Mimar Sinan Fine Arts University and 6 engineering students from Koç University. The first part of the workshop focused on hands-on exploration of technological components such as electro-luminescent materials, LEDs, cables, motors, conductive threads and fabric along with conventional materials such as textiles in order to create art objects that were not concerned with the functional aspects of the technological components. In this phase, only fashion design students were included since we did not want to restrain them with technical concerns but wanted to give them an opportunity to explore the electronic components without any restrictions. However, two of the authors helped them to implement technological components into their design process. The second part of the workshop was aimed at designing fashion objects with the experience the students had gained from the first phase of the study. It also included engineering students to help fashion design students to implement their ideas. The aim of our workshop methodology was to overcome the fashion designers' lack of technological knowledge (Flanagan, 2015; Martin, 2008; Walker et al., 2015) by letting them explore and experiment with technological components in order to create visual expressions for wearable devices.



2 Structure of the workshop.

TRANSITION FROM FUNCTIONALITY TO FASHION DESIGN EXPRESSIONS

In this practitioner's essay, for the notion of expression, we refer to the definition of Hallnäs (2011) which considers how an object displays itself based on its formal qualities. This definition excludes individuals' experience with the object or how its displayed qualities are perceived by individuals (impression). Instead, it focuses on the intrinsic qualities of an object through which it presents itself. The reason for this was our intention to highlight the expressive qualities of the technological materials that formed the interactive garments, rather than focusing on the meanings those particular garments might evoke from the wearers.

The focus on expressive abilities of technology on the body needs special attention given to the material qualities of the technological components, and how they can contribute to the form of the wearable devices. This approach is highly visible in the research known as a 'material turn' in Human Computer Interaction design as an alternative perspective on designing computers (Wiberg, 2015). This research specifically focuses on how computers can be redesigned by exploring the material qualities of technological components in the design processes. Tomico and Wilde (2016) apply this notion to wearables in their work. In their study, they discuss how experimenting with materials in an embodied and situated way might yield meaningful wearables by referring to design studies that they undertook with architecture, interaction and fashion design students. Although this study highlights the contribution of material explorations to defining meaningful wearables, it did not reflect the ways that material explorations contributed to visual expressions when technological components are used as design materials with their expressive qualities.

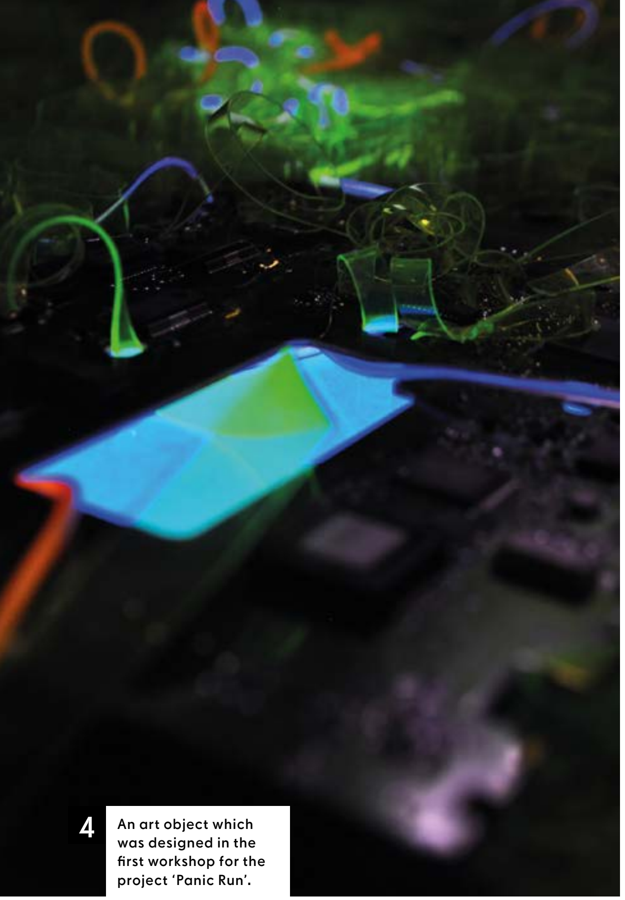
Fashion designers comprise some of the fundamental stakeholders when exploring expressive qualities of technology on the body. In modernity, while common usage of the term 'being fashionable' is seen as being appropriate for fashion trends, the creation and consumption of fashion has more to do with aesthetics and the symbolic meanings expressed through clothing in the social lives of human beings (Wilson, 2003: 9). Therefore, the most important role of fashion designers is to translate the most recent state of modernity into clothing through design processes (Blumer, 1969). To accomplish this role, they are not only trained to fulfil the functional needs of wearers, but also to supply garments that are suitable for a specific fashion consumer group's expressive and aesthetic needs (Lamb and Kallal, 1992). Moreover, the close relation of fashion designers with art potentially enables them to produce garments that challenge the current state of visual languages on clothes. These aspects of fashion design expertise differ from other design disciplines such as interaction design and product design, and make them valuable for wearable device design processes.

The engagements between technology and fashion designers yielded different design movements in wearable devices. Ryan (2009), in reviewing two of them (critical and positivist approaches), highlights the critical point of view of designers and artists on the design of wearable technologies. She mentions that designers who take this approach prefer to exaggerate the visibility of technology due to social and ethical concerns. These kinds of approaches are highly visible in the field of wearable devices and provide examples of how technology can provide expressive properties to the garments that would not be possible with traditional materials of fashion (see, e.g., Hartman et al., 2015). However, detailed examinations of critical fashion approaches to interactive garments that explain how 'mingling with technology might influence fashion designers to create visual expressions' is relatively under explored. Existing studies do not present any examinations of design processes where electronic components and textiles are combined nor has design knowledge about how electronic components can be used in forming visual expressions for fashionable wearables undergone any systematic investigation. Therefore, we aimed to provide design knowledge in this area by conducting a design workshop that combined conventional fashion materials such as textiles with electronic components.

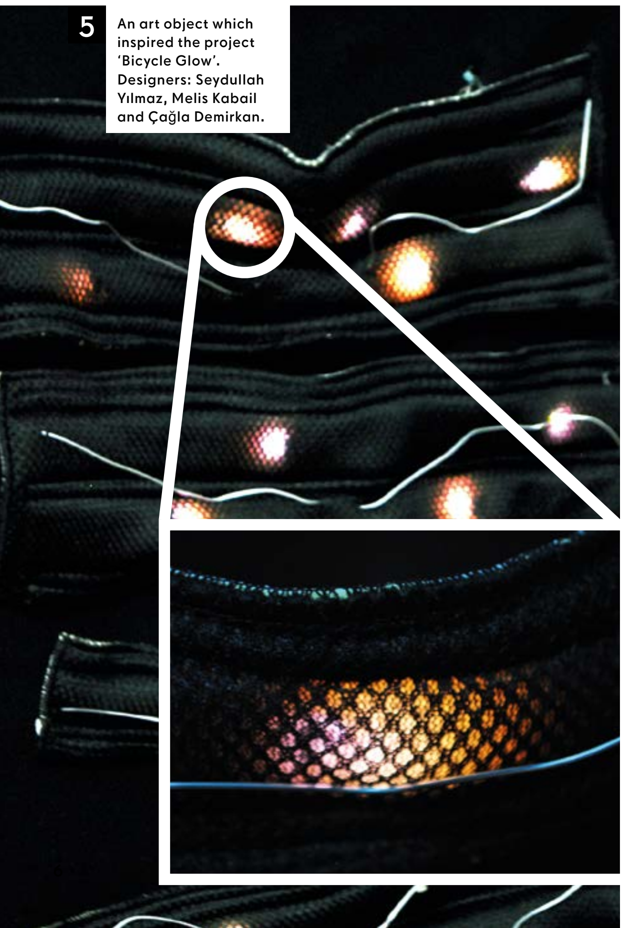
In our workshop, we found it was a fruitful starting point to primarily focus on designing art objects so that students could gain knowledge about how technological components might be used as design materials to form visual expressions enabled by technology (see Figure 2). In this way, students engaged with technological components in combination with various fabrics and other fashion materials to create art expressions where practical functionality was not a concern (see Figure 3). Then, in the second part of the workshop, these experiences helped students to 'discover the functionality in given expressions' (Hallnäs and Redström, 2002) of the artworks that they created, while enabling them to gain knowledge of the expressive qualities of technological components for designing wearable devices.

In what follows, we present our observations and reflections on both the process and the outcomes of the workshop. The examples presented here are used to illustrate the effect of discovering expressions via hands-on experience with technological components on the design of wearable expressions in three different ways.

3 A scene from the first phase of the workshop where fashion design students are exploring different kind of LEDs with different fabrics.



4 An art object which was designed in the first workshop for the project 'Panic Run'.



5 An art object which inspired the project 'Bicycle Glow'. Designers: Seydullah Yılmaz, Melis Kabail and Çağla Demirkan.

FORMING GARMENTS WITH LIGHT

The use of light as a visual design element was a common pattern during the workshop. In the first phase of the workshop, the fashion designers explored the relation of light with non-interactive materials. The knowledge from the art object phase led them to use light to form interactive garments by creating a contrast to highlight details of the form, diffused light in combination with translucent materials and utilization of light in layers. In this way, they achieved new visual expressions that would only be possible by using conventional materials such as textiles.

The designers of 'Panic Run' (see Figures 4 and 6), a rain coat for use by night joggers, started their design process by exploring the combinations of light with translucent shiny PVC material. At the end of the first phase of the workshop, they created a composition by using these materials. They explained how the high contrast achieved by electroluminescent wires and plates, making a smooth interaction with the closest PVC parts, are meant to reflect the abstract concepts of the brain at times of stress. Visually, the use of light in this way helped them to create a contrast between the ground and the various parts, highlighting the active neuron-like details. In the artwork, the light is also scattered to the PVC parts creating a smooth interaction in low light conditions. In addition, they also explained that the overall composition gives the composition an urban look.

For the garment, the art expression that evolved had an aim of night joggers being visible for safety reasons. Here, the designers did not use light as a sole functional element in the garment design but starting by exploring the ways that it could contribute to the intended expression of a feeling of panic but that also increased its wearer's visibility. In addition, the moving forms created in the art object gave them the idea of a dynamic coat that tightens while jogging but loosens when stationary. Here again, instead of trying to find a mechanism that might achieve this function, the designers realized that the density of moving PVC parts reflected that practicality. They speculated how changing shape occurs in a natural way which they had planned to achieve with shape-changing PVC-type pieces that tighten and loosen in order to alter the size of the coat.

Another example for using light as a design material to form a garment was 'Bicycle Glow'. The group who designed the 'Bicycle Glow' first created a mood board on digital waves and said they were working on a garment for cyclists. They associated these two notions (digital waves and the identity of the cyclist) by focusing on the dynamism between them. In the first phase of the workshop, they experimented by creating different combinations of LEDs and fabrics in layers. In this process, they found that light in between the layers of fabrics reveals the unnoticeable patterns of the fabric on the top layer by creating a contrast in the pattern (see Figures 5 and 7). Then, by transferring the notion of digital waves into a glove for cyclists, they redefined the expression to provide navigational information and extra visibility for wearers while cycling. In the final design, an electro-luminescent wire used as an edge binding of the glove aimed to emphasize the wave form. Later, designers loaded a signal function to this part which could be used to sign that the rider is about to turn left or right, like a car direction signal

Almost all other projects in the workshop utilized light; however, these two demonstrated examples of how light and fabric yield to visual expressions that cannot be formed without the involvement of technological components. We observed that, with light, the invisible patterns of textiles can be revealed and, with different combinations of textiles, visual expressions that do not belong to fashion design activities with conventional materials can be created. Apart from that, we also noted that the sharp contrast originating from the extremely bright nature of light could create new opportunities for designers to play with in the shape/background relationship in their cloth designs.

6 Project 'Panic Run' in day and night state. Designers: Cemre Eren, İrem Öğütçü and Cansın Gürler.

7 Project 'Bicycle Glow' in different light conditions.

DYNAMIC EXPRESSIONS

Temporality is the most common feature mentioned when computers are interpreted as design materials (Vallgårda et al., 2015). By experimenting with technological components, fashion designers explored this quality in different ways while forming expressions of both art objects and interactive garments. One approach was to use the interactivity of those materials to achieve multiple expressions of the clothing. Moreover, the dynamism introduced by technological components was also used as a visual element to build up an expression as a reaction to an outside effect on interactive cloths.

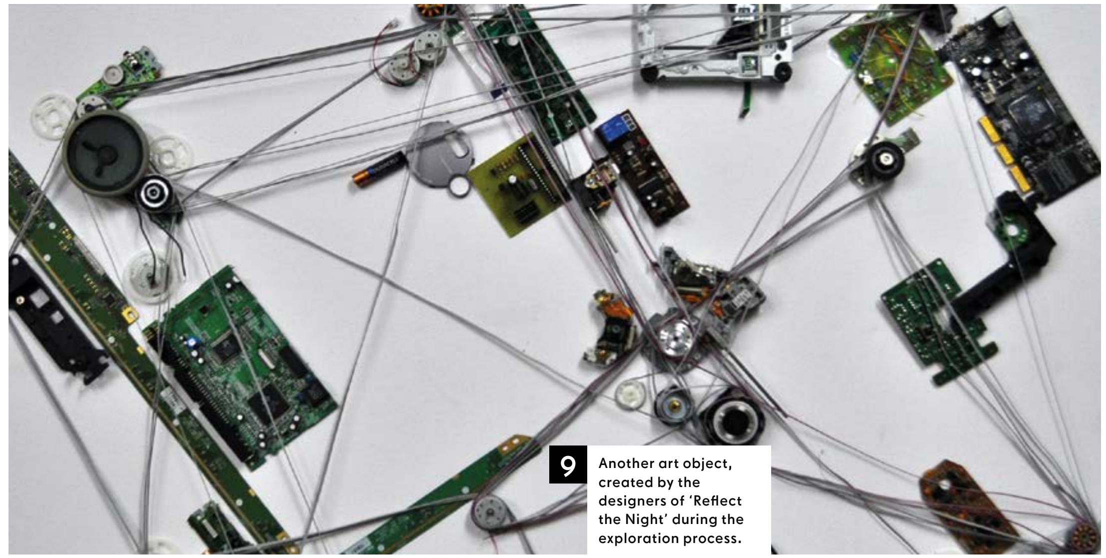
'Reflect the Night' was one example of bringing multiple expressions into a garment through exploring the use of technological components. In the process of artwork creation, the designers focused on two notions: Cybersea and dynamism. They ended up with different artworks for these two starting points (Figures 8 and 9). For the concept of Cybersea, they scrutinized a relationship between a reflective surface and netted fabrics to reveal wavy patterns in cases with intense light projection. While presenting their artwork on this concept, they speculated that their ideas could achieve two alternative expressions in one dress: 'A garment constructed with this structure might look more like night attire in normal light conditions, but it can reveal a sportier look when light is projected on the garment.' The other focus of the artwork was on the exploration of the mechanical dynamism that motors and old electronic devices (PCBs, cables) might reveal. In their presentation, at the end of first phase of the workshop, we suggested to them that they could somehow connect these two notions from two different artworks. Thus, in the process of designing the interactive garment, they first explored the visual language of the reflective artwork. While implementing this style, they felt the need to use light sources facing onto a reflective surface to reveal the second expression without needing an outside source. Then they carried the concept of dynamism further by exploring the alternatives in which the servo motors could fold the fabric. The result was 'Reflect the Night' which is capable of revealing an alternative form when the wearer dances by activating LEDs facing onto the reflective surface. Moreover, the dress has two states which are 'Cluttered Top' and 'Flat Poncho' (Figure 10 and 11). In Cluttered Top, servo motors gather the pile of cloth to the neck part of the dress and create a swollen look. When servos release the cloth, a more flat and smooth character of the cloth presents the 'Flat Poncho' state. Two different states in one cloth is not a new thing and is even present in conventional fashion. However, here we emphasize how the dress form is shaped by the programmable and clearly defined temporality provided by servo motors. The spin motion and its manipulability led designers to the final form of the dress which embraces both curly and flat patterns.

The approach in 'Reflect the Night', revealing alternative expressions by using technology, is very relevant to wearers' daily practice of wearing fashion objects. Giddens (1991: 100) argues that people should adapt their attitudes and visual representations towards their sense of what is appropriate for that setting. On that subject, 'Reflect the Night' gives us clues about how technology on a body can contribute to changes in the visual representation of a particular dress.

'Water Drop Bracelet' (Figure 12) is another example of how new dynamic visual expressions can be created on interactive garments. In the first phase of the workshop, the designer of this project experimented with LEDs placed on a patterned fabric. She explored the different effects of light on the fabric. Then, inspired by the colours and the dotted look of the LEDs, she created an installation which is a recreation of the painting of Henri Edmond Cross, 'Seated Nude', with pins, LEDs and dust paint (Figure 13). Although the time-consuming nature of connecting and programming multiple individual LEDs did not lead the designer to implement a whole working composition, she intended to create an interactive experience where the lights on the installation brightens depending on the position of the viewer. The aim here was proposing different expressions from different angles by highlighting the parts of the composition. In the second phase, inspired by the look and interactive possibilities of LED usage, the designer created a surface with bubble wraps which contains polymer spheres that swell when contacted by water. Moreover, she also implemented LEDs on the back side of the surface. She noticed that the diffused light enabled the water bubbles to turn into different colours and patterns. After experimenting with these colour and pattern changes by implementing a system that reacts to sound inputs from environment, in the end she designed the 'Water Drop Bracelet' which is a bracelet that could be used in open air activities like concerts. In her design, the LEDs on the backside of the surface react to the beats of the music, changing patterns and the colour of the water bubbles. The interaction of water bubbles with water in rainy environments also presents random and alternative patterns on the bracelet (Figure 15). Here, the designer benefited from the interactive use of light to define constantly and randomly changing wearable expressions according to the sound of the environment. Additionally, the designer proposed the use of this kind of surface on different parts of different kinds of dresses (Figure 14).

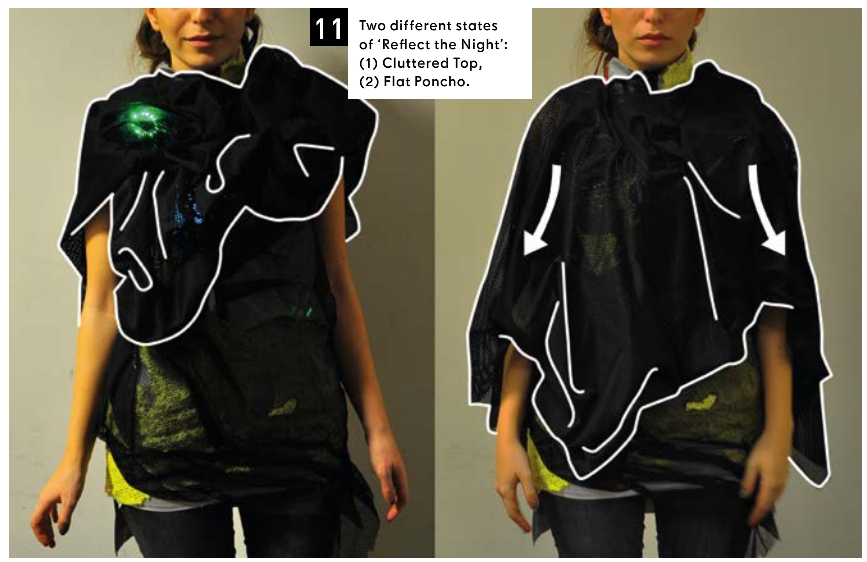
An alternative utilization of technology on the body was making use of dynamism as a visual element on the dress. One remarkable example from our workshop was the project 'Jellyfish'. In the first phase, the designers of this project were interested in the woven structure of the conductive fabric that is presented as a technological component that can trigger desired events in an interactive system. Keeping this in mind, they started to explore the material by tearing and loosening it. The shape they obtained recalled the contours of jellyfish. Inspired by the bioluminescent nature of these animals, they also experimented with light on these forms. At the end of the first phase of the workshop, they created a composition in which three-dimensional jellyfish forms react via light when somebody touches them (Figures 16 and 17). On the second phase, they also tried servo-motors used behind the fabric to increase the 'alive' quality of the jellyfish form. At the end, they proposed a scarf that reacts to the invasion of private space (if somebody touches

8 (AQ3) An art object which led to the project 'Reflect the Night', demonstrated under normal light and intense light.

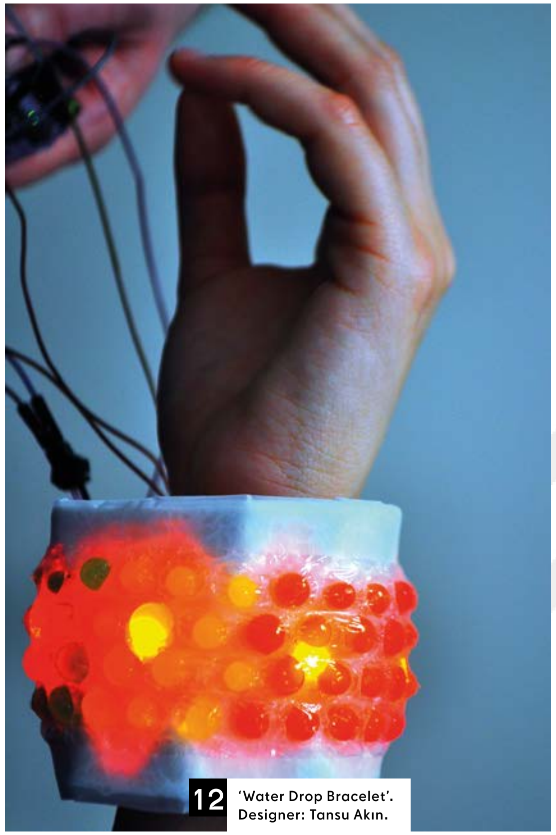


9 Another art object, created by the designers of 'Reflect the Night' during the exploration process.

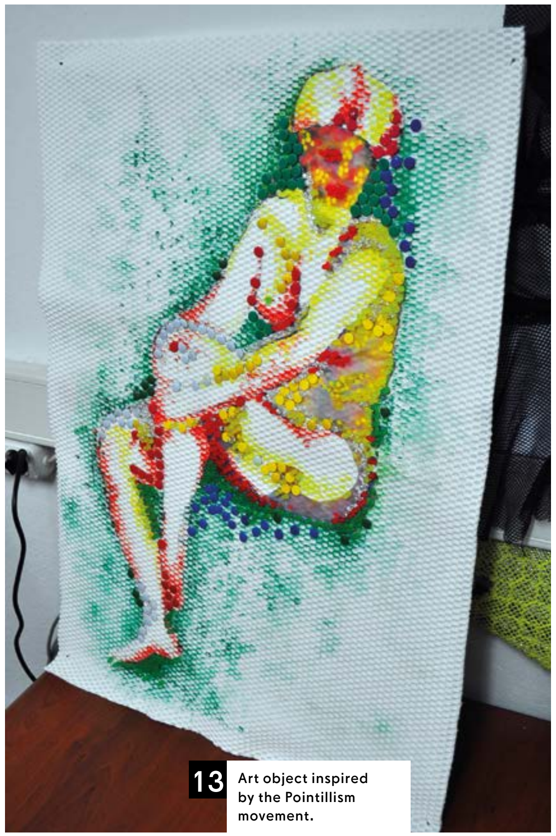
10 'Reflect the Night' under two light conditions. Designers: Muhammed İloğlu Yağmur Gevrek



11 Two different states of 'Reflect the Night': (1) Cluttered Top, (2) Flat Poncho.



12 'Water Drop Bracelet'. Designer: Tansu Akın.



13 Art object inspired by the Pointillism movement.

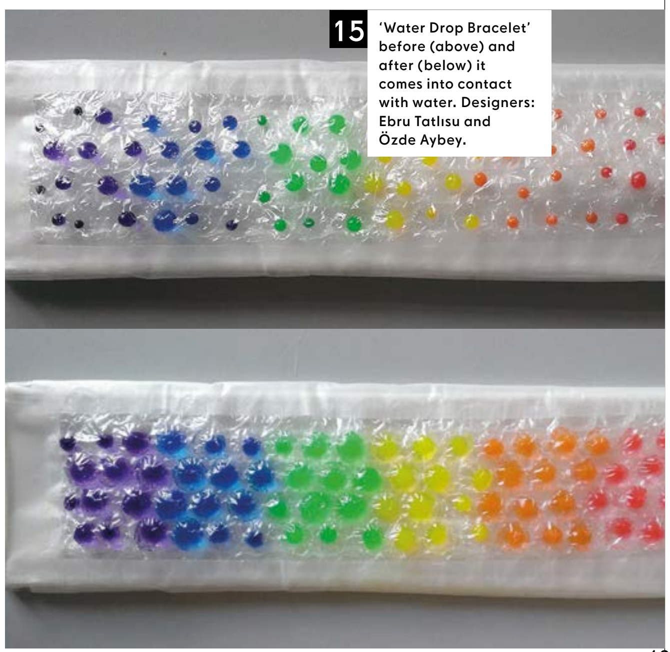
the scarf) by moving jellyfish-like patterns which are augmented with light. Here, the expression itself was formed by the movement of these pieces.

Drawing upon the projects in this section, we claim that temporality will be one of the remarkable sources for new visual expressions of the augmented fashion era. Our observations from this study also showed that dynamic patterns (as in 'Jellyfish), multiple states of dress (as in 'Reflect the Night') and randomized and unexpected forms (as in 'Water Drop Bracelet') could be some of the results sparked from this rich source of temporality.

VISIBLE ELECTRONIC COMPONENTS

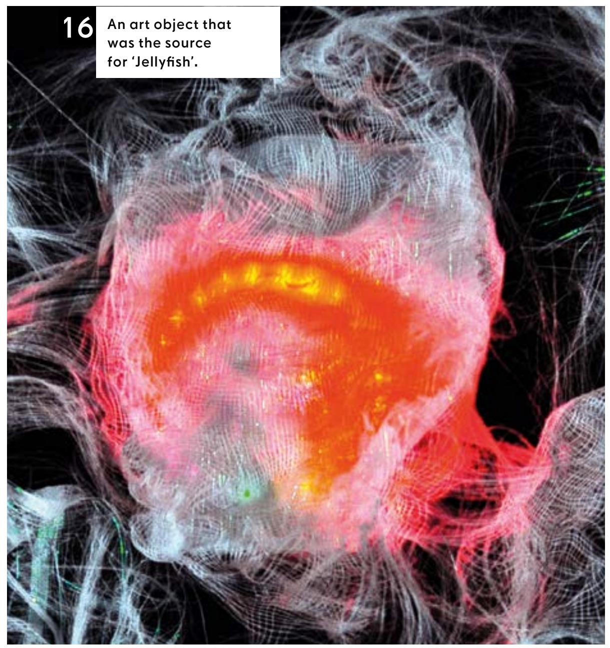
Our choice of facilitating the workshop was the motivation of seeing possible visual expressions enabled using technological materials. Most of these electronic components that we gave the participants (such as wires, cables and chips) are hidden from view not only in wearable gadgets but also in other end-user products. However, in the workshop, a fashion designer was inspired by the form of these components and saw the opportunity of using these as a visual part of their designs.

14 Applications of 'Water Drop Pattern' on different clothes and accessories.



15 'Water Drop Bracelet' before (above) and after (below) it comes into contact with water. Designers: Ebru Tatlısu and Özde Aybey.

'Cable Bag' (Figure 18) was a good example of how the most basic electronic components such as cables can contribute to the visual expression of fashion accessories. The designer of the 'Cable Bag' tried using different weaving techniques by using cables and electro-luminescent wires. In the process of designing artworks, she found that the structures achieved by weaving cables are capable of providing a flexible form that expresses the given shape without needing an additional rigid structure inside. Moreover, she found the relationship between cables, wool threads and electro-luminescent wires interesting enough to use this relation in the final design. At the end of the first phase of the workshop, she presented different alternatives that she had achieved by weaving cables and electro-luminescent wires in combination with wool, metal wire structures and embroidery hoops (Figure 19). During the design process of the bag, she researched a material that can change shape to weave it with cables and electro-luminescent wires. Although we did not give her any, she experimented with shape-changing fibre in the final design of the bag. Her aim was to provide a practical functionality of the bag that could increase its capacity if needed, while keeping the visual expression that dangling cables and EL wires present (Figure 20). This project is a remarkable example of using a fundamental mate-



16 An art object that was the source for 'Jellyfish'.

17 'Project Jellyfish'. Designers: Ebru Tatlısu and Özde Aybey.

18 'Project Cable Bag'. Designer: Ezgi Tokgöz.

rial for achieving interactivity on any technological device, as the main actor in the appearance and the structure of a wearable garment.

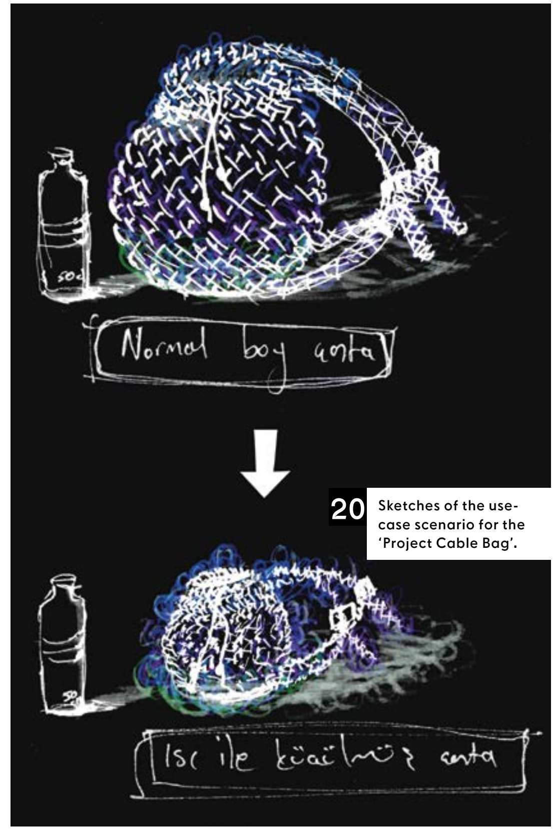
In addition to this project, 'Water Drop Bracelet' referred in the 'dynamic expressions' section demonstrates how electronic components can inspire designers to create forms even if they do not directly use the electronic components as visual elements. These two projects demonstrate that it is crucial to introduce electronic components to designers in the design process. This not only overcomes the struggles caused by designers' lack of technological knowledge but also provides new opportunities for the utilization of electronic components in different ways and styles.

CONCLUSION

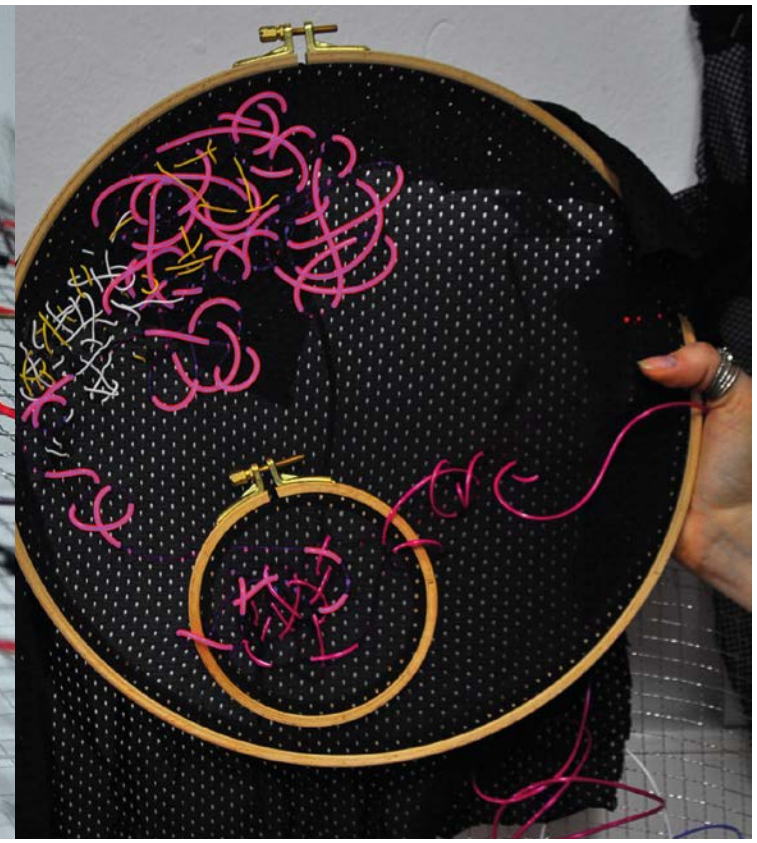
In this practitioner's essay, we have presented an alternative approach to the design of wearable devices which prioritizes exploring expressive qualities of technological components as opposed to the common tendency of technology developers to focus on defining practical functionalities.

To critique this state of wearable device design, we presented our observations and the reflections on the workshop that we conducted with fashion and engineering students. During the workshop, we found it useful to lead students to create art expressions before designing interactive garments. By first focusing on the explorations with technological components, the students were able to extract and experiment with the expressive potential of these pieces. We also witnessed that these expressions reflected some practical functionalities in later phases of the design processes.

Our observations suggest that the contribution of the technological components to the expressions of the designed artworks and interactive garments presented different methods: using light as a formal element to create expressions on a garment, the creation of dynamic expressions and using electronic components as a visual element. In contrast to previous work on fashionable wearables, these results demonstrate possible design directions for forming visual expressions in a process that prioritizes the aesthetic opportunities that can be provided by technology. Moreover, our results are grounded on a detailed analysis of a material-oriented fashion design process. Although these results are limited to the projects in our workshop, more explorations in this area might offer more clues on how technology on the body might contribute to the expressions of wearable devices.



20 Sketches of the use-case scenario for the 'Project Cable Bag'.



19 Art objects for the 'Cable Bag' in the first workshop.

21 Another prototype of the 'Cable Bag'.

BIOGRAPHICAL NOTES

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FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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13.3. Paper 8: Exploring Computational Materials as Fashion Materials: Recommendations for Design Process of Fashionable Wearables

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Journal: International Journal of Design [h5-index: 21]

Role: Main Co-Author, Design Researcher

Year: 2018 (Under Revision)

Type: Full Paper

Exploring Computational Materials as Fashion Materials: Recommendations for Design Process of Fashionable Wearables

Fashion is becoming an inevitable part of the wearable devices. Yet, it is not clear how the cross-pollination between computational and fashion materials might suggest directions for wearables. We believe exploring this territory is important for providing actionable directions to the designers and engineers. Therefore, we followed a two-pillared research through design method: (1) a design workshop with 14 fashion design and 6 engineering students where they created 7 artifacts by exploring computational and fashion materials and (2) semi-structured interviews with 10 wearable design experts from different countries, in which discussed our analysis on the workshop outcomes. After we refined our findings with the feedbacks of the experts we came up with 5 design recommendations for designers along with the strategies that they can follow for applying them. This kind of recommendations, achieved through an examinations that bridges fashion design and computational materials by also considering expert opinions, was not implemented before. In this respect, our recommendations are shaped up as follows: (1) Giving information through fabric augmentation, (2) defining bi-directional interaction between the contexts and garments, (3) controlling the form of the garments, (4) treating surfaces, and (5) supporting the three dimensional shape of the garment with computational materials.

Keywords **-** Fashion, Wearable Devices, Human Computer Interaction

Relevance to Design Practice **-** This paper provides design themes and recommendations to be followed in the design processes of fashionable wearables, which will be valuable for both practitioners and researchers in the area of wearables.

Introduction

Nowadays, technological advancements enable computational materials to be implemented on devices, which can be worn in the form of garments, or accessories. These devices –often called *wearable devices* or *wearables*- are providing various functionalities for their wearers (i.e. health monitoring, augmented reality applications). HCI researchers have been investigating the subject for decades now, yet wearable devices are still often accused of not being *fashionable* enough (Berzowska, 2005; Oskar Juhlin, 2015). As a response, more and more wearable studies started to engage fashion-oriented approaches (i.e. Devendorf et al., 2016; Oskar Juhlin, Zhang, Sundbom, & Fernaeus, 2013a). These studies exemplify new material combinations with the merger of conventional fashion materials (fabrics, leather, threads etc.) and electronic components. Although there are many studies about designing fashionable wearables, an analysis and actionable directions about combining computational and fashion materials in the design process lacks. To fill this gap, in this study, we aim to reveal a deeper understanding on the opportunities that cross-pollination between computational materials and fashion design can bring. In other words, we aim to answer: *What kind of expressive sources might the interactive technologies provide for fashion practitioners to design what we wear? How can this inform the design of wearable devices to be more fashionable?*

For answering these questions, we followed a *research through design method* (Zimmerman, Forlizzi, & Evenson, 2007) which adopts creating artifacts through *material exploration*. We conducted a design workshop together with 14 fashion design students and 6 engineering students to make observations in the design process of fashionable wearables to have a deeper understanding about the visual expressions that can be created in the cross-pollination of computational and fashion materials. We analyzed the outcomes of the design workshop by using the *form element categorizations for computational composites* (Vallgårda, 2014). We also analyzed the same outcomes in terms of *fashion forming techniques* as exerted in (Sorger & Udale, 2006). Our analysis resulted in design themes which can be turned into actionable directions for wearable designers. Therefore, we turned these themes into *design recommendations* and discussed them with 10 on wearable design from different countries to understand their usefulness and make any refinements if needed. Our discussion yielded in productive critics which led us to refine and broaden the scope of our findings and create the final form of our recommendations for the designers of wearables.

As we focus on the *cross-pollination between computational* and *fashion materials* in terms of the fashionable expressions, our research touches very diverse concepts. The notions of the *form* and the *expression* is among these critical concepts to understand how the computational materials can aesthetically enhance wearable devices in the context of fashion. Within this study, we refer to definitions of Hallnass (2011) for examining these two notions. He defines the *form* as how the materials are physically based on its geometry or how they define the space. The expression is how the thing presents itself based on these formal decisions of the designers. This definition excludes the *impression* which is how the people perceive the thing and focus on the definitional logic of the expressions defined by the designer. These assumptions work towards our method, as we do not intend to examine how fashion design or computational materials might make people feel. In contrast, our intention is to explore how computational materials provides opportunities for the form and the expressions of these devices in the context of fashion.

We look for the expressions and while doing this, we put the material itself into the center. This means that we are not actually looking for meta-meanings but try to explore how these materials can interact with each other. Therefore, we approached *the computers as design materials* which is already an adopted and a trending movement in interaction design. This movement, namely *Material Turn* (Wiberg, 2015), promotes the exploration of these materials drawing upon the *material qualities*. For example, in that sense, computers do not only provide a feedback with light sources but create a visual effect while they do not only sense via a sensor but also take space, have a form. As Vallgårda and Redström (2007) suggested, exploration on material qualities of computers can help designers to gain knowledge for creating *computational composites* with conventional materials (in our case common fashion materials such as fabrics, threads, leather etc.).

On the other hand, *fashion* is the main concept of our study and it is important to understand how it is referred especially in HCI field. In HCI, fashion is usually referred to as the aesthetic appearance of products which make those objects desirable. Although this definition is inadequate, indeed, fashion is strongly related to the aesthetic and symbolic values of the material objects. Wilson defines fashion as "an aesthetic medium for the expression of ideas, desires and beliefs circulating in society"(Wilson, 2003, p. 9). In that direction, fashion designers focus on pleasing expressive and aesthetic needs of the targeted consumers together with functional needs (Lamb & Kallal, 1992). Traditionally, *textile* is the dominant design material of fashion design (Loscheck, 2009, p. 15). In that sense, designing garments can be seen as a process of altering the formal state of the textile material (Loscheck, 2009) through fashion production techniques (Sorger & Udale, 2006). However, the emergence of wearable devices introduced new design materials, namely computational materials and how to involve/use/create these materials in purpose of designing fashionable products is still underexplored.

Therefore, we believe that an approach which takes the computational materials as a starting point for fashion design may yield results for understanding the meanings of these materials in designing fashionable wearables. In this direction, our method uses *material exploration* as an *approach in the research through design* and focuses on *fashionable expressions* that will emerge in the *cross-pollination of fashion and electronics.*

Computers as Design Materials

In our study, we mainly followed a research through design approach (Zimmerman et al., 2007) in which the researchers produce design knowledge through designing artifacts. However, in this study we centered material explorations in the design process. More specifically, we explored *computers as design materials.*

For few decades, there is an ongoing debate which critics the traditional perspective of HCI which emphasizes *functionality, efficiency* and *usability* over the formal and aesthetic qualities (Dunne, 2008; Hummels & Overbeeke, 2010; Redström, 2005). In response to those critics, the perspectives which center the material qualities of computers, namely "*the material turn*" (Wiberg, 2015), gained interest. These approaches suggest that we can apply designerly perspective on computers as design materials to form new expressions and experiences (Wiberg et al., 2013).

Understanding the material qualities of computers as design materials is the basis of *material turn* (Wiberg, 2014). On that subject, Vallgårda and Sokoler (2010) argue that the properties of computers as design materials cannot be perceived unless they are combined with other materials. Thus, they present *material strategy* for interaction design in which they explored *computational composites* together with other materials. At the end, they described the unique qualities of computational materials as *temporality*, *reversibility & accumulation*, *computed causality* and *connectability*. Moreover, exploring *immaterial* features, invisible and complex qualities, of computational materials is another focus in this branch of work (Arnall, 2014; Solsona Belenguer, Lundén, Laaksolhati, & Sundström, 2012; Sundström et al., 2011). These studies highlight the importance of hands-on explorations for understanding complex nature of computers as design materials.

Based on these explorations, researchers argue that interaction design should be seen as a form giving practice. For instance, Jung and Stolterman (2012) proposes *form-driven interaction design*, in which understanding capabilities of materials is an important aspect of designing meaningful interactive objects. Moreover, in her more recent work, Vallgårda (2014) suggests terminology for form elements used in interaction design as *physical form*, *temporal form* and *interaction gestalt*.Also, Kwon et al. (2014) proposes an alternative terminology which separates physical form into two categories, *tangible materials* (physical materials), *intangible materials* (i.e. air, magnetism, light, smoke, sound). Similarly, Wiberg & Robles (2010), instead of considering digital and physical materials separately, they propose creating intentional links (textures) between substrates (either physical or digital) of the compositions. Interrelated with the decisions of designers on these form elements, Hallnäs (2011) highlights the design space of interaction expressions as *timing*, *spacing*, *connectivity* and *methodology* of use proposed. These studies suggest that designers can play within these design spaces to form new expressions for interactive artifacts.

More branch of work also highlights how focusing on materials might lead to meaningful expressions in HCI design research. Hallnäs and Redström (2002) suggest designers to pay attention to the expressions which phenomenologically defines what these designed artifacts mean to their users and the observers around in daily lives. By concerning computers as design materials, they suggest a *leitmotif* to achieve meaningful expressions that "function resides in the expressions of things". This creates the basis of their design method named "function-expression-circle" and stands as an alternative to "form follows function" principle (Hallnäs & Redström, 2002a). Additionally, Giaccardi and Karana (2015) introduced a framework of materials experience which conceptualizes experiential levels of materials in designed objects in order to create a connection between theoretical roots of experience design and interaction design practice.

Taken together, those approaches that we called material centered design, suggest that prioritizing exploring the qualities of the computational materials might help designers to extract these materials' expressive potential for creating meaningful expressions. Yet, to date, it is not clear how hands-on explorations on the cross pollination between computational materials and fashion design might contribute to the design of fashionable wearables. Therefore, in our study, we try to contribute to this lack using a material centered research through design.

Fashion Design

Visual appearance is an essential element in clothing. Wilson (2003) states "Like any other aesthetic enterprise, fashion may then be understood as ideological, its function to resolve formally" (p. 9). On that subject, Fortinati (2005) and Quinn & Tran (2010) reported greater impact of aesthetic appearance on consumers decisions, compared to functionalities. To supply these demands of fashion system, fashion designers use the traditional techniques of forming dresses (Sorger & Udale, 2006) including constructing fabrics (i.e. weaving, creating non-woven fabrics), treating those to alter their aesthetic and functional abilities (i.e. dying, embellishing), and constructing silhouettes on the bodies (i.e. by draping fabrics, creating darts).

Traditionally, materials for designing garments are comprised of textile products (Redström, 2005, p. 47; Udale, 2008). However, *fashion designers also play with alternative materials, technologies and explore new production methods to innovate forms and functions in the clothing* (B. Quinn, 2002). In that sense, material explorations play important role in the fashion design process (Nimkulrat, 2012). Moreover, achievements on material sciences provide new materials for designers to construct novel expressions and new functionalities in dresses (Honhu, Philips, & Takigami, 2005).

However, in interdisciplinary design studies, the challenge caused by the designer's lack of technological knowledge is highly mentioned (Flanagan, 2015; Martin, 2008; Walker, Kettley, Downes, & Dias, 2015). Hence, we believe that the material explorations followed in our study might provide clues for fashion designers about how to use and manipulate the computational materials.

Fashion & Computational Materials in Wearables

Fashion has been a research subject in HCI for a long time. Predominantly, the researchers focus on revealing consumer behaviors on digital artifact usages (i.e. Fortunati, 2005; Katz, 2006), derive design insights for fashionable devices by examining fashion media (i.e. O. Juhlin & Zhang, 2011) or interview participants on the effect of fashion on possessing their digital devices for achieving sustainable technologies (i.e. Pan, Roedl, Blevis, & Thomas, 2015). However, in this article, our aim is to examine the cross-pollination between fashion design and computational materials on creation of fashionable wearables. Therefore, we present our review of wearable studies that focus on fashion and computational materials.

The most of the works done in the area of fashionable wearables explored functional usage of the technology on body such as focusing on helping people with disabilities (i.e. Lin, Zhou, & Koo, 2015; Profita, Farrow, & Correll, 2015; Waldhör, Greinke, Vierne, Bredies, & Seidler, 2017) promoting healthy behaviors (i.e. Almeida, 2015; Fortmann, Cobus, Heuten, & Boll, 2014). Moreover, several studies focused on expressing emotions (i.e. Moere & Hoinkis, 2006; Pailes-Friedman, 2015), personal activities (Lee, Cha, & Nam, 2015) and fashion behaviors on accessing information (Liu &

Donath, 2006) with interactive clothes. Also, some researchers explored the ability of interactive technologies reacting to environment (i.e. Kim, Paulos, & Gross, 2010) or wearers' clothing selection attitudes (i.e. Sokol & Kunze, 2015).

Other than those, some studies reported the opportunities that specific technologies developed for wearables open up. For instance, Google's ATAP focuses on variation of specific technology called conductive yarn for providing dynamic displays and interfaces on the garments to derive insights from fashion designers and wearers (Devendorf et al., 2016; Poupyrev et al., 2016). Barati et al. (2015) also focused on an underdeveloped computational composite (combination of flexible OLED and piezoelectric polymer) and reported the value of hands-on experience with material samples and prototypes in design processes. Moreover, Juhlin et al. (2013), suggested the possible implications of hypothetical wearable technology that switch shapes and colors, by consulting fashion conscious users. Based on their findings, they discussed how designing soft and interactive devices might highlight the style of the designer and provide aesthetically pleasing interactive accessories that can match the occasions and the outfit of the wearer.

Overall, these projects reported explicit information on how computational materials can contribute to the field. However, due to their perspective focused on specific applications or technologies, yet they do not provide coherent understanding of how computational materials would affect wearable design in the context of fashion.

On the other hand, several studies constitute significant exceptions in terms of providing broader examinations on wearables with a special attention to computational materials. For instance, Zeagler et al. (2013) reported positive pedagogical impact of introducing their electronic textile interface swatch book in the beginning of their multidisciplinary workshops series. Rossi et al. (2011) conducted an interdisciplinary project with students from fashion and technical departments. They described the designed interactive garments which consist of acceleration sensors in combination with textile materials and other computational components such as LEDs, ventilators.

Moreover, Perner-wilson et al. (2011) presented a workshop series in which authors introduced diverse palette of craft materials to their participants for creating textile interfaces. They reported that tinkering with material yielded unique end-products with clear clues for viewers about what they can be used for. Tsaknaki et al. (2015) presented four interactive accessories which they have designed throughout a process of collaboration with a jewelry designer. They highlighted that including jewelry materials (i.e. copper, wood) in the interactive accessories might decrease the perception of wearables as gadgets. They further argue that those materials together with electronic components might lead to new form languages and new interaction modalities with more sustainable practices. Wang et al. (2016) also conducted a workshop in which they collaborated with fashion designers to explore the future of fashionable wearables by focusing on the aesthetics that might be enabled by interactive technologies. In the end, they presented several findings on transparency, irregularity and contextual expressions.

Also, a branch of design programs proposed that textile materials and interaction design can be merged (Hallnäs & Redström, 2008; Nilsson, Vallgårda, & Worbin, 2011; Redström, Redström, & Maze, 2005). Works of Jacobs & Worbin (2005), Worbin (2010), Hallnas et al. (2002), and Persson (2013) exemplify these design spaces of interactive textile materials with experimental design projects. While these projects reveal the affordances computational textiles in interaction design as displays and expressive interactive objects, they stay within the limits of their specific explorations and do not intend to provide actionable design suggestions for designers, which is the specific aim of this paper.

Moreover, Tomico and Wilde (2016) presented a comparison among three design processes based on material explorations, material explorations on the body and material explorations on the body in the context. Their work suggests that tinkering with material on the body and staying in a context is useful for designing meaningful wearables. Although their study is highly relevant to our aim in terms of revealing the advantages of material explorations for the design of wearables, the study does not aim to provide insights into computational materials in the context of fashion.

Additionally, Seymour (2009, 2010) summarized her visions on fashionable wearables in her two books named Functional Aesthetics and Fashionable Technology. The visions she proposed, contain valuable insights into how fashion can shape the wearable technologies which also involve projects on material explorations in the sections of her books ("material explorations" in Functional Aesthetics and "material witness" in Fashionable Technology). However, her works consist of categorized presentation of selected wearable projects.

Overall, this review presents exclusive knowledge on specific applications and possibilities that specific computational materials might reveal in wearable design. Moreover, broader examinations on fashionable wearables also highlight the importance of exploring computational materials on achieving meaningful wearables. Yet, those studies do not offer a thorough analysis of how computational materials is utilized by fashion designers. For this, we find adopting an approach which prioritizes the opportunities of the computational materials with fashion design students, useful starting point.

Method

As we stated above, we followed a research through design approach. In this respect, our method involved (1) a design workshop and (2) semi-structured interviews with international experts. The design workshop aimed at exploring the material properties of electronic components in the context of fashion design. In our analysis, on the results of design workshop, we looked into how the computational composites contributed to form of the garments, and how the fashion production techniques incorporated them. This process yielded design themes and nine recommendations related to these themes. Finally, we sought feedback from wearable design practitioners and scholars experienced on wearable device design to refine our findings and, ultimately, to substantiate our claim that these recommendations can be perceived as useful by designers and researchers.

Participants

14 fashion design students and six engineering students participated in the first part of the workshop. The 12 of fashion design students were comprised of third and fourth grade students. Two of them were graduate students. Engineering students were third and fourth grade undergrad students.

For the interviews, we contacted 10 international wearable designers and scholars who have experience on designing wearable devices. The five of the participants were researchers and/or educators and five of them were professional designers and/or artists in the wearable design field. See Table 1 for the backgrounds of the interviewees.

Title	Experience	Background
Researcher/Lecturer	4 years	Research Assistant in University of Maastricht. Co-Lecturer in “Interactive Materiality” course at TU Eindhoven.
Researcher/Lecturer/ Artist/Curator	15 years	University for Creative Arts Epsom (Lecturer/Researcher) . PhD Digital Media, Founder of e-textiles & art/design meet up group "E-Stitchers"
Researcher/Jewelry Designer/Artist	4 years	PhD candidate in Queen Mary University of London. Digital Jewelry Designer. The works are selected for many international exhibitions.
Researcher/Lecturer /Fashion Designer	10 years	Utrecht School of Art, Saxion University, Eindhoven University. She advises Philips Research others on product development.
Lecturer/Artist/Curator	13 years	Curator at "Pretty Smart Textiles" in Holland, Denmark, Austria and Belgium. Coach at Wearable Senses at TU Eindhoven (2010-2012)
Fashion Designer	1.5 years	Organized and moderated many workshops on E-textiles in Turkey.
Multimedia Artist / Fashion Designer	5 years	Owns her fashion studio located in London. Wearable projects involved in many international exhibits.
Fashion Designer	5 years	Owns her fashion brand. Co-creator of many wearable devices, including a collaboration with Intel.
Fashion Designer	5 years	Owns her fashion brand. Co-creator of many wearable devices, including a collaboration with Intel.
Designer	1 year	Researched and developed wearable products for people with movement disorders

Table 1 – Background of the wearable design experts. Mean approximate experiences of the participants was 5.5 years

Procedure

Design Workshop

Design workshop is comprised of two phases. The first phase of the design workshop aimed at exploring the electronic materials independent from any technological or fashion-related (ergonomics, context of use etc.) restrictions. We also did not include engineering students in this phase since may possibly put restrictions on the ideas. In this first phase, we asked fashion design students to design “art” objects using electronic materials and fashion materials such as textiles or leather. We first greeted students and made a brief presentation. This presentation included information about wearable devices, different design approaches for smart garments and several distinct examples about how different elements such as light, motion or 3D forms were used previous studies. This presentation aimed to increase the knowledge of students about the subject and broaden their vision about how to use computational materials as a design material. During workshops, we encourage the participants not to limit themselves to the presented examples and to come up with novel ideas by exploring materials. Then we introduced the electronic components which are used in smart wearable design such as conductive cloths and threads, single LEDs, LED strips and rings, electro-luminescent (EL) wires, tapes and surfaces, microprocessors, electronic cards, mechanical parts and motors. We also let them to use any conventional fashion materials such as leather, textiles and threads. After the introduction of the materials, students individually worked on the materials with a hands-on approach and examined the boundaries. We also helped them with interactive properties such as how to light the LEDs and ELs or how to use conductive clothes and threads. After the first exploration phase, fashion design students came up with ideas, presented and formed groups to work on ideas. The ones who wanted to work individually were allowed to do so. At the end, there were seven groups to design "art objects". The production phase was mostly based on exploration. Therefore, although students had initial ideas to progress from, the whole idea was shaped around the boundaries of the materials. A fashion design professor and three graduate students also advised students about design decisions when they asked for recommendations. This first phase lasted for 3 days in total of 18 hours. At the end of the workshop, students presented the "art objects" which were made of computational composites comprised of computational and conventional fashion materials.

The second phase of the workshop aimed at designing *"fashion objects"* such as garments or accessories. In this phase, engineering students also participated in the process for aiding fashion designers about the technical availabilities. We wanted fashion designers to base their designs on the "art objects" designed in the first phase. This phase also lasted for 3 days (18 hours) and same materials were provided for students. We also wanted students to design use-cases for their "fashion objects" and present them with video sketches (Zimmerman, 2005). We used video sketching, since it is a quick method for presenting use-cases. Moreover, with this method, flaws in the design can easily be realized and new ideas can be generated as well as letting designers to describe the details of their project which could not be implemented.

At the end of each phase of the design workshop, students presented their concepts via verbal and visual presentations. Their visual presentations included video sketches of intended use cases for their concepts, an implemented prototype and speculative sketches for the parts could not been implemented due to technical reasons.

Expert Interviews

In each interview, we first stated our aim for this study and presented the outcomes of the design processes from the workshop. After this brief introduction, we presented recommendations extracted from the workshop separately. Each recommendation was presented with its headline, a description of the recommendation and our proposed strategies for the designers in the context of this recommendation. We also added the evidences from the design workshop as examples from which we derived the recommendation. The aim here was to start conversations about the notions proposed in the recommendations. Each recommendation was discussed within the scope of following questions: “How would this recommendation affect the creation of fashionable wearable devices when they are presented to wearable designers?”, “How useful and valuable is the recommendation on creation of fashionable wearables based on your experience and observation?” and based on their critics on the recommendation we asked “How can it be improved?”. After getting feedbacks on the recommendations separately, we asked their general feedbacks on the recommendations and gathered their additional opinions.

The interview sessions were conducted either in person or via Skype. Eight of them were individual interviews. One of them included two of the participants together as these two designers are working collectively on the design of wearable devices at their own fashion studio. Each interview lasted approximately one and a half hour.

Main Categories of Investigation	**Framework**	**Sub-categories of the frameworks**	**Descriptions**
How computational materials contributed to form of wearables	Three formal elements for computational composites (Vallgårda, 2014)	Interaction Gestalt	Performance of movements that a user(s) and systems will do in relation to the thing or the environment
		Physical Form	The three-dimensional shape of the thing or environment, including intangible materials (i.e. Light, sound, air streams)
		Temporal Form	The patterns of the state changes that the computer will produce
How fashion production techniques incorporated computational materials	Traditional techniques for fashion design (Sorger & Udale, 2006).	Fabric Construction Techniques	The techniques used for constructing the fabrics (i.e. weaving, knitting)
		Surface Treatment Techniques	The techniques used for enhancing or altering the fabric qualities (i.e. printing, dying, embellishing)
		Garment Construction Techniques	The techniques used for creating the three-dimensional shape of garments (i.e. using seams, darts, pleats and gathers)

Table 2. The framework for our systemical analysis

Data Collection and Analysis

Design Workshop

All the presentations were video recorded and additional sketches were collected. We also took notes during the both workshops.

In the analysis phase, we first reviewed our results from design workshop, examined videos of the presentations and sketches for the projects according to two main categories of investigation: (1) how the combinations of computational materials and fashion materials contributed to the forms of the garments which would not be possible only fashion materials, and, (2) how the production methods usual to fashion -such as weaving, draping- incorporated the computational materials. We included all projects from the workshop. For the contribution of computational materials on the forms, we used Vallgarda's categorization of the three form elements for computational composites (Vallgårda, 2014) as a framework for our investigation. For analyzing the production methods, we categorized the fashion forming techniques (Sorger & Udale, 2006) used or speculated in the design processes in our study. The aim here was to decompose and understand how each project contributed to our main areas of investigation. See Table 2 for detailed scope of our systematical analysis. Two of the authors analyzed the data separately, then discuss their findings until they reached an agreement on the results.

Expert Interviews

We recorded the interviews sessions and also took notes. For the analysis, we first reviewed the recorded interviews to extend our previous notes. Then we coded comments with tags according to recommendations or if they are general. Afterwards, we incorporated second level coding to describe the details such as “positive”, “too specific”, and “suggestions”. We consulted the video recordings in times where we need more detailed explanations about notes. We used codes such as “positive” to understand and highlight the useful sides about our recommendations. We used codes such as “suggestion” and “too specific recommendation” to refine and improve each recommendation.

Preliminary Results of the Design Workshop

Overall, the design workshops yielded 8 art objects and 7 fashion objects (Figure 1). In what follows, we present the design themes emerged from our analysis of the workshop results. These themes are presented according to their relationship to computational composited classification and the garments and fashion production techniques.

Form elements of computational composites

Interaction Gestalt

Contextual triggers

The existence of the computational materials in design processes opened up the opportunities for designing garments more responsive to potential contexts where these garments are worn. More specifically, the designers examined these contexts to use the potential triggers readily exists in these conditions to activate interactions on the garments.

In Bicycle Glow and Panic Run, these triggers are the GPS data to support wearer with navigational information through the garments. Designers of the Bicycle Glow also thought it would be practical for the wearer if the glove is charged whenever the cycler holds the handles. In the Panic Run, designers used gestures like holding the arm to activate the screen, or detected running or resting state of the wearer to activate loosening or tightening of the garment. Another project, Reflect the Night, is speculated to be used as a night dress as well, and the dress itself was reacting to the dancing state of the wearer by turning the lights on. Moreover, The Water Drop Bracelet provides passive interaction depending on the environmental sound and rain, the Jellyfish reacts to the external touch, and in the Reform Season, and the movement of the patterns depends on the environmental temperature.

Physical Form

The light on the surface

In the design workshop, most of the designers explored the effects of light sources on the fabrics as an element for altering the physical form of the fabric surfaces. During the design processes, the designers explored how light interacts with different materials achieving different effects on the fabric surfaces. In Bicycle Glow and Reflect the Night, the light sources are placed behind the netted fabric. That way, they achieved increased visibility of fabric patterns. In Water Drop Bracelet and Jellyfish, light casted from behind the surface materials resulted in a diffused effect on the surface by passing through semi-transparent materials. The designers of Panic Run created drapes by using plastic materials that can reflect and carry the light. Different than regular drapes in conventional clothes, this design represented a very strong contrast between the background and the drape figures. Cable Bag was another project that utilized EL wires in the knitted structure of the bag which resulted in

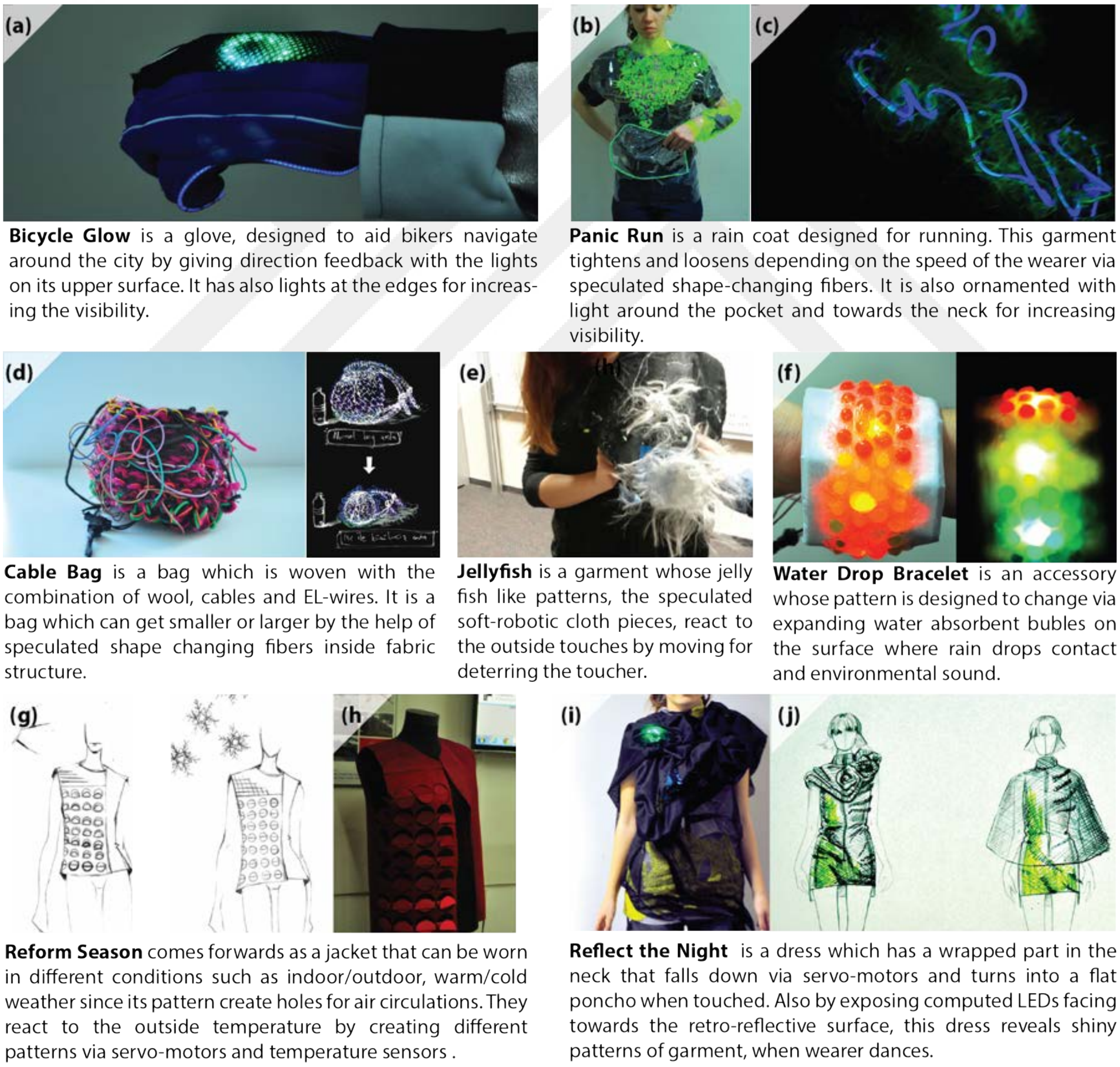

Figure 1. Descriptions of the projects. (a) Bicycle Glow, (b) Panic Run (c) Panic Run – EL wires, (d) Cable Bag, (e) Jellyfish, (f) Water Drop Bracelet, (g) Reform season –patterns opened & closed,, (h) Reform Season, (i) Reflect the Night, (j) Reflect the Night – clustered and wrapped states.

rhythmic patterns on the surface of the bag as the illuminating wire travel through different layers of the knit pattern.

Extending the expressions of the garments to the environment

The exploration of light sources on the garment revealed another opportunity for using the light casted from the garments to extend the garment's expression to the environment. In Bicycle Glow and Reflect the Night the light which is casted behind the netted fabrics resulted in patterns projected onto the surfaces in the environment. The designers of Reflect the Night, highlighted that effect in their video sketch, where the protagonist expresses "I am spreading light!" while she is dancing when LEDs are activated. Also, in the Bicycle Glow, designers used a similar approach to project abstract marks through the gloves on the ground while the wearer cycles.

Visible components on the garment

The shape of the conventional computational materials such as cables or microprocessors is usually unfavorable for designers to be visible on the garments. However, the designer of Cable Bag scrutinized how the visual appearances of the cables can contribute to the *physical form* of the interactive garment. Instead of using them hidden behind the fabrics, which was the case in most of the projects in our workshop as well as most of the projects in the field, she used the visual qualities of cables by incorporating fashion techniques such as weaving and consider these materials as elements that can add up to the visual quality of the object.

Temporal Form

Conveying information through cloth

Although different projects in the workshop utilized many different modalities for interacting with the garments, different dynamics of different fabrics provided distinct ways of conveying information. Projects aimed at giving information internally to the wearer or externally to the people around by using computational materials to augment the communication abilities of the fashion materials. In the Jellyfish, motion of embellishments carries a direct message of "Stay away!" for unwanted touchers. In Bicycle Glove, information about the navigation is transmitted through netted fabric and the bindings. In Reform Season, the condition of the cut outs, being closed or open, is somehow a display of environmental temperature. Therefore, we observe that rather than using displays, fashion designers wanted to use the properties of fabrics or the dress form for transmitting messages.

Fashion Techniques on the Computational Materials

Fabric Construction

Weaving Computational Materials

Two of the projects used computational materials in the fabric structures to increase the expressive abilities of these surfaces. In the Panic Run, designers speculated on shape-changing fibers which will gradually change the fittingness of the coat. In Cable Bag, the cables are weaved together with wool. Although the designer expressed the difficulty of weaving cables in both of her presentations, she mentioned the aesthetic which is formed by dangling cables. She also expressed that methods can be developed for weaving cables easier. These projects let us to observe that when computational materials are blended into fabric construction techniques, new visual styles which are both dynamic and static can be created.

Creating Non-woven Computational Composites

The design process of Water Drop Bracelet suggested that experimenting with computational materials can inspire the creation of interactive fabric surfaces with non-computational materials. The designer of this project, explored a composition which is a recreation of a painting of Henry Cross with LEDs, pins and paints. She speculated that this artwork will react to the position and the sound of the viewer by lighting parts of the composition. In the second part of the workshop, by being inspired from the possibility of this causality on garments, she searched for a new material which will not emit light but refract it when the light casted from the behind. The aftermost result she came up with was placing superabsorbent polymers, which are swollen, when contacted water, into a bubble wrap. By placing LEDs on the bottom layer of this composition, she achieved a new computational composite that has interactivity on two levels: A material that interacts with rain (water absorbent polymers) and the environmental sound (microphones and LEDs casting from behind).

Surface Treatment

Dynamic surface treatments with computational materials

While the static effect of light sources on the fabrics (reported under *physical form*) created a visual shift on the fabric surfaces, providing similar effect such as dyeing or printing; the computable nature of these computational materials are used to create dynamic treatments and alterations in time. A good example of this was the Water Drop Bracelet that changes its patterns with light sources reacting to the environmental sound. The designers of Panic Run and Cable Bag also explored the shape changing materials to alter the pleats on the fabric, again creating dynamic alterations on the fabric surfaces.

Embellishing with computational materials

The designers experimented with computational materials for revealing how they can be used as a part of the visual form. The designers of the Panic Run stated that they will implement a retro-reflective piece and use a pico-projector to project on it. They placed the piece on to the fabric surface as embellishment and also a surface for information display. Using the retro-reflective piece in such way was similar to the *applique* technique, which is to stitch fabric pieces onto another fabric surface to deepen its appearance and traditionally used in fashion design. Also, in the Cable Bag, the designer embroidered EL wires on both the art object and the garment design phases. Moreover, the Jellyfish and the Reform Season had computational embellishments as well. While the former used jellyfish-like moving embellishments with speculated micro-robots, the latter used servo motors to control the *cutouts* for opening and closing them.

Garment Construction

Changing silhouettes of the garments by controlling the fabrics with computational materials

The computational materials are incorporated into fabrics to alter volume of the garments for altering the silhouettes. In Reflect the Night, the fabric is controlled by servo-motors, wrapping or releasing the drapes to alter the overall form of the garment from poncho to clustered state. Moreover, in the Cable Bag and Panic Run, the fabrics were controlled with shape changing materials which are loosening or expanding for creating predetermined pleats. By that way, they altered the sizes of the fashion objects while providing dynamic visual alterations.

Using hard computational materials to create structures for the garment

The designers of the Cable Bag and Bicycle Glow took advantage of hard or elastic material qualities of electronic components by incorporating them in *garment* or *fabric construction techniques* to support the three dimensional shape of the garments. The designer of Cable Bag, experimented with different usages of cables in the art object phase of the design workshop. In the second phase, she knitted the cables and EL wires with wool. While presenting her interactive accessory, she stated that including cables in the knitted structure enabled her to define a structure for the shape of the bag. Also in the Bicycle Glow, the designers used EL wires as an edge binding which supported the shape of the glove as it is firmer than the fabrics used to construct the garment.

The themes that we presented above helped us to form our arguments for the recommendations that we can extract from them. Although these themes are valuable individually, some of them complement each other. For instance, the contribution of light sources on the physical form is also related to the dynamic behaviors of treating surfaces with those materials. Thus, as a recommendation, we concluded with "Treat surfaces with light throughout its interaction with cloth". By combining the themes according to these kind of relations, we derived nine recommendations that might inspire and guide designers while forming fashionable wearable devices with computational materials. Our aim here was to present them to the experts in the field for starting conversations about the specific notions exemplified in the recommendations and get feedback on if those approaches might inform the designers or the engineers in the field for creating fashionable wearables. To prevent repetitions, we present the refined recommendations under "Design Recommendations" section.

Feedbacks from the Expert Interviews

The feedbacks from expert interviews helped us refine our findings and turn them into more inclusive recommendations that designers can readily adapt their design processes. Overall, the experts found the presented recommendations valuable and useful for designers: For instance, one participant stated *"I think it* (overall recommendations) *is extremely useful. It would improve wearable tech design, because it is a different way of looking at a new subject which has not really been disrupted enough."*

Another comment was *"…it's* (cross-pollination between fashion techniques and computational materials) *still not always on the surface of discussions about wearables and I think it should be there."* Besides those, there were some criticism and suggestions for improvements. This section presents the general feedbacks from experts, and summarizes the changes we adapted on the recommendations. However, it should be noted that we were not able to address all of the criticisms and suggestions as some of them contradicting each other and others were too out of the scope.

Extending the scopes of the implications

First of all, the recommendations were found to be focusing too much on the usage of light as a visual element on the wearables. On that subject, the experts suggested extending the scope of the recommendations by highlighting the other modalities and opportunities. They also gave examples for which should be mentioned in the specific recommendations other than using light as a visual element. Therefore, we included these highlights and opportunities in the final versions of the recommendations. Moreover, the experts highlighted the relations between the recommendations suggesting that some of the recommendations are too specific and providing a case for some other recommendations. Thus we combined the recommendations that are complementing each other to explain a broader phenomenon.

Simplifying the language

The language we used for presenting the recommendations for the experts found to be too "technical" or "academic" by the experts, especially for presenting them to the practitioners. "Modalities" and "compute" were two examples for these words the experts highlighted. Therefore, finally, we replaced these words with simpler ones.

External references

One expert specifically insisted on adding external examples for the recommendations to be more convincing. Therefore, we added additional examples that demonstrates the usage of that recommendation by the designers or the researchers in the field.

Design Recommendations

In this section, we describe the recommendations for contributing the expressions of the wearables based on the cross-pollination between computational materials and fashion design.

1- Give information through the computational augmentation of the clothing

Instead of being restricted by the qualities of fashion or computational materials on the garment, define multi-modal ways of giving information (either for the wearer herself or for the viewers) by combining the controllable nature of computational materials with aesthetics affordances of fashion materials on garments.

As mentioned in the design theme of *"Conveying information through cloth"*, Bicycle Glow and Panic Run uses cloth surface for representing the direct information while the Jellyfish and the Reform Season prefer more abstract ways (**Error! Reference source not found.**). However, all of

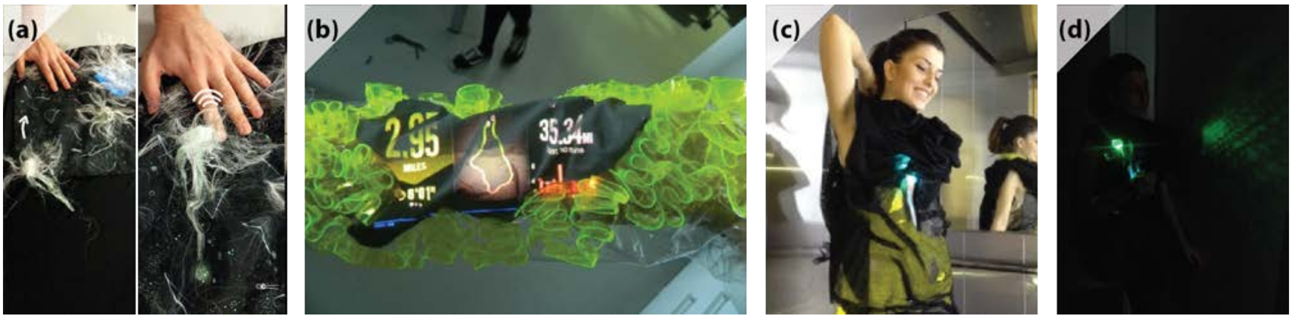

Figure 2 (a) Video sketch of the Jellyfish illustrating moving patterns towards touched area, (b) Interface of the Panic Run on the wearers arm, (c) Reflect the Night, activated LEDs via dance and music, (d) Reflect the Night, extended expression

these projects uses different qualities of fabric forms or surfaces. Our findings indicate that combining the controllable nature of the computational materials with the techniques of crafting garments creates a potential for representing both practical and expressive information by augmenting the abstract language of the garments. Therefore, instead of dictating the qualities of only computational materials or the other way around, this approach creates a new medium by decomposing the features of these two and merging them together.

Flutter (Profita et al., 2015) dress is a good example for how the integration of computational materials can augment the language of fashion materials with a purpose of conveying information. In this project, researchers aim providing navigational information for the ones with hearing loss. They integrated tiny microcontrollers, actuators and sensors into winglet like embellishments on the garment, by which they augmented these fabric pieces to vibrate and face towards the noises on the environment to aid the wearers.

Strategies for designers:

- Explore how the garments can be controlled or altered with computational materials so that wearer can understand the intended meaning in specific contexts.
- Consider the criticality of the information for defining the abstraction level of the way it is presented.

2- Define bi-directional interaction between the contexts and the garments

For defining the relationship between the interactive expressions and the contexts (that the garment are worn), examine the opportunities of both how the context can affect the expression and how the garments' expression can alter the contexts.

Garments usually define the close physical space around the body and the interactions with the clothing are limited to wearing or taking them off except for interactions such as unzipping or the fabrics' wearing off to environmental conditions. However, our results suggest that the controllable and connected nature of the computational materials enable the garments to give expressive responses to wide range of triggers that are readily available in the contexts (i.e. physiological data, environmental data, gestures), while also providing opportunities of garments affecting the contexts (i.e. surfaces around, other people).

The evidences which hints to this recommendation was mentioned in design themes of "*Contextual triggers" and "Extending the expressions of the garments to the environment"*. The Reflect the Night is a good example of this bi-directional interaction between the garment and the context that the garment is likely to be worn. In a Night-Club Context, Reflect the Night is triggered by the music and the body movements of the wearer while affecting the environment by spreading its light patterns and extending its expression towards the environment (**Error! Reference source not found.**).

As an external example for this recommendation, we can name the Butterfly Dress (Landau, 2014), which is a dress that has robotic-butterfly-like-embellishments on the top part of the dress. By using the implemented proximity sensor on the garment, the garment reacts to the approaching person by activating the butterflies to fly away from the garment. The relevance of this garment to our recommendation is how it uses a contextual trigger to extend the garment's expression (butterflies flying) to the environment.

Strategies for designers:

- Examine the specific use scenarios to find natural triggers for the interactions. Try to experience these contexts (Tomico & Wilde, 2015).
- Consider designing the impact of the garment to the environment, to wearer herself or to the other people.

3 - Control the form of the garments with computational materials

Using electronic components in traditional construction techniques to define the form of the garment can provide controlled changes in garment's overall silhouette or the patterns which can lead to altered expressions on the form of the garment.

Traditionally, clothes can be designed either in a dynamic or static way. While some dresses may fit in to body and have a very limited dynamism, others can be designed to move by external effects such as wind. Still, these changes are usually spontaneous or even if not, they have only limited amount of states. Our results suggest that by using computational materials to control the states of the traditional construction techniques, the garments gain the ability of changing their silhouettes or patterns in a more controlled way, altering their expression or creating an expression out of continuous changes on their form.

Design themes of "*Conveying information through cloth" and "Changing the silhouettes of garments by controlling the fabrics with computational materials"* led us to create this recommendation. A good example of how changes can be controlled through controlling the appearance of the fabrics via fashion production techniques is Panic Run. In this project, the designers speculated the pleats that are created with shape-changing materials. Computed pleats transform the silhouette and the patterns of the dress. Transition process is also a part of the expression as its properties such as how speed can be controlled. In that direction, the Water Drop Bracelet exemplified how continuous changes can be created on the patterns of the garment for creating dynamic expressions (Figure 3).

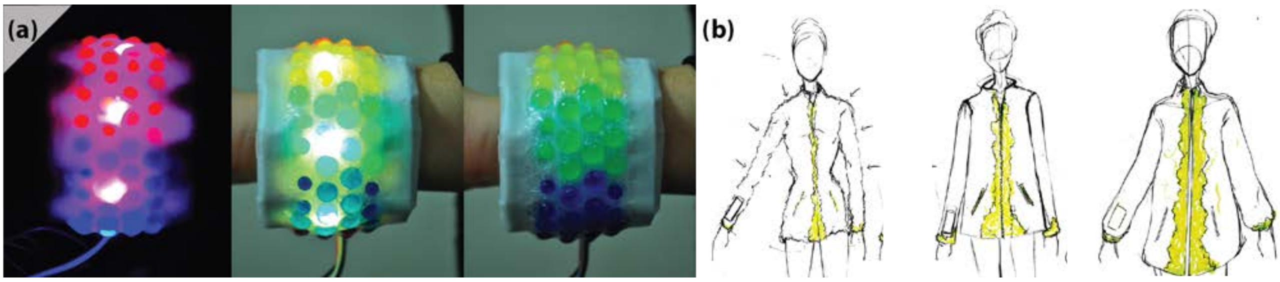

Figure 3. (a) Continuous changes in the patterns and interaction of the light in the Water Drop Bracelet, (b) Sketch of the Panic Run illustrating silhouette change through computed drapes.

Monarch (Hartman, McConnell, Kourtoukov, Predko, & Colpitts-Campbell, 2015) is another example that demonstrates how this recommendation might alter the expressions of the wearers. In this project, the shoulder pieces are augmented via a muscle sensor, micro controller and servo-motors to alter its appearance based on wearer's activation through holding shoulders up. When activated the pleats on the shoulder pieces quickly widen for creating an altered silhouette as an extension of expression of the wearer.

Strategies for designers:

- Explore the ways of controlling the silhouette of the garment via altering traditional fashion production techniques (i.e. controlling pleats, drapes)
- Keep in mind that transitions during state changes are also subject to expressions.
- Experiment with non-computed materials to see how alterations on the form might result before implementing computational materials.

4 - Treat surfaces with computational materials

The computational materials can be applied onto fabric surfaces as an alternative way for traditional surface treatment techniques (i.e. dying, printing, embellishing) by considering their static decorational effect directly by using them as embellishments or indirectly by augmenting the expressive abilities of the fabric surfaces.

In fashion design, the physical form of the fabrics can be diversified by different kinds of surface treatments techniques including print, dyeing, and embellishment. While printing and dyeing provide two dimensional alterations on the fabric surfaces, the embellishments are modification of the fabrics by manipulating the surface (i.e. cutting holes) and by stitching the pieces (i.e. threads, pieces of fabrics, beads) that adds more depth to the surface. Our results suggest that the sensory abilities of the fabrics can be augmented by exploring the dynamic or static decorational effects of the computational materials for using them as embellishments on the surfaces and by experimenting the interaction between computational materials and fashion materials.

"Light on Surface", *"Dynamic surface treatments with computational materials"* and *"Embellishing with computational materials"* are the design themes which help us to create this recommendation. In our workshop, Water Drop Bracelet (Figure 3) and Reflect the Night (Figure 4) augmented the surfaces by considering the interaction between light sources and fabric surfaces. While the former

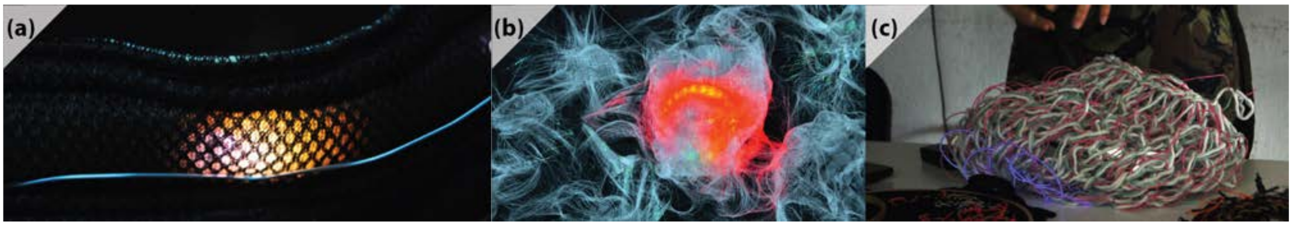

Figure 4. (a) Reflect the Night – high contrasted pattern achieved through light sources, (b) Jellyfish – jellyfish embellishments with loosened conductive fabric, (c) Cable Bag – supported shape of the bag with knitted cables.

altered the patterns of the surface by scrutinizing the relationship between light sources with semi-transparent non-woven fabrics on the top layer, the latter uses light sources to create high contrast on the patterns of the netted fabric. Another good example is Jellyfish since it speculates the construction of new computational embellishments which alters the form of the fabric with its presence as well as by moving (Figure 4).

Project Jacquard (Devendorf et al., 2016) is a good example of how the computational materials can augment the expressive abilities of the fabric surface. In this project, fibers that construct the fabric surfaces are improved with thermochromic paint and conductive fibers. By that way, they achieved visual patterns on the surface that are controllable via computation. Also, more and more electronical components are designed to provide aesthetics directly on the garments. With its flower like look, Lilypad Arduino processor board is a good example of how these computational materials can contribute aesthetics of fashionable wearables by using them directly as embellishments on the garment (Buechley, Eisenberg, Catchen, & Crockett, 2008).

Strategies for designers:

- Consider and experiment on how computational materials will interact with the fashion materials to alter their sensorial expressions.
- Experiment the decorational effect of computational composites by trying to use them as embellishments. However, this should not be considered as dropping electronic chips etc. on garment surface to pulling it towards a cyborg-like styles. What we mean here is to use electronic components by considering its contribution to the overall form of the garment (i.e. incorporating weaving technique and treating the cables as fibers).
- Think on ways of creating new computational materials (chips, sensors etc.) which can lead engineers to construct fashionable electronics.

5 - Support the three dimensional shapes of the garment via computational materials

The computational materials can be designed and used to create a structure for the fabrics to support the three dimentional shape of the garments.

In fashion design, there are ways of altering the silhouette of the body by using additional structural elements to the fabric. For example, designers use plastic and metal internal structures on the fabric. The computational materials, which have usually hard and firm bodies, creates an opportunity to use them for supporting the three dimensional shape of the garments, instead of just hiding them on the garments. Our results from our empirical study and discussions with experts highlighted that this can be achieved through improving the capabilities of the computational components like redesigning them to fit the exact needs of specific garment shapes (i.e. customizing the shape and the flexibility of the microprocessors), strengthening the fragility of these components or designing custom supports with computational supports (i.e. producing supports with 3D printing).

"*Using hard computational materials to create structures for the garment*" design theme led us to form this recommendation. Still, it expanded into different methods such as 3D printing for creating the structure after we got the feedbacks of experts. In our workshop, the example for using computational materials for supporting the shape of the fashion object was the Cable Bag. The designer of this piece, specifically mentioned that, by using cables in the fabric structure, she was able to define an elastic shape for the bag which was not normally a case in wool bags (Figure 4).

Spider Dress (Kaplan, 2015) is a very good former example of how computational materials can inspire designers to create hard structures to change the silhouettes of the dress by creating materials with computation. Spider Dress can be an extreme example and may not be seen fashionable as of now, yet it clearly exemplifies the opportunities.

Strategies for Designers

- Explore the ways of which and how the computational materials can support the fabric to create the 3d form of the dress.
- Customize and create components for computational materials to support the structure of the garments.

General Discussion & Further Work

In this study, we examined the cross-pollination between fashion design and computational materials on creation of fashionable wearables. Many previous studies explored this relation, exemplifying and reporting possible design knowledge on this field. However, our study puts forth actionable design recommendations on this subject via combining our deep analysis of the design process of seven projects with the opinions of 10 international experts in the area from different countries. This kind of systematic examination with the involvement of many different actors was not done before. By providing this broader perspective bridging two disciplines, we revealed the design knowledge and actionable directions for supporting expressive explorations in wearable design processes.

We believe that designers can benefit from the recommendations in several ways since we do not only emphasize what might be the best practices but also introduced *annotated portfolios* (Gaver, 2012), different examples, of applying them to different contexts and material combinations . We argue that, as also claimed by several different experts, different from previous work, these recommendations are useful for designers while discovering the possible outcomes of different combinations of fashion and computational materials. For instance, previous work indicated that cloth can be an abstract way of ambient display (Jacobs & Worbin, 2005). However, our results suggest that, also benefiting from the expert feedbacks, criticality of information should be considered and experimentation with the information giving property of cloth should be altered according to it. Moreover, we also present two distinct examples from our workshop such as Jellyfish and Panic Run which represents two ends abstraction and the directness in terms of giving information. We believe that other recommendations are also informative in the same, way organizing and detailing the information fragments which are present in the field.

The experts' positive feedback on design recommendations indicated that engaging hands-on material explorations led practical recommendations for fashionable wearables. They mentioned that some of the aspects proposed in the recommendations match their practices which might be used as a "reflective tool". They also highlighted that the recommendations are really valuable for educating novice designers and engineers in the field. This underlays the real value of our findings beyond this study. We can claim that by incorporating expert feedbacks, we achieved clarity and applicability of our findings (Mueller & Isbister, 2014).

Besides providing practical guidance on how to explore fashionable wearables, we believe that our results lead designers to explore theoretical notions of two disciplines in action. For instance, as also suggested by one of the experts, first two recommendations might propose new approaches for the designers and researchers to seek embodied interactions (Dourish, 2001) on the body. By crafting the materials of fashion design with computational materials, designers can create wearables which let the meanings to be formed out of the intentional augmentation of what is already "physically manifested" in daily lives - clothing (see 1st recommendation). Also, the second recommendation directs designers to take the specific actions of uses into account to define the interactions. This is supporting, but different from, the arguments Tomico & Wilde (2016) presented as our results direct the attention to exploring augmentation of fashion materials and production techniques which are usual to the users for achieving embodied interactions.

Furthermore, our recommendations reveal new exploration possibilities for the practical and the theoretical attributes of fashion (i.e. symbolic communication, constant need for change and context dependency of fashion). For instance, with the recommendations on controlling the form of the garments (see 3rd recommendation) and treating & embellishing fabric surfaces (see 4th recommendation) with computational materials, the designers are motivated to use dynamic and controllable ways of alterations on the expressions of these garments. We believe exploring these alterations might correspond the different expressive needs (i.e. sporty, business) of different people and contexts in one garment, as well augmenting self-expressions with continuous dynamic changes on the garments. Although, such alterations of the form of the garments are practically exists in many of wearable device examples, our work puts forth a detailed view on the subject by referring to the fashion techniques and terminologies and how those can incorporate the computational materials to create expressions. For instance, while previous study explored changing the overall form of a garment (Perovich, Mothersill, & Farah, 2013), our study suggests that designers can control the silhouettes of the garments via computational materials by borrowing terminology from fashion design for opening up new areas of investigations. Also, it broadens the previous knowledge by emphasizing that the transitions between these changing states are a concern of design or the interaction between cloths should be considered (see 3rd recommendation). Moreover, proposing that the computational components can both have a sensorial effect on the aesthetic design of the garment with its physical presence (see 4th recommendation) or they can support the shapes of the garment (see 5th recommendation) provides a new perspective on these functional components that are not usually neutralized or hidden in the garments. By highlighting the importance of adapting them into the sensorial composition on garments with their physical presence, we do not direct designers to create a critical wearables where showing these materials motivated by ethical reasons (Ryan, 2009). Instead, we point to a direction where these materials can blend and contribute to the expressions on the garments, by describing the examples.

Still, further studies following this up can expand our recommendations. For instance, as one expert commented on "treating and embellishing fabrics with computational materials", such treatment methods achieved through detachable computational materials might create more sustainable practices for wearables. Explorations on how the fabrics can incorporate computational materials to create recyclable material combinations can lead more sustainable practices in wearable designs. Moreover, although we provided wide range of materials which are used in wearable device design. We believe that with a wider range of materials, the scope of the outcomes can be extended. By considering those points, we intend to do more research through material explorations to reveal more knowledge on the contribution of fashion design to the wearables. Additionally, we want to realize the contribution of our recommendations by presenting them to the designers asking them to design wearables considering our recommendations.

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14. Side Publications for Research Training

14.1. Paper 9: DubTouch: exploring human to human touch interaction for gaming in double sided displays

Co-Authors: Oğuzhan Özcan (Advisor).

Conference: In Proceedings of the 8th Nordic Conference on Human-Computer Interaction [h5-index: 19]

Role: Main Co-Author, Design Researcher

Year: 2018

Type: Full Paper

DubTouch: Exploring Human to Human Touch Interaction for Gaming in Double Sided Displays

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ABSTRACT

Human to human touch interaction (social touch) has not been investigated thoroughly as a control apparatus for gaming purposes although it holds potential. Therefore, we have developed the concept of DubTouch which is an interactive environment comprised of double sided display and touch areas where two players can touch each other. To investigate its potential, we conducted two step research method comprised of a *user study* and a *design workshop*. As a result of the user study with 10 participants, 6 categories of social touch patterns are generated. Two of these categories, found both intuitive and exclusive to DubTouch according to our evaluations. *Design Workshop,* with 10 experts, concluded with two games. The properties of control schemes of these games match with the results of the user study. Moreover, our observations showed that both games have created uncommon gaming experiences by utilizing social touch and by benefiting face to face positions of players.

Author Keywords

Game; social touch; human to human interaction; double sided display; gaming; social; exertion games; exergames; touch patterns; gestures; tangible interaction.

ACM Classification Keywords

H.5.2 Evaluation/methodology - *Input devices and strategies - Interaction styles*

INTRODUCTION

The general concept of a double sided display is already provided with two computers connected to a network. This kind of structure lets players manipulate or control the content in their own screens separately, but we believe that an interactive environment with a double sided display is more meaningful if the players can physically interact with each other especially while playing games. In that sense, physical interaction may mostly occur with human to human touch (social touch). Differing from the sense of touch which is obtained by everyday objects, social touch refers to touch interaction between people [14].

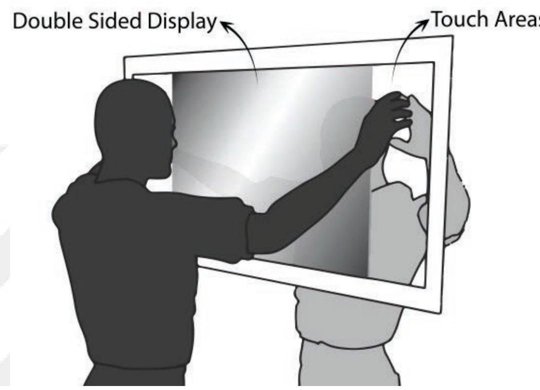

Figure 1: Concept of DubTouch

Utilization of *social touch* in digital gaming holds the potential to create new opportunities for innovations in gaming area. The use of social touch may let us design games which involves other humans and their body parts as control devices. The way two people *touch* each other shows great diversity and it is possible to create patterns according to the shape, intensity and the position of the touch. The different kinds of touches are actually considered specific symbols and they raise similar feelings and reactions in the bearer of touch as well as the receiver of the touch [11]. This fact indicates that it is possible to design games enhancing social interaction which can be played via social touch.

Therefore, we have developed an interactive environment concept called DubTouch (Figure 1) which two players can touch each other while playing digital games. In this respect we expect DubTouch, if it is successfully built, to create new gaming experiences with social touch and face to face positions of players emanated by double sided display and create a new control style based on social touch.

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http://dx.doi.org/10.1145/2639189.2639234

To support this hypothesis, we have conducted a *two-step research method.* In the first step we ran *a user study* with 10 participants. In the second step, we organized *a design workshop with 2 game designers, 2 developers, 2 illustrators, 2 modelers and 2 interaction designers.* In this paper, we discuss the results to provide insights about the capability of DubTouch interactive environment to be used in the gaming area.

BACKGROUND AND RELATED WORK

Human to human interaction has been the subject of research in the digital gaming field. Although online or co-op games provide interpersonal interactions, gaming experience in the social context is not prosperous enough to be compared with face to face interaction of traditional games [17]. Several research projects named as *Fish Pong* [24], *Human Pacman* [5], *Touch Space* [6], *Pirates!* [2], *Propinquity* [22], *Pass the Bomb* [19], *i-dentity* [8], *JS Joust* [23] take human to human interaction to their base. The aims of the games in these studies are to blend the virtual environments to real life by creating social interactions between people which resemble the real life interactions. These studies are mostly built on the principle of spatial awareness of players differing from the online gaming by letting players to see and feel each other while playing. According to these studies, this type of interaction has the potential to enhance the gaming experience by adding social interaction opportunities. Nevertheless, all these games in the indicated researches have no or little use of *touch sense and tangible feeling* of players. The sense *of touch and its social properties* are not studied thoroughly in these works.

Touch as a *social interaction device* is a phenomenon. Social touch may be considered as a supportive communication device between people since it can be categorized due to its properties. Symbolic meanings of touch have been categorized under six different properties: *positive affection, control, playful, ritualistic, task related and accidental touches*[11]. Another categorization for social touch gathers the types of touches under three categories which are simple, protracted and dynamic. If a touch is limited to specific parts of the body like hand or arm, it is called *"simple touch"*. The other type, *"protracted touch",* refers to skin to skin contact involving pressure which is available for a longer time. The third type is the *"dynamic type"* which is continuous and mostly iterative such as stroking [14]. These types and categories show that different meanings or commands can be assigned to touch since it bears different patterns and meanings in itself. Several studies have made use of these kind of meanings [4,14,18,21] yet these meanings have not been considered as an input device which can be used in games.

Some studies examine *social touch as a digital interaction device*. *Freqtric Drums* provides audial feedback when the users touch each other to provide a musical interface [1]. *Enhanced Touch*, proposes an electronic bracelet which gives feedback when users touch each other and keeps track of touch patterns [15]. Another study, *Touching a Stranger,* provides audial feedback and visual feedback in results of touches to the different part of users' bodies [12]. Furthermore, *Musical Embrace* [13] is a game in which two players embrace a pillow-like controller and each other at the same time to control the game character. However, none of these studies investigate *social touch* as a detailed game control mechanism to which complex commands can be assigned.

Overall the information provided here indicates that *social touch* has not been explored thoroughly although it could be a valuable source for digital gaming. It could enlarge the possibilities of new game mechanics and at the same time create opportunities for social interaction which is lacking in computer gaming. Moreover, as seen in the studies about social touch, different touch patterns may carry different meanings which strengthens the possibility of social touch to be used as a control device.

Depending on these analyses, we designed the interactive environment, DubTouch, to try to fill specified gaps.

METHOD

We conducted a two-step research method to explore the potential of DubTouch. These steps are:

- *User Study* to understand users' expectations and impulses on social touch based control system
- *Design Workshop* to design games using social touch as a control scheme benefiting from the results of user studies

Our aim by conducting this study was to understand (1) if users can intuitively find touch patterns for commands, (2) if the proposed touch patterns have an exclusive value, (3) if these control commands can be categorized, (4) if games can be developed according to user expectations, (5) if designed games for DubTouch have potential to provide an added value for digital gaming.

Touch Patterns are defined as the characteristics of the social touches depending on the movement area and posture of the hand, touch style, one or two hand usage and collaboration of users.

User Study

In this first step, we conducted practices with users individually to elicit ideas from their suggestions and understand their expectations about the DubTouch environment. We used an experience prototype of DubTouch to conduct these user studies. Obtaining ideas from users and include them in the design process has also been used before in previous research[16].

Participants of User Study

In this step, we gathered 10 users (6 females, 4 males, Age Ave: 22; *sd* = 0,18). Half of the users play games actively in their daily life while the other half does not play often and mostly prefer casual/mobile games. We preferred this kind of difference since we wanted to explore alternative reactions by different user types to explore the furthest possibilities.

The Experience Prototype of 'DubTouch'

Experience Prototype (Figure 2) means a representation of the product which is used for understanding the possible experience while interacting with it. Experience prototypes are suitable for understanding the user and exploring new ideas with them [3]. This prototype benefits us as we wanted users to be involved with the study from the very beginning. Our reason for using an experience prototype before implementing the working prototype is (1) to not restrict users with technological constraints during the conceptual development phase, (2) to explore distinctive ideas and reach the extreme alternatives, (3) to clearly understand user needs and expectations.

The conceptual setting of "Dub Touch" was designed as a double sided display which enables an interactive environment which Two Users can touch each other through touch areas. In the experience prototype, we used 100x70cm transparent acrylic sheet and two touch areas, cut out from cardboard, in both sides which were spared for users to touch each other. Both of these areas' dimensions are 24x53 cm. One of the touch areas also was covered with an elastic material which let players feel each other but restrict their movements. The other one is not covered and left empty allowing users to move their hands freely. We also wanted to understand if the users prefer a restricted or an unrestricted area to touch the other player. Other than that, the acrylic sheet used was transparent since we wanted to communicate with users during the user studies. In the design workshop, designers were allowed to modify the screen by attaching opaque paper to the acrylic sheet which prevents players seeing each other.

Phases of the User Study

Each sessions of the User Study were operated with only one user. User Study sessions were constructed from 4 phases which are *"Rigid Object", "Amorphous Object", "Emotional Recalling" and "The Game"* (Figure 3). In sessions, the designer was in the role of the 2nd user as well as the moderator. The participant was in the role of 1st user. In each session, the designer controlled the objects, which were assumed as the digital content, to help the user visualize the effects of their interactions with the 2nd user by social touch. Other than that, in the phases where we could not simulate the setting by using existing probes, the designer helped users to visualize the scenes by explaining the properties of the content in the screen. In sessions, we asked users to design touch patterns for specific commands. For example, we wanted users to define a touch pattern for "rotating the rigid object".

Figure 2: Experience Prototype of DubTouch

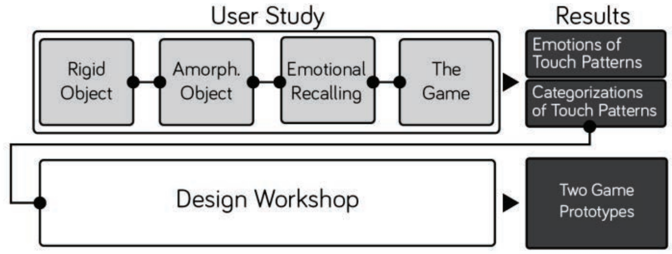

Figure 3: Structure of Research Method

Each participant was asked to conduct 27 tasks, which will be explained along with the phases in the paper, and they suggested between 27 to 35 patterns. The total number of the patterns designed for control commands is 340. However, this number does not reflect the unique number of patterns since some of them are the same or very similar.

Phase1: Rigid Object

The Rigid Object phase provided an insight about the capabilities of social touch interaction in controlling a rigid object by manipulating its basic transformation values. As an object, we used a *cardboard cube* (Figure 4/a) and we tested the commands *rotate, translate, scale, explode, smash, standing on a corner and morph.* The first three commands are the most used actions in games as the characters in most games perform three fundamental actions which can be counted as moving *forward, backward and sideways, turning and looking*. The other commands let us to understand the capability of touch patterns to provide control possibilities for actions falling outside range of the generic commands. Apart from the remarked commands we also asked users to propose an

Phase2: Amorphous Object

Since touching by the human hand can provide more organic interaction compared to using a game pad or keyboard, social touch may be appropriate for manipulating and controlling an amorphous object. To see the outcomes of the control commands for amorphous objects, we have used an *elastic fabric* which was fixed to two cardboard pieces (Figure 4/b). Our aim was to make users illustrate the movements of an amorphous object easily in their minds. In this session we asked users to design patterns for *expand, roll, twist and deform*.

Phase3: Emotional Recalling

Although the definition of game does not necessarily include the narrative, most of the digital games today adopt narrative as an important element. Narrative property of games evokes different kinds of emotional reactions in the user by using cinematographic representations. Moreover, according to Fagerberg et al., active loop concept iscons if a game reacts to the player, in the same direction with his/her emotional expressions, this will effect player's body and mind emotionally too [7]. Other than that, most touch is actually considered as specific symbols and they evoke similar feelings and reactions in the bearers of touch as well as the receivers of touch [14] which creates a potential for creating touch patterns which are capable of conveying recognizable emotions. Therefore, in this phase, we will explore if the touch patterns are available for conveying emotions and interpret whether they have the potential to be used in games with narrative. We refer emotions which are reflected through narrative experiences.

The Emotional Recalling phase has two stages. In the first stage we wanted users to name the emotions they felt when 2nd user touched their hands by using pre-defined touch patterns (Figure 5). We defined these patterns according to the categorization which gathers the type of touches under three categories: *simple, procreated and dynamic* [11]. We made every pattern should fit in these categories and be distinctive from each other to be recognized easily.

In the second stage, we wanted users to define touch patterns for specific emotions. The most recognizable emotions by humans are happiness, sadness, fear, anger and

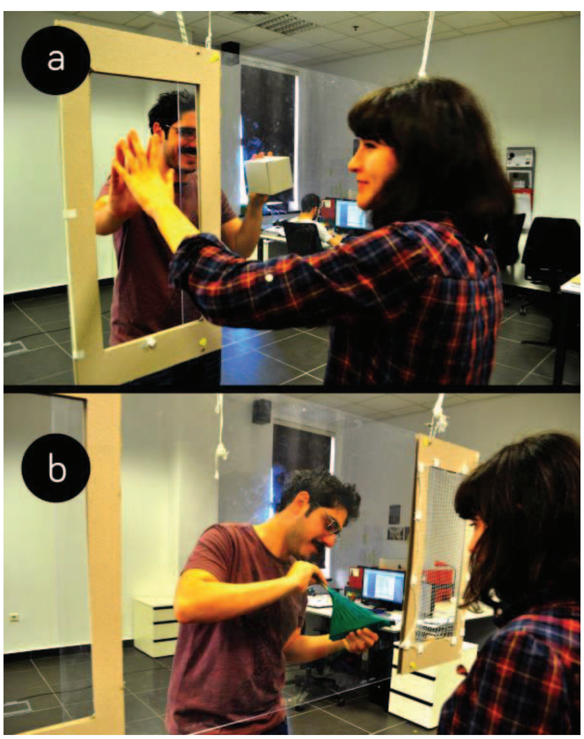

Figure 4: User Study: (a) Cardboard Cube (b) Elastic Cloth

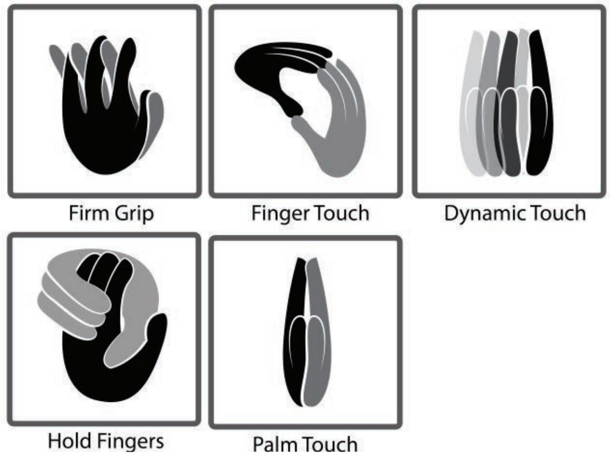

Figure 5: Pre-defined touch patterns which are used in Emotional Recalling Phase

surprise [25]. In the direction of this information, we decided to ask users the emotions of *joy, love, melancholy, fear and thrill* considering that these are also the most emphasized emotions in game narratives.

Phase4: The Game

The last phase of the session is a two leveled game which creates space for users to test the patterns they designed. *The first level* of the game consists of a rigid object and an amorphous object. The aim of the level is to put the rigid object to the hole which is placed to the top right corner of the display. This hole is also covered with wood pieces and these pieces should also be destroyed. However, the player is not able to carry the rigid object to the hole since it is quite heavy to carry. The user needs to make use of the amorphous object like a trampoline for throwing the rigid object in the hole.

The second level of the game tests if the patterns produced in the *Emotional Recalling* phase can be used in meaningful actions. In this step, we imagined a scene where colorful cubes are tumbling around a complete black background. We wanted user to imagine this scene as if it is a cut scene in a game and to integrate emotions which would affect the narrative of the scene by using the touch patterns.

These two levels are conducted in a role playing format. The designer explained the scenes to the users to help them create these scenes in their imaginary worlds. The artifacts, rigid object and amorphous objects, were also used when they are needed.

The user study resulted with 6 different categories generated according to the characteristics of touch patterns proposed by users. The outcomes of the user study were used in "Design Workshop" by experts.

Design Workshop

The second step of our research method is the *Design Workshop.* In this step, experts benefited from the results of the user studies to design games for DubTouch. The aim of the workshop was to understand if games which have added value and meet with the user expectations can be designed.

Participants of Workshop

2 sound designers, 2 programmers, 2 illustrators, 2 modelers and 2 interaction designers participated to workshop. These participants were divided into two teams. Each team had at least one participant from each expertise area. In each group there were 3 participants who are actively involved in game development.

Procedure of Workshop

At the beginning of the workshop, a presentation about the "design thinking" approach was presented to participants. Moreover, booklets which explain the results of user studies were given to participants to make them aware of user needs and expectations.

The experience prototype of DubTouch was also supported with pico-projectors allowing participants to project visuals to both sides of the screen. However, they had to simulate the touch commands with "The Wizard of Oz" method. In this method, two group members controlled the games from the computers while the players try to accomplish tasks by touching each other.

The workshop ran continuously for 48-hours like game jams. First 12 hour of the workshop was spent on the sketches about game mechanics and concepts. Participants actively used the experience prototype while sketching about games. After teams decided their game concepts, they spent the rest of their times to the development of the games. At the end of workshop we have obtained working prototypes of the games.

Two games were created at the end of the workshop, called *"d-Coder"* and *"Worm Hole"*.

RESULTS AND DISCUSSION

In user studies, as a result of *Rigid Object (Phase 1), Amorphous Object (Phase 2)* and *The Game (Phase 4)*, we have come up with *categorizations* of *social touch patterns* which can be used in gaming area. We have evaluated each

Figure 6: Design Workshop

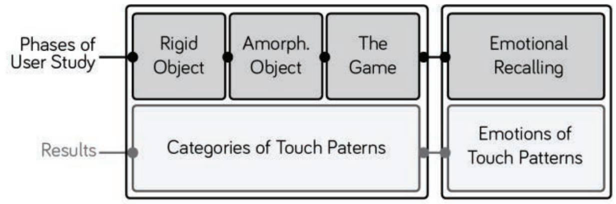

Figure 7: Relation of User Study with Results

of these categories in the means of 'exclusive value' and 'intuitiveness'. Moreover, we also have results of *Emotional Recalling (Phase 3)* which indicate that the touch patterns may convey same messages or feelings for different users.

The Exclusive Value of patterns was evaluated by reviewing their different characteristics from the command languages of the existing environments like gesture controlled interactive systems and touch screens. We have considered patterns *exclusive* if their replication in the existing environment was not likely to create the same experience.

Intuitiveness is the respond time of the user to a specific feedback. The shorter the respond time, the more intuitive the feedback is [9]. In our research, we did not take account the time passed since the users were in the design process and were encouraged to think about the patterns while proposing them. Users created several different touch patterns for some commands. Our *intuitiveness* definition only includes the *first proposals* of the users.

Categories of Touch Patterns

To identify *touch patterns*, we took video records of each user and noted every touch pattern proposed by users. We analyzed touch patterns by observing from the videos and group those under six categories according to their distinctions. These distinctions are explained below:

1. **Direct Manipulation:** Direct Manipulation refers to actions which aim to control the content directly by manipulsating its physical properties. Although, our environment does not let player to touch the object directly over the screen, the patterns which are transferred directly from the touch screen interaction, which mostly depends on direct manipulation, falls under this category.
2. **Two Hand:** If the touch pattern requires the use of both hands, it falls under *Two Hand* category.
3. **Hand Posture:** This category represents the patterns which the user makes use of the different kinds of touch postures. For example, usage of a *firm grip* or a *fist* belong this category.
4. **Two Users:** Patterns which are composed of the different or synced actions of Two Users were put under the category of Two users. In general, it may be expected that the nature of the DubTouch will force

users to design patterns in a way that include both of the users in the action. However, some patterns are proposed as if they are conducted without the contribution of the second user. Therefore, the patterns which is involves both users effectively are put under this category.

5. **Physical Impact:** The Physical Impact category indicates the patterns which depend on the force applied by users to each other. For example, strongly pushing to each other's hands with a force.
6. **3D Space:** Some actions led users to make use of the 3D Space in the touch areas. Users mostly prefer this kind of movement if the related action requires movement or presence in 3 dimensional space.

Category	Total Number	Intuitive Patterns	Evaluation out of 10
Direct Manipulation	88	73	10
Two Hand	34	25	4
Hand Posture	65	56	9
Two Users	88	69	10
3D Space	26	24	3
Physical Impact	38	33	4
Total	**340**	**280**	

Table 1: Total and Intuitive Pattern Amount

We have evaluated these categories in the means of intuitiveness and exclusive value. *Intuitiveness* measurements guide us in the user's expectations and impulses about human to human touch interaction in a digital interactive environment. **Table 1** shows number of the intuitive touch patterns falls under each category. *Direct Manipulation, Hand Posture* and *Two Users* are the categories under which "intuitive" patterns are clustered. The evaluation out of 10 is done according to the category which has the highest number of intuitive patterns. We set the grade 10 for "Direct Manipulation" and rated the others proportionally.

It is not surprising that *Direct Manipulation* is among one of the most intuitive categories since it has become a standard for interacting with 2D objects [20]. However, *Two Users* and *Hand Posture* categories bear more importance since the structural nature of DubTouch proposes an interaction which focuses on hands and collaborative usage. Thus, these results indicate that the DubTouch environment can be used intuitively by users in the way we illustrate.

Table 2 presents the number of patterns with *Exclusive Value* under each category. The evaluation out of 10 is calculated according to the ratio of patterns with exclusive value to the total amount of patterns distributed under the same category. According to the evaluation, patterns falling under the *Physical Impact, Two Users and Hand Posture* categories are mostly original patterns which are not encountered in existing game control languages.

Category	Patterns with Exclusive Value	Evaluation out of 10
Direct Manipulation	14	3
Two Hand	6	3
Hand Posture	39	8
Two Users	51	8
3D Space	8	4
Physical Impact	30	10

Table 2: Exclusive Value of Touch Patterns

Two Users and Hand Posture have exclusive value, since in gaming field face to face positioning and use of hand postures are not common. Another category having high exclusive value is Physical Impact. Although it is not valued as intuitive in our research, commands requiring physical force such as "explosion" and "smash" are mostly responded with patterns under the *Physical Impact* category. The *Two Hand, Direct Manipulation* and *3D Space* are expected as non-exclusive categories since WIMP, gestural interfaces and touch interfaces include the control styles matching the characteristics of the touch patterns of these categories.

According to our evaluations, these results support our conceptual environment since the structural nature of the DubTouch requires the collaboration of *Two Users* and utilization of *hand postures*. Therefore, we propose that touch patterns which falls under these two categories will work better for the DubTouch games. In addition, all users designed patterns falling under the *Physical Impact* category for the "explosion" and "smash" commands. Thus, this study needs to be expanded by investigating touch patterns for other commands commonly used in the gaming field. Moreover, low grades of the *Two Hand* category in intuitiveness measures may be the hint for using hybrid control mechanisms. Since one hand of the users is not usually used, the social touch control mechanism may be combined with gestural or touch interfaces.

Some of the touch pattern categories like *Direct Manipulation, 3D Space* and *Two Hand* express similar properties with the mid-air [10] and 2D gestures used in games. However, this study is based on the investigation of the touch patterns which can occur as a result of hand to hand touch of two people. These 3 categories were not the aimed results of this study being opposite to categories of *Hand Posture, Two Users* and *Physical Impact* which have high grades in the aspect of exclusive value. Therefore, these categories combine novel control mechanisms which cannot be encountered on previous platforms using mid-air, 2D gestures and tangible interfaces including kinesthetic and haptic feedback.

Emotions of Touch Patterns

The Emotional Recalling Phase is a two-staged phase. As a first stage, we touched the user's hand with previously designed patterns (Figure 5) and wanted the user to express the feelings or messages received. In the second stage, we wanted users to design touch patterns for specific feelings: *joy, love, melancholy and thrill.*

Table 3 gives the number of users who ascribe the written feelings to the predefined touch patterns. For example, two users relate the feeling of "commitment" with the "firm grip" pattern.

Pre-Defined Touch Patterns	Emotions, Meanings and Feelings			
Firm Grip	Commitment *(2 User)*	Intimacy *(3 User)*	Merger *(3 User)*	
Hold Fingers	Help *(2 User)*			
Finger Touch	Exploration *(3 User)*	Transfer *(2 User)*	Distant *(2 User)*	Neutral *(2 User)*
Palm Touch	Collaboration *(5 User)*			
Dynamic Touch	Warning *(8 User)*	Confusion *(2 User)*	Collaboration *(5 User)*	

Table 3: Number of users who expressed indicated emotions for pre-defined touch patterns. Only the emotions expressed more than one user are counted.

According to the results, the users expressed mutual feelings in some of the touch patterns. Although it is clear that they did not share same feeling on one pattern, especially in some patterns like "Dynamic Touch" and "Palm Touch", a higher number of participants expressed mutual feelings. Other than that, commitment, intimacy and merger are related feelings all expressed in the context of a firm grip. The other patterns, *Hold Fingers* and *Finger Touch* do not express a strong agreement although some of the feelings are expressed by more than one user. Nevertheless, touch patterns may carry similar messages or emotions for users if they are designed correctly. Our results are also supported by the previous research about social touch which claims that similar touches convey similar meanings for people [11].

The second step of this phase was to propose patterns for specific feelings which are *joy, melancholy, love, tension and fear.* As seen in *melancholy*, *love*, *tension* and *fear,* the ratio of users who proposes similar patterns have higher numbers (Table 4). If the emotions have a strong connection with touches, similar touch patterns are likely to be proposed for these.

Emotions	Proposed Touch Patterns			
Happiness	Grip and Shake *(2 User)*	High Five *(2 User)*	Giggle *(3 User)*	Caress *(3 User)*
Melancholy	Move Downwards *(6 User)*	Close Fingers *(3 User)*		
Love	Firm Grip *(8 User)*	Caress Gently *(2 User)*		
Tension	Shake *(4 User)*	Dynamic Touch *(2 User)*	Hold Tight *(2 User)*	
Fear	Intense Shake *(3 User)*	Sudden Touch *(3 User)*	Spontane ous Grip *(2 User)*	

Table 4: Number of users who defined indicated touch patterns for specified emotions. Only the patterns proposed more than one user are counted

This phase shows that specific touch patterns may carry similar meanings or raise similar feelings for different users. Clearly, it is not possible to generalize this statement to all kinds of touch patterns. Therefore further study for filtering specific patterns which convey the same feelings to most users need be conducted. We believe that this filtration will benefit us to implement touch patterns to the narrative quality of the games.

Two Games of 48-Hour Workshop

Our 48-hour workshop has resulted with two game prototypes named as *d-Coder* and *Worm Hole.*

d-Coder (Figure 8)

"d-Coder" is a game which combines the properties of a table-top card game and a digital game. In the game, two players have different roles as the *messenger* and the *cracker.* The aim of the game is to progress with the *cracker* cracking the codes via the help of the hints from the *messenger*. The nature of the game is both collaborative and competitive as the code should be solved by the contribution of both players while any mistake will cause loss of points for the mistaken player.

"d-Coder" was designed as a table-top card game at the beginning. Therefore, the digital feedback turned out to be make-up for the game rather than a functional element as it is added later. However, the game mechanics hold potential for richer interaction if the double-sided display takes the place of the cards by producing more explorative puzzles by using the computational power which will exist in working prototype. Designers of d-Coder also added some commands which can be considered as embodied interaction like step dancing. Therefore, while designing games for DubTouch, touch patterns including full body interaction may be included in control schemes. Nevertheless, this should be justified with further user studies.

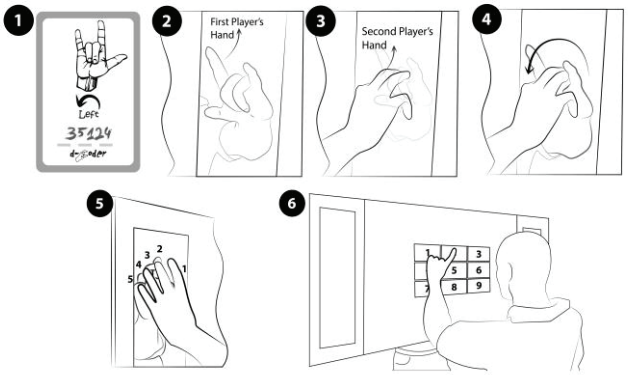

Figure 8: d-Coder Rules; (1) Take a Card (2) First player shapes his/her hand as on the card (3) Second player makes a complementary gesture (4) Second player tries to guess which direction to turn (5) Messenger gives the code with fingers every one of which has a number assigned (6) Second player tries to crack the given code by touching the screen

Worm Hole

The second game, "Worm Hole", was also designed with card game properties at the beginning. However, different from the d-Coder, Worm Hole is meant to be played at a fast pace which is not possible as a conventional card game. Therefore, the properties of the double-sided display were used in a more functional way compared to d-Coder. In Worm Hole, both players see some objects which carry different meanings in their screens. Each object can be destroyed with a touch pattern which can be only formed with the contribution of two players. Gestures have a key & lock relationship and each should be responded with the right complementary gesture by the opposite player. As a result, each player needs to do the right gesture for their own object and at the same time pay attention to the other player's gesture to provide the complementary gesture. In worm hole, except for the rules which are dependent on the digital content, there is also a rule which restricts "speaking". Therefore, all the messages should be transmitted by touching or signing to other player with hands. These kinds of meta game interactions enrich the digital gaming experience since they propose game mechanics about bodily interactions as in party games.

Worm Hole also creates physical interaction mechanics with the touch patterns it uses. There are four touch patterns in the game which match with four objects. Figure 9 lists the touch patterns and the related objects. The touch

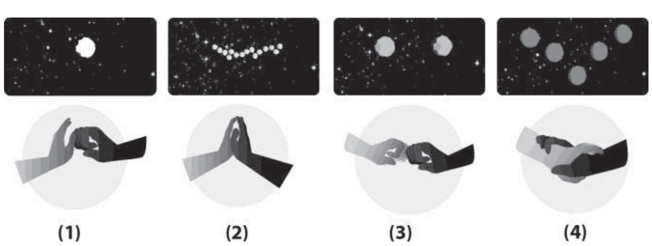

Figure 9: Four types of touch patterns in Worm Hole: (1) Power (2) Collaboration (3) Togetherness (4) Energy

pattern, called *Energy*, requires both players to hold their hands firmly along for 2 seconds which mandatorily makes players miss some tasks. This action restricts them to do another action not mentally but physically. They cannot do any other move not because they will lose points, but because they are literally unable to do it.

Discussion for Games

In our workshop, our main aim was to understand if games propose an added value for gaming field and if command languages of DubTouch games match with the results of user studies. Our criteria for added value are (1) emergence of a control language which is not seen in existing platforms, (2) proposal of a game style which differs from existing, (3) hints and, if possible, guidelines for visual presentations and (4) audial presentations of games in DubTouch.

We observed that emergence of *new control languages (1) are possible* since both games have made use of the categories of *Hand Posture, Physical Impact, Two users and Two Hand* which have higher exclusive value. Moreover, if these touch patterns are replaced with keystrokes, they would not carry the same experience. For example, an explosion can also be activated just by a keystroke, however; touch patterns in the category of *Physical Impact* mentally fit to an explosion action which also create more joyful experience for the players.

The design workshop also showed that properties of double sided display and use of social touch patterns propose game styles which differ from previous research (2). Before anything else, social touch patterns require two players to act together and physically interact with each other by *holding hands.* This condition adds physical rules and mechanics to the digital games. For example, some tasks can be achieved only if players hold their hands for several seconds. Different from conventional control devices, these kinds of rules restrict users physically rather than mentally.

Other than that, the double sided display creates face to face positions which two players cannot see or partially see each other. These positions cause game mechanics to occur dependent on the physical positions and physical interactions of the players. For instance, when players do not see each other they cannot communicate with facial expressions which load important tasks to hands and hand gestures. Besides, designers come up with ideas like adding "boosts" to games which enable players to see each other as a reward. One of the groups expressed that this would increase the social interaction. Moreover, the double sided display also encouraged designers to assign different roles to the players. These different roles can be observed in both games. Therefore, games designed for DubTouch may also propose different mechanics for the players in the opposite sides of the display.

Another aim of the workshop was to observe if the games for DubTouch reflect different representations in the *visual* *language* of the game (3). We observed that neither of the groups produced remarkable hints or guidelines for visual elements. Although the visual elements are partially related to the touch patterns, they do not have properties which can be considered unique to DubTouch. The participants of the workshop also agreed that the visual representations are not different from the existing visual languages of games. They expressed that, not enough time was spared for this aspect since they spent most of the time to explore the social touch concept and DubTouch environment.

In *audial representations* we succeeded to detect some hints which differ from the audio properties of existing systems. Our findings are (1) a requirement for supporting the process of finding the right touch pattern which is a continuous and an ambiguous act with *continuous audio feedback,* (2) assigning audio feedback only to major changes in the game world instead of every command as it is in existing systems, (3) using spatial audio effects to help players concentrate on the game. Moreover, sound designers also proposed applications like letting players activate some perks or boosts by using voice input or integrating audio sources with players' bodies.

The touch patterns of the d-Coder and Worm Hole did not differ from the users' impulses according to the results of our user studies. The command schemes for the games match categories which are intuitive and exclusive. However, both games also made use of the *Two Hand* category. We believe that this difference originated from the sophisticated command scheme of the games requiring more than one steps which can be realized only with two hands opposite to the single step commands in user study. Other than this confliction, participants did not propose any interaction in the emotional context opposite to what is expected. Although a game concept dependent on the happiness and anger of the players was produced during the design process, this idea was left in the further parts of the workshop. We still think that this emotional aspect of the touch patterns should be investigated more in further studies with workshops focusing on the narrative part of the games rather than the mechanics.

In addition, we also had some feedback on the ergonomic use of the DubTouch. The width of the screen is found surplus by participants that they needed to open their arms too wide which resulted in a position too close to the display. They proposed a decrease in the width of the screen. Participants also expressed that the touch areas are not wide enough and they proposed to remove them completely. However, they also expressed that it is better to define the touch areas, yet this should not be done in a way which creates physical restrictions.

As a result of our workshop, we have seen that it is possible to design games for the DubTouch environment which meet with the user expectations. Moreover, these two prototypes showed that DubTouch games hold potential to create new gaming experiences since face to face positions of people and social properties of games proposes uncommon interaction possibilities.

CONCLUSION

We began this study believing that the DubTouch environment has a potential to create new gaming experiences with social touch and face to face positions of players emanated by double sided display and create a new control style based on *social touch*. To support this idea, we used the process of two-step research method comprised of a *user study* and *a design workshop.* As a result of our user studies we produced 340 touch patterns with users categorized under the 6 categories named as *Direct Manipulation, Two Hands, Hand Posture, Physical Impact, Two Users, and 3D Space* and we have found that *Two Users and Hand Posture* categories are both *intuitive and exclusive to* DubTouch. Therefore, we believe that the games designed for DubTouch should include touch patterns falling under these two categories primarily. Other than that, we found that identical touch patterns recall similar meanings and emotions for different users. Therefore, this finding will help further studies to understand the emotional reflections of social touch on game narrative.

In *Design Workshop* experts benefit the outcomes of the User Study. At the end of the workshop, two games called *d-Coder* and *Worm Hole* was designed and implemented to be experienced with the experience prototype of DubTouch. We observed that the control schemes (used touch patterns) of both games match with the results of the user studies. Moreover, collaborative game styles differing from existing research emerged due to the face to face positions of players originated by use of double sided display and control schemes based on social touch. These outcomes show that the DubTouch environment will satisfy our expectations about creating new gaming experiences and proposing a new control style.

As the gaming field prospers in the way that involves the full body interaction, collaborative game play of that kind may be expected to utilize *social touch* of the players. Therefore, we believe that the outcomes of this study can be considered as guidelines for the future game developers of exertion games and games based on collaboration and full-body interaction. Moreover, DubTouch environment can be a platform which the *social touch* in gaming context can be investigated in the aspect of sociology and psychology as it has an important part in child development and relationships.

The result of early study in this project encouraged us taking this study further by improving especially ergonomic form of DubTouch, focusing on the visual representations of games, filtering the touch patterns to obtain standardizations of control commands and conduct conceptual development for the emotional aspects of touch patterns.

ACKNOWLEDGEMENTS

We thank Asst. Prof. Evren Yantaç for the help in the research method design, Asst. Prof. Tilbe Göksun for the help in the evaluation of the results and Vicki Taylor for detailed proof reading. Further information about design workshop and the participants' backgrounds can be found at designlab.ku.edu.tr web site.

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14.2. Paper 10: Sensation: Measuring the Effects of a Human-to-Human Social Touch Based Controller on the Player Experience

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Conference: In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems [h5-index: 85]

Role: Concept Creator, Main Co-Author, Design Researcher, Supervisor

Year: 2016

Type: Full Paper

Sensation: Measuring the Effects of a Human-to-Human Social Touch Based Controller on the Player Experience

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ABSTRACT
We observe an increasing interest on usage of full-body interaction in games. However, human-to-human social touch interaction has not been implemented as a sophisticated gaming apparatus. To address this, we designed the Sensation, a device for detecting touch patterns between players, and introduce the game, Shape Destroy, which is a collaborative game designed to be played with social touch. To understand if usage of social touch has a meaningful contribution to the overall player experience in collaborative games we conducted a user study with 30 participants. Participants played the same game using i) the Sensation and ii) a gamepad, and completed a set of questionnaires aimed at measuring the immersion levels. As a result, the collected data and our observations indicated an increase in *general, shared, ludic* and *affective involvement* with significant differences. Thus, human-to-human touch can be considered a promising control method for collaborative physical games.

Author Keywords
Social touch; human-to-human interaction; gaming; controller; control apparatus; pervasive games; physical games; SFCS; Touché; game design; game research; embodied interaction; exertion games; exergames.

ACM Classification Keywords
H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles

INTRODUCTION
The new generation of digital games offer instinctive machine-human interaction with the use of natural user interfaces such as gestural control systems. However, human-to-human social touch, any kind of touch which occurs between people [17], as a detailed game control apparatus has not been implemented and its effects on player experience has not been investigated. This study proposes that the immersion experience felt by a user might be increased if human-to-human social touch can be implemented as a control apparatus for gaming. The proposed system could be a viable alternative for pervasive and computer augmented physical gaming.

Some of the new generation games offer various gestures with the use of either touch screens or other kinds of motion tracking methods. For example, numerous games made for both Android[5] and iOS[6] use different touching gestures and gyroscopic gestures for controlling the games. The Wii Game Console[7], introduced by Nintendo, is equipped with motion capture and a gyroscopic device, allowing players to move naturally rather than hitting buttons while playing games like baseball, tennis etc. Similarly, Sony Playstation's[8] latest controller includes a touchpad and gyroscope, as well as buttons. Moreover, Microsoft's method of involving players with full-body interaction, Kinect[9], uses camera based tracking. These sensing devices increase the players' engagement via natural movements, and through increasing the invisibility of machine-human interaction which can be provided flawlessly with human-to-human touch.

While these recent devices suggest game designers' endeavors for more instinctive interaction, human-to-human social touch (HHST) as a control mechanism has room to expand. Among these methods, social touch may take a step further and create a rich experience for collaborative or competitive co-located multiplayer games by letting players interact with each other physically. In addition, the invisibility of controls, instead of traditional machine-human interaction methods, are needed to intensify the immersion experience [4]. Immersion refers to the feeling of being absorbed and surrounded by media on such a level that the connection to the real world weakens as the bond to the virtual world strengthens [4]. From this perspective, total

CHI'16, May 07 - 12, 2016, San Jose, CA, USA

ACM 978-1-4503-3362-7/16/05…$15.00
DOI: http://dx.doi.org/10.1145/2858036.2858418

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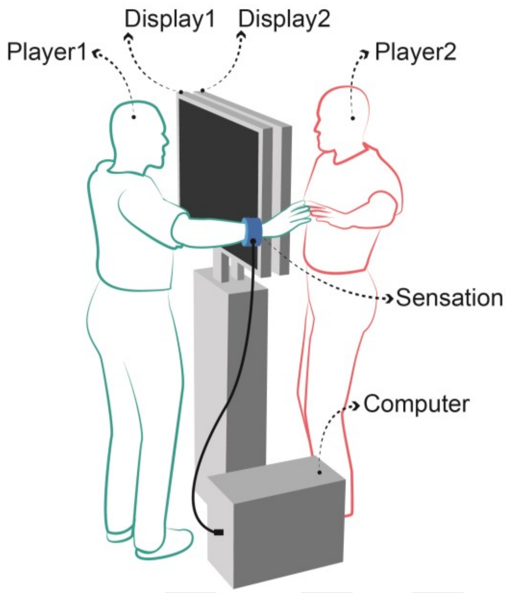

Figure 1: Gaming environment designed for the Sensation

immersion is more likely to be achieved through human-human interaction.

In this study, we introduce and explore a novel interaction technique for collaborative game play, human-to-human social touch, through the use of *the Sensation*, which is a device for sensing different touch patterns between two players. We used the Sensation with a specifically designed collaborative game, Shape Destroy, and conducted a user study with 30 participants to see how using HHST affected the gaming experience. To achieve these goals, we set an interactive environment which allows players to play games via social touch in a face-to-face position (Figure 1). This environment is based on our previous research in which we introduced HHST as a controller concept for gaming for the first time [5]. We used this environment to conduct the user study which compared the difference in the experience between social touch, *Sensation,* and a conventional gamepad in a specifically designed collaborative game. The game, *Shape Destroy*, which was used during our study was also a modified version of the game Worm Hole [5], specifically designed by experts for such environments. Calleja's *Player Involvement Model* [6] was used to explicitly qualify the effect of HHST on the immersion level. We believe that utilization of social touch will contribute to the collaborative gaming experience by increasing 1) kinesthetic, 2) shared, 3) ludic and 4) affective involvement which in turn will boost the 5) overall immersive experience of the players.

BACKGROUND AND RELATED WORK

Human to Human Interaction in Games

In digital PC and console games, there are many strict guidelines and rules which inhibit spontaneity [25]. Online games try to increase spontaneity by providing players a chance to communicate with real players, but they cannot be compared with the feeling of playing the game face-to-face [25]. Using social touch in digital games can break these barriers and may help to bring a new approach for the control of pervasive games. Several research projects were conducted on human-to-human interaction in games like Human Pacman [7], Pirates! [2], Pass the Bomb [31], i-Dentity [11] JS Joust [36]. The aim of these experiments is to transfer the game boards of digital media to the real world [2,7] and make the physical existence of players affect the game world or build game rules upon it. As a result of co-located multiplayer game play, social touch occurs as a resultant effect. However, none of these games solely focus on social touch as a control apparatus.

Several studies on games have focused on the body contact of players. *Musical Embrace* [16] is a study which employs social touch in a more similar way to our study. It facilitates a hug between two players by making them hug a pillow together. Another study, *intangle* [10], investigates the different levels of body contact and social boundaries in a gaming context. These studies, however, do not concentrate on different kinds of touch patterns, either. Moreover, their concern is social interpretations and design inspirations resulting from human-human interaction, while our focus is on player experience presented by the game and the interactive environment.

In our previous study, we investigated social touch in the context of gaming and gained insights about its use in digital games. This study proposed a conceptual environment called DubTouch, which used a double-sided display and let players play the game by touching each other's hands in a face-to-face position. According to this study, user preferences addressed that touch patterns can be categorized into six groups: *Direct Manipulation*, *Two Hand*, *Hand Posture*, *Two Users*, *Physical Impact*, and *3D Space* [5]. Moreover, this study also introduced two games which are specifically designed for this interactive environment which are called *Worm Hole* and *d-Coder*. Although this research offered many predictions about touch patterns that can be used in the games, it did not investigate the effects of social touch on player experience since it was a study done on a conceptual environment without a working prototype. Nevertheless, we used the insights from this work in the implementation of the game, the organization of the environment and the selection of touch patterns.

Our investigation into the use of social-touch in games shows that physical interactions of players is considered an important subject for games. However, different types of social touch between players, although described in our previous work, was not implemented as a control apparatus for gaming. Different from the previous work, our study focuses on introducing a novel control method which is based on social touch patterns and understand how it contributes to player experience.

Social Touch in HCI

Social touch is a general term used for any touch interaction between at least two people. It includes all touch patterns like shaking hands, hugging, and bumping fists. People use social touch in daily life for communication, and every touch has a symbolic meaning [17]. For example, touching someone's shoulder signals that you want to have a conversation with the receiver of the touch. Furthermore, social touch also employs the transfer of specific emotions between people. The previous study shows that specific touch patterns are capable of delivering emotions like love, fear or melancholy between people [5].

There are several studies about the interpretation of social touch. Haans & IJsselsteijn created six categories according to their interpretations: *positive affection, control, playful, ritualistic, task related and accidental touches* [13]. Another study organized the phenomena into three groups*: simple touch, protracted touch, and dynamic touch* [17]. In both of the definitions, people must be in each other's proximity for social touch to occur. These classifications refer to different kinds of touches in the manner of touch duration, touch surface or body area. For example, simple touch refers to touches only for specific parts of the body such as hands or arms. Protracted touch refers to continuous contact of skin with pressure, while dynamic touch specifies a touch with a repetitive character; for example stroking.

We believe that even if not considered in the context of gaming, usage of social touch in other areas of HCI is related to our work. The TaSST is one of the projects which is capable of generating different kinds of touches with the use of haptic motors [17]. Another study focuses on how mediated social touch alters the experience in a social presence environment [30]. *Emobaloon* considers touches like *Stroking or Hugging* as input and examines its effects on the user through the use of an interactive balloon [29]. Several other studies investigate the directions and capabilities of social touch for possible applications in HCI through extensive research or implementations of interactive systems [9,13,23,28,33]. Application of mediated social touch to digital games is possible, nevertheless, our interest is to attain the genuine social touch between people who are co-located.

Apart from the mediated touch, a spotlight has been held on interpersonal touch by numerous projects. *Enhanced Touch, Touch-Shake* and *Touching a Stranger* employ a similar system to ours by providing face-to-face interaction between users [15,18,38]. *Enhanced Touch* provides a playful interaction between users via a bracelet, while *Touch-Shake* investigates the interaction of users in face-to-face position via different kinds of touches through the use of a hand-held device. *Touching a Stranger* introduces a wearable vest, which grants auditory and visual feedback when someone or something touches different parts of the wearer's body.

Research in social touch indicates that it is capable of transferring messages and feelings among people. Moreover, different kinds of patterns can be interpreted in different manners; thereby we believe that these different meanings can refer to different actions while increasing the bond and communication between players.

Immersion

Even though there is an ongoing discussion about the meaning of immersion, it can be defined as "the sensation of being surrounded by a completely other reality that takes over all of our attention, our whole perceptual apparatus" [27]. More specifically, the prevalent definition of immersion in gaming offered by Brown and Cairns is the degree of involvement that moves along the path of time [4].

According to Brown and Cairns, who conducted experiments on gaming immersion, there are three levels of immersion: engagement, engrossment and total immersion. Total immersion is the presence in the most basic words. When one attains the total immersion level, he is cut off from reality and feels himself in a virtual world. The game becomes all that matters [4]. To become totally immersed one must first become engrossed. Engrossment is the middle step from engagement to total immersion, where the barrier is game construction [4]. If achieved, emotions are directly affected by the game. Brown and Cairns claimed that engagement and enjoyment is not possible if usability and control problems exist. Invisibility of the controls is an important aspect for all levels of immersion, but is vital for total immersion. Therefore, there needs to be an invisibility of controls for total immersion [4].

Ermi and Mäyrä, who have also conducted experiments on gameplay experience and immersion, identified immersion differently. According to them, there are three different immersion dimensions, all having different aspects. These are sensory, challenge-based and imaginative immersions [8]. These three immersions can mix or overlap in many ways and together create a gameplay the player wants. The first dimension, sensory immersion, relates to the audiovisual aspect of games. The second dimension, challenge-based immersion, can be related to motor skill, mental skill or both. Lastly, imaginative immersion means that the player is able to use her/his imagination, empathizes with the character, or enjoys the fantasy of the game and feels absorbed by its story. Although this definition investigates the game immersion considering its ludic, artistic and narrative properties, it does not offer an obvious hypothesis about the game control interface, therefore does not provide a strong base for our study.

While these definitions do not administer arguments about embodiment in games, experiments conducted by Berthouze, Kim and Patel clearly show a positive correlation between body movement and engagement [1]. Moreover, Isbister et al. pointed out that, as the body movement and effort put in a game increase, perceived fun also rises [19]. Thus, the more one moves, the more effort one exerts and the more immersed one becomes. In addition, the experiments show a contrast against the predominant view that immersion can only be achieved in a virtual reality environment. With increasing body movements, immersion is achievable with less virtual reality than previously thought [1].

In conclusion, previous work showed that total immersion can take place with more body movement and less machine-human interaction. We believe that social touch interaction can increase immersion by providing invisible controls and engaging players with bodily interactions.

PLAYER INVOLVEMENT MODEL

To overcome the ambiguity about the definitions of immersion, Calleja investigated immersion as a multidimensional concept, and introduced *the player involvement model* [6]. The model categorizes involvement into six dimensions and investigates immersion considering the players' perception about games in many different aspects which are adaptable to different types of game play styles. The experiment conducted by Herrewijn, Poels, and Calleja shows a positive correlation between player involvement model and immersion [14]. Furthermore, we believe that the involvement model is very useful for examining social touch as it separately focuses on social, kinesthetic, ludic and affective experiences. Therefore, our study takes the Player Involvement Model as a base for investigating the player experience. Dimensions of the player involvement introduced in that model are kinesthetic, shared, ludic, spatial, narrative and affective involvement [6]. In our research, we excluded spatial and narrative involvement and focused only on *kinesthetic, shared*, ludic and affective involvement since the game, Shape Destroy*,* does not include a gameplay that consists of characters, environment or story. Our reason for designing Shape Destroy is that a quite similar game was developed by professional game developers for a similar conceptual gaming environment in a previous research [5]. Details of the dimensions on which we base our study are listed below:

Kinesthetic Involvement: This involvement is related to all kinds of avatar or other game object controls in digital games. Calleja states, "This dimension of involvement requires more conscious attention when the controls make themselves present…" [6] meaning that the controller has a significant effect on this dimension, since it forms the communication between the game and the player. For example, Kinect and Wii controllers, which grant players to use their body for interaction, are thought to increase Kinesthetic involvement by providing the feeling of presence in the game environment. In other types of controllers like a gamepad, presence can be achieved by making it invisible to players. We contemplate this dimension as an important one, since our main contribution in this paper is to investigate the effects of a novel control method in digital games.

Shared Involvement: This dimension occurs when the same game is played with others. It can be achieved by split-screen multiplayer games like Mortal Kombat [32] or with online multiplayer games like World of Warcraft [3]. In both cases, players share the same game environment and react to same events. Players establish social bonds in those games, and these social bonds can sometimes be stronger than other types of communication like chatting [6]. Both the collaborative and competitive types of interaction between players have effects on the Shared Involvement. By design, shared involvement is the essence of our gaming environment since we believe that human to human social touch will create a strong attachment between players bolstering their shared involvement.

Ludic Involvement: Ludic involvement focuses on one of the most crucial differences between games and other digital entertainments like cinema and music: choices made by the player related to the game environment [6]. These choices can be made to achieve the goal of the game or just to enjoy the game. For the occurrence of the ludic involvement, players must feel like they control the game, and the flow of the game is affected by their decisions. Since we changed the control method, the perception of the game by players may change, too. Thus, it can change the level of ludic involvement.

Affective Involvement: During and after the gameplay, players give various kinds of emotional responses to the game. Feeling positive, irritated, victorious or bored can be examples of such emotions. We believe that Sensation will provide a boost in *Affective Involvement* since players' feelings and emotional responses will change when human-to-human touch, which is capable of expressing specific emotions, is involved in the process.

SENSATION

We developed Sensation as a device that is capable of detecting different kinds of touches, *touch patterns*, between players. The current version of the prototype is connected to a power supply and to a PC over the USB. Therefore, this prototype does not provide a wireless connection, although one is planned for future versions. Nevertheless, the cables attached are long enough to provide players freedom of movement.

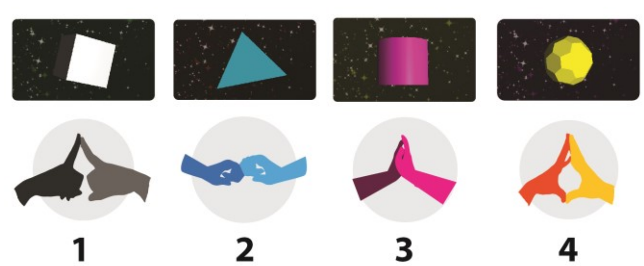

Figure 2: 1) 1-Finger 2) Bro-fist 3) Palm Touch 4) 4-Finger

In our current system, one of the players wears the Sensation on her/his arm. When worn, Sensation can detect several types of touch patterns by making use of changes in capacitance as two players touch each other. A simple calibration interface is implemented for players to map touch patterns to different actions. Therefore, players need to go under a brief calibration process in order to make device recognize different touch patterns that they defined.

Game: Shape Destroy

Shape Destroy is a two-player game based on social touch. It is played on a double-sided display, with players standing and facing each other and the screens in between them. The aim of the players is to destroy the four different objects in the shapes of cube, pyramid, cylinder and polyhedron. This game is based on a game which was designed in an expert workshop in our previous study [5].

Each shape can be destroyed by either a certain button (with a gamepad) or a touch pattern (with the Sensation). Touch patterns of the game are very similar to the ones designed in the expert workshop in our previous work, Dubtouch [5]: one finger touch, fist, firm grip, and hand touch. We made minor modifications by adapting them to this version of the Sensation (Figure 2). Therefore, the patterns we used were finger touch, bro-fist, palm touch and 4-finger. Palm touch pattern required a hold for several seconds. These gestures fall into Two Users and Hand Posture categories which were found to be both intuitive and exclusive touch patterns [5].

The process of the game is shown in Figure 3. In the 1st step, only the 1st player sees the shape and both players perform the required touch pattern. The 2nd player needs to guess the touch pattern by looking at the hand of the 1st player. In the 2nd step, the roles of the 1st and 2nd players are exchanged. In the game, only one participant sees a randomly created object at a time in her/his own screen, alternating each round. The goal is to destroy the objects by pushing the same button (with a gamepad) or applying a complementary touch pattern

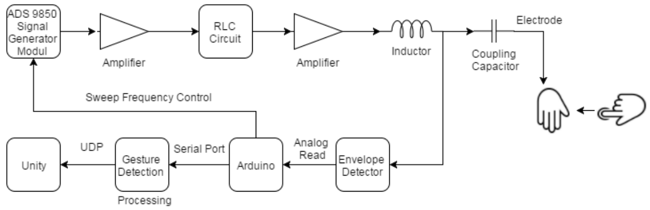

Figure 4: Sensation and its communication with unity.

(with the Sensation) that relies on the contribution of both players. The players need to cooperate and when a shape appears on one participant's screen, the player who can see it will try to describe a complementary pattern or show the button to the other player without speaking.

Technical Information

Sensation, which was developed to detect human-to-human touch patterns, is based on the Swept Frequency Capacitive Sensing technology (Figure 4) behind the Touché developed by Disney Research [35]. Capacitive Touch sensors, used in many display technologies, utilize single frequency capacitive touch sensing. This technology uses a single frequency periodic signal to create oscillations on an electrode. Once the touch event occurs, a capacitive link is formed between the human body and the electrode. Charge flows through the human body and brings about a change in the obtained signal. However, the sensor only detects whether the touch event occurs due to the change in the signal (Figure 4).

Unlike single frequency capacitive sensing which provides binary info, swept frequency capacitive sensing allows us to detect touch patterns. The electrode is a conductive material and is excited by a chirp signal in a certain frequency range; then the frequency response of the system is analyzed. The magnitude of the frequency response of the system reaches its maximum at the resonant frequency and the resonant frequency is directly proportional to system's total capacitance. The capacitive link changes the resonant

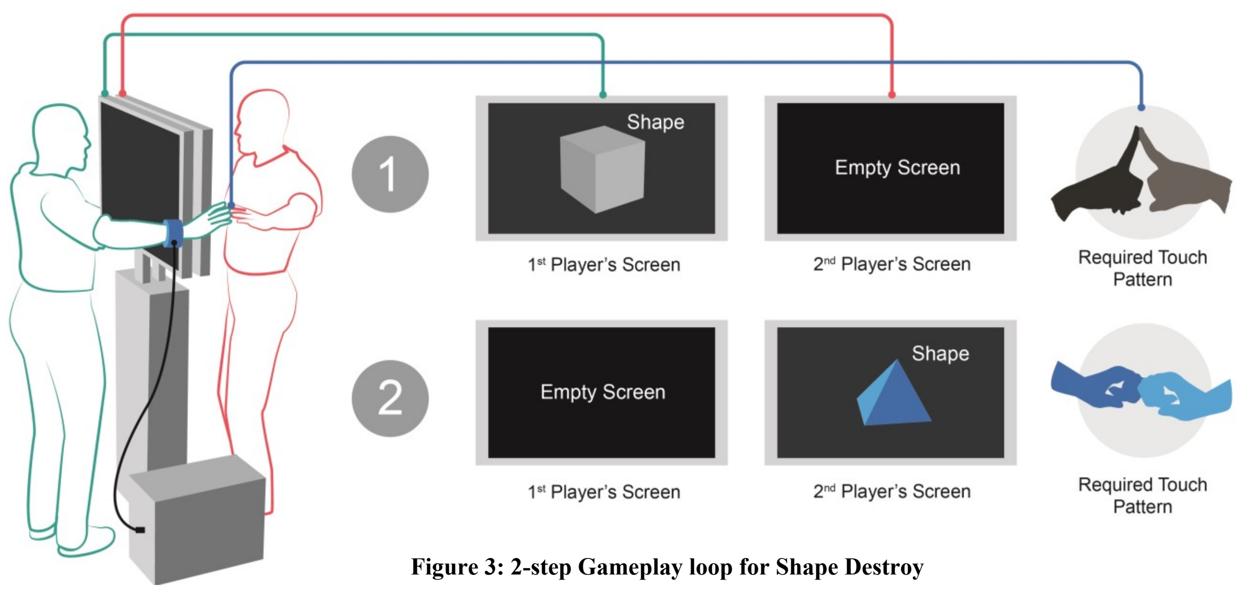

Figure 3: 2-step Gameplay loop for Shape Destroy

frequency of the system; in other words, shifts the frequency response. Thus, even the tiny shifts in the frequency response become detectable thanks to utilization of the swept frequency.

Human skin is a conductive surface, approximately 1MΩ (as found by our experiments) and can form a capacitive link nearly 200 pF [21]. The quantity of that capacitive link has values between 150-250 pF when a touch occurs between two people, proportional to the touch surface. According to these values, we designed the Sensation circuit to detect the effect of a small change on the total capacitance. The circuit design consists of a RLC circuit for bias resonant frequency ~100 kHz, a coupling capacitor for the capacitive link, an envelope detector circuit for detection of the return signal, AD9850 signal generator module and Arduino Uno as a microcontroller. The RLC circuit is excited with a swept frequency sinusoidal wave generated by AD9850, and the signal returned from the envelope detector is used for the detection of the touch area.

USER STUDY

We utilized a 6-step user test to compare immersion level differences between a conventional controller, a gamepad, and a touch pattern based controller, Sensation. A total of 30 participants played Shape Destroy both with a gamepad and with the Sensation and completed a set of questionnaires. We divided participants into two groups, group A and B, equally swapping the orders of control methods respectively. Group A played the game first with *a gamepad* and later with the *Sensation* while Group B used the *Sensation* first and a gamepad second. This process aimed at minimizing the *"learning effect"* on test results.

The steps of the user study were as follows (Figure 5): 1) fill out the Immersive Tendency Questionnaire (ITQ), 2) play the game with *Gamepad (A)/Sensation (B),* 3) fill out the Immersive Experience Questionnaire (IEQ) for the 1st gameplay session, 4) play the game with *Sensation (A)/Gamepad (B),* 5) fill out the IEQ for the 2nd gameplay session and 6) fill out the Experience Comparison Test. We used an environment similar to *DubTouch* and used the game *Shape Destroy*. Each session lasted for approximately 45 minutes.

Participants

Thirty participants (19 Male, 11 Female, M_{age}=21.4, SD_{age}=1.99) attended the experiment. Of these participants, 21 expressed that they allocated *0-3 hours* of their time a week for playing games while 9 of them allocated more than *3 hours*. Seven participants were involved only with *mobile games*, 12 with only *PC or Console games,* 7 played both PC/Console and Mobile games. Three of the participants indicated they were not into playing games on PC/Console nor on a Mobile Platform.

None of the participants had prior knowledge about the game and the study, so that all began at the same experience level. Group A had *16 participants* while Group B had *14 participants*. Each couple played the game in 5-minute-long sessions consecutively after a tutorial phase with each controller.

Questionnaire

Herrewjin, Poels and Calleja investigated the relationship between immersion and player involvement [14] and developed a comprehensive questionnaire which was compatible with the player involvement model. This questionnaire was prepared by combining several authenticated questionnaires: The Presence Questionnaire [37], The Immersion Scale [20], The Narrative Engagement Scale [12], The Self-Assessment Manikin [22], and The Game Experience Questionnaire [34].

The questions gathered from these studies are categorized as *General Involvement, Immersion, Kinesthetic Involvement, Spatial Involvement, Shared Involvement, Narrative Involvement, Ludic Involvement and Affective Involvement.* Other than these dimensions in the player involvement model, this questionnaire includes questions which measured *General Immersion* and *General Involvement*. *General Immersion* stands for presence related experiences while

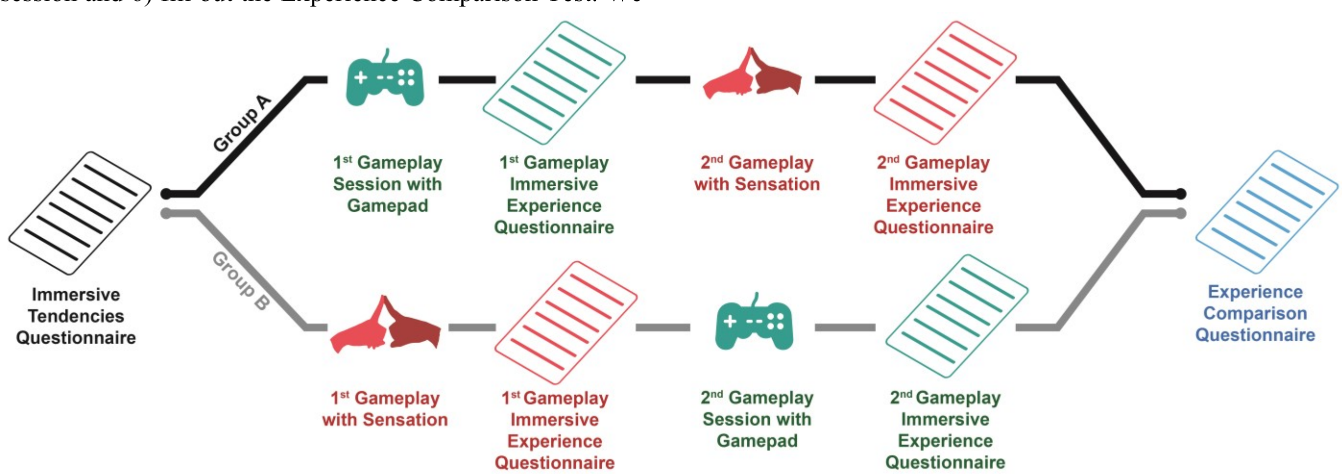

Figure 5: Structure of the User Study

General Involvement refers to absorption by the game which can be defined as the "game's capability of holding one's attention".

We selected the questions from this questionnaire to build two different questionnaires (the Immersion Experience Questionnaire, and the Experience Comparison Questionnaire) for our experiment. We chose questions which aimed at measuring general involvement, kinesthetic involvement, ludic involvement, shared involvement and affective involvement. Since the game had no story or characters, questionnaires did not include any questions about spatial and narrative involvement. Moreover, we did not include the questions for general immersion since these questions are based on presence, which requires a game world that players can feel in the shoes of their avatars.

RESULTS

Repeated Measures ANOVAs were used to analyze the difference between a gamepad and the Sensation for each immersion sub-category. The order of playing with a gamepad and the Sensation was the independent variable in these analyses. Results showed that *Order* did not have a significant relation with how subjects performed using a gamepad or the Sensation for all categories, *ps* > .05. However, there was an effect of playing on Gamepad vs. Sensation for all subcategories (*ps* < *.05)* except *Kinesthetic* and *Challenge*. Finally, no interactions between order and the type of play were found in any of the categories, (*ps* > .05); except *for the General Involvement* category, (*p* < .05).

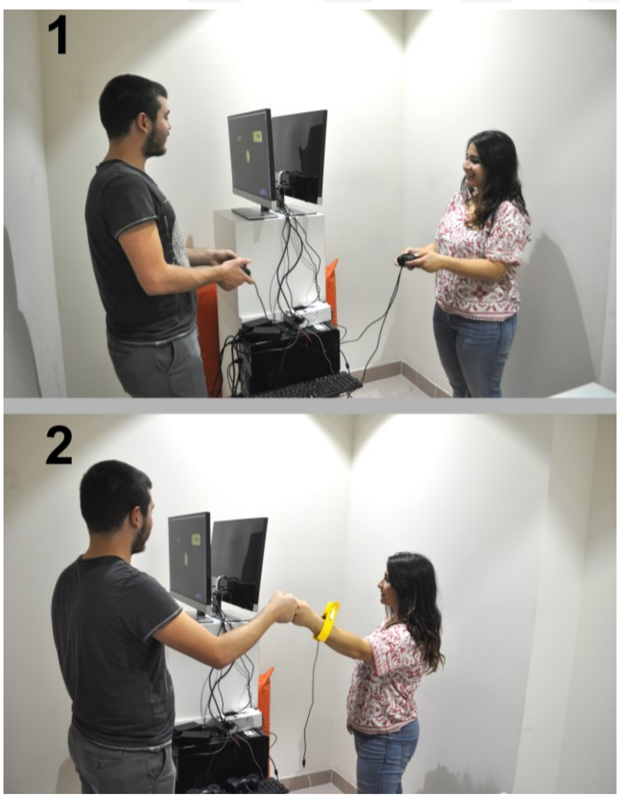

Figure 6: 1) Gameplay session with a gamepad 2) Gameplay session with the Sensation

Overall results presented in *Table 1* showed that the gaming experience provided by the Sensation outrivaled the Gamepad in the means of *General Involvement* ($F(1, 28) = 21.18$, $p < 0.001$, $\eta^2 = 0.43$), *Shared Involvement* ($F(1, 28) = 8.75$, $p < 0.01$, $\eta^2 = 0.24$), *Ludic Involvement* ($F(1, 28) = 7.00$, $p < 0.05$, $\eta^2 = 0.20$), *Competence* ($F(1, 28) = 5.46$, $p < 0.05$, $\eta^2 = 0.16$), and *Tension* ($F(1, 28) = 10.11$, $p < 0.01$, $\eta^2 = 0.27$), (*Positive* $F(1, 28) = 9.45$, $p < 0.01$, $\eta^2 = 0.25$) *and Negative Effect* ($F(1, 28) = 5.43$, $p < 0.05$, $\eta^2 = 0.16$). Due to an increase in these dimension, the *overall immersion score* also increased ($F(1, 28) = 8.16$, $p < 0.01$, $\eta^2 = 0.23$).

Results indicate that experience in these dimensions is more, (less for *Negative and Tension)*, likely to be provided in the gameplay sessions conducted with the *Sensation.* Nevertheless, the difference in *Kinesthetic Involvement* ($F(1, 28) = 3.52$, $p > 0.05$, $\eta^2 = 0.11$) scores does not indicate a strong significance level, meaning that although an inclination towards the Sensation was observable, this tendency is not as strong as expected.

	G.P Mean	G.P SD	Sens. Mean	Sens. SD
General	3.18	0.85646	**3.84*****	0.69339
Kinesthetic	3.39	0.85592	**3.72**	0.73227
Shared	3.64	0.78381	**4.04****	0.57988
Ludic	3.30	0.89558	**3.58***	0.76357
Affective Involvement(AI) (Competence)	2.99	1.07829	**3.45***	1.01971
AI (Challenge)	3,01	,53028	**3,10**	,55024
AI (Tension)	**1.84****	0.74460	1.54	0.51327
AI (Negative)	**1.81***	0.63561	1.56	0.46346
AI (Positive)	3.35	0.93366	**3.70****	0.89263
Overall	3.52	0.66895	**3.84****	0.54918

Table 1: Overall Results for Gamepad and Sensation Comparison. G.P. = Gamepad, Sens.= Sensation Note: * p<.05, ** p<.01, *** p<.001

Other than the overall scores, we also analyzed the results of *"Order"* and *"Order Interaction"* values to see whether being in Group A or Group B affected the test results. This analysis aimed at understanding if *learning effect, fatigue* or other factors altered the outcomes. *Order* value referred to whether using controllers in different orders had any meanings on results. Collected *Order* values showed that Order Value did not affect the significance level of the results. The *Order Interaction* value demonstrated the impact level of the order difference for controllers. Outcomes implied that players in Group A seemed inclined towards experiencing *General Involvement* more, compared to Group B ($F(1, 28) = 7.51$, $p = 0.01$, $\eta^2 = 0.21$). Our results showed that the experience level in other dimensions did not show difference between the two groups.

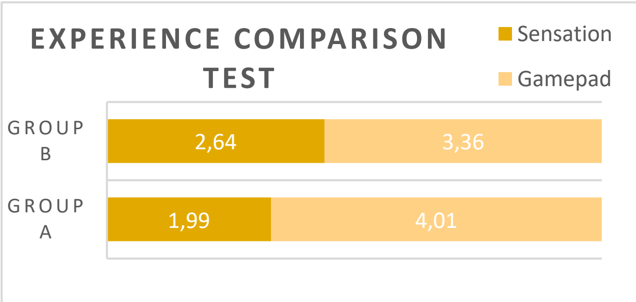

Table 2: Results of the "Experience Comparison Test" Closer scores to 1 indicate participants' preference for Sensation over Gamepad for both groups.

Table 2 presents the result of the Experience Comparison Test. We analyzed the comparison questionnaire to examine the total immersion level differences between the Sensation and a gamepad. In this questionnaire, participants were asked to select a score near 1 if they enjoyed the *Sensation* more, or to select a score near 5 if they preferred a gamepad, and select 3 if they enjoyed the Sensation and a gamepad equally. The two groups were analyzed separately. The lower mean value indicates that the participants favored the *Sensation* more. Both results show that both groups preferred the Sensation over a gamepad. However, we can see that the comparison questionnaire indicates a significant difference between the results of Group A and Group B, ($t(27) = 2.12$, $p < 0.05$.) We believe that the *learning effect* resulting from the different gameplay order may be the reason.

We also administered an Immersive Tendencies Questionnaire (ITQ) prior to the games to see whether subjects' individual variation in their tendencies to get immersed in activities would have any correlation with their actual immersions in the two game conditions. A correlation analysis showed that there was no significant correlation between the tendency questionnaire and subjects' actual immersion scores, $p > .05$. Therefore, participants' enjoyment is not affected by their immersive tendencies.

DISCUSSION

Player Experience

In the beginning of this study, our hypothesis was "Using social touch as a controller device would increase 1) kinesthetic, 2) shared and 3) ludic involvement 4) affective involvement and 5) increase total immersion level". Our findings show a strong relationship between immersion and social touch in digital games. While *general (p<0.001), shared (p<0.01), ludic involvement (p<0.05) and competence (p<0.05), tension (p<0.01), negative (p<0.05), positive feelings (p<0.01)* and *overall immersion (p<0.01) score* was ostensibly high in the Sensation, *kinesthetic involvement (p>0.05),* although inclined towards the Sensation, did not show a clear increase as expected.

The results show that our hypothesis seems to be verified, in the means of shared, ludic involvement and total immersion, yet the control method does not provide a strong kinesthetic experience which outplays the conventional controls effectively. Nevertheless, we can claim that our aim to provide invisible controls was achieved, since the specific questions[10][11] about this quality specifies an increase for the Sensation ($t(29) = 2.77$, $p < 0.05$). Therefore, we believe that this score can vary greatly for the games where physical interaction feels more natural. Furthermore, compared to a gamepad, using the Sensation is tiring and some of the participants expressed that they were tired during the game which may have affected their experience with kinesthetic involvement. Thus, games that require more ergonomic body position or use fatigue as a feature as proposed in previous research [26] may increase this value.

As we predicted in the hypothesis, an increase in shared involvement provided by the Sensation is observable. Shared involvement refers to how players empathize and feel connected to their game partner. We believe that physical contact between players may facilitate the empathy between players and increase their connectedness to each other compared to the distant position. Therefore, social touch can be an appropriate and novel control method for pervasive games having collaborative mechanics.

Our analysis did not indicate a clear difference between the immersion scores of players whose gaming habits were different. However, during the study we observed that less experienced players tended to enjoy the *Sensation* more. Experienced players still found the Sensation more involving than a gamepad; however, with a smaller difference, when compared to the second group. These facts indicate that rather than replacing traditional controllers, Sensation might attract new players who do not play games often. People who find traditional controllers less stimulating might find the Sensation more interesting.

Comparison Questionnaire demonstrated that Group A enjoyed the Sensation more than Group B. We believe that the *learning effect* can be the reason. None of the participants had prior knowledge or experience about the game that we introduced. Therefore, experience in the 1st gameplay sessions was affected by a learning process. Thus in group B, participants could not engage with the game via Sensation as much as group A.

[10] "I could concentrate on the assigned tasks or required activities rather than on the game controls used to perform those tasks or activities."

[11] "I became unaware that I was even using any game controls."

Different aspects of Human-to-human Social Touch in Games

Results of the study indicated a rise in the player experience with the use of the Sensation. HHST has many aspects which may cause this rise. In this part we will discuss possible reasons for the enhanced experience.

According to our observations, we believe that the main reason for the increase in experience is the varying physical quality of the interaction with players. The palm touch, the 3rd touch pattern, was one of the interactions which let us observe this quality clearly. The physical impact, which was reported as an exclusive touch pattern in our previous work [5], and the protracted contact heightened the collaboration feeling and thereby the fun experience. Moreover, we observed that different characters of touch patterns alter the experience of touching each other. If touch patterns were not varied, same touch interaction would become mundane even if it was in the physical impact category. We observed that players overtly enjoyed switching between touch patterns especially when they had different characteristics. For instance, changing from 1-finger touch, which was in the "Hand Posture" category [5], to bro-fist, appearing in the "Physical Impact", were more exciting compared to changing from 1-finge to 4-finger. Therefore, improving our previous work, we can state that usage of different touch pattern characteristics is preferable for HHST in games.

With the Sensation, the level of ludic involvement felt by players increased. Changing the control mechanism also changed the way players used to reach the goals although the other properties of the game were exactly the same. Most participants concentrated better on their goals while playing with the Sensation, since they were in physical contact with their partner. It was also more intuitive to understand the complementary gesture compared to checking other players' gamepads to see the right button. Thus, their ludic involvement increased significantly as their concentration on game tasks increased. The game pad controls, although they took longer to adapt, did not make the gameplay significantly difficult since we passed the adaptation process in the tutorial section. Overall scores also did not indicate a better performance with the Sensation. However, we observed that the control method also became an enjoyable game while participants tried to explain the right gesture without speaking. Yet, the same effect was not observable for the gamepad since checking the controls become mundane after a while. Therefore, the use of social touch as proposed in our study reveals a new approach to control interfaces by involving these interfaces as a part of the game. The invisibility of the controls is not provided by making them unnoticeable to players but to integrate them as a part of the game. It gets different from pushing a button, which is an action solely done for triggering events in the game, by being transformed into an action which is the part of the game.

A novel character of the Sensation may have an effect on the player preferences between the game pad and the Sensation. The IEQ aims at measuring the experience in many different aspects. If we only measured the effect on the fun experience, the novelty of the Sensation may have had a stronger manipulating effect. However, in this case, we did not observe an increase in Kinesthetic Involvement on which we expect the novelty of the controller to have the biggest effect since this dimension is strongly related with the perception on controllers. Moreover, the game and the way it is played was also novel to players even when they were playing it with a game pad. Therefore, the boost in the immersion level was not caused by the usage of a novel control method but by novel experiences provided by it.

Although this study focused on the effects of social touch on the game experience on an individual basis, different characters of couples playing the game may result in different experiences. For example, some participants who had previous acquaintance indicated that their friendship affected the enjoyment they got. Previous research about the utilization of social touch in HCI verifies that experience [38]. Our observations showed that those players who knew each other well tended to play the game with a more synchronized body language than those who did not. Therefore, further studies may be conducted to understand the effect of acquaintanceship in a gaming environment utilizing social touch.

Game: The Shape Destroy

The game, Shape Destroy*,* was specifically designed for social touch and face to face positions of players in an expert workshop which was conducted in our previous research [5]. As a sole digital game, Shape Destroy is quite simple. However, we believe that it fits our context where we introduce a novel control method and a completely new way of collaborative interaction. Although the digital properties of Shape Destroy are simple, the face to face positions of players, alternating visibility of displays and no-speaking rule are novel additions to game mechanics. These additions also made the game appropriate to be played with social touch.

Although we believe that Shape Destroy is an appropriate game for the introduction of such system, different kinds of games also have possibilities to be played with social touch. Positions different than face-to-face, like side-to-side, also may prove novel interactions. Moreover, our previous work proved that social touch is capable of conveying emotional messages between players [5] which suggests implementing narrative based games to be played with social touch. In this way, investigation of Spatial and Narrative involvement will also be possible.

As a result of our study, employment of social touch in digital games proved to be a valuable contribution. Results show that social touch increases the general, shared and ludic involvement in the game. Moreover, players felt more positive, competent and less tense towards the *Sensation*. Although kinesthetic involvement scores were prone to *the*

Sensation, they do not show a strong significance as a general control method. However, results show that it provides a much more invisible interaction than a gamepad. Moreover, the player experience study also cast light on different aspects of social touch which should be researched by further studies. The effect of the relationship between players on the experience, how touch patterns specifically alter the experience, different game genres for social touch and different body positions during the gameplay are some of these aspects. Overall, we believe that social touch is proved to be a valuable alternative as a control method for pervasive and physical games and further studies should be conducted to explore this area with more depth.

CONCLUSION

In this study, we introduced a novel controller, the Sensation, which enables players to play games by touching each other by different touch patterns and designed a game, Shape Destroy, drawing on an expert workshop conducted in our previous study [5]. Moreover, we conducted a user study with 30 participants by analyzing four dimensions of the player involvement model [6]: (Kinesthetic, Shared, Ludic Involvement and Affective Involvement) to understand if HHST can add to the collaborative game experience and have potential for further research.

Results of the user study indicated that the overall user experience is improved especially with the boost in *ludic* ($p<0.05$), *shared* ($p<0.01$), *general* ($p<0.001$) and *affective involvement (competence* ($p<0.05$), *tension* ($p<0.01$), *negative* ($p<0.05$), *positive feelings* ($p<0.01$)). Due to the rise in these dimensions, the *overall score* ($p<0.01$) of the test also advanced. The increase in *kinesthetic involvement* ($p>0.05$) with the Sensation is lower than what we expected. Although results indicate that invisibility of controls was provided, other dimensions of control should be improved and tested with different game genres and body positions. Therefore, we believe that HHST could be very meaningful as a new controller even in simple games as we used. With this system, it is possible to put social touch into games collaboratively and its contribution to competitive games is open for exploration.

Our observations showed that HHST changes the player experience by letting players physically affect the controller (the other players' hand) and manipulate it. Moreover, non-digital rules like "no talking", can be more easily achieved with social touch. Therefore, we see that new non-digital mechanics, rules and interaction styles can be possible in games with the use of HHST. It is possible to apply these to both collaborative and competitive games along with different game genres.

Results showed that the use of social touch interaction between people in a gaming context is an important alternative considering the growing popularity of full-body utilization in games. Results indicate that social touch can be quite valuable for enhancing collaborative gaming experiences in games designed for full-body engagement.

LIMITATIONS & FUTURE WORK

We have gathered successful results regarding touch experience in gaming, but since we worked with a new technology there were some technical limitations.

The Sensation module works smoothly for games controlled with basic gestures. The available gestures can be increased with the use of different sensors like tendon or sound sensors. Therefore, a wide range of games with different characteristics can be developed.

Capacitive effect due to interaction varies from person to person. Therefore, the Sensation can work after an individual calibration. We plan to improve this feature to make it work for everyone without calibration. Moreover, we are still studying the Sensation device to detect touch patterns between three or more people for multi-player games.

In order to obtain more comprehensive, reliable and extensive results on player experience, usage of psychophysiological methods is also possible [24]. However, experiment setups have a possibility to hinder social experience since additional devices need to be attached to players. Nevertheless, we consider applying these if we can reduce their effects on social experience.

The comparison made in this study included the Sensation and a conventional game pad. However, how social touch alters the player experience when compared to embodied control methods like mid-air gestural interaction which can be provided by game consoles like Xbox with Kinect and Wii will be investigated in further studies.

Our results showed that human-to-human touch is promising for the gaming field; therefore, our work aims to improve the *Sensation* in technical aspects and measure its effects on *Player Experience,* with a wide range of game genres and with objective methods.

ACKNOWLEDGEMENTS

We would like to thank our colleagues at KUAR for the detailed review of the paper and Selim Ölçer for his support in development of the prototype.

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14.3. Paper 11: Experiencing Human-to-Human Touch in Digital Game

Co-Authors: Mert Canat, Mustafa Ozan Tezcan, Celalettin Yurdakul and Oğuzhan Özcan (Advisor).

Conference: Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems [h5-index: 85]

Role: Concept Creator, Main Co-Author, Design Researcher, Supervisor

Year: 2016

Type: Demonstration

Experiencing Human-to-Human Touch in Digital Games

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CHI'16 Extended Abstracts, May 07-12, 2016, San Jose, CA, USA
ACM 978-1-4503-4082-3/16/05.
http://dx.doi.org/10.1145/2851581.2890231

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Abstract
Digital games have been equipped with novel control styles which promotes natural interaction. However, Human-to-Human Social Touch (HHST) has not been investigated as a gaming apparatus thoroughly. We believe that HHST can be a valuable contribution since it can convey different messages with different patterns and would provide a rich collaborative experience with physical contact. To explore this area, we developed the Sensation which is a control apparatus detecting the different touch types between two players. To observe the gaming experience we implemented the game, *Shape Destroy*, and conducted a user study with 30 participants to understand its effects on player experience. Results showed that HHST, provided by the Sensation, added to game experience boosting social, ludic and emotional aspects.

Author Keywords
Social touch; human-to-human interaction; gaming; controller; control apparatus; pervasive games; physical games; SFCS; Touché; game design; game research; embodied interaction; exertion games; exergames.

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ACM Classification Keywords

H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles

Introduction

Embodied interaction methods which do not require specific controllers have provided more natural ways to interact with games. However, the effects of human-to-human social touch (HHST) to digital games are not investigated thoroughly.

We believe that HHST is capable of providing novel experiences in collaborative game play of co-located players. Firstly, HHST can convey different messages and different patterns may mean common meanings for users. [4] Therefore, it can be considered as a sophisticated controller. Secondly, it can provide a more immersive experience by becoming invisible to players as a controller. Tertiary, different touch patterns are likely to provide space for novel mechanics which combines digital and physical properties of the game.

To investigate the usage of HHST in gaming we developed the Sensation which can detect different touch patterns between players and the game Shape Destroy specifically designed for HHST. The Sensation and the Game were played in the simulated version of DubTouch environment comprised of double-sided displays allowing players to play the game in a face-to-face position. We also conducted a user study in order to understand its effects on immersion level of players.

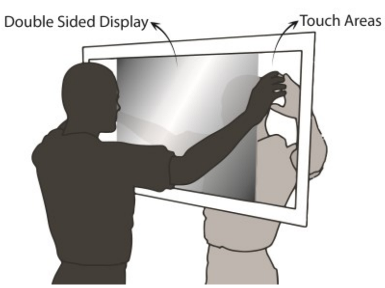

Figure 1: Conceptual DubTouch Environment [1]

Background and Related Work

Any touch interaction between two people is regarded as social touch. This can be referred almost every kind of contact with other people in our daily life. Patterns like hugging, bumping fists and shaking hands are forms of social touch and they have different meanings by having different characteristics [6]. Moreover, touch patterns could refer to various meanings and actions, which flourish the bond and communication between players [1]. Therefore, HHST may be used as a controller which can trigger different actions and the same time facilitate social interaction with physical contact.

Several studies on games have focused on the body contact of players. *Musical Embrace* [5] facilitates a hug between two players by making them hug a pillow together. Another study, *intangle* [3], examines the social boundaries while two people touchin each other in a playful context. These studies, however, do not focus on different and discrete touch patterns. Moreover, their concern is social interpretations and design inspirations resulting from human-to-human interaction, while our focus is on player experience presented by the game and the interactive environment.

DubTouch Environment

In our previous study, DubTouch [1] (Figure 1), we investigated the usage of social touch in digital games on a conceptual level. DubTouch is a interactive environemtn comprtised of two-sided display for playing two-player games in a face-to-face position by letting players touch each other. In this study we analyzed HHST patterns which can be used in games. These patterns categorized under Direct Manipulation,

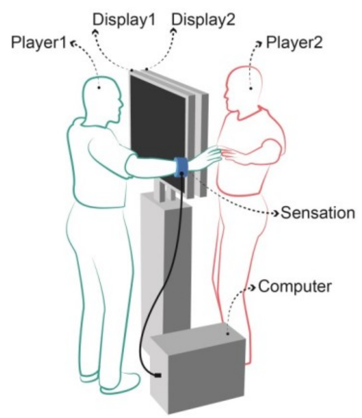

Figure 2: Simulation of DubTouch Environment with the Sensation Controller

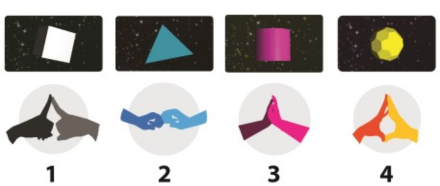

Figure 3: 1) 1-Finger 2) Bro-fist 3) Palm Touch 4) 4-Finger

Two Hand, Hand Posture, Two Users, Physical Impact, and 3D Space. This study is based on the preliminary results of DubTouch environment. Moreover, the game *Shape Destroy* is a modified version of a game designed by the experts in our previous study [1].

Sensation Controller

We developed Sensation for detecting different kinds of touch patterns between players. It uses Swept Frequency Capacitive Sensing method introduced by Sato, Poupyrev, and Harrison *[7]*. The prototype which we used during the user study was connected to a power supply and to a PC over the USB cable. Figure 1 illustrates the initial setup we used during the study. Imitating two-sided display concept, two screens are positioned backward to each other. While playing, each player is able to his/her own screen. Their hands touch each other next to the screen.

In our current prototype, we shrank the previous prototype to a wearable wristband which has wireless capability. One of the players needs to wear the Sensation module on his/her wrist. Afterwards, Sensation should be calibrated by two players. The module can detect up to 6 touch patterns based on the area of touch patterns.

Game: Shape Destroy

We improved the game that is designed at the workshop of our previous research [1]. It is a two-player collaborative game. The aim is to destroy the different objects by collaboratively performing the required gestures. We used the touch patterns in Figure 3 drawing upon the previous study. The shapes which matches with the gestures are visible only one player at a time. Therefore, players should be in a collaborative communication to be able to destroy the shapes with right patterns.

Effects on User Experience

We conducted a user study with 30 participants to investigate the effect of HHST on gaming expreience. Participants played the *Shape Destroy* by both Sensation and gamepad. We observed an increase in shared, ludic and affective involvement level which are the dimensions of immersion experience according to Calleja [2]. Therefore, we believe that several aspects suggest that HHST can contribute to the gaming experience. These aspects are as follows:

Social Touch as a controller

HHST, provided by the Sensation, contributed the shared feelings of players. Shared involvement increased as it is easier to read the other player while in physical contact. Another aspect, different touch patterns involved in the game added to the collaborative gaming experience. Physical contact transformed into a playful activity enhanced with different kinds of discrete touch patterns. Different from the previous studies we were able to facilitate social touch as a control apparatus which moves skin to skin contact beyond social interaction and transform it into a entertaining activity.

Invisible Controls

Collaboratively playing the game was harder to adapt with a gamepad since players were not accustomed to use the controller (gamepad) as a game mechanic. When they get adapted though, it became mundane to check the other players' controller all the time. This problem was overcome with *the Sensation* by establishing the invisibility of controls. Social touch is

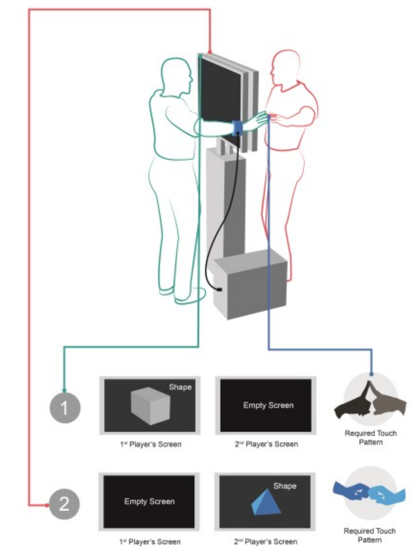

Figure 4: Flowchart of the Game Shape Destroy
1) 1st player sees the shape and 2nd player does not

1)2nd player sees the shape and 1st player does not

one of the common communication types, so controlling the game is more natural and easier with Sensation. Participants were better at concentrating the goal of the game, therefore ludic involvement increased. Furthermore, we observed that apart from the digital game rules, forming the right touch patterns also became a gaming experience. Players enjoy the physical part of the game as much as the digital side.

We provided innovative game mechanics and interaction styles. The first thing was face-to-face position of players resulted from the use of double-sided displays. This added a mystery to the game. This mystery resulted from the interaction style could be easily solved by letting players explain the shapes in their own screen. However, by adding "no-talking" rule which is unusual for digital games, we achieved to that even in a simple game, HHST may lead to novel mechanics.

Shape Destroy was a game that can be consumed quickly which is suitable for introducing a novel interface like HHST. However, we believe that it is possible to achieve different game mechanics with *the Sensation* in different and more complex games. It can be further experimented with different game genres.

Conclusion

In this study, we introduced a contemporary controller, *the Sensation*, which enables HHST in DubTouch enviroment. We developed a controller and conducted a user experiment with 30 participants to inspect the results and observed significant increases in 1) shared 2) ludic and 3) affective involvement, therefore an increase in overall immersion.

Sensation provided a more natural way to interact with games and increased the enjoyment level of players significantly. We believe that addition of HHST in collaborative games is valuable since if 1) facilitates social interaction, 2) casts light on novel ludic experiences and 3) create opportunities for new game mechanics

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14.4. Paper 12: GestAnalytics: Experiment and Analysis Tool for Gesture-Elicitation Studies

Co-Authors: Oğuzhan Özcan (Advisor).

Conference: Proceedings of the 2017 companion publication on Designing interactive systems [h5-index: 31]

Role: Concept Creator, Developer, Main Author, Design Researcher

Year: 2017

Type: Poster

GestAnalytics: Experiment and Analysis Tool for Gesture-Elicitation Studies

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ACM ISBN 978-1-4503-4991-8/17/06.
http://dx.doi.org/10.1145/3064857.3079114

Abstract
Gesture-elicitation studies are common and important studies for understanding user preferences. In these studies, researchers aim at extracting gestures which are desirable by users for different kinds of interfaces. During this process, researchers have to manually analyze many videos which is a tiring and a time-consuming process. Although current tools for video analysis provide annotation opportunity and features like automatic gesture analysis, researchers still need to (1) *divide videos into meaningful pieces*, (2) *manually examine each piece*, (3) *match collected user data with these,* (4) *code each video* and (5) *verify their coding*. These processes are burdensome and current tools do not aim to make this process easier and faster. To fill this gap, we developed "GestAnalytics" with features of simultaneous video monitoring, video tagging and filtering. Our internal pilot tests show that GestAnalytics can be a beneficial tool for researchers who practice video analysis for gestural interfaces.

Author Keywords
User-Elicitation, Gestures, Video Annotation, Video Analysis, Gesture Elicitation, User Centered Design

ACM Classification Keywords
H.5.2 Evaluation/methodology – Screen Design - GUI

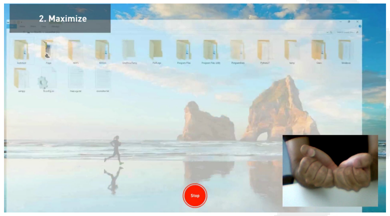

Figure 1: Recording Screen of GestAnalytics

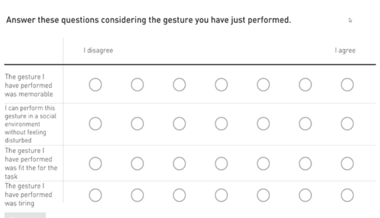

Figure 2: Questionnaire Screen

Introduction

Gestural interfaces encapsulate many different modalities such as mid-air gestures [11], on-skin gestures [1] or surface gestures [13]. Since these modalities are novel interaction methods, how these control types will be taken by users are unknown. Therefore, to understand the user preferences about new types of gestural controls, researcher often use user-elicitation studies [1,8,9,10,12]. In these studies, researchers want users to generate some gestures which they think are appropriate for specific tasks. For example, they show the name of animation of a task such as "accept" and want users to produce gestures which they think fit with this "accept" action.

Our internal elicitation studies [1,4] indicate that, to document and analyze this process, researchers must (Issue1) *video/sound record* the whole process and *divide these recordings into meaningful pieces,* (I2) *get user feedback and questionnaire data* (if applicable), (I3) *match this data with video pieces*, (I4) *manually watch and code each video* to extract similarities and differences and (I5) *verify the coded data*. This process is quite time-consuming [7] and we believe that the current assistive tools do not accelerate and ease it. To feel this gap, we developed GestAnalytics which regulates this process covering both the experiment and analysis procedures.

Current tools which are used in gesture elicitation studies provide advanced annotation features to researchers. Two annotation tools, ELAN [2] and ANVIL [3], are the most common tools for user-elicitation studies. These tools are designed for adding notes and annotations to the specific parts of the videos and extracting them as text files. They provide many options and alternative settings and are considered as successful annotation tools. Another tool, GestureAnalyzer [7], was also specifically developed for gesture analysis and capable of tracking mid-air gestures and automatically analyze and illustrate them. However, this tool is specialized only for mid-air gestures and relies on existing technology. Thus, many studies using Wizard-of-Oz [5] or focusing on gesture elicitation for non-existing technologies [1,12] cannot benefit from this application. Moreover, none of these tools solves the mentioned issues.

To overcome these issues, we developed an analysis and an experiment tool for gesture analysis called GestAnalytics. During the experiment, it automatizes the process of matching the questionnaire data with specific videos. Moreover, it saves video pieces after each task is completed and eliminates the need for dividing videos after the experiment. During the analysis, it allows researchers to monitor up to 50 videos simultaneously and eases the process of comparing different videos for extracting their similarities and differences. It also provides a tagging tool for taxonomical coding and lets researchers filter all videos according to these tags. In this paper, we explain the features of GestAnalytics, how these features may help researchers and discussed the shortcomings and potentials based on our pilot tests.

GestAnalytics

Experiment Tool

Experiment Tool of GestAnalytics mainly automatizes the video/sound recording and matches the related questionnaire data to each video. In the conventional workflow, researchers video record the whole process and make participants fill a questionnaire after each

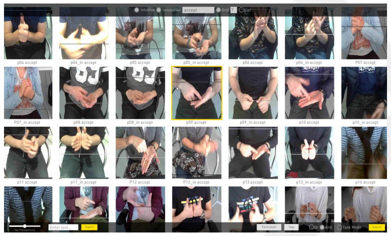

Figure 3: Simultaneous Video Monitoring

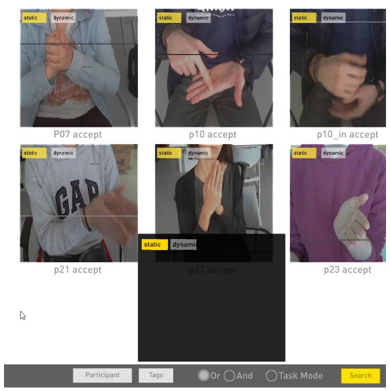

Figure 4: Some Videos which are filtered with "static" tag

task in a separate medium. In a randomized test, they have to keep track of each task name and match these with videos later on. Moreover, they have to watch each video to mark the parts that refers to gestures and divide these videos accordingly. By eliminating this time-consuming process, GestAnalytics records a single video for each task and save this video along with the questionnaire items and the answers by labeling them with the "name of the task and the participant." This data can be exported as a ".csv" file which can easily be edited with analysis software such as SPSS. With this new workflow model, researchers can gain time by skipping video dividing and data matching processes.

Analysis Tool

SIMULTANEOUS VIDEO MONITORING (FIGURE 3)

Gesture elicitation studies usually focus on extracting gesture sets which are preferable by users. For placing the most preferable gestures, the agreement scores of gestures for one task are calculated. This can only be done by identifying the similar gestures by examining each video. In a 20-participant user test with 20 tasks, a researcher has to open 400 video files and annotate or take notes about each to a separate medium. In GestAnalytics, 20 videos which belong to a task can be monitored at the same time, ordered in a customized matrix grid and zoomed in and out to examine it closely. Moreover, researchers can unmute to sounds of any videos to listen to participants' ideas if think-aloud protocol was applied during the experiment. Monitoring these videos simultaneously saves researchers time since they do not need to open each and every video file and more importantly create the opportunity to compare many videos at the same time.

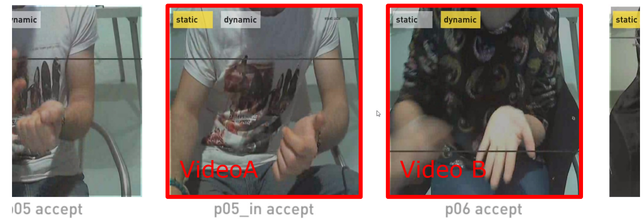

Figure 5: Tagging Feature

TAXONOMICAL TAGGING

Gesture elicitation studies, besides extracting gesture sets, can yield results such as gesture taxonomies. For taxonomizing a gesture set, each video needs to be tagged with the related taxonomy item. In GestAnalytics, tags can be added to the videos on-the-fly and when a taxonomy tag is added, it creates a slot in each video to be marked. In Figure 5, you can see two different videos which are tagged with different taxonomy items. In this example, gesture in the Video A has the "static" item while the one in the Video B has the "dynamic" item. Still, all videos have inactive items, that can be activated easily with a single click. In this tagging system, researchers can tag videos quickly and double-check their coding easily by comparing it to other videos. For further operations, tagging information can be exported as a ".csv" file.

FILTERING (FIGURE 4)

GestAnalytics lets researchers examine the videos per task in the default mode. However, tagging for taxonomy creation is a process with a lot of back-and-forth to make sure that each video is tagged with the correct taxonomy item. It is a burdensome process to check each video file to verify the tags. However, GestAnalytics allows researchers to filter and view all videos belonging to a tag or multiple tags at the same time. In this way, it is easier to notice faulty information about a taxonomy item. Additionally, videos also can be filtered per participant for making examinations about a specific participant.

Discussion and Conclusion

Gesture elicitation studies are common practices in the field and we believe that a specialized tool for this practice will be beneficial for many researchers in this area. We used GestAnalytics in one of our elicitation studies [1] and our observations suggest that it eases this burdensome process remarkably. Moreover, it also prevents many mistakes that can be raised due to the human involvement. For example, we experienced that matching the questionnaire data or naming them per tasks can be problematic and open for mistakes in our other similar studies [6]. Therefore, besides allaying the time-consuming process, GestAnalytics can help researchers to come up with more valid results with less faulty data. Moreover, filtering feature also will help researchers to double-check taxonomy items and decrease the erroneous information.

We believe that current tools for assisting the experiment and the analysis process for gesture elicitation studies fail to address main problems that researchers face in the process. Current tools offer many advanced annotation tools and even automatic analysis of gestures from videos. Still, dividing long videos into meaningful small parts, matching the questionnaire data, examination of videos and the verification process are very time-consuming processes and these have to be manually done by researchers to ensure the quality of the research project. Therefore, we developed a new tool, GestAnalytics, which assists researchers in these problematic areas which were not solved by existing studies and software. Although, in many research projects, customized software is created according to nature of the research data, our project proposes an interface framework that can also be adopted by customized software for overcoming the mentioned issues. A demo of GestAnalytics which includes our research data can be downloaded from the link (bit.ly/gestanalytics). We also plan to present GestAnalytics as an open source software as we improve the user interface for other researchers' use.

Limitations and Future Work

GestAnalytics is developed in Unity3D, which is a game engine. Unity3D is not a tool which is optimized for video viewing, thus the performance of the software can increase if it is moved to another platform which performs better for video rendering.

Continuous video recording, which should be divided into pieces afterwards, is a must for studies which requires the videos of uninterruptible events such as a conversation environment. Therefore, we also plan to improve GestAnalytics with tools speeding up the video dividing process. Moreover, although it prevented mistakes in coding and data/video matching, several videos were accidentally stopped by participants before recording the gestures in our study. Therefore, we need to implement a timer which prevents to stop recording before a certain period.

Percentage and agreement score calculation are quite common practices in gesture-elicitation studies. Hence, we plan to equip GestAnalytics with tools that can do these kinds of basic calculations without the need of a external software. After presenting the software to the field, we will continue improving the tool per feedbacks of the users.

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14.5. Paper 13: Hands as a Controller: User Preferences for Hand Specific On-Skin Gestures

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Conference: Proceedings of the 2017 ACM International Conference on Designing Interactive Systems Conference [h5-index: 31]

Role: Concept Creator, Main Co-Author, Design Researcher

Year: 2017

Type: Full Paper

Hands as a Controller: User Preferences for Hand Specific On-Skin Gestures

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ABSTRACT

Hand-specific on-skin (HSoS) gestures are a trending interaction modality yet there is a gap in the field regarding users' preferences about these gestures. Thus, we conducted a user-elicitation study collecting 957 gestures from 19 participants for 26 commands. Results indicate that (1) users use one hand as a reference object, (2) load different meanings to different parts of the hand, (3) give importance to hand-properties rather than the skin properties and (4) hands can turn into self-interfaces. Moreover, according to users' subjective evaluations, (5) exclusive gestures are less tiring than the intuitive ones. We present users' subjective evaluations regarding these and present a 33-element taxonomy to categorize them. Furthermore, we present two user-defined gesture sets; the intuitive set including users' first choices and natural-feeling gestures, and the exclusive set which includes more creative gestures indigenous to this modality. Our findings can inspire and guide designers and developers of HSoS.

Author Keywords

Mobile computing; on-skin input; touch input; skin gestures; elicitation study; two-hand input, free-hand interaction.

ACM Classification Keywords

H.5.2 Evaluation/methodology - Input devices and strategies - Interaction styles.

INTRODUCTION

Increasing presence of electronic devices in daily life enlarges their field of application, driving researchers to discover new interaction modalities for different purposes and use-case scenarios. Among many modalities, recent research emphasizes the on-skin interaction as an input field for remote controlling the devices. These studies indicate that skin can be auspicious as an input apparatus since it is always available with a wide surface area [43,49]. Moreover, gestures performed on skin are claimed to be superior in terms of social acceptance, required physical effort and precision compared to the free-hand/3D gestures [9,15] since their boundaries are more defined as the sensors can clearly recognize when the touch to the skin occurs. Furthermore, skin is also stretchable, enabling interaction styles from a wider range compared to traditional surfaces.

However, most studies who take skin as input surface work on the whole arm or the forearm as the work space. We believe narrowing the focus down to hands yields promising results for privacy, convenience, and efficiency as hands are always available [6], subject to high proprioception [42], require minimal movement [6], thereby socially acceptable [41] and available for producing distinct gestures [1,43] originating from hand properties like hand-posture. Users' preferences on HSoS gestures is an unexplored territory within the HCI field and previous studies did not present user-preferences for skin gestures that can be performed specifically in hand area. Furthermore, most studies work on gestures for specific devices like mobile devices [42], TV Remote Control [6] or smart watches [29,49] while we aim to produce more generalizable and inclusive results for remote controlling of any electronic device.

Another shortcoming of the previous studies is that their user-elicitation methodology was highly affected by other modalities such as the existing touch interaction practices. In a previous study, most of the skin gestures share very similar characteristics to multi-touch gestures [43]. Therefore, novel interaction techniques specific to on-skin gestures are only partially available. We believe that user habits originated from touch screens and similar modalities cause this uniformity and users tend to fall back onto customary gestures when asked to produce new ones. This phenomenon was observed also by [23]. They claim that this "legacy bias" occurs because users do not want to spend too much mental or physical energy during the gesture production process. They propose three potential solutions to this problem, named as "production", requiring the production of multiple gestures; "priming", priming the participants to properties of the new modality before the elicitation; and "partners", grouping multiple participants to produce the gestures.

DIS 2017, June 10-14, 2017, Edinburgh, United Kingdom

ACM ISBN 978-1-4503-4922-2/17/06…$15.00
http://dx.doi.org/10.1145/3064663.3064766

In the light of this information, we followed a two-phased user-elicitation methodology to have an understanding of users' preferences. First phase focused on getting users to produce their own, preferred gestures for certain commands [45]. In the second phase, we followed a similar approach to "production" and "priming" methods [23] in which we asked users to propose gestures that were specific solely to this modality, considering the capabilities of hand and skin like elasticity or different hand postures. Therefore, in addition to most preferred intuitive gestures, we also introduce exclusive gestures. A total of 957 HSoS gestures were collected from 19 participants for 26 different tasks. We analyzed the produced gestures for their various characteristics, certain qualifications as perceived by the users and their agreement scores based on Wobbrock et al.'s formula. We required usage of two hands as most of the implemented technologies for on-skin input need two-handed interaction [6,11,42,43,49]. Although some studies also investigated one-handed on-skin gestures, these are usually referred to as micro-gestures [18,19,44,47] and do not provide a diverse set of gestures because of the limited reaching capacity of thumbs and fingers. Therefore, one-handed interaction is not in the scope of our study.

As a result, with this study we contribute to the field with (1) a user-defined gesture set containing most preferred on-skin gestures specific to hand area, (2) in addition to the most preferred gestures, a set of exclusive gestures specific to this interaction modality, (3) analysis of various characteristics of gestures by creating a taxonomy and analyzing user input over the quantitative subjective evaluation scores, semi-structured interview and mental models, and (4) discussing implications for difference between intuitive and exclusive gestures, design implications and possible application areas.

BACKGROUND AND RELATED WORK

Skin-based input

Skin-based input systems are trending user interface modalities because of the skin's many affordances. Skin is claimed to have benefits such as its availability, accessibility and elasticity [9,14,30]. People work on it intuitively based on years of muscle memory and hand-eye coordination, even though it works reliably without visual feedback [21,42,43]. Instead of an external controlling system, skin-based technologies augment one's own body, creating a direct link between the user and the product [20]. Moreover, compared to the other free-hand modalities like mid-air gestures, these systems can be more precise [9] since touch/non-touch state can be interpreted as the beginning and end points of the gestures which normally created a blurriness in mid-air gesture systems [33]. They can also overcome the problems of getting tired and being socially unacceptable [21,28,36].

Many recent studies from diverse domains work on skin-based gestures as a form of input. Various methods have been developed to track skin touch which work by optical sensors [6,13,16], auditory sensors [14], electrical capacity [3,35], and magnetic sensing [4]. These studies present a large selection of application that realizes skin-to-skin input for device control, yet they do not guide the field about the skin-gestures preferable by users in terms of design specifications.

Still, several research indicated the user preferences for skin-gestures for specific parts of the body without being exposed to technical restrictions. Some of skin-based systems work on the whole body [21]. However, since touching various points on the body is not efficient and socially awkward in public settings, many studies have turned to the arm or the forearm as their input surface. Arms provide a reachable surface for the users as they are less likely to be covered by clothes compared to other body parts [43]. For example, [43] have found that when asked to perform a gesture anywhere on the arm, participants performed 50% of the gestures on the forearm and 44% on the hand area. However, we believe that the whole arm is still too broad for an efficient use since it lacks privacy and requires larger movements than conventional methods of interaction with electronics.

This selection of previous work shows that there are plenty of studies conducted on skin input. It is proved to be a usable and well-received modality by many users across different domains. Studies also investigate users' preferences and behavior regarding skin-based gestures. However, most of these studies use a large input surface and there is a gap in the field on the matter of hand-focused gestures.

Hand-focused gestures

Among other body parts, hands are particularly important for gestural interaction. First, hands enable various poses and gestures provided by numerous knuckles, resulting in a fruitful input set [1,7,34] and much effort has been put on hand posture detection [10,40,48]. Hands also provide a precise tracking for sensors as [42] have shown by developing a tracking system which can detect touch to inner palm with 1 mm error. [6] showed that users can detect 9 different areas of the inner palm eyes-free and easily interact with the surface. This indicates a high level of proprioception around the hand area resulting in increased usability. Hands are also unlikely to be covered by clothes, which makes them the most available and accessible skin surface on the body. Moreover, gestures performed by hands/palms are more acceptable in social environments [17,38], since they require minimal movement and can be concealed.

Parallel with above information, many studies were conducted on on-skin gestures focusing on the hand area. [6] created a palm-based interaction system for eyes-free TV remote controlling. [42] developed a system which recognize gestures drawn to the palm area. [11] implemented a palm-based imaginary interface and collected user data suggesting that palm-based interfaces are usable without visual cues. [38] generated a gesture-set and taxonomy for hand-skin interaction, yet it is done in a comparison context with other modalities and only for gaming scenario. These studies show that, much effort has been put into implementing and understanding the use of hand-specific on-skin gestures. However, user-preferences for this type of modality were not investigated by a focused study and for casual/daily interactions with electronic devices.

METHOD

For understanding the user preferences on HSoS gestures, we conducted a user-elicitation study. Guessability studies based on user-elicitation give voice to users' preferences and provide a user-centered design setting. Developers and designers often underestimate the needs and the preferences of end-users regarding gestures while developing gestural interfaces. A mismatch between designers' and users' mental models for the input gestures can result in a gulf of execution [27]. User-elicitation involves presenting users with tasks (referents) asking them to create gestures to accomplish these [45]. This method has proven beneficial for different types of novel systems across many studies [22,32,36,37,39,43]. Giving voice to users in the production process yields many benefits as it increases usability and provides designers with a solid ground where they base their inspirations for future work. Furthermore, these kinds of user-defined gesture sets resulted in increased memorability and likability, compared to designer-made gestures, even by users who have seen the gestures for the first time [25].

No	*Task name*	*No*	*Task name*	*No*	*Task name*
1	Select	10	Previous	19	Emergency call
2	Navigate	11	Switch task	20	Increase volume
3	Open	12	Scroll up	21	Decrease vol.
4	Minimize	13	Scroll down	22	Shuffle
5	Maximize	14	Accept	23	Play
6	Close	15	Reject	24	Pause
7	Zoom in	16	Accept call	25	Rewind
8	Zoom out	17	Reject call	26	Forward
9	Next	18	Mute		

Table 1: List of the tasks

Participants

A total of 19 undergraduate students took part in the study (M_{age}= 21,2, SD=3,1, 9 Females, 10 Males). All participants reported frequent use of computers and smartphones in daily life, so they were familiar with touch as a form of input.

Materials

21" size screen was used as a display for showing tasks. Gestures were recorded by Logitech C270 Webcam HD with 640x480 resolution that was placed to capture the upper body of the participant. This process was completed by an experiment and an analysis tool, which we developed and named GestAnalytics [2], to standardize the process and decrease human error factor (Figure 1 and 2).

Procedure

Participants were welcomed to the setting by the researcher and they signed the informed consent form. They were informed about the process and were asked to perform *two-hand gestures that involve skin-to-skin touch* for each video clip they saw, and then they filled the subjective evaluation questions for each gesture.

As the process began, the software we developed first asked the participant to (1) fill in demographic information, then

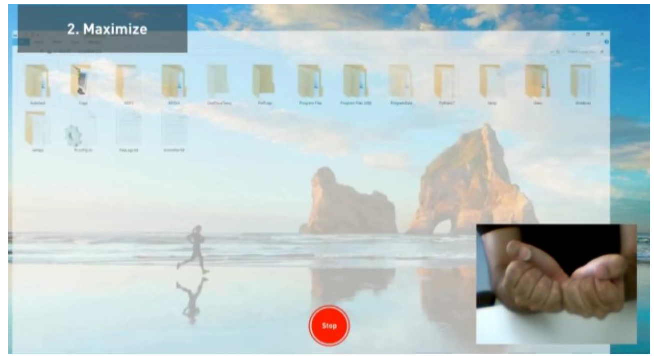

Figure 1:Recording of a gesture video for Maximize task

(2) presented a short clip of the task (e.g. a browser window maximizing as in Figure 1) with the command appeared in verbal form on the top of the screen (e.g. "Maximize"), (3) started recording with the participant's cue, (4) recorded as the participant performed their preferred gesture and (5) stopped afterwards, (6) presented subjective evaluation questions (Table 2) after the gesture of each of task [36], and (7) presented the clip of the following action when the participant clicked next. All 26 tasks (Table 1) were in randomized order for each participant (These tasks are a modified version of [24] by filtering the tasks for daily interaction). With this method, participants were able to complete the process with minimal interference from the researchers. The videos of the tasks were shown along with the relevant command name to create a cognitive feeling of completion for the participant. In the beginning, we asked participants not to limit themselves only to desktop or mobile devices albeit demos only showed several types of interfaces.

Following the user-elicitation method discussed earlier, participants were asked to perform skin gestures with two hands that felt natural and intuitive to them to complete the tasks that were shown. At the beginning of the study, they were encouraged to perform different gestures for each task so they would be pushed out of their comfort boxes to create

Item Code	
A (Memorable)	The gesture I have performed was memorable
B (Social) [46]	I can perform this gesture in a social environment without feeling uncomfortable
C (Fitting) [46]	The gesture I have performed was fit the for the task
D (Tiring) [36]	The gesture I have performed was tiring

Table 2. 7 Point Likert Scale Subjective Evaluation Items

variation, but same gestures were accepted when participants wanted to perform it again for different tasks. There was no limitation to the types of gestures they performed, with the only mandatory condition being skin-to-skin touch. Think aloud procedure was also applied to obtain rich qualitative data, where participants were asked to verbally describe which movements they were making and why they chose that specific gesture. At the end of this production process, we obtained the "*intuitive gesture set*".

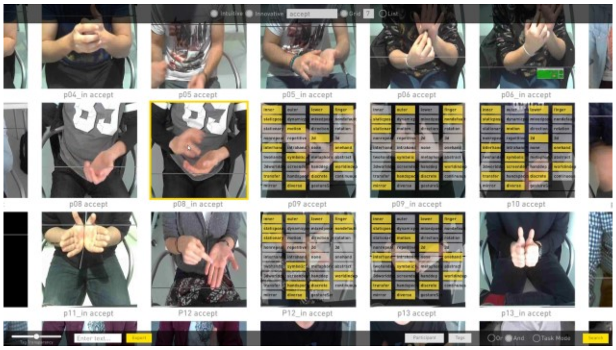

Figure 2: Analysis tool for participant gesture videos

After this phase, the second phase began with an identical process. The only difference was that participants were asked to perform more creative gestures. They were explained that some of the gestures they performed earlier were actually transfers from existing user interfaces like multi-touch screens; thus this time they were requested to avoid this and use their hands in more innovative ways that benefit the hand properties like hand posture, finger positions and skin elasticity. They were told that they could perform the same gesture they produced in the first phase if they believed it follows this rule. Based on the second phase, we obtained the "*exclusive gesture set*". Finally, researcher carried out a short semi-structured interview with the participants focusing on their attitudes towards this kind of a controlling system and scenarios or contexts where this system could be preferred over classic ones. In total, the two phases and the interview took approximately 50 minutes.

Coding and Analysis

Taxonomy

Firstly, a new system of taxonomy for classifying gestures was created. With this taxonomy, we aimed to categorize gestures according to various features and wanted to acquire a quantitative record of the characteristics of HSoS. Later, another software for better analyzing the data was developed. As seen in Figure 2, all gestures belonging to a single task can be seen in one window enabling the researcher to identify patterns and differences within a task easily. All participants' video clips for the related task play simultaneously, so one can either focus on one single user's suggested gesture or overview all suggested gestures for one task at once. Moreover, one can tag each video with different keywords, in our case with taxonomy elements. This way, all gestures were examined according to our taxonomy and tagged one by one. A total of 988 gestures were collected, yet 43 of them were dropped from analysis due to the corrupted recording or lacking of skin-to-skin contact in the performed gesture. One experimenter who is experienced in gesture coding and another trained coder coded the data. 20% of the data was coded by both coders with 81% agreement; conflicts were discussed and dissolved as done in the literature [5].

Agreement

Agreement score (*A)* among all suggested gestures for each task was calculated based on the following formula [45]:

$$A = \frac{\sum_{t\in T}\sum_{Pi\subseteq Pt}\left(\frac{|Pi|}{|Pt|}\right)^2}{|T|}$$

In Eq. 1, t represents a task in the set of all tasks T, P_t is the set of proposed input actions for task t, and P_i is a subset of identical input actions from P_t. The range for A is [$|Pt|^{-1}$, 1].

The agreement scores were calculated separately for intuitive and exclusive gestures. Since intuitive gestures were performed in the first phase and were the first choice of participants, we expected them to feel natural and thus agreement scores for intuitive gestures to be higher compared to exclusive gestures' scores. An important part of calculating agreement score is the identification of similar gestures within the set of all proposed gestures for each task. We marked gestures which were identical, very similar with minor differences or shared similar mental models as "similar" gestures. The gesture which had the highest count among all gestures was selected for the final user-defined gesture set. For example, during the second phase opening joined hands like book had a count of 6 over 19 gestures for *open* task so it went into the *exclusive gesture set.*

Subjective Evaluation

We ran paired sample t-tests on the means of subjective evaluation scores to get an idea of what participants felt about the gestures they proposed. These scores were used to determine the most liked and disliked gestures, examine the differences between intuitive and exclusive gesture sets and were evaluated along with other results to see if they yielded any correlations.

RESULTS

Taxonomy

There are several types of gesture classifications in the field, but we did not encounter one directly related to HSoS gestures. [46] created a taxonomy for surface gestures examining characteristics like hand pose, movement and gesture location. We followed a similar method where the main skeleton of the taxonomy was inspired by Wobbrock et al.'s surface gestures taxonomy [46], but we further involved considerably more and some revised categories since our study extends beyond surface gestures. Composing this taxonomy was a process of repeated examination of the data and extensive discussions among the authors. Every time one of the facets failed to exhaustively cover an aspect of a gesture, new terminology was created to include these aspects. By creating this new categorization system, we aimed to achieve a new arrangement where HSoS gestures can be analyzed thoroughly.

Hand posture category refers to the condition of the hand while performing the gesture. "Surface" subcategory indicates which surfaces of the hand are involved in the skin touch. "Pose" refers to the hands' shape and is based on [37]'s *Form* category. In this group, *default pose* refers to situations where hands are either held flat or one hand is flat

Category	Subcategory	Tag	Description
Hand Posture	Surface	Inner	Touch on the hand's inner surface
		Outer	Touch on the hand's outer surface
		Lower	Touch on the lower area; palm/back of the palm
		Upper	Touch on the upper area; fingers
	Pose	Static Pose	Pose held same during gesture for both hands
		Dynamic Pose	Pose changes during gesture for both
		Mixed Pose	One hand static, one hand dynamic
		Default Pose	Flat hand or pointing posture
Hand Action	Movement	Stationary	Hand is stationary in one location in 3D space during gesture
		Motion	Hand changes location during gesture
	Movement Nature	Direction	Movement has deliberate, specific directionality
		Rotation	Rotational movement from the joints
		Non Repeatable	Random movement, not replicable
		Repetitive	Exact movement is repeated to complete task
	Depth	2D	Movement only in x and y axes within its world
		3D	Movement in x, y and z axes within its world (depth)
	Environ ment	Inter Hand	Movement limited to two hands
		Intra Hand	Movement extends to 3D environment around the two hands
	Moving Hands	One Hand	One hand moves
		Two Hands	Both hands move
Nature		Symbolic	Gesture visually depicts a symbol
		Metaphorical	Gesture indicates a metaphor
		Abstract	Gesture- task mapping is arbitrary
Binding		3D World Dependent	Location defined on actual 3D world space
		Screen Dependent	Location within hand defined based on mapping from the screen
		Hand Dependent	Location based on the form of hand
		World ndependent	Location is irrelevant to any factor
Interface		Transfer	Gesture is transferred from existing interface modalities
		Hand Specific	Gesture is specific to human hand interface
Flow		Discrete	Task response occurs after the gesture
		Continuous	Response occurs while gesture is performed
Hand Relation		Mirror	Two hands do the same gesture
		Diverse	Two hands do different gestures

Table 3. Taxonomy Categories and Tags

while the other one uses the index finger as if using a tablet screen. We decided to mark these two specific incidents of posture since they were very common among all gestures. *Hand action* category is based on the movement of the hand. "Movement" subcategory indicates whether hands move in space to perform the gesture. If gesture is *stationary*, no further examination is made within the hand action category. However, if the gesture is in *motion*, we report different characteristics of this movement.

Since these "Movement nature", "Depth", "Environment" and "Moving hands" subcategories are only used for gestures which are *in motion*, it should be kept in mind that their percentages, by design, cannot be equal with elements which are applicable to all gestures. For example, the percentage for *inner* tag could be valid for all 484 intuitive gestures whereas *inter-hand* tag can only be valid among 360 dynamic intuitive gestures. It is also important to note that elements of the "Movement Nature" and "Surface" categories are not mutually exclusive, and therefore one gesture can have multiple tags from those categories.

Nature and *Binding* categories were borrowed from [46]'s taxonomy with minor modifications. *Nature* category refers to the mental origin of the gesture and how the relation between the task and gesture was made. *Binding* indicates whether the location of gesture was deliberate and if so what it depends on. *Interface* refers to whether the gesture was a transfer from other conventional modalities (keyboard, mouse, touchscreen etc.) or can be performed uniquely within this modality. *Flow* is another category borrowed from [46] which marks whether the action is completed by the computer as the gesture is occurring or after it has been completed. This tag was most relevant for tasks like *increase volume* or *scroll up* since the amount of increasing or scrolling depends on the duration of the input in many other interfaces. Finally, *hand relation* signifies whether the two hands were doing the same gesture or not.

We had 484 intuitive gestures at the end. While 124 of these gestures were *stationary*, 360 involved *motion*. Similarly, out of 473 exclusive gestures, 133 were static and 341 involved motion. A breakdown of all taxonomies is shown in Table 4.

Agreement

The user-defined gesture set was one of the main goals of this study. Most preferred gestures for each task is depicted in Figure 4 and the comparison of agreement scores are reported in Figure 3. These sets contain both the intuitive and exclusive most-preferred gestures. We illustrated one gesture for each task in both gestures sets, even when the agreement scores were low since we believe that these demonstrate the mental models of the participants and create inspiring and noteworthy alternatives for each task. As we expected, there was a higher rate of agreement among intuitive gestures (M=0.24, SD=0.16) compared to exclusive gestures (M=0.14, SD=0.04), $t(25)$=3.00, p<.01.

In intuitive gesture set, *scroll down* and *scroll up* tasks had the highest agreement scores among all. This result is not

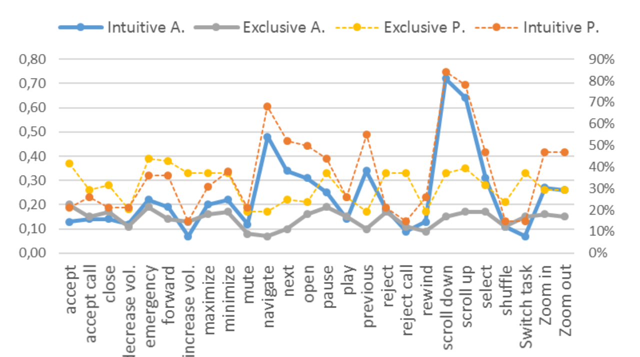

Figure 3: (A) Agreement Scores and (P) Percentages of Gestures in User-Defined Gesture Sets

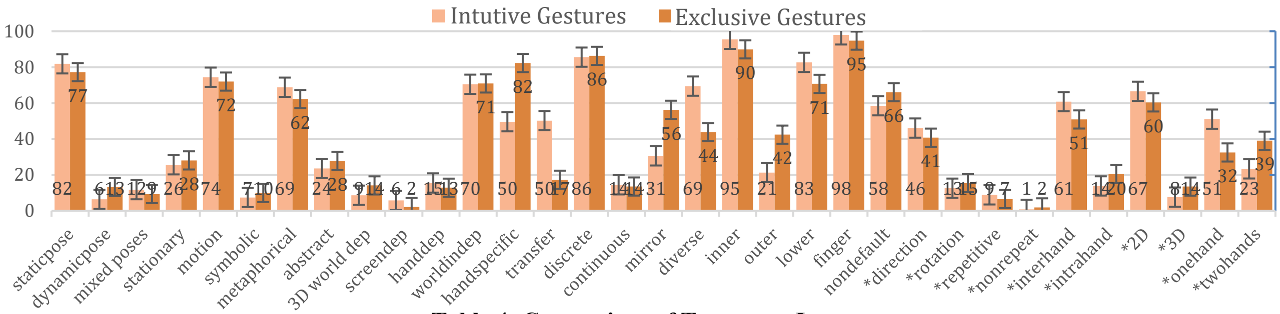

Table 4: Comparison of Taxonomy Items

surprising since scrolling is a widely-used task either in desktop computers or mobile devices. *Increase/decrease volume, mute, shuffle* and *switch task* were those among the lowest agreement scores. These tasks are either not frequently used compared to the scrolling or they have different command sets (e.g. switch task is alt-tab for Windows OS while it is double pressing the home button for iOS). Therefore, they did not evoke a clear memory for participants. *Accept*, *pause* and *emergency call* had the highest scores among exclusive gestures. *Accept's* agreement score was even higher than its counterpart in the intuitive set. Similarly, *switch task* also has a higher score than the intuitive one. Moreover, *accept call, close, emergency call, increase volume, play, reject, reject call* and *shuffle* tasks have similar agreement scores with intuitive gestures. All of these gestures do not carry a clear gesture memory from existing interfaces or a visual correspondent when compared to some other tasks like zooming or scrolling. Therefore, we can state that exclusive gestures can be alternatives especially to tasks that do not have a strong gesture memory or depend on visual cues such as accept, reject, shuffle, play etc. Moreover, the case of *Switch task* and *accept* may show that during the study participants were so much accustomed to transferring from existing modalities, they were not able to think of a gesture that can be more suitable or even intuitive for the action.

The resulting user-defined intuitive gesture set contains 186 of 484 suggested intuitive gestures, culminating a 38.43% coverage of all suggestions. Exclusive gesture set contains 130 of 473 suggested gestures, covering 27.48% of all.

Subjective Evaluation

As expected, intuitive gestures had higher mean scores for items A (Memorable), B (Social) and C (Fitting) than exclusive gestures. This difference was significant for items A, $t(25)=5.18$, $p<.0001$; for B, $t(25)=7.75$, $p<.0001$, and C, $t(25)=2.08$, $p<.05$. We expected this result since intuitive gestures were mostly transferred from the interfaces that participants were used to use. Therefore, the gestures proposed by the users were naturally easier to remember, feel less awkward to perform in social environments and better corresponded to the tasks. The comparison of average subjective evaluation scores for each task is in Table 5.

A remarkable result of subjective evaluation was that exclusive gestures were perceived as less tiring than intuitive gestures. Item D (tiring) had significantly lower scores for exclusive gestures than intuitive ones $t(25)=3.33$, $p<.001$. This result is also visible from the exclusive gesture set. Overall, the exclusive gesture set has 13 gestures with the *stationary* tag while the intuitive set only has 5. Furthermore, we observe less directional gestures in exclusive set which may suggest the motion in these gestures are more minimal or subtle as in *open* gesture. Therefore, we can state that although gestures proposed in the intuitive set may be easier to get used to, it does not always mean that they are more usable. The unique characteristics of hands to form different poses create opportunity to express tasks with less motion.

After evaluation scores were determined, we ran correlations between evaluation scores and agreement scores for each task. Although there were some individual tasks showing clear preference based on their high ranks in both agreement scores and subjective evaluations as mentioned above, we only found a significant relation for item A in intuitive gestures, $t(24)=0.47$, $p<.05$. For all other items in both gesture types, there were no significant correlations. It should be kept in mind that this evaluation only gives idea about the perception of the users and should be elaborated with further studies in actual use-case scenarios.

	Intuitive				Exclusive			
Task Name	***A***	***B***	***C***	***D***	***A***	***B***	***C***	***D***
accept	6,37	6,21	6,00	2,05	6,37	6,16	5,84	1,47
accept call	6,42	6,58	6,00	1,63	6,00	5,95	5,68	1,53
close	6,32	6,58	6,11	1,95	6,00	6,26	5,58	1,58
decrease v.	6,37	6,42	5,79	1,79	6,11	6,11	5,47	1,68
emergency	5,74	6,21	3,74	1,79	6,05	6,26	4,84	1,74
forward	6,26	6,58	5,79	1,74	6,00	6,16	5,79	1,58
increase v.	6,42	6,37	5,84	1,63	6,32	6,26	5,79	1,63
maximize	6,37	6,42	5,68	1,89	6,26	6,26	5,74	1,63
minimize	5,89	6,32	5,11	1,68	5,89	6,16	5,63	1,63
mute	5,84	6,32	4,79	1,74	5,63	6,21	5,16	1,53
navigate	6,58	6,58	5,63	1,79	6,11	5,95	5,53	2,05
next	6,58	6,74	6,32	1,74	6,26	6,37	5,68	1,63
open	6,21	6,11	5,89	1,63	6,05	5,95	5,68	1,89
pause	6,37	6,53	5,68	1,53	6,42	6,37	5,79	1,47
play	6,05	6,53	5,26	1,68	6,26	6,00	4,95	1,53
previous	6,58	6,42	5,84	1,89	6,32	6,32	5,95	1,53
reject	6,63	6,58	6,21	1,63	6,37	6,21	5,74	1,37
reject call	6,42	6,42	5,89	1,84	5,95	6,16	5,74	1,63
rewind	6,37	6,42	5,84	1,74	6,00	6,21	5,47	1,63
scroll down	6,53	6,58	6,16	1,58	6,11	6,21	5,89	1,53
scroll up	6,68	6,47	6,53	1,84	6,26	6,21	5,84	1,37
select	6,37	6,53	6,00	1,84	6,11	6,16	5,11	1,58
shuffle	6,16	6,32	6,05	2,11	6,21	5,89	5,89	1,42
switch task	5,79	6,63	5,05	1,84	5,37	5,95	4,79	2,11
zoom in	6,58	6,63	6,11	1,89	6,00	5,84	5,79	1,63
zoom out	6,47	6,58	5,89	1,63	6,05	6,05	5,58	1,74
Mean	**6,32**	**6,46**	**5,74**	**1,77**	**6,10**	**6,14**	**5,57**	**1,62**
SD	*0,26*	*0,15*	*0,57*	*0,14*	*0,23*	*0,15*	*0,33*	*0,18*

Table 5: Average subjective evaluation scores for each task

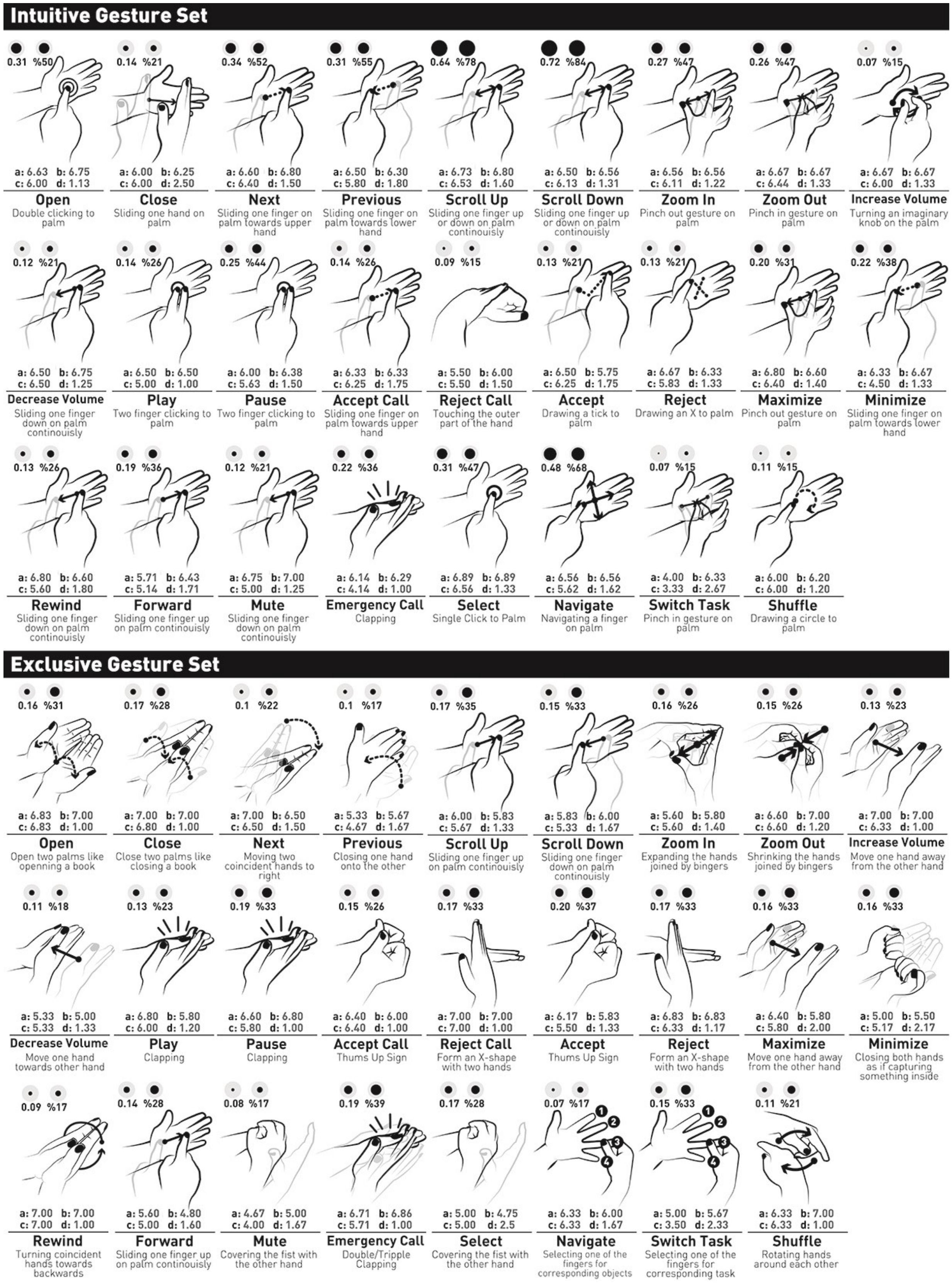

Figure 4: Intuitive and Exclusive Gesture Sets. (a,b,c and d refers to A (memorable), B (social), C (fitting), D (tiring) orders respectively. Dots in the left corner of each gesture represent agreement score and percentage respectively. Dashed Line: Discrete Motion, Continuous Line: Continuous Motion)

The means were also calculated specifically for gestures in the gesture sets. For the gesture sets, the significant difference between intuitive and exclusive gestures disappeared for items A, C and D, $p>.05$. Intuitive gestures still scored higher than exclusive ones in Item B, $t(25)=2.18$, $p<.05$, but since the exclusive gestures are uncommon to perform in social environment, this is expected. This lack of difference between two gesture types shows that for those gestures that people agreed upon, the level of fitness is the same and exclusive gestures in the set are just as usable as intuitive ones. Still, in Figure 4, the total number of gestures in the average calculation differs for each gesture. Therefore, this information only gives idea about the users' disposition towards that specific gesture, not for comparing gestures.

Semi-Structured Interview

Five participants saw the remote controlling opportunity without mediator device as the biggest advantage. They claimed that it would be especially beneficial in home environment where electronics around the house can be easily controlled from a single point. They also believed this interface is fast and efficient since one directly interacts with their own body, which makes it practical and accessible.

Participants' biggest concern was that the obligation to use two hands was *limiting*, where in some tasks one hand would be sufficient. Although item A (memorability) had an average of 6.21 out of 7, three participants believed that the gesture set necessary to use the system would be hard to memorize and this could cause user-related problems. A conceptual interface with all 26 tasks may have overwhelmed the users in that case, and in more simple systems with fewer tasks memorability may not be an issue. Last concern reported by three participants was that using the system in public could be awkward since outside observers would not immediately be able to understand that the user is engaged with an unseen device. However, the overall mean of item B (social) was 6.3, pointing to almost complete agreement with gestures' social acceptability. These participants may have answered this question considering gestures performed poor in Item B.

Overall, participants were excited to try a new type of interaction and reacted positively to being involved in the production process of a new system. They believed such an interface could allow multitasking where one has their hands dirty or while driving. Other than home use, contexts such as gaming, disabled users and teachers in the class environment were introduced by participants as potential areas of use.

Mental Model Observations

Although there is plenty of quantitative data regarding different characteristics of user-defined gestures, an examination of underlying mental patterns of participants is necessary to understand and interpret the numbers. Some of our most salient observations are already noted by previous work in their analysis of mental models based on think-aloud data [24,43]. The most explicit one was that participants frequently fell back onto touchscreen gestures that were readily available in mind. Tasks which do not possess a popularly recognized gesture scheme such as *reject call, pause* and *emergency call* yielded more hand-specific gestures as participants were compelled to create more innovative ones. Moreover, we observed that taxonomy item *transfer* decreased in exclusive gestures while *hand specific* item showed a significant superiority. This indicates that the second phase of the study worked for yielding gesture types which can be unique only to this modality as expected. An expected but still a prevalent case was the use of reversible gestures for reversible actions. Tasks such as *zoom in/out, scroll up/down* were almost always the exact replications of their opposites, with only the direction of movement changing. The rest of our observations are our novel contributions to the field.

Part of the Hand is a Factor

Different surfaces of the hand held different meanings for the participants. We observed that the inner palm was seen as the "main" surface to base gestures upon. Some participants pushed their calls "away" from their palms for *reject call* by swiping their whole hand over the palm, therefore excluding it out of the hand. A similar case is the outer surface of the hand which is often associated with "negative" actions. *Reject call* is a good example where participants tapped on the outer surface of the hand because it was the "other" area. P5 reports, "*It is the back of my hand, so it is a refusal movement*" as he taps on the outer fist. Use of fingers was also notable. Although the index finger is mostly used for pointing, when the metaphor of fragmentation was needed, finger area was the preferred choice because of their separated form. This was most salient in *switch task* where different fingers had different programs assigned to them which would be opened when the finger is selected.

One Hand as Reference Point/Object/Surface

One of the hands was often used as the reference point or the touch surface. For example, in *increase volume* from the exclusive set, one flat hand was still while the other flat hand would move away from it, and the distance between the two would represent the increased volume. For touchscreen-transfer gestures, they would hold one of their hands flat and worked on it with the other hand as if using a multi-touch screen. Therefore, most of intuitive gestures involved the movement of only one hand whereas the use of two hands increased for the exclusive gestures. When they were forced not to use the touchscreen anymore, the second hand became more active and the use of 3D space surrounding the hands increased, as can be observed in *3D world dependent, 3D, non-default pose* and *twohands* of the taxonomy.

Hands also transformed into many different objects from daily life. For example, for the task *mute*, P7 suggested a gesture where one fist became a speaker and the other hand covered it as if shutting its sound down. *Switch task* and *select* from exclusive set and *increase volume* and *reject call* from intuitive set are examples for this tendency. These gestures show that hand is easily imagined as a more customary object when users are faced with more abstract versions of similar tasks they perform in daily life.

Behavior Observations

We reported the common behaviors and characteristics that we observed even if these were not verbally expressed by participants in think aloud process.

Become the Interface

When participants were instructed not to use the touchscreen metaphor anymore in exclusive gestures, they often tried to create an interface or feedback system of their own. In intuitive gestures, they imagined the flat hand as the customary touchscreen. However, with exclusive gestures, they were forced out of this comfort zone and the habitual imagined feedback was gone, so their gestures became more physically present and contained more spatiality. For example, *open* was a single click for intuitive gestures, but it was opening two flat hands as if opening a book for the exclusive gestures, which was a more visible gesture and defined in starting and ending points. Similarly, P09 triple tapped his palm for *emergency* in intuitive gestures but made his hands into a wing shape for the exclusive gesture, using the metaphor of a helper angel. We believe participants could not rely on simpler gestures anymore when they lost the advantage of past experience, so they created gestures that were more well-defined and give feedback signaling the completion of the task. *Open, close, mute, minimize, switch task in* exclusive set can be examples of gestures which provide self-feedback. We can also observe this as gestures with *dynamic pose*, *3D world dependent, non-default pose* tags increase in exclusive set.

Unsophisticated Use of Skin

Most of the gestures involved movements such as clapping, clicking or dragging fingers along the hand surface which are quite habitual movements in daily life, outside of any electronic context. Contrary to a previous study which focused on skin-gestures in arm area [43], participants did not prefer using rather complicated actions such as pinching or twisting the skin or using the fingernails for their gestures although we had highlighted the skin properties of hand during gesture elicitation process. This indicates that although exclusive gestures differed from intuitive ones in terms of the space they occupy, the amount of movement and different hand postures; the use of the skin and the hand surface remained simple and unsophisticated for both gesture types. This may have originated from the fact that when hands were involved, the manipulation opportunity for posture, movement availability in 3D environment or use of different areas like finger zone, palm and outer hand overcame the preferences for skin-manipulation in gestures.

DISCUSSION

Our findings about reversible and transfer gestures, and agreement score averages corroborate with Weigel's study [43] which similar to ours in terms of methodology. However, while results of [43] mostly elaborate on upper arm and skin properties like elasticity, our work specifically focuses on hand area. Our results, contrary to [43], suggest that skin use was not common and other hand properties were more frequently used. As a result, their final gesture set has 3 hand-specific gestures whereas all of our gesture set consists of hand-specific ones. Thus, different from [43] our results interest research like [6,8,11,42] directly while [43] focuses to a wider part of the body. We further present exclusive gestures by comparing to the intuitive ones, obtaining remarkable results such as exclusive gestures being perceived less tiring than the intuitive ones. We also present a 33-element taxonomy quantifying the characteristics of hand use that may be useful for also other hand related studies like [19,31].

Intuitive and Exclusive Gestures

Legacy bias is an inevitable part of creating novel interaction techniques, and our findings indicate that participants often fall back onto habitual gestures in order to avoid mental and physical demand [23]. They do not only produce conventional gestures, but also believe those are fitter to the related tasks than the exclusive gestures. Still, we can observe that most of the gestures are almost identical in intuitive gesture set like *volume, scrolling, next, previous, forward* and *rewind*. Therefore, these gestures can be used without confusion only when one of these functions present. A system that has availability to play a video and manipulate the volume of the sound at the same time would not be able to benefit from the intuitive gesture set. Therefore, although agreement scores and percentages are mostly lower, exclusive gesture set forms a favorable alternative to intuitive gesture set. Moreover, it also shows similar agreement scores between tasks that are abstract in nature and do not have a strong gesture memory.

Other than that, exclusive gesture set can be more favorable in use-cases where a visual interface is not available since most of these gestures have meanings independent from the visual context. For example, *open* gesture represents a book and when it is open, user can understand the opening action is completed without seeing it on a display.

Design and Development Implications

Our observations suggest that hands can be perceived as interface elements by participants. In the intuitive gesture set, one hand usually replaced the actual screen and participants performed gestures on one of their palms. The exclusive gesture set yielded similar results, yet hands were considered as various objects instead of screens. For example, it became a speaker in *mute* task where the user covered it to prevent sound spreading. In this direction, we suggest designers to make use of hands' capability of transforming and being perceived as different objects.

Furthermore, hand is perceived as a segmented interface. Participants perceived outer part of the hand as negative and dedicated it to negative actions like rejecting an incoming phone call. Fingers, inspired by their form, are considered as segmented interface elements like tabs. Moreover, palm is recognized as an area to keep things in, other than a control surface. Therefore, while designing gestures for such interfaces designers should mind the different parts of the hands so they can assign gestures which require less movement and still be in parallel with users' minds.

In terms of the development, we classified requirements for our gesture sets as *detection of relative hand positions, posture detection, rotational and directional movement and single and multiple finger tracking in palm.* We recommend possible technologies which work towards realizing these aspects. For detecting relative position of hands, millimetric-radar wave sensors [19] can be used. [19] can also detect basic postures like open hand or fist which are sufficient for our gesture set. For finger tracking, [49] proposes a way to include a ring sending AC signals and a wrist-worn bracelet and [42] comes forward with an IR cam and a laser-line projector worn on wrist. With placements on upper or bottom part of the wrist, these can also recognize inner or outer parts of the hand as touch area. Fingers can be tracked with a sonar as in [26] by placing it around the hand. [26] is also speculated to track multi-finger gestures, yet an implementation was not made. Multi-finger tracking is possible with computer vision as in [12], however it is disadvantageous because it requires a stable cam that constantly sees the palm and is liable to low-light conditions. Finally, movement detection can be provided with IMU sensors by placing it to wrist's closer part of the hand. All technologies require wrist, hand or head worn devices. Thus, in daily use, usability of these devices can be a concern, which is beyond the scope of the current study. Other than that, we must indicate that there is not a current sensor fusion system that can realize the proposed gesture sets. However, this area is developing rapidly and a system that can recognize our gesture sets can be developed with the proposed methods.

Possible Application Areas

Participants proposed several application areas for usage of HSoS. Although most of the previous work suggests the usage of skin gestures for mobile devices and smart watches, users favored the usage of this system also for remote controlling of devices like TV, PC or tablet. They also found it useful when they are far away from their mobile devices.

One of the use-cases proposed by participants was using this modality while driving for controlling the radio or other car functions without taking hands off the steering wheel. However, only simple actions like tapping the back of the hand or connecting two hands over the steering wheel can be used. Another context proposed was watching a recipe while cooking. In this case, they expressed that this system may be useful since touching to any device would not be comfortable or hygienic. Participants' speculations indicate that this modality can be useful in conditions where direct contact with the devices is not possible or preferable.

CONCLUSION

In this study, we conducted a detailed analysis on hand-specific on-skin (HSoS) gestures preferred by users. With the user-elicitation method, we created a 33-element taxonomy and analyzed gestures based on the subjective evaluation and the semi-structured interview data of the users. Upon these, for the very first time we developed two user-defined HSoS gesture sets with gestures referring to various qualities of hands. While one of these is based on users' natural preferences, the other one has the potential to inspire designers to create more innovative interaction techniques while still staying loyal to users' expectations.

Among all results regarding to underlying mental models of users and insights to negative and positive sides of such interface, we put forth that users found exclusive gestures less tiring than the intuitive ones, indicating that hand-specific interface designers and developers should look for the systems which should detect not only the directional movements of the hands but the 3D motion, different postures or interaction with different parts of the hand.

We believe that HSoS gestures is a promising way for skin interaction and our data is inspiring for both designers and developers. Benefiting from the amorphous form of hands and many potential postures, unexplored areas other than the palm can be integrated into gesture design with increased usability. Moreover, compared to previous work, interaction and interface designers can benefit from the exclusive gesture set which provides a better understanding for novel gestures that can only performed be within this modality.

LIMITATIONS AND FUTURE WORK

The study was conducted while participants were seated. Sitting may have primed the participants towards inertia which resulted in smaller actions. They may have produced more physically demanding gestures if they stood freely and this can be tested in future studies.

All participants were university students who have extensive experience with touchscreen devices. An older generation who does not share touch-screen habits may result in a decreased proportion of transfer gestures from conventional modalities. Still, we observed some participants transferring gestures from old-fashioned phones or binoculars. Thus, an older generation could hold habits which will still result in transfer gestures, only from older types of devices.

This study was conducted in Turkey with Koç university students. Since social norms are highly influenced by culture, social acceptability is open to change under different contexts. Although our findings are mostly congruent with previous work, replicating the study in various other cultures may result in differences in social perception of gestures.

ACKNOWLEDGEMENTS

We thank Işıl Sager for her efforts during the gesture-elicitation study. Moreover, we thank M. Yarkın Ergin for his support in the research process.

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14.6. Paper 14: It Made More Sense: Comparison of User-elicited On-Skin Touch and Freehand Gesture Sets

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Conference: Distributed, Ambient and Pervasive Interactions: 5th International Conference, DAPI 2017, Held as Part of HCI International 2017 [h5-index: 20]

Role: Concept Creator, Supervisor

Year: 2017

Type: Full Paper

It Made More Sense: Comparison of User-Elicited On-skin Touch and Freehand Gesture Sets

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Abstract. Research on gestural control interfaces is getting more widespread for the purpose of creating natural interfaces. Two of these popular gesture types are *freehand* and *on-skin touch* gestures, because they eliminate the use of an intermediary device. Previous studies investigated these modalities separately with *user-elicitation methods*; however, there is a gap in the field considering their comparison. In this study, we compare user-elicited on-skin touch and freehand gesture sets to explore users' preferences. Thus, we conducted an experiment in which we compare 13 gestures to control computer tasks for each set. Eighteen young adults participated in our study and filled our survey consisted of NASA Task Load Index and 4 additional items of *social acceptability, learnability, memorability, and the goodness*. The results show that on-skin touch gestures were less physically demanding and more socially acceptable compared to freehand gestures. On the other hand, freehand gestures were more intuitive than on-skin touch gestures. Overall, our results suggest that different gesture types could be useful in different scenarios. Our contribution to the field might inspire designers and developers to make better judgments for designing new gestural interfaces for a variety of devices.

Keywords: Gestures · Comparison · On-skin touch · Freehand · User-elicitation · Mid-air · Embodied interaction · Skin gestures · On-body gestures

1 Introduction

Today digital artifacts come in various shapes and dimensions. With decreasing and increasing sizes of instruments (e.g. smart watches, wall-sized displays etc.), traditional ways of interacting with existing interfaces such as the pointer (WIMP) paradigm become more and more ineffective and impractical. One of the alternative methods of interaction that has a promising future is gestures. Until now, various gesture recognition devices and gestural interfaces have been presented for interaction [1–7]. The interaction modalities for these devices predominantly fall into three categories: handheld devices, touch gestures, and freehand gestures.

N. Streitz and P. Markopoulos (Eds.): DAPI 2017, LNCS 10291, pp. 159–171, 2017.
DOI: 10.1007/978-3-319-58697-7_11

Among these gesture types, *on-skin touch gestures* and *freehand gestures* come forward as they offer an interaction model where intermediary devices, such as remote controllers, are no longer needed. Previous studies have explored these models separately with various device implementations [2, 7, 8] and user-centered studies [9–12]. However, there is still a gap in the field regarding a comparison of user experience of these two gesture types. There is not enough design knowledge, which informs designers about strengths and shortcomings of these modalities that points to appropriate application fields comparatively. To produce this design knowledge in this unexplored area, we aim to investigate users' preferences about these gesture types and see the conditions in which one would be advantageous to the other.

In order to make a comparison of on-skin touch and freehand gestures, we procured and adapted two user-elicited gesture sets: a skin-to-skin touch gesture set obtained by our previous study [13], and a freehand gesture set, obtained by Vatavu [14]. In this work, our goal was to explore users' intuitions and preferences regarding these gestures. Twenty participants evaluated thirteen computer tasks and their corresponding gestures, which were taken from each set, summing up to twenty-six gestures in total. We used the NASA Task Load Index (TLX) [15] to evaluate users' subjective evaluations about the gestures. We added four 7-point Likert scale items about social acceptability, learnability, memorability, and the 'goodness' [16] of gestures to this Index.

Our findings reveal that on-skin touch gestures were less physically demanding and more socially acceptable compared to freehand gestures. It suggests that on-skin touch gestures are more suitable for daily use where time and space are limited resources. They are more appropriate for controlling smaller personal devices such as smartphones. In comparison, freehand gestures were more convenient for large displays. Since they were found to be more engaging, they can be more suitable for entertainment contexts such as TVs or gaming consoles. Predominantly, our results suggest that different gesture types have different advantages in different contexts. Our work contributes to HCI community in inspiring designers and developers to choose and design new gestural interfaces for various devices and their ambient displays.

2 Related Work

2.1 Gesture-Based Interfaces

With varying size of displays, the need for new interaction modalities emerged to create better-suited methods for controlling vast amount of technological devices in different sizes. Interfaces with accustomed modalities such as WIMP paradigm have shifted towards interfaces with novel modalities such as gestural interfaces to fill the gap. Studies investigated gestural interactions with various application devices such as different home appliances [17] and ambient displays [18] with the aim of evaluating types of gestures proposed. Others tried to understand and define gestures for these diverse contexts [19, 20]. However, participatory experiments regarding mainly large screen implementations [1] revealed the users' preferences and shifted the focus to 'intuitiveness' of the gestures [21–23]. With the aim of achieving this intuition, several studies focused on designing gestures through user-elicitation methods instead of pre-defined design methods [24–26].

Moving on to user-centered approach of gesture design, Nacenta et al. underlines the importance of user-elicitation methods as they create more memorable results [27]. They further argue that users explicitly prefer user-elicited gesture sets over pre-defined sets as they seem more usable. On the other hand, the reason behind this preference is still ambiguous. Heydekorn et al. evaluate a user-elicited gesture set by conducting a usability test to clarify the ambiguity [28]. The participants of the study were able to use an interactive display, spontaneously through touch gestures they did not know of, which indicates the benefit of intuition for controlling ambient displays.

2.2 Gesture Types

There are many interaction modalities presented to control ambient displays; however, handheld devices, touch gestures, and freehand gestures predominantly adopted user-elicitation method in creation. Among these gesture types, on-skin touch gestures and freehand gestures stand out, because they offer an interaction model that excludes the use of intermediary devices, such as remote controllers or touch sensitive displays. In this section, we address these two gesture types that we incorporated in our study.

On-skin Touch Gestures. In this gesture type, the input is taken with the various contact methods of two skin-related items. There are different subsets under this category with various elicitation and implementation methods. As an example, Cahn et al. has created a set called Single-hand Microgestures (SHGMs), in which the users touch different parts of their palms with different actions to carry out the referent, using only a single hand [29]. Despite the fact that SHGM clearly creates a more subtle, discrete and mobile interaction with devices, it also lacks to propose an implementation method other than external hand tracking sensors. On the other hand, several studies proposed implementations of on-skin touch gestures through using an armband [2], a wristband [3] or a smart watch [5] for partial recognition of body parts. Skinput can even detect multiple parts of the body through acoustic transmission with an implementation of an armband [7]. All of these studies propose a method to measure the input of a single user. On the contrary, Nakatsuma et al. use another armband to measure the electrical capacitance between two users by active bioacoustics measurement [4]. It creates new application fields for on-skin touch gestures by adding a second user to the equation; however, lack of user experience is still an issue regarding on-skin gestures.

Freehand Gestures. In this gesture type, the input is taken by moving one's hand in mid-air. Studies investigated freehand gestures by evaluating and defining the gestures [30], and by understanding users' preference and creating a taxonomy [31]. While creating sets for freehand gestures, studies mainly focused on devices that will be controlled. As an example, Henze and Hesselmann created a user-elicited gesture set for music playback [32], where as several other studies focused on creating a user-defined gesture set for controlling televisions [33, 34]. These studies create an advantage for users to control necessary referents for specific devices; however, they also lack to evaluate the general perception of freehand gestures from users' perspective. To enhance the solution, some studies focused on feedback of freehand gestures in which users can understand if they performed the gestures right. Hood and Karvinen proposed haptic feedback regarding the issue [35, 36]. Nonetheless, it still lacks to fulfill users' experience over ambient devices.

2.3 Comparison of Gestures

Until now studies evaluated these gestures within the boundaries of their own sets. Both user preference and elicitation studies only concern a single type of gesture set, although there are several studies that compare a type to another. BodyScape is a device implementation that can both recognize freehand and on-skin touch gestures [6]. The study both compares and combines these two types of gestures for large displays. However, it does not compare every gesture one-by-one and it lacks to report the results of this comparison. Instead, what the study reports is a combination of freehand and freehand-on body elicitation study. Moreover, the on-skin touch gesture set they use to compare is not a user-elicited set, where some of the gestures have extreme actions like touching the feet. In another study, Jakobsen et al. compare touch and freehand gestures for large displays [37]. They reported that although touch gestures were faster to perform and easier to select small targets, when the affordance of movement was calculated freehand gestures were preferred over touch gestures. Both of these studies clearly investigate advantages of one type of gesture over another; however, they are limited to a single scenario of controlling a large display.

Adverting to the concern, Vatavu compares handheld and freehand gestures for ambient home entertainment displays [14]. He reports that users prefer handheld devices to perform gestures because they prefer buttons and familiar actions such as WIMP paradigm. The work illustrates users' experience towards two different gestures types, yet it does not compare usage scenarios with new interaction modalities, where there is no use of accustomed intermediary devices. The results demonstrate users' bias for already known interactions. On the other hand, what we strive for is to understand user's preference for new interaction modalities for different contexts.

The literature review suggests that despite the shift toward users' experience concerning different gesture types, there is still a gap in the field regarding a comparison of user experience for new modalities. There is a lack of design knowledge to inform researches about which gestures will be advantageous for varying technological devices and contexts. We aim to explore users' preferences comparatively for these gesture types to produce design knowledge in this uncharted area. Thus, we designed a study to compare on-skin touch and freehand gestures, and observe the conditions in which one would be advantageous to the other.

3 Methodology

3.1 Participants

Twenty individuals (12 females and 8 males) participated to our study. Participants' ages ranged from 18 to 26 ($M = 21.15$, $SD = 2.01$), and they were all university students with various level of education from undergraduate level to PhD. All participants were right-handed and regular technology users with no professional relationship to design and/or HCI. Although we have conducted a previous user-elicitation study for creating on-skin gesture set, none of the participants were engaged in creating that set and they performed the gestures for the first time in their lives.

3.2 Setting

We conducted the experiment in an audio studio located in our university to minimize the external stimuli and control for possible extraneous variables such as lighting. There were 3 computers in the room (Fig. 1), where the first one (A) recorded videos via two external cameras, one in front of the participant (A1) and one above (A2). The second computer (B) displayed the survey to the participants via an external screen (B1). The third one (C) transferred the videos and the actions of the gestures to a LCD TV (C1) that was visible to the participants. Also, one of the two experimenters (D) used this computer to perform wizard-of-oz (WoZ) actions. The interface displayed to the participants was an edited Microsoft Power Point presentation, where the actions of the tasks were controlled by a simple click of WoZ.

Fig. 1. The setting of the experiment: (A) Computer no. 1, (A1) Camera no. 1, (A2) Camera no. 2, (B) Computer no. 2, (B1) Survey screen, (C) Computer no. 3, (C1) LCD TV, (D) Wizard-of-oz, (F) Participant

3.3 Gesture Sets

Freehand. We obtained the freehand gesture set from a previous work done by Vatavu [14]. In that study, he conducted a user-elicitation experiment with twenty participants (12 females and 8 males) with various technical backgrounds. The participants were all right-handed similar to our case. He collected the gestures using Xbox's Kinect sensor. Originally in his study, he obtained 22 freehand gestures for corresponding tasks with some task having more than one referent. However, for this study we chose 13 tasks, which correlated with our previous study [13], and chose the gestures with the highest agreement scores set by Vatavu (Fig. 2).

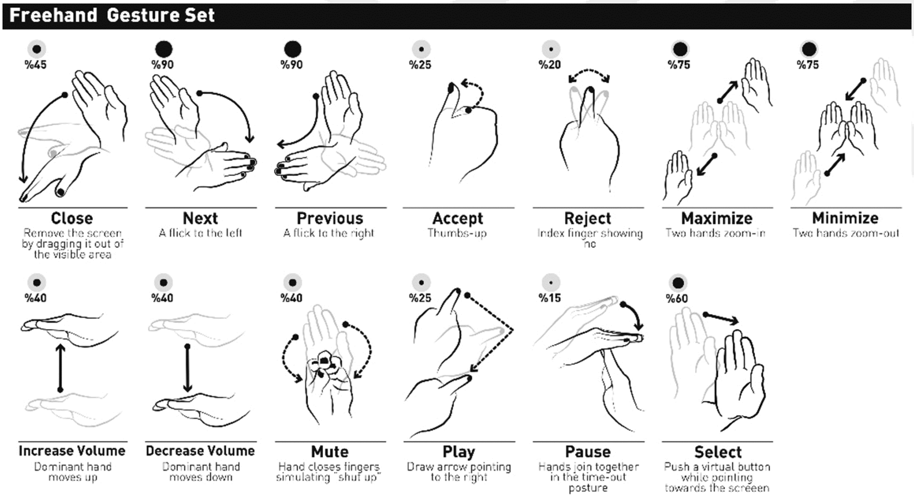

Fig. 2. Freehand gesture set for 13 tasks

On-skin Touch. We used the on-skin touch gesture set from our previous work [13]. Nineteen undergraduate students (9 females and 10 males) participated in that study creating two on-skin touch gesture sets, an intuitive and an exclusive set. These sets included 26 tasks each and again we selected 13 tasks that correlated with Vatavu's set [14]. We mainly chose the referents from the intuitive gesture set due to higher agreement scores; however, some of the referents were very similar for different tasks because of being intuitive. When this was the case, we gave the referent with the highest agreement score to the corresponding task and replaced the others from the exclusive gesture set. As a result, we obtained an on-skin touch gesture set with 13 referents with the highest agreement scores (Fig. 3).

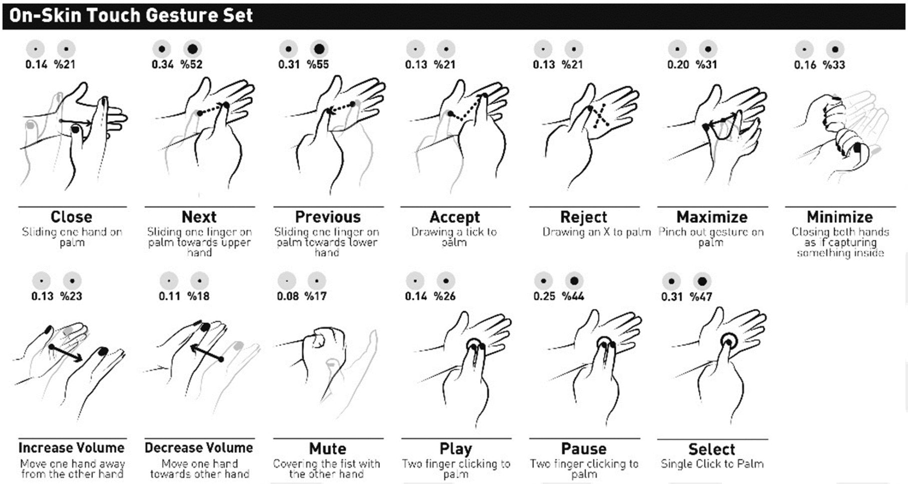

Fig. 3. On-skin touch gesture set for 13 tasks

3.4 Procedure

First, the participants were greeted to the setting and seated. Here, while the first experimenter informed the participant about the experiment and handed the informed consent forms, the second experimenter started the video recordings. Both the experimenters and the participants signed the two consent forms, one for the participant and one for the experimenters. Then, the participants were situated in front of the main screen where they were visible to the cameras. Here, participants were told that they would see two gesture sets on the screen, both containing the same 13 tasks but different 13 corresponding gestures. The order of these sets was counterbalanced for each participant such as first on-skin touch gesture set or first freehand gesture set. Also, the order of these tasks was randomized for each participant and each set.

As the process began, the participants were asked to watch the videos of the gestures with the task name on top twice and repeat the gesture when the command screen shows up. They were told if they repeat the gesture as they see, *'the machine'* would recognize the gesture and carry the necessary action for the corresponding task. We first presented a sample gesture (e.g. open menu) for each set to show them the process. After they successfully repeated the gesture and the WoZ initiated the action, they filled our 7-point Likert scale survey consisted of NASA Task Load Index (TLX) and our additional questions of social acceptability, learnability, memorability, and the goodness (Table 1). As the participants filled the surveys, we went over the questions together to make sure they were understandable. When the participants were done with the sample survey, we filled in their demographic information and chose their groups (e.g. on-skin gesture set first).

Table 1. 7-Point Likert Scale survey questions

No	Index code	Question
1	Mental demand	How mentally demanding was the gesture you performed?
2	Physical demand	How physically demanding was the gesture you performed?
3	Temporal demand	How hurried or rushed was the pace of the gesture you performed?
4	Learnability	How hard was it to learn the gesture you performed?
5	Memorability	How hard was it to remember the gesture you performed?
6	Performance	How successful were you in performing the gesture?
7	Effort	How hard did you have to work to accomplish you level of performance?
8	Frustration	How insecure, discouraged, irritated, stressed and annoyed were you?
9	Goodness	How fitting was the gesture you performed to the task?
10	Social acceptibility	How comfortable would you be in performing the gesture in public?

Next, we continued with our designated gestures. The participants again watched the videos twice, repeated until they were successful and filled the survey for each gesture. Mention that although we presented a single large display to control with gestures to shorten the process, we continuously reminded the participants to think for various and ambient devices they use. They were also encouraged to think out loud and comment on anything that comes to their mind. After they finished all 13 tasks for the first set, we again showed a sample gesture and repeated the procedure for the second set. Subsequently, we seated the participants again and had a semi structural interview about the process. Here we also informed them about the WoZ process. In total, the procedure lasted approximately 30 min.

4 Results and Discussion

4.1 Survey Results

Two of the participants were dropped from the analysis because they were outliers in multiple items, leaving 18 participants for the final analysis. Repeated measures ANOVA was conducted for the items in the 7-point Likert scale survey, controlling for order effects of seeing either gesture set first. Results showed that freehand gestures (M = 1.62, SD = 0.56) were found more physically demanding than on-skin touch gestures (M = 1.28, SD = 0.33), $F(1,16) = 10.55, p < 0.01$. Freehand gestures (M = 6.07, SD = 0.91) were also less socially acceptable than on-skin gestures (M = 6.62, SD = 0.42), $F(1,16) = 10.77, p < 0.01$. For all other items in the survey, mean differences between freehand and on-skin gestures were not significant, $p > 0.05$.

4.2 Mental Model Observation

In this section we will share the results of semi-structural interviews together with our insights regarding participants' behavior during the study. Predominantly, participants preferred freehand gestures (8 participants) over on-skin touch gestures (5 participants). However, another 5 participants expressed that both sets have advantages over the other considering various end devices, thus they want to use both of these sets. They indicated that the preference could easily shift from a device to another, so there should be a personalization option for the given sets, where the user can decide which modality to choose. In this section, we will discuss pros and cons of these gesture sets over the other in the given contexts.

Physical Demand. One of the significant items in our comparison analysis was physical demand. Four participants specified freehand gestures as *'large.'* Five further participants described them as *'tiring'* and *'difficult.'* On the other hand, 3 participants found on-skin touch gestures as *'easy.'* The significance of the result may be due to higher physical demand caused by the nature of freehand gestures. Freehand gestures are indeed take much space and effort in reality. Their use of larger space felt too much for some participants while the on-skin touch ones were easier because they require less effort.

Intuitive vs. Artificial. We observed that most of our participants perceived the palm as the multi-touch sensor. They transferred the metaphor of accustomed devices such as the smartphone or the tablet onto their hands and perceived on-skin touch gestures as similar. Therefore, we observed a legacy bias of standard smartphone touch gestures onto the on-skin touch gesture set, with 5 participants pointing that these gestures were *'habitual.'* One participant expressed this situation by referring to on-skin touch gestures as "transporting the touchpad to the palm." As a result, another participant indicated it to be *'artificial,'* pointing to its man-made qualities. They evaluated accustomed gestures (e.g., swipe left for "next") as *'boring.'* On the other hand, many of the freehand gestures were taken from daily life, which one naturally performs while manipulating actual objects. Two participants even reported that they are *'suitable for daily life.'* Another 2 participants found freehand gestures as '*intuitive.*' Additionally, the interviews revealed that the gestures which were derived from symbols (e.g., thumbs up for "accept") were more liked because they were claimed to be more memorable and that they "made more sense."

Social Acceptability. The other significant item in our comparison analysis was social acceptability. Twelve participants reported that they would prefer on-skin touch gestures in public context, while freehand gestures had less social acceptability on the survey questions. We believe this relates to many factors such as the size of the gestures, their relatively covert nature and their *'artificial'* quality. First, as many participants indicated, freehand gestures take up larger space and this constitutes a problem while performing gestures on the street or on crowded public transportation. The possibility of trespassing strangers' personal spaces was one of the main reasons why these gestures would not be socially acceptable in public. Second, on-skin touch gestures are usually performed within the palm area and can easily be concealed from public by correctly positioning the hand. Since they take small space, they can easily go unnoticed by public, providing the user with increased privacy in his use of the sensor. Finally, on-skin touch gestures are perceived to be more man-made while freehand gestures resemble gestures used in daily life communication. Therefore, some participants thought freehand gestures could be perceived as rude in the public context if strangers confused command gestures with communicative gestures. Since on-skin touch gestures are clearly directed towards an electronic device, these have a higher social acceptability.

Areas of Use. Participants suggested many application areas or contexts for both gesture types. A general overview reveals that on-skin touch gestures were mostly seen appropriate for controlling *'smaller personal devices'* or those require more *'precision.'* Two participants reported they would prefer these gestures for *'reading'* or 'writing'. On the other hand, freehand gestures were found more *'fun'* (2 participants) and *'immersive'* (1 participant), which resulted in them being suitable for *'large displays'* (7 participants). Five participants also indicated they can be used to control *'public displays'* such as an interface of an automat or a presentation for a meeting. Further, 2 participants indicated a use for 'gaming' correlating with immersion, another wanted to interact with *'holograms'* using freehand gestures. Participants believed they could have more fun with these gestures and increase immersion in multimedia by performing such large, intuitive gestures.

5 Conclusion

In this study, we compared user-elicited freehand and on-skin touch gestures through a user participatory experiment. In this experiment, twenty participants completed 13 tasks with the correlated gestures for each set and filled our survey. Our results revealed that on-skin touch gestures were less physically demanding and more socially acceptable. On the other hand, freehand gestures were found more intuitive. Further they were expressed as more fun and immersive.

From our results, future interaction designers should take account that smaller and artificial gestures like on-skin touch gestures are more appropriate modalities for publicly used devices such as mobile phones, mp3 players, smart watches or maybe even POS machines. They are preferred by the users because these gestures are divergent from one naturally performs. They have a lower possibility to confuse public because they are clearly to perform or control some action. Also, the subtler nature of these gestures helps to conceal the action if wanted. Moreover, this nature also enables smaller movements for the gesture, which made participants think that they are more appropriate for smaller devices and the devices with precision. In a sense, most of the devices we publicly use are small devices because they need to be easily carried and mobile. Thus, there is also a link between small devices preference and public use advantage of on-skin touch gestures.

On the other hand, designers should also account that intuitive and immersive gestures like freehand gestures are more appropriate modalities for fun contexts such as gaming, watching movies, listening music, sports or maybe even cooking and using other home appliances. Users preferred these gestures because compared to on-skin touch gestures, which were found boring, freehand gestures are more engaging. They need the use of larger parts of the body with wider motions ending up immersing the user in the action they perform. That is one of the reasons why they are also preferred to be used in private actions, because the true immersion of the self can hardly be achieved with spectators. Furthermore, immersion and wide motions of these gestures are the reason why they are preferred to control large displays. Controlling televisions to large billboards or even an automat was more convenient for our participants. Thus, we can speculate, it is even more convenient to make a presentation using these gestures to be more engaging, although it is a rather public environment.

Although, we presented advantages of these two gesture sets over another in different contexts to inform designers of the modalities, note that many of the participants preferred to customize these sets. They want to use both sets according to their needs, which can change over situations. For instance, they prefer to use on-skin gesture set to control their smartphones during a crowded bus trip, but they also prefer to use freehand gesture to control the same smartphone during a house party where they choose the music. Therefore, while both of the sets have clear advantages over another, interaction designers should also take account that these advantages are mainly context related and these contexts change over time. Thus, the most user-friendly way to approach the topic is to prepare a customizable interaction modality where users can adapt according to their needs.

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14.7. Paper 15: CHI 2039: Speculative Research Visions

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Conference: Proceedings of the CHI Conference Extended Abstracts on Human Factors in Computing Systems [h5-index: 85]

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CHI 2014, April 26 - May 01 2014, Toronto, ON, Canada
Copyright 2014 ACM 978-1-4503-2474-8/14/04…$15.00.
http://dx.doi.org/10.1145/2559206.2578864

Abstract
This paper presents a curated collection of fictional abstracts for papers that could appear in the proceedings of the 2039 CHI Conference. It provides an opportunity to consider the various visions guiding work in HCI, the futures toward which we (believe we) are working, and how research in the field might relate with broader social, political, and cultural changes over the next quarter century.

Author Keywords
Future, vision, fiction.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Prelude – Theme
What will be published at CHI 2039?

Our visions of the future profoundly influence current research. From the inspirational role of science fiction, to narratives about development and progress, to both utopian and dystopian predictions about the impacts of technology on society, the tomorrows toward which we work, consciously or unconsciously, significantly shape what counts as an important contribution in today's research. Despite growing acknowledgement of the importance of identifying and discussing such visions and their impacts [1,2,3,4], relatively few venues as yet provide the opportunity to consider what will constitute rigorous, publishable research in the future. This paper provides such an opportunity by considering what might be published at CHI 25 years from now.

The choice of a 25-year interval intentionally makes for a time point that is simultaneously both proximal and distant. Many of those who currently attend and publish at CHI will likely be alive and publishing in 2039. Conversely, papers published 25 years ago at CHI in 1989, long before smartphones, social media, and even the Internet, can feel almost as alien as some in this collection [5].

These abstracts were collected by soliciting submissions via the CHI-ANNOUNCEMENTS mailing list. The call asked authors to submit abstracts for "papers that might appear, will appear, should appear, or perhaps should not appear in the proceedings of the 2039 ACM CHI Conference."

The call resulted in submission of 33 abstracts. As described in the call for submissions, the criteria guiding selection of abstracts included "their ability to represent a diversity of guiding research visions, their excitatory or provocative potential, the space allotted by the CHI extended abstracts format, and the likelihood of engendering conversations about the future of HCI." The selection and curation process began with this paper's first author removing names and affiliations from all abstracts and reading through each. After reading all abstracts, they were sorted into three groups: "likely" to be included, "unlike" to be included, and "uncertain" about inclusion. The first author then reread the abstracts in each group, occasionally changing the group in which an abstract was placed.

All the abstracts in the "likely" group were then arranged in an effort to create a larger narrative structure. The goal was not to tell a story but instead to see each abstract as a movement in a musical composition, each providing a different variation on a theme, sometimes with resonances among different movements' variations. During the organizing process, if an abstract did not seem to fit well with the rest of the collection, it was moved to the "uncertain" or "unlikely" group. Conversely, if it felt as if there were gaps in the collection, abstracts were selected from the "uncertain" or "unlikely" groups to fill perceived gaps in the flow of the piece.

Thus, this process should not be seen as one of review but one of curation. The inclusion or exclusion of any particular abstract should not be seen as a judgment of its quality. Rather, the process was intended to select abstracts not that allowed for creating a thematic flow but also that hung together as a coherent whole. Ultimately, this process resulted in 15 abstracts being chosen for inclusion in this collection.

The abstracts included here span a variety of topics and application domains, from neural implants and memory manipulation, to bioengineering and body augmentation, to long-distance- and inter-species collaboration. Some provoke, some entertain, some insult, some condemn, some inspire. Navigating a space between science fiction, design fiction, and social fiction, these abstracts collectively represent a variety of visions for what the next quarter century of research in HCI might hold.

Abstracts – Variations

NEURAL INTERACTION THROUGH VISUALLY IMAGINED SHAPES

Florian Echtler || University of Regensburg

Delivering visual information to the human brain through direct neural stimulation of the optical nerve is now becoming commonplace. However, interaction with such a system is still performed through relatively slow methods such as sub-vocalization of speech or slight muscle movements. In this paper, we present a novel approach to performing interaction via a neural interface: by visually imagining simple geometric shapes such as a circle or a square, the user can issue commands to the system with very low latency. To this end, we adapt existing nanoprobes inserted into the user's visual cortex in order to extract a low-resolution image of what the "mind's eye" sees. After an individual training and calibration phase, simple computer vision methods can then be used to determine the visualized shape. A preliminary evaluation with 3 volunteers shows significant performance gains over more traditional means of interaction (Figure 1).

Figure 1: Reconstructed outdoor scene with visually imagined "get directions" command (red circle). Effective resolution is approximately 100 x 80 pixels.

TWENTY YEARS OF AUTONOMOUS DRIVING: A REVIEW

Andreas Riener || Institute for Pervasive Computing, Johannes Kepler University Linz

The first self-driving car cruised on our roads in 2019. Now, 20 years after, it is time to review how this innovation has changed our mobility behavior. This article sheds light on the topic from two sides, the driver (questionnaire analysis) and the car (trace data analysis). It compares statistics from NHTSA, the European Road Safety Unit, and the Chinese Ministry of Transport (MOT), as well as corresponding drivers from before (2016) and after (2036) the broad application of autonomous driving. The results are controversial: 1) fewer people own a private car (US/Europe/China: -17%/-29%/+3%), as cars can be ordered online and returned after for use by other drivers; 2) self-driving cars save lives (+2%/+4%/+1%) and improve on driving efficiency, as they eliminate the unpredictability of drivers; 3) driving is no longer perceived as fun, leading to changes in recreational activities, 4) drivers no longer have a social relationship with their cars and do not spend time on grooming or money on upgrades. As a consequence, the rate of outages increased, on average, by 8% compared to 2016 figures.

INTERNET OF PERSONAL THINGS VS. PERSONNET: WHICH MENTAL MODEL IS EASIER TO LEARN?

Michael Muller || IBM Research

We conducted user experience simulations using UxSims to compare two theories: IOPT (Internet Of Personal Things) and PN (PersonNet of personal objects). The UxSims generated three contrasting predicted emotion patterns for listening experiences. We obtained EmoPat evaluations from three potential human user groups (composers, mixnet creators, and listeners) and two musicbot groups (mymuse and crowdthump). Composers had the highest EmoPat ratings for collections of highly-similar tracks, while listeners and mixnet creators had higher ratings for diverse aggregations of tracks. The two musicbot groups took an intermediate position along the similarity-to-dissimilarity dimension. We discuss implications for design of future musicbots.

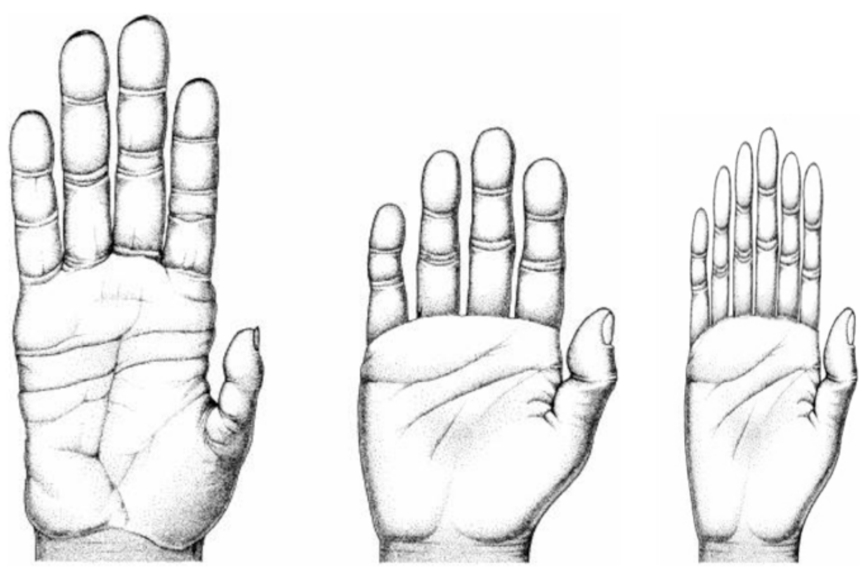

Figure 2: The evolution of humans hands. Chimpanzee's hand (left), homo sapiens hand (middle), homo technicus hand (2039 A.D.) (right) based on [6].

Using Mobile Touch Interfaces with More than 10 Fingers: A large scale study on how people with additional fingers use mobile touchscreens

Johannes Schöning[1,] Antonio Krüger[2] || [1]Hasselt University, [2]DFKI GmbH

Advancements in personal bio engineering have led to the mass production of low-cost extra body parts, as demonstrated for instance by artist Stelarc in the early 21st century. Nowadays, people can easily afford extra fingers to extend their interaction possibilities with various interfaces. Previous work studied how these extra fingers can increase performance and precision when interacting with various digital systems. In this paper we present the first large-scale study over a period of one year with 124 users that had 13.4 fingers on average. We investigate how different hand and finger configurations can help people interacting with computer systems and explore users' strategies and motivations. We found out that the optimal finger count is 12.5, with 6 normal-sized fingers on each hand and the dominant hand having an extra half-sized finger that can be moved with 6 DoF (Figure 2).

Being there in 2039: Embodied co-design with children

Allison Druin, Beth Bonsignore, Mona Leigh Guha, Tamara Clegg, June Ahn, Jason Yip, Leyla Norooz, Brenna McNally, Chelsea Hordatt, Mei Bie, Meethu Malu, Karen Rust || University of Maryland

Today's children expect to design their new technologies with children from around the world as well as across town. Currently, advances in telepresence technologies support remote yet embodied co-design techniques as easily as our face-to-face collaboration did decades ago. These robotic, social, and distributed technologies are not only welcomed by children, parents, and educators; they are the norm. Flash-mob co-design sessions between children and adults across India, the EU, and Antarctica are now commonplace. As designers continuously iterate and elaborate upon low-tech prototypes, they share via globally positioned 3D printers. Despite these technological advancements, researchers continue to struggle with understanding how differences in culture, resources, and a 'sense of place' can act as barriers to empowering co-design. In this video-paper, we apply a culture-sensitive lens to the now classic *extreme ethnographic* approach to highlight how nuances in cultures and native locales can both enrich and confound co-design with children.

PLANTASTIC: SOCIAL NETWORKING FOR BACK YARD FOOD PRODUCTION

Juliet Norton, Six Silberman, Don Patterson, Bill Tomlinson || University of California, Irvine

Increasing food insecurity, the rising cost of fossil fuels, and the natural resource tariffs being imposed by local governments have led to growing interest in back yard food production. Usage of systems such as the Plant Guild Composer, Grainiacs, and AgroforestryBook, which provide IT support for such efforts, has skyrocketed over the past several years. Related literature has demonstrated that the ecosystems designed by these tools would benefit from interaction (pollination, pest deterrence, nutrient gathering). This paper describes a system, called Plantastic, that makes friend connections across the online profiles of each of the plants in the ecosystems designed by these three tools. An evaluation with ten backyard gardens over two growing seasons suggests that integrating plant social networks increases yields by 4-12%, depending on proximity.

BORROWING ANCIENT CLUES FOR TODAY'S MORPHING MEDIA

Ahmet Börütecene, Oğuzhan Özcan || Design Lab, Koç University

Figure 3: Creating hand-made visual content on current morphing media by engraving.

Since the invention of image recording, our thinking on visual content creation has been conditioned mostly by flat surfaces. Alternative studies conducted to break this conditioning remained as experiments for lack of technology. However, today's media surfaces are able to assume any kind of shape, to "record without a camera" and "reflect like a mirror" what they see, and to offer every kind of interaction. This allows us to regain the previously lost possibility to create hand-made visual content by engraving literally on media surfaces themselves, as was the case with craftsmanship methods in ancient times. In order to achieve this, though, we need to thoroughly understand the creative processes in those ages and learn from them. This article, by re-reading non-flat content creation from ancient times, investigates what kind of clues we should collect for current morphing media content (Figure 3).

The Distance Matters Hypothesis in Earth-Lunar near-Synchronous N-meetings

Michael Muller || *IBM Research*

N-meetings emerged as a distributed form of e-meeting with role-based advantages in handling temporal and spatial challenges. However, long-term delays in synchronous meetings remain a challenge, especially for lunar members of earth-based teams. We compare two n-meeting protocols: a "fairness" protocol in which we inject earth-lunar equivalent delays into all messages (including earth-to-earth messages) vs. a "differential" protocol that assigns n-meeting roles according to actual or anticipated transmission delays. Unsurprisingly, the fairness protocol leads to better team satisfaction ratings for n-meetings with few role distinctions. More interestingly, the fairness protocol also leads to higher productivity assessments among these n-meetings.

What You and I Remember?

Shachar Maidenbaum || *Hebrew University*

Memory sharing is becoming part of every-day life, from education, to legal testimony, to social and even self-sharing. However, since current memory sharing interfaces only through existing sensory i/o channels to the brain, only the originator's series of multisensory perceptions are shared, not the actual memory. Thus, the receiver's experience of the memory might be significantly different. Here, we suggest a calibration algorithm based on a series of events, ranging from simple single-sensory stimuli to complex real-world scenarios. Participants (N=300) each underwent 75 events, and their sensory i/o were fully recorded. We then compared users' experiences with the same memory from different sources, including their own. We found that users easily recognized their own memories of the event when experiencing unprocessed memories (83%,$p<3E-17$), but when memories were calibrated to them their ability to recognize their own memory dropped significantly (41%,$p<2E-5$). This result has significant ramifications both for practical legal purposes, for generating synthetic machine "memories," for interacting in social memory-networks, and for our general understanding of memory and the uniqueness of our world perception.

My Liver and my Kidneys Compared Notes: User acceptance of collaborative recommendations from indwelling monitors

Michael Muller || *IBM Research*

Indwelling organ monitors can now be connected via personal ArterioNets. Using a temporary implant, we provided an external server where the output of each organ monitor was processed. In that server, we simulated enhanced inference engines that could one day be included inside each organ monitor. Our server also provided simulated ArterioNet communication protocols for data aggregations among the simulated inference engines. This architecture permitted an exploration of future inference networks built on top of ArterioNets. We computed simple health recommendations to users, using our servers' simulations based on each user's own organ monitors. While most users were skeptical, many users proposed additional features that could lead to greater acceptance and compliance with such recommendations.

Telling the Trees When We're Hungry: A novel interface to connect calendars to solar powered resource-production systems

Bill Tomlinson || University of California, Irvine

The downward spiral of the global economy over the past two decades has created an array of challenges for human wellbeing. New innovations, however, have addressed some of the human concerns that have arisen as a result. A well-known example is the rapid proliferation of the "Sun Tree" – a mechanical/electronic device shaped like a tree that uses solar energy to collect water vapor and CO2 from the air, synthesize complex carbohydrates, and provide both food and water for human use. This paper describes a novel interface for Sun Trees that enables those devices to integrate with the calendar systems of frequent users, predict likely future usage, and thereby reduce waste by allowing the Trees to store energy in their batteries and only produce resources when they are likely to be needed.

Something Doesn't Smell Right: How do you know when a thought isn't yours?

Daniel Gruen || IBM Research

The growing use of implantable memory jogs and inforetrievers introduces challenging questions about personal initiative and the provenance of one's thoughts. This is of particular concern with implants provided by providers who still derive much of their revenue from advertising, and the socioeconomic communities where use of such commercially-sponsored devices is most prevalent. We explored use of adjunct sensory channels, by accompanying sponsored information with a distinctive taste or smell, as hints that a thought had been influenced by an external entity. Most subjects learned to recognize such indications as triggers for skepticism, with smell proving most effective in practice. A second experiment showed how sensory nuances could be used to effectively indicate the source of external influence, such as from a commercial vs. a political entity, and the level of influence exercised.

Pixlay: Interaction with materiality of media objects and co-located users

Oğuz Turan Buruk, Oğuzhan Özcan || Design Lab, Koç University

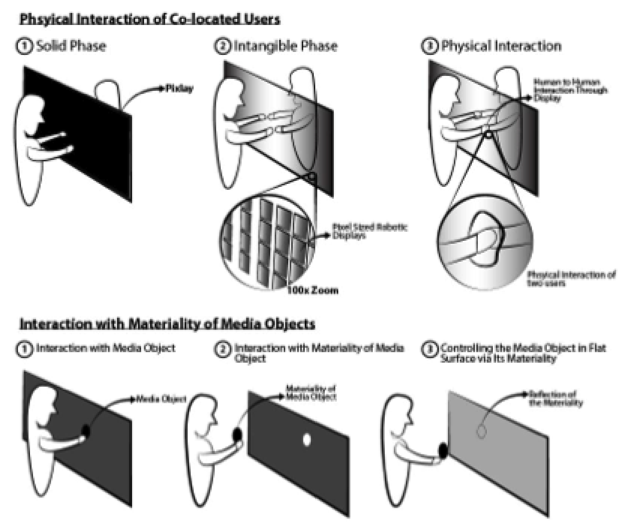

Figure 4: Interaction possibilities introduced by Pixlay.

Influenced by flat displays, we comprehend media objects as virtual presences. Moreover, flat displays let the interaction with media occur only between humans and computers. However, recent studies in the 2030s, on nano-robotic displays, constitute space for designing a novel interactive media environment comprising

Pixlays. Pixlay is a display capable of creating a transition between solid and intangible phases as well as of double-sided usage by making use of nano-robotic displays which replace every pixel in the display. This property makes it possible for users to interact with the materiality of media objects beyond their virtual presence and with co-located users physically, letting them penetrate the display via physical impact. The opportunities presented by this kind of system can be understood concretely if the interaction patterns in traditional shadow play are analyzed, since it encapsulates a similar interactive structure among puppets (materiality of media objects), puppets' shadows (media objects),the puppeteer and spectators (users). In this paper we propose interaction patterns for a novel interactive environment comprising Pixlays by extracting interaction patterns from traditional shadow play (Figure 4).

Seeing the Mall through a Faceplate: Understanding inter-species shopping experiences

Michael Muller[1], Ch'k'sh' F''''an[2] (Liaison officer Nr. 3) || [1]IBM Research, [2]Arcturian Expedition Liason

Limited access to Arcturian society has created challenges for human-initiated design of environments for collaborative undertakings. In response, the contact-liaisons of the Arcturian Expedition have sought new opportunities for engagements with human institutions. This paper provides an in-depth qualitative account of Arcturian experiences in a human shopping mall. We apply the principles of Reciprocal Simultaneous Ethnographic Encounter (RSEE) to co-analyze Arcturian experiences of human commerce, and human experiences of Arcturian commerce. We propose that further RSEE investigations can inform a research agenda for co-adaptation among our two cultures.

Resistance is Futile: Emerging techniques for extracting participation in collective intelligence processes

ST3V3N R055 || IBM Research

Even back in the early days of the 21st century, approaches such as CAPTCHA and PageRank were used to elicit computational contributions from unwitting participants who provided data or solved certain problems in pursuit of their own personal goals. With the advent of Massive Online Collectively Intelligent Entities (MOCIEs), the threshold was crossed where the collective brainpower of these collectives could be turned toward the goal of harnessing contributions from unsuspecting individual contributors in pursuit of their own enhancement. These entities have been providing free news sites, games, and other services which effectively harness the participants' efforts in furthering the goals, and indeed the cognitive processes of the entities themselves, often without the participants' knowledge. In this paper we survey the ten most prevalent forms of crowdharnessing that we have uncovered, and rate their effectiveness and ubiquity. Several of these methods were used by the author (a MOCIE, ourself) in the preparation of this paper.

Coda

The abstracts presented in this collection provide varied visions for the future of HCI research. Not only are they captivating in the details they provide, but the details omitted from or merely implied in the abstracts, such as the functionality of the Grainiacs or AgroforestryBook systems, the methods involved in extreme ethnographic approaches or a Reciprocal

Simultaneous Ethnographic Encounter, or how exactly musicbots complete the EmoPat inventory, become just as if not more compelling.

Several ideas also emerge and re-emerge across different pieces, such as memory manipulation, ecological crises, or biocomputing. Perhaps more interesting than the fact that these themes recur, however, are the variations in how they are presented and interpreted. Indeed both the similarities and the differences among these abstracts, and their concomitant visions, carry potential significance.

However, this paper explicitly avoids presenting any deep analysis of this collection for two reasons. First, the abstracts herein certainly do not constitute a representative sample of data about how the CHI community collectively envisions its future. Self selection biases, over-sampling multiple abstracts from the same authors, and other issues would likely make any conclusions drawn from such an analysis at least somewhat suspect.

Second, as a curated collection, the process of analysis and interpretation was left intentionally open. What to make of the collection, what it means or might suggest, is purposefully left up to the reader. Avoiding any rigorous analysis makes more room and creates more opportunity for a variety of interpretations, as may be found in the commentaries for this paper.

Ultimately, the conversational potential of such work as this lies not in the details of the futures depicted but in their ramifications for the present. In short, what do these visions of tomorrow suggest as important research directions to pursue today?

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14.8. Paper 16: Anything Left to Borrow From Cinema? Guidelines for Game Narrative

Co-Authors: Oğuzhan Özcan (Advisor)

Conference: CONFIA: International Conference on Illustration & Animation

Role: Main Author

Year: 2013

Type: Full Paper

Anything Left to Borrow From Cinema?

Guidelines for Game Narrative

Oguz Turan Buruk

Abstract

Storytelling in computer games is a subject on which many researches have been done throughout the years. With the technological development in rendering and animation techniques, the cinematographic approach to storytell- ing in games also improved dramatically making games stand closer to cinema. Therefore, we decided to analyze 7 movies to see if any alternatives left which games designers can barrow from cinematographic representation. As a result of our analysis we came up with 8 guidelines holding potential for enhancing the story telling in games. Our research showed that, the techniques used in cinema still have clues for storytelling in games and further researches will be useful for improving the quality of narrative in interactive stories of digital games.

Keywords

Storytelling, Narrative, Computer Games, Movies, Cinema

1 . Introduction

Storytelling in computer games is a subject on which many arguments have been emerged throughout the years. While some researchers claim that the games and storytelling are different domains and games does not have a pure story telling [1]; many other researchers believe that; we need to focus on how to enhance previous narrative experience in the game content. Above argumentation between gameplay and storytelling, mostly arises from the iterative nature of gameplay and the cut scenes (non-interactive parts which interrupt the game play for the sake of the story) which spoils the immersion of the game [2]. Although these problems exist, game developers have not left using cut scenes or telling stories in other ways. Moreover, current visual representation techniques improved by advanced technologies which provide many opportunities such as more realistic rendering, better realtime animation and sophisticated visual effects. These improvements result in more realistic and immersive storytelling sequences in video games.

Cut-scenes, being the main elements for expressing the story in the background, are likely to adopt camera movements, shot selection and framing from the cinematographic techniques [3]. "Point of view" -looking angle to the outside world which is defined as first or third person- also changes according to the camera angles as it is in the cinema [3]. In addition to these two, narration with motion is another mutual point of video games and movies. These three subjects are mostly experimented and developed in cinematography long before. Therefore we believe that there are still alternatives left which game designers can borrow from cinematographic representa- tion.

To improve this hypothesis, we have selected 7 movies of which their narrative structures and techniques have potential to be transferred to interactive stories of the computer games. The first three movies are Three Colors: Blue, White, Red [4] provides a genuine structure which makes unconventional relations between the movies of the trilogy. The forth movie, Run Lola Run [5], and the fifth movie, Sliding Doors [6] have stories branching into different story lines which can be named as "tree structure". "32 Short Films about Glenn Gould" [7] has a web structure [8] which is an unorthodox method holding a potential to be an inspiration point for interactive structures. And finally seventh movie Baraka [9] is chosen since it does not use any voice-over narration and express the information with only visual and audial composition which can be related with iterative sequences of the games.

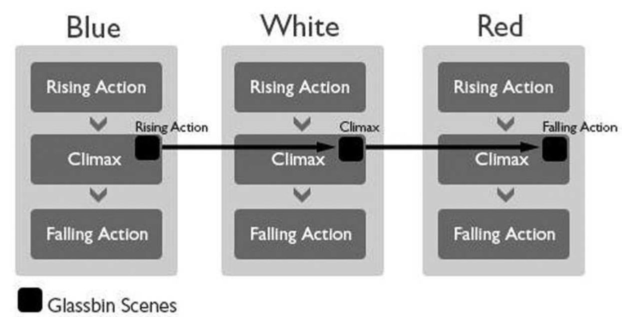
The analyze method of ours are based on narrative structures and narrative techniques used in the movies. Narrative structures vary into several different types which are named as Dramatic Arc, Kishōtenketsu, Hero's Journey, Hollywood and Robleto [10]. Dramatic arc, is the most known and used structure being defined with three main stages called "Rising Action", "Climax" and "Falling Action" in Freytag's Triangle. In dramatic arc, "rising action" is the part where characters are introduced. In "climax", the problem is explained and the "falling action" is the part which the problem is resolved. This structure can be a reference to even the most complex stories [11]. The movies chosen do not convey the traditional structures; however their complex forms of narrative structures can be explained by using terms of dramatic arc as it is done in this paper. After defining the structures, we will try to explain the narrative methods which makes possible to survive in these kinds of structures to see if they are sufficient for creating guidelines for the interactive stories of computer games overcoming the problems like interruption of the gameplay for the sake of the story. By this method, the guidelines for advancing the narrative in branched stories are also proposed in the paper finally.

2 . Unconventional Ways to Tell Stories

The trilogy of "Three Colors: Blue, White, Red" considered as the masterpiece of the Kieslowski includes the first three movie as mentioned above. The first movie of the trilogy, "Blue", is telling the story of "Julie" and dram after her husband dies in a traffic accident. In "White", a Poland Citizen Karol, his girlfriend and the tides of his life between France and Poland is the case. The last film of the trilogy, "Red", introduces us Valentine who is a student and a model in Geneva and depict the story between her and Kern who spies into the phone calls of citizens. In each movie, independent stories of different characters are narrated in a linear fashion. However, non linear structure of whole trilogy which connects these different characters to each other is the most exceptional side. The sequences where the characters in each movie come across, are placed in the plot of the trilogy in a way which makes the spectator create a link between movies in their mind. One of the scenes which takes place in a court can be given as an example for the sequences in that appearance. "The court scene" appears firstly in "Blue". The scene shows Julie being stopped by a courtroom staff while entering the wrong room incidentally. At this moment, the defense of the defendant is heard in a foreign language which is translated by a translator to the French. The same scene is repeated in "White", showing Karol, the main character who is Polish, defending himself, making us realize that the defense which we heard in "Blue" belongs to him. Soon after, we see the Julie who is stopped by the courtroom staff. Plot here makes us think that we saw the movie before. This confusing moment, immediately evokes our mind to create a bond between two movies, although there is not any direct connection in the stories. The method used is worth attention to understand an authentic way to connect different chapters or sequences. To simplify, showing same events from the different point of views or from the eyes of different characters can be used for creating links between chapters and sequences.

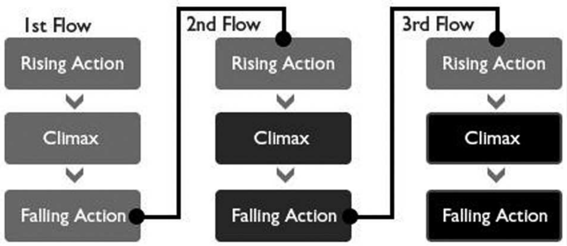
Apart from the court scenes, there are other obvious, yet indirect scenes which connect the three movies to each other (Fig. 1). In these scenes, an old person tries to throw a glass bottle into the glass bin. All three movies have the same scene, never- theless in each movie a different part of the story is narrated. In "Blue", the old woman tries to throw the bottle; however she remains incapable of reaching to the hole of the glass bin. The main character, "Julie", realizes the old woman when the sunlight reflected from the bottle disturbs her eyes, anyhow she chooses to remain indifferent to the situation. The climax of this short story takes place in "White" when the same process is iterated by an old man with the same result while the Karol, unlike "Julie", watches him and gives an emotional reaction by smiling at him. The very same scene reaches to the end in "Red" when the glass bottle is eventually threw to the glass bin by the help of Valentine. The process in these scenes, unlike the main plot, is directly related with each other in all movies of trilogy. The completion of the process in "Red" gives the message that we are watching the last movie of the trilogy. The technique used here can also be a guideline for

linking the different chapters and sequences. Placing a short story which is indirectly related with the main story line while progressing all along the chapters or sequences can be a way for linking these different chapters.



F.1 Narrative structure of Three Colors Trilogy

he fourth movie to be examined is "Run Lola Run" which is an art house classic. The movie tells the story of Lola who needs to find 100.000 Mark in 20 minutes for his boyfriend. Narrative structure of the Run Lola Run is separated into three different story lines and these 20 minutes are told for three times in the movie by rewinding it to the beginning and telling the story with different progress and endings. The story is changing in each cycle depending on small differences in Lola's actions. For instance, in one cycle she hits a woman while running and in the other cycle she passes her by making the story change. The same method can also be used for games in which more than one story line is available. Current games divert the story into different directions with conscious decisions just as killing a character or leaving him/her alive. Other than that, a game named Heavy Rain [12] proposing a story line which continues even if one of the characters dies along the way. It also promises the failures in quick time events affect the story letting it continue with this impact instead of ending it. Nevertheless, although the system seems like having a potential to be divided into abundant number of story lines, the possible outcomes are not varying as expected [13]. Therefore, making "failures in timing" or decisions which seems unimportant affect the story may enhance the narrative in games.



F.2 Narrative Structure of Run Lola Run

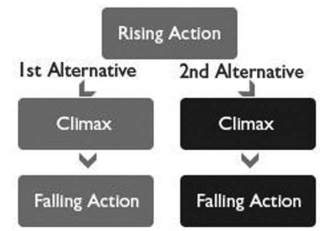
Run Lola Run hosts also unconventional narrative techniques for telling the story of the people who the Lola comes across while running without disturbing the pace of the story. When Lola passed the certain characters by, the main scene is interrupted by still images which are presented like a fast slide show. These photos tell the stories of the side characters in a very brief moment without interrupting the pace of the action. It also breaks the routine of the scene where only the running action of Lola is shown. As a guideline principle it can be said that the implementation of other do- mains which narrates a story in such a brief moment can be used for storytelling with- out interrupting the immersion of the game play sequences.

One more aspect of the movie which should catch the attention is the scenes where it turns into a cartoon. Beginning of each cycle, while Lola is passing her mother's room, camera zooms into the television which Lola's Mother is watching. In the tele- vision, we see a cartoon showing that a red haired girl (actually she is Lola) is running down the stairs. The scene makes the spectator question the reality of the events taking place in the film. As being a transition between the inside of the house and the outside, these scenes also seem like the transition between reality and imagination. It is also an example for transferring from another domain for enhancing the narrative without adding any extra text or voice-over.

The sixth movie, Sliding Doors, has a narrative structure similar to "Run Lola Run". The climax of the story starts when Helen misses the subway. At that point, the story is divided into two branches, one of which is advancing as if Helen did not miss the subway while the other branch tells the real story where Helen misses the Subway. Although the structure is similar with Run

Lola Run, in Sliding Doors, two branch of the narrative structure is presented at the same time instead of telling the whole story from the beginning. The transitions between these two storylines are usually so sudden; however with the use of certain symbols like Helen's distinctive hair styles which are changing in each story line, the possible confusions are prevented. It is an exceptional point for making such scenes, which can confuse the perception of the spectator, more understandable. Confusions which are resulted from the sudden tran- sitions between different states can be overcome with the help of certain visual symbols.

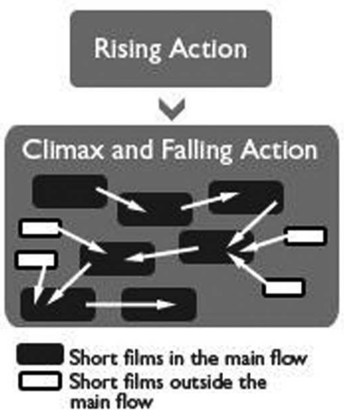
F.3 Narrative Structure of "Sliding Doors"



These two movies were using the tree structure to tell their stories. Another movie, we examined, 32 Short Films about Glenn Gould, is progressing along on a narrative structure defined as a web structure [8]. Movie is composed of 32 short films which constitutes the biography of Glenn Gould in an authentic way. Looking to the main flow of the movie, it can be said that there is a chronological order, beginning from the childhood of Glenn Could, continuing with the period when he decides to start radio broadcasting and ending with his lifetime after he decided to quit giving concerts. However, being a property of the web structure, there are scenes which are completely outside of the main flow and also different in the aspect of narration style. For instance, the scene named as "Diary of One Day", where we watch the skeletal movements and other body functions of Glenn Gould while playing piano as if we are looking through an "x-ray device", informs the audience about a day of Glenn Gould by showing the notes about medicines he took and his "blood pressure" in specific times of the day. Iterative actions in the scene are presented in unconventional ways such as showing the body movements in the x-ray view instead of a normal view. The doses and the names of the medicines are expressed by interrupting the action for brief moments. Interval between these interruptions changes according to the rhythm of the music. All these composition integrate narrative into the repetitive action of playing piano. As it is done here, narrative can be implemented into the repetitive sequences of the game play by using unconventional imagery and composition which is in harmony with the music.

Another property of the narrated story is how the structure is related with the per- sonality of the Glenn Gould. The Glenn Gould built his career on the unconventional variations and fugues of Bach [14]. The movie also attracts the attention with the variety of different styles used in short films and unconventional placement of them in the structure. The connection between the personality of Glenn Gould and the narrative structure of the film is one of the most exclusive point of the movie. Even changing the rhythm of the gameplay in line with the main character can be used to imple- ment the narrative into the game without causing any interruption.

F.4 Narrative structure of "32 Films About Glenn Gould"



The narrative structures of the three movies and the trilogy mentioned above are outside the accustomed fashion. However, when it comes to Cinema, how you tell the story is not restricted with the plot. A movie consists visuals and audial elements. The camera angles, frame, visual effects, sounds, conversations and music are all narrative elements in movies. Considering these facts, besides the movies which are important with their narrative structure we also analyzed a movie using the narrative elements in an unexpected way. Baraka [9] is one of the movies which can be an example for this kind.

Baraka, originally being a documentary, centers its subject among culture, religion and nature. Unlike the mainstream documentaries, Baraka does not use voice-over narration. Therefore, the burden of the narration is on the shoulders of visual representation and music. Baraka tells its story with the composition of visual elements and the music accompanying it. The placements of the scenes are planned carefully to express the messages correctly. "Traffic Chaos" chapter is an obvious example show- ing the carefully ordered sequences in that manner. In this scene, while flow pattern of the heavy traffic in the city is shown, imagery from a chicken factory interrupts the scene at intervals. Concurrently the people walking in crowds as if they are directed by someone are presented. When all this composition is blended with a rhythmic tribal song playing in the background, the scene lasting 9 minutes is watched in an instance in spite of the repetitive actions existing in the scene. These 9 minutes is very successful in showing that how the lives of the people in a city are performed in a routine as if they are products in a factory band. Baraka shows that, with a right composition of imagery accompanied with music, a strong narrative can be transmitted. Compositions of these kinds can be ideal for storytelling in iterative sequences of gameplay.

3 . Guideline

Above, 4 single movies and a trilogy utilizing different narrative structures and techniques are examined. As a result of examination we come up with 8 guidelines as stated below:

1. Different Point of Views: Showing same events from the different point of views or from the eyes of different characters can be used for creating links between chapters and sequences. Some games make available to play the game with different characters. Even, these characters can be controlled simultaneously. Moreo-

ver, trilogies and series are quite common in the game industry. This guideline can be a clue for creating link between different games comprising series or different sequences which can be played with different game charac- ters. This kind of approach for linking different scenes to each other would be a genuine way in digital games. For example, Diablo III [15] is a game which can be played with different kinds of characters making available different stories in every play session with different character. An environment like in Fig. 5, can be visited more than one time in different play sessions with different characters. A basic example for this guideline can be applied by placing a previously played character and make him/her act according to the previous game-play session, while the player is visiting the same environment with a different character in another gameplay session.

F.5 An Inn in Diablo III

2. Short Stories: If there are chapters in the game, whose stories are completely different than each other, the connection between them could be created with the use of short stories which have indirect relation with the main flow while having an obvious connection with each other. This method could also be an authentic approach in digital games for bonding the different sequences of the game. These short stories can be differentiated even with the animation and art styles used and may aim to tell a story during the game play sequences.

3. Unconscious Choices: The effect of the user to the story could be built on uncon- scious choices instead of conscious choices. Especially in games, the player is allowed to manipulate the story with the choices he made. However, this choices are usu-

F.6 Mini arcade game "Qub3d" in GTA4

ally the conscious ones. The reflexive moments, where the player should dodge an attack or jump from an edge have usually effects only on game play. Instead failures in reflexive actions may lead other story pieces. These may also end up with different game mechanics which requires different expression and animation styles.

Different Domains: By the implementation of different domains in the game play sequences, the narrative can be administered without causing any interruption in gameplay. The method also useful for breaking routines. Similar methods have been used in digital games. For example: In GTA4, it is possible to play retro Arcadegames in game machines. However, since the game

F.7 A-Usual game camera (third person action type) B- Parts where Batman: Arkham Asylum looks like a 2d platformer

machines are the part of the world created in GTA4 [16], it is not exactly the same. One of the closest examples can be the Batman: Arkham Asylum [17]. In one part of the game, although the main genre of the game is "Third Person Action", the game turns into a 2d platformer

4. Fig. 7). The transition is not sharp as it is in "Run Lola Run", however it is an authentic transition between two different game genres. Yet, it does not have any effect on narrative of the game. The method can be extended for telling stories during the game-play.

5. Symbolic Visual Cues: To represent the different states which are created by different choices of player and have the possibility of being confused, could be overcome by using symbolic visual cues. In games where the story is led more than one branches, similar methods can be used to express distinction between storylines. These methods can be especially applied to the animated characters in game play. By using different animation styles on the same character, dif- ferences as indicated can be provided throughout the game play.

6. Unconventional Imagery: Narrative can be implemented into the repetitive se- quences of the game play by using unconventional imagery and composition which can be balanced by making them fit the rhythm of the game music. As mentioned, one of the main problems of narrative in games that they are not integrated into the playing sequences and the use of cut scenes interrupts the game play. Narrative elements comprising unconventional imagery with a composition suiting the rhythm of the music can represent the story during the gameplay. The anima- tions of the characters, objects and effects should be in synchronization with the rhythm. Rhythmic animations combined with narrative objects which can be placed to the screen as result of interaction of the user may provide a nar- rative without interruption.

7. Personalities of Game Characters: Spiritual states and personalities of the game characters, which are abstract concepts, can be related with the narrative structure and used techniques. For instance, if the story is built upon a character having a manic depressive disorder, narrative can be transmitted by composing game levels with sharp changes in rhythm.

8. Compositions Delivering Messages: The iterative actions can turn into strong narratives by composing the scenes in an order which can constitute a story. By show- ing obvious similarities between different cases sequentially, these kinds of mes- sages can be generated without voice-over narrations. By creating similar compo- sitions during the game play sequences, it may be possible to tell stories during play sequences without the need of a narrator. Simply, an example for this kind of situation can be given as two different animated characters can act in two different, nevertheless visually similar areas. The kind of composition can provide a narrative about similarities between two domains. If the similarities in the environment are enhanced with animated objects, this will also alter the rhythm and break the monotonous atmosphere of the levels and iterative actions.

4 . Conclusion

In this paper, we analyzed seven movies whose narrative structures are appropriate for interactive narrative to reach guidelines which can be used in interactive stories of digital games.
As a result of our studies, we are able to extract principles of "different point of views", "short stories", "unconscious choices", "different domains", "symbolic visual cues", "unconventional imagery", "personalities of game characters" and "compositions giving messages" which can be considered guidelines. These guidelines hold potential to be used for enhancing the narrative experience in digital games. The games are considered inappropriate for storytelling because of their iterative na- ture [1]. However, guidelines in the paper referring to the iterative actions promise solutions for telling stories during the gameplay sequences without causing any interruption. Although the used methods and compositions are designed to be suita- ble for the movies, further researches should be conducted to understand the ways for applying these guidelines on games.

Other than the iterative actions, guidelines we created give also clues about creat- ing links between events and characters in the branched stories. Especially, using the "certain symbols to express the distinctive story lines", "showing same events from the eyes of different characters", "integrating short stories progressing along different chapters" are quite clear guidelines to apply. Moreover, instead of conscious choices of the player affect the story, the ways of making the "successions or failures", which are the results of unconscious choices, affect the story progress should be studied on.

Relating the narrative structure and the game character's personality is a complex process. However this kind of relation holds potential for turning game play sequences into narratives. Composing the levels or the rhythm of the game affiliated with main character's personality or spiritual state can be an authentic method for games to tell stories.

The result of our study shows that, still more principles can be established by analyzing movies having non-linear structures. To obtain more guidelines which can be inspirations for directors of interactive narrative, further researches should be done by analyzing more movies. Even this short analysis proves that, the game designers can still borrow from cinematographic representation techniques for enhancing the narra- tive in games.

5 . Acknowledgements

The contribution to the CONFIA2013 supported by the research project funded by the Scientific and Technological Research Council of Turkey (TUBITAK), project number 112E056.

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14.9. Paper 17: The Effectiveness of Mime-Based Creative Drama Education for Exploring Gesture Based User Interfaces

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Journal: International Journal of Art & Design Education

Role: Co-Author

Year: 2017

Type: Full Paper

THE INTERNATIONAL JOURNAL OF ART & DESIGN EDUCATION, 2017
DOI: 10.1111/jade.12136

The Effectiveness of Mime-Based Creative Drama Education for Exploring Gesture-Based User Interfaces

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ABSTRACT

User interfaces that utilise human gestures as input are becoming increasingly prevalent in diverse computing applications. However, few designers possess the deep insight, awareness and experience regarding the nature and usage of gestures in user interfaces to the extent that they are able to exploit the technological affordances and innovate over them. We argue that design students, who will be expected to envision and create such interactions in the future, are constrained as such by their habits that pertain to conventional user interfaces. Design students should gain an understanding of the nature of human gestures and how to use them to add value to UI designs. To this end, we formulated an 'awareness course' for design students based on concepts derived from mime art and creative drama. We developed the course iteratively through the involvement of three groups of students. The final version of the course was evaluated by incorporating the perspectives of design educators, an industry expert and the students. We present the details of the course, describe the development process, and discuss the insights revealed by the evaluations.

KEYWORDS

design education, user interface design, gestural interaction, creative drama, mime art

Introduction

The term 'gesture' denotes a movement or position of a human body part that conveys meaningful information (Kurtenbach & Hulteen 1990). Recently, through developments in sensor and computer vision technologies, user interfaces (UIs) have appeared that can accept gestures as input for computing applications. Current gesture-based UIs can detect and recognise gestures performed in mid-air, without requiring users to touch and manipulate an input device such as a keyboard (Zhang & Li 2014), a touch-sensitive surface, or a deformable structure (Warren *et al.* 2013). Throughout this article we will use the term 'gesture' to denote such mid-air movements and poses that can be recognised via computer vision. Gestures can be desirable as an input modality for various applications. Gaming is one of these applications in which using movements with 'prior mappings' to the real world contributes to immersion (Cairns *et al.* 2014). Another application is public interactive systems, as UIs that do not require physical contact are more economical to deploy and maintain, and more hygienic for users. Cooking, gardening, mechanical repairs and surgery (Wen *et al.* 2013) are other domains where contactless UIs can be preferable due to hygiene. Convenient control of smart homes (Tang & Igarashi 2013), interactive art and music, interfaces for manipulating 3D images (Gallo 2013) and spatial medicine (Simmons *et al.* 2013) are further examples of cases where gesture-based UIs can enable novel capabilities. As related technologies progress and mature, we may expect gestural UIs to become increasingly common and novel user experiences to surface.

While developments in gesture-based UIs continuously enable novel computing applications, the possibilities and limitations of gesture-based UIs and what constitutes effective gestural interaction are still topics under study. Currently, compared to UIs that utilise pointing devices, tangible sensors and touch, examples for gesture-based UIs that have reached end-users are few. In parallel, few designers possess insight and experience regarding the nature and usage of gestures in UIs. The coming years will require a growing number of design professionals who can fuel the creative industries with an ability to develop novel products and foster innovation in electronic entertainment technologies (UNCTAD 2010). In line with this requirement, we consider how to educate today's design students who will be expected upon graduation to work in such contexts to be an important problem to investigate. Aspects of this problem include pedagogical approaches, practices and apparatuses for use in design education, preparatory activities and student engagement. Tackling such issues, we believe, requires a practical course that aims to accomplish the following:

- Students should gain an understanding of the nature of gestures and how to use them to add value to UI designs.
- Students should experience and discuss the novelties of using gestures in UIs instead of duplicating previously learned UI concepts such as clicking or tapping.

Briefly, we call this an 'awareness course'. Building on the considerations outlined above, we have constructed a theoretical foundation that investigates the following in order to reveal the nature of an awareness course for designers of gestural interfaces:

1. On which existing educational structures should the course be based?
2. How should the course incorporate existing research on the nature of gestures and gesture-sensing technologies?
3. Based on various models of learning, what are some considerations regarding students' eligibility and the execution of the planned course content?

We designed a 10-day course plan based on the theoretical findings and taught the course to three groups of at least 17 design students. We identified issues and revised the content after each iteration (see Figure 1). At the end of each group's

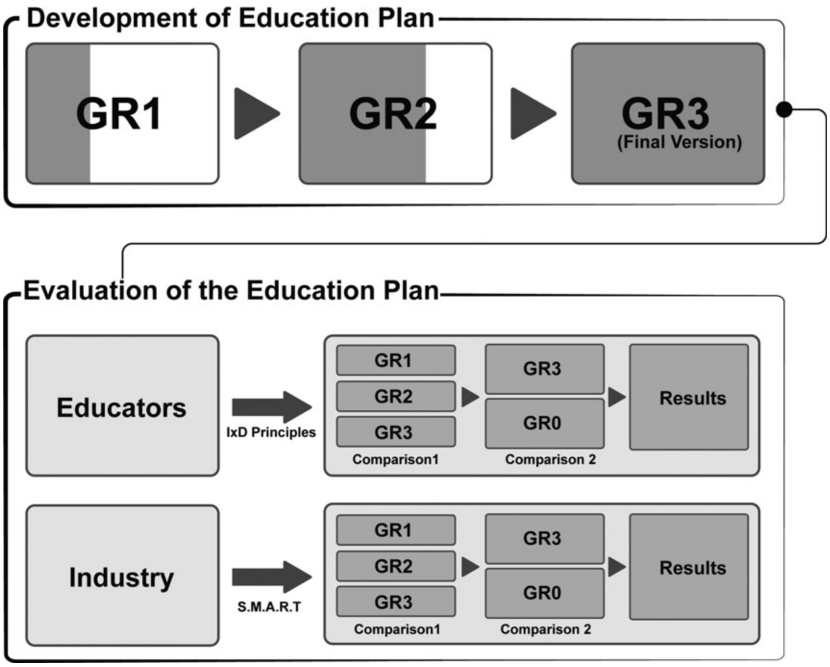

Figure 1. The awareness training programme has been revised through three iterations

session, students completed final projects, which were analysed by educators and industry professionals. We assigned similar final projects to a control group of students who were characteristically comparable and had received traditional design education, but had not participated in the awareness course we had developed. The projects were similarly evaluated and analysed, and we compared the results to those from the treatment groups. We observed students' progress in this manner, seeking meaningful insights.

Finally, we compared results from observations of the third treatment group and the control group. We discuss the success of the course that we propose based on this comparison and considering student output.

Background

Gesture-related issues for user interfaces

In human–computer interaction, gestures, like all input signals, are performed to obtain some desired result from a system. Current interactive technologies afford these results to be communicated in a variety of ways: in addition to conventional 2D visual outputs (Wexelblat 1995), 3D visual outputs, auditory outputs and system-commands can be produced as responses to gesture inputs. However, merely presenting examples of these experiences to students may not encourage creativity and the exploration of novel solutions. Instead, we provided an environment for students to experience and discover these structures themselves.

When working with gestures, designers should consider attributes such as discoverability, trustworthiness, responsiveness, appropriateness, meaningfulness, smartness, playfulness, and pleasurability (Saffer 2008) to leverage the advantages of gestural interfaces. On the other hand, in current user interfaces, the issues that hinder the usage of gesture-based interfaces are speed, recognition and fatigue (Cabral *et al.* 2005). We prepared exercises that allow students to discover these issues through experience using gestural communication. Most of these issues pertain not to the technical aspects of a gestural interface, but to human factors. These are highlighted in the exercises we propose, where communication between individuals using gestures and the use of gestural interfaces in public or social settings are emphasised.

Furthermore, mapping is an important consideration when designing gestural interfaces (Hunt *et al.* 2003). Gestural mapping is the design of system responses according to gestural input. Taking mapping into account, although vision-based gesture sensing has a distinct nature from touch-based sensing and other technologies, gestures used for different types of UIs may share common attributes. Exercises within the awareness course that we designed aim to highlight both the differences and similarities between different gesture modalities and consider the adaptation of gestures across modalities.

Another important topic for gestural interfaces is issues related to the ergonomics of movement. Bearing this in mind, we designed the awareness course to largely eschew ideating designs on paper, preferring embodied ideation, thereby promoting an understanding of physical and cognitive ergonomics. Students can thereby experience operating gestural interactions in different physical environments and in different user scenarios, familiarising themselves with a variety of narratives and experiencing physical difficulties inherent in using gestural interfaces.

Mime-based creative drama education

An appropriate model on which to base an awareness course for gesture-based UI design comprises creative drama exercises due to the emphasis on bodily and gestural communication in creative drama. In parallel, we especially consider the art of mime – where concepts and/or emotions are expressed purely in body language, without requiring words – to be important in informing gestural interaction design.

Prevalent models where creative drama has been utilised in design education are role-playing (Johnstone 1999; Svanaes & Seland 2004), video sketching (Zimmerman 2005) and participatory drama techniques (Türkmayalı 2008). One field where gestural interfaces are prevalent is pervasive computing. Observations with design students working on pervasive computing projects within an educational context indicate the value of staying away from the computer while designing pervasive interactions (Zimmerman 2005).

In exercises with role-playing and participatory drama, participants who have not been directed by a moderator to employ mime-based techniques have been observed to rely on verbal expression when acting out roles (Gerber & von Wroblewsky 1985). The practices of professional designers who have received training in mime-based drama have not yet been investigated. How the study of non-verbal mime could impact the practice of gesture-based interaction design is a domain that warrants investigation.

Previous research has not directly investigated how mime art and drama can impact design education, with regard to embodied and gesture-based interactivity. However, works that pertain to drama exist within education research, in which aspects of mime art have received attention (Fitzgerald 2007; Kerekes & King 2010; Ozdemir & Cakmak 2008; Wee 2009).

In studies that pioneered the use of role-playing in education, drama is employed to steer students towards developing and reflecting on new ways of seeing and thinking that engender novel problem solving skills rather than enacting a given performance or scenario (Neelands 1992).

In sum, we believe that creative drama and mime art – as tools for expressing concepts or emotions through body movements without verbal communication – may be effective in informing the development of gesture-based UI design practices.

Method

Development of the course

Based on the theoretical underpinnings derived from studies on creative drama, mime art, gestural interaction and learning styles in design education, we developed an awareness course comprising various exercises. This programme was iteratively revised as we conducted exercises with three groups of students and recorded our observations. During the course, students first practised the exercises we designed, and then they completed final projects. Later, educators and an industry expert evaluated the final projects.

Participants

To observe the utility of the awareness course, the exercises were conducted with 52 students in groups of 17 (Group 1), 18 (Group 2) and 17 (Group 3) students respectively. The control group comprised 18 students. In total, 70 participants were involved, 36 of whom were female. The mean age among participants was 22.

Participants were selected from among design students who had completed at least two years of university-level design education, comprising at least two project courses and fundamental notions of design practice. Participants were recruited randomly from submissions to the online announcement.

Procedure

The exercises that make up the awareness course were first given to Group 1. We revised the course for Group 2 according to our observations and data collected from Group1 and applied the same iterative process for Group 3. In the end, observations collected during activities with the third treatment group were compared to observations from experiences with the control group (Group 0).

For the control group, we leveraged the 'design thinking' model pioneered by IDEO (Brown 2008) rather than the awareness course that we designed. This model is often utilised in generalised design education contexts. It is not tailored specifically for gestural UI design and does not include any exercises based on mime art. In order to obtain comparable results, the final projects given to the control and treatment group participants were identical in scope, subject matter and the expected format for the deliverables.

Evaluation

The awareness course we describe was evaluated by incorporating the perspectives of design educators and an industry expert. The perspective of educators and the industry expert was also leveraged to facilitate the iterative evolution of the programme: a criteria-based evaluation of student works was conducted to reveal the contributions of the course; the results from each iteration were compared statistically.

Different evaluation criteria were used by each party, since each field may value design and innovation differently. Educators used evaluation criteria based on the interaction design principles by Blair-Early & Zender (2008), while the industry experts applied the S.M.A.R.T criteria (Doran 1981) which is commonly used for assessing commercial projects. Per their backgrounds, educators could assess the quality of the projects by analysing creativity, usability, gesture ergonomics and visual quality, while the industry experts focused on feasibility and profitability.

The awareness course

The initial version of the awareness course – developed based on previous research – was revised iteratively as it was taught to three groups of students consecutively. The changes implemented in these iterations included improvements to exercises with additional props and items, revisions in terms of implementation,

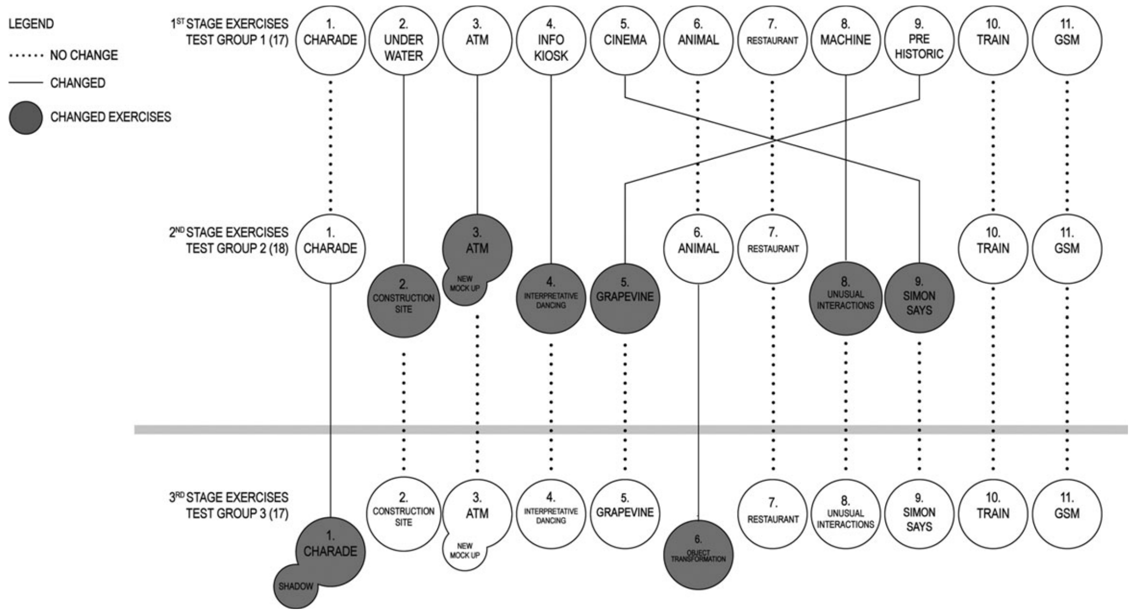

Figure 2. The evolution of the exercises that make up the awareness training programme, following three iterations

and reordering and replacement of certain exercises with new ones. All changes were made upon comments by students and according to our observations. Figure 2 depicts the iteration process, including additions and replacements.

The final design for the course comprises 8 tiers and 11 exercises in total. All exercises are recorded on video to improve students' understanding and create the possibility of them examining and criticising their own gestures. A full version of the described course plan can be viewed online at the following address: http://bit.ly/gesturetraining

Tier 1: Warm-up

Shadow charades. In this exercise, like a conventional game of charades, students act out a word or phrase through miming, while an audience of their peers tries to guess the word. However, unlike a conventional game of charades, they use body gestures to manipulate light cast by a projector onto a screen that is viewed by the audience.

The first exercise was designed to highlight the following:

- introduction to nonverbal narration;
- awareness of the challenges introduced by the fusion of 3-dimensional frame of reference for the input modality (body gestures) and 2-dimensional media (projector screen);
- awareness of various performance parameters (speed, timing, consistency . . .) that influence the efficacy and legibility of gestures.
- awareness of interactions involving gestures that may be difficult to prototype and document using conventional UI design tools. Video and storyboarding are workable tools when designing gestural interfaces.

Tier 2: Bodystorming in a disabling environment

This tier of exercises is designed to serve a quartet of aims:

- exploring ideation via embodied experiences;
- venturing into the design space of full-body gestures beyond hand gestures;
- exploring alternative communication channels and creative narration through unusual constraints such as *disabling environments* (Newell & Cairns 1993; Newell & Gregor 1999; Yantaç *et al*. 2011);
- once again, highlighting the occasionally inscrutable and emergent nature of design issues, and the need for designers to experience or simulate them.

The two exercises that make up this tier are as follows:

Construction site. Two students perform a dialogue at a distance and act as if they are on a noisy construction site in which they cannot hear each other. Thus, they need to use body gestures to communicate (see Figure 3).

ATM. Students take turns playing an ATM user who is trying to input an account number and PIN code into the calculator, while the rest of the group forms a

Figure 3. Students partaking in the 'construction' site exercise

Figure 4. Students partaking in the ATM exercise

crowd behind the user. One of them acts like a 'criminal' who tries to see the user's information (see Figure 4). The exercise aims to highlight the social and physical issues surrounding the use of interactive devices in public spaces and question how privacy, safety and comfort notions can be examined in gesture-based UIs.

Tier 3: Bodystorming

Exercises in this part introduce drama and mime skills and further explore embodied ideation. The exercises also capitalise on the power of metaphor for transferring qualia and concepts between communication modalities such as speech and gesture.

Interpretive dance. Students create a video for a popular song and present its lyrics with gestures synchronously. In the classroom, students (the audience) attempt to guess the song that is being performed without the music. This exercise is meant to facilitate the exploration of metaphorical gesturing and temporal issues related to gestural compositions.

Grapevine. For this exercise, the well-known children's game of Grapevine is adapted for gestural communication in lieu of speech. A word is given to the first student in line who tries telling the word with gestures to the next person when the others are not looking. This exercise helps to analyse transformation of the word in each turn, detect commonalities between students, gestural narratives,

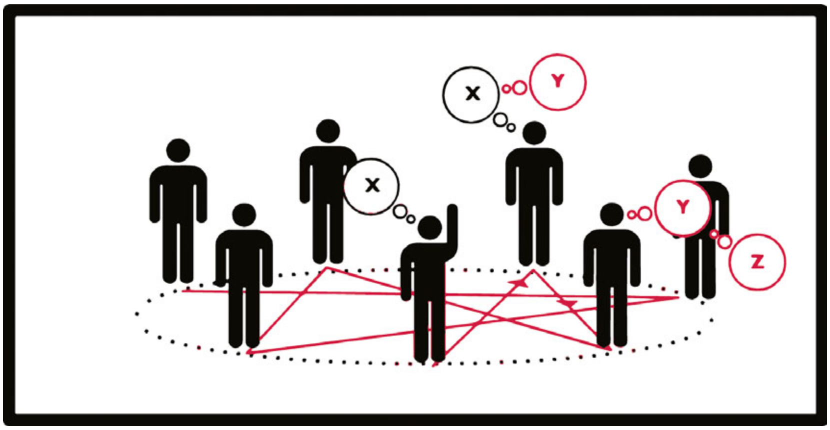

Figure 5. Diagram illustrating the 'object transformation' exercise

and emphasises the subjective nature of gestural interaction. It also presents an unconventional approach to ideating gesture designs.

Object transformation. This exercise begins with one student describing an object via gestures and throws it to another student, all the while observing the characteristics of the object (size, material, weight, etc.) and adapting their movements to stay true to the object's nature. The student who catches the object 'transforms' it into another by manipulating it with gestures and 'throws' it again (see Figure 5). This exercise, derived from drama techniques, facilitates reasoning about the role of manipulation, metaphor and comprehensibility in gesture designs.

Tier 4: Distorted role-playing

Design scenarios in these exercises are explored via role playing. The scenarios are constructed in ways that abstract, distort and reconstruct aspects of the interactions between the user, the environment and the user interface. Here, we intend to draw attention to the following notions:

- Cognitive and physical ergonomic issues, as well as the interface between them, are important design considerations for gestural interfaces.
- Although nearly all of current gestural interfaces capitalise extensively on hand and arm gestures, the rest of the body retains significant gestural expressive power.

Restaurant. In this exercise, students are divided into two groups to act like waiters and customers at a restaurant who do not know each other's languages. They try to communicate only with gestures and mime techniques. This builds an appreciation for the cognitive ergonomic difficulties of using gestural interfaces for human–computer interaction through experiencing the same difficulties in interpersonal communications.

Unusual interactions. In the second part, students work in groups of four and are asked to create a composition; a bus interior, then expected to implement the composition with the remaining members of the group (see Figure 6). The design

Figure 6. Students participating in the 'unusual interactions' exercise

scene should be invisible to all the other students. The unusual aspect is that the designer is not allowed to use their hands or arms to perform gestures; they need to use the rest of their body – the legs, the torso and the head. Here, we introduce further ergonomic difficulties that capitalise on the previous exercise. Moreover, we aim to build awareness regarding the expressive power of the body.

Tier 5: Reflexive gestures

Exploring the use of metaphor in gesture designs for interactive systems, and the consequences of both simplicity and complexity in UI design, are the goals of this tier.

Simon says. In this exercise, again adapted from a well-known children's game, students are given a word by the moderator, which they are expected to describe via gestures within a few seconds. The objective of this exercise is to explore gestures assigned reflexively to various concepts. Similarities and differences between gestures elicited from different individuals, and how these considerations may affect user interface designs in practice, are to be discussed after the exercise.

Tier 6: Mime-based gestural communication

A single exercise that facilitates the discovery of natural, everyday gestures through inspiration from mime art makes up this tier.

Train trip. For this exercise, students are split into groups of 4–6, and they each pick a nationality for themselves to emulate in a train trip with a multicultural group in the same compartment. Although this exercise is similar to the Restaurant exercise where students formulate gestural representations to communicate, mainly culture-specific elements are highlighted in this activity. Communicating concepts to a group of people rather than a single person is another salient aspect of this exercise. Gesture designs that are effective in overcoming the interpersonal barriers simulated in this exercise are meant to inform effective gesture designs for human–computer interfaces.

Tier 7: Gestural shadow mapping

Gestural shadow mapping aims to support students' exploration of how a visual composition can be narrated using gestures and devices, independent of the specifics of any gesture-sensing technology. Students are asked to perform a gesture in front of a projector – the same as the Shadow charades exercise – that represents a photograph which includes both natural and artificial elements and information about the weather, the time of the day and so on. While the narrator describes the photograph via gestures, others attempt to draw it. Then the drawings and the photograph are compared. The aim here is to introduce ideation through developing connections between a visual composition and a gestural one. Additional topics to discuss after the exercise include the expressive power of static gestures versus dynamic movements and which gestures are more appropriate to describe different visual concepts.

Tier 8: Gestural UI design project

After completing the exercises described above, students are given a final project. The projects are to be completed individually, rather than with a group. The project we chose comprised a gesture-based user interface design for a restaurant. Students are to fulfil various functions such as representing the system state, informing the user of available choices or communicating what interactions are possible.

Evaluation of the course

Educators' perspective

Two educators with at least 2 years (each) of experience in teaching interaction design and assessing student work in project-based learning contexts were recruited to support iterative development and verify the programme's contributions. Both hold postgraduate degrees in design. Project materials were available for the two educators to evaluate independently. The educators did not know which group the projects belonged to – projects from all groups were given in one batch. Each project was graded out of 10, based on the criteria described in Table 1. The criteria were formulated in collaboration with the authors and the recruits, based on experience, previous works on interaction design principles (Blair-Early & Zender 2008) and gestural interaction concepts described in the 'Background' section. The criteria were refined through a pilot evaluation conducted by the recruits and the authors, with three similar student projects from outside the course. The two educators' marks were averaged for the analysis.

Table 2 shows a statistically significant difference in terms of the sums of the grades assigned by the educators between the control and final treatment groups [$F(2,49) = 4.761$; $p = 0.13$].

A more granular analysis of the individual criteria reveals the following statistically significant differences between the final treatment group (where the final design for the course was implemented) and the others:

- Cognitive Ergonomics [$F(2,49) = 6.737$; $p = .003$]
- Control [$F(2,49) = 3.475$; $p = .039$]
- Concept [$F(2,49) = 5.306$; $p = .008$]

Table 1. Evaluation criteria constructed by the educators

Innovation	**Innovative Interactions (0.5):** Does the project offer any innovations as to the use of gestures and interacting with a system via gestures?
	Innovative Function (0.5): Does the project embody any innovative design elements?
Gesture Variety	**Diversity (0.5):** Does the project utilise deictic, semaphoric and manipulative gesturing?
	Full-body Interaction (0.5): Does the project utilise full-body movements and poses, proprioception and posture?
Physical Ergonomics	**Compatibility with Motor Skills (0.4):** How easy are the gesture designs to perform?
	Exhaustion (0.3): How tiring are the gestures to perform?
	Accessibility (0.3): Is the project accessible for people with disabilities?
Cognitive Ergonomics	**Memory Strain (0.5):** How easy is it to remember the gesture commands after they are learned?
	Intuitiveness (0.5): Are the gestures intuitive, requiring little training to learn and use?
Consistency	**Gestural Consistency (0.4):** Are gesture commands utilised and mapped to events in a consistent manner?
	Visual Consistency (0.3): Is the use of visual UI elements consistent?
	Mental Model Consistency (0.3): Does the design for the project consider the user's mental model?
Control	**Enabling Control (0.5):** Does the project afford rich interaction via gestures?
	Modelessness (0.5): Does the interface require intermittent re-learning?
Dialogue	**Feedback (0.5):** Do user commands receive appropriate responses?
	Forgiveness (0.5): Does the project accommodate user mistakes?
Social Factors	**Privacy/Fun/Public Use (1):** Depending on the subject matter for the project, does the project afford privacy, fun or undisturbed use in a public environment?
UI Design	**Use of Metaphor (0.5):** Is metaphor utilised appropriately in the UI?
	Direct Manipulation (0.5): Is the direct manipulation of UI elements supported?
Concept	**Relevance (0.5):** Is the design appropriate for the subject matter?
	Originality (0.5): Does the project offer novel solutions, as opposed to recycling existing designs?

Table 2. Breakdown of grades assigned by the evaluating educators to student works

	Group 3	Group 0
Innovation	0.62	0.41
Gesture Variety	0.58	0.48
Physical Ergonomics	0.72	0.86
Cognitive Ergonomics	0.73	0.56
Consistency	0.74	0.62
Control	0.43	0.21
Dialogue	0.59	0.36
Social Factors	0.70	0.48
UI Design	0.58	0.31
Concept	0.70	0.42
Total	6.38	4.7

When the final treatment group is compared to Group 0 (the control group), improvement can be seen in 9 of the 10 criteria (all except 'physical ergonomics'). The most marked improvement pertains to the 'concept' criterion, which assesses the relevance and originality of student works. This is in line with our goals for the course, in which we primarily aimed to support student creativity and concept development. The lack of significant improvement over the 'physical ergonomics' criterion may be explained by the exercises in the course focusing on gestures that utilise the whole body. This increases the effort in performing gestures, causing more exhaustion, which, in the educators' view, negatively affects their assessment of physical ergonomics (see Table 1). While future studies may focus on this criterion for developing exercises and contribute to favourable physical ergonomics in student works, overall, the contributions of the course are validated by the educators' assessment.

Industry expert's perspective

To contribute to the evolution of the course and verify its efficacy from an industrial perspective, the final projects submitted by students from the four groups were evaluated by an industry expert. The expert was a consultant and project manager from Inventram, a technology and innovation company (Inventram 2014), who had 5 years of prior experience in contributing know-how to technology-, innovation- and design-based startups. Per the expert's recommendation, a rubric based on a modified version of the SMART criteria (Doran 1981), described in Table 3 was used. Each criterion was graded within a range of 0 to 2.5.

All criteria except 'realistic', along with the sum total of the scores, show statistically significant improvements [$F(1,33) = 20.497$; $p = .000$] (see Table 4). From here we can argue that the course that we propose guides students towards articulating goals (specific), understanding and formulating evaluation criteria (measurable) and aiming for novel visions while being grounded in feasibility (attainable). That the 'realistic' criterion does not show improvement may be attributed to both groups being given demonstrations on relevant gesture-sensing technologies before attempting projects. Thus, students from both treatment and control groups have had opportunities to establish a design space that relates to existing technology. We may even argue that, since the course is designed to support the

Table 3. The modified SMART criteria recommended by the industry expert for evaluating student works, phrased as questions

Specific	Does the project articulate a precise and clear focus? Are coherent goals explicated and pursued systematically?
Measurable	Can the success of the project be measured in some way? Does the project offer a quantifiable improvement over the current world state?
Attainable	Does the project articulate goals that are attainable, and how they are to be attained? If the project adopts a utopian perspective, is the utopian world state broken down into – at least partly – attainable constituents?
Realistic	Are methods and design constituents employed in a relevant manner? Are the means appropriate for the ends?

Table 4. Breakdown of grades assigned by the evaluating industry expert to student works, according to the modified SMART criteria

	Group 3	Group 0
Specific	1.82	1.19
Measurable	1.68	0.78
Attainable	1.59	1
Realistic	1.61	1.33
Total	6.71	4.31

emergence of novel concepts, the limitations of existing technology may remain meagre. Thus, the significance of the 'realistic' criterion may be disputed. In sum, the industry expert's evaluation presents statistically significant differences that highlight the contributions of our course.

Conclusions

In this article, we tried to discover the formulation for an awareness course that will effectively teach design students to understand the nature of gestures and how to use them for added value in UI design. For this, we employed techniques from mime art and creative drama, and analysed the resulting student works to evaluate the course.

The most important result of our analyses is that encouraging students to

- maximise the utilisation of bodily, non-verbal communication; and,
- employ gestural expressions geared towards narrating abstract concepts and abstract thinking rather than concrete cases

contributes to an awareness that is relevant in terms of both design education and industrial requirements.

Our efforts have resulted in a course that comprises 11 exercises and a final project. The types of gestures utilised by students during the exercises have yielded unconventional relationships between the UI and gestures that may be of use for gestural UIs. These relationships – since they may be either technologically ahead of the times or remain undiscovered by designers since they have not been subjected to an awareness-developing process – may not be sufficiently emphasised in existing applications. However, during educational practice, we argue that experiencing and discussing unconventional aspects yields important outcomes in terms of design education.

Evaluation of the projects turned in by students indicates improvement with regard to 9 of the 10 criteria used by the educators (see the 'Method' section). The only decline was observed in relation to the criterion 'physical ergonomics' of gestures, which we relate to the increasingly exhaustive nature of full-body gestures as concepts become more and more diversified. The most meaningful improvement was observed with regard to the criterion 'concept', which relates to concept development skills. These results, as we stated before, are novel to the literature and warrant further investigation. We believe that the clues we have uncovered will form a foundation for such investigations. Future iterations may also investigate how the same methods can be applied to design for other modalities such as sound, and consider multi-modal designs.

In the industry-perspective evaluation, the 'Specific', 'Measurable' and 'Attainable' criteria show improvement with significant differences. These results indicate that during the design process, students in Group 3 were able to undertake a more systematic approach which aims at more explicit outcomes and have a clearer focus. Moreover, the projects they proposed imply improvements in either user experience or usability which can be evaluated by different measurement criteria in further studies. These projects are also more feasible for implementation either partly or entirely. The industry-perspective evaluation revealed no improvements on the 'realistic' criterion. We think that the aim of creating a novel interface may compromise the immediate practical value of the projects, since some of the designs proposed by students are not within the capabilities of current technologies.

In conclusion, we may say that the awareness course that we have developed will serve as a lodestar for both educators and industrial stakeholders. The value of the course will be more apparent as others adopt and refine it.

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15. Research Materials

was always cold like winter. It was not long before Narut Zugo and his team noticed that new way of perception was all about with tiny Fire Gem pieces stuck to their bodies.

This discovery, with a long years of research, led to the invention of a new equipment which is called the Elemental Bracer. With the help of this bracer, Wearers were able to attach elemental gems to their bodies and master the skills bestowed by these. Commemorated as “The Day of Invention”, it was a new start for Wearers. From this day, they were blessed with elemental burden of the nature. From that day, they were the “Wearers.”

how to play?

WEARPG is a game which aims at enacting the fictional characters with the help of interactive wearables and augmented dices. It is inspired by “free form” role playing games and aims to leave space for role-playing by loading the burden of the calculation to the devices.

There are **three pillars** of the game play session of WEARPG:

1 - Activation Moves

2 - Globe Rolling

3 - Character Skills.

The second and the third pillar what is all players are used to from previous role playing games. However, WEARPG has another pillar which is the Activation Moves. Activation moves can be explained as mini games just before the globe is rolled. These moves can grant the character bonuses or penalties according to the success of the player. There are 4 different types of activation moves which are Power, Reflex, Concentration and Precision.

Power1: The player needs to squeeze the globe as strong as possible before rolling it. The more strong the player can squeeze it, the more effective bonus she/he will get.

Power2: The player needs to throw the dice as fast as possible. The speed of the dice, if fast enough, will add bonus to the attack.

Reflex1: The player needs to move her/his arm or body according to the haptic feedback given by the device. If device will send a vibration feedback from the right, the players need to move towards left. This feedbacks will be casted in a fast sequence. The player need to react as fast as possible in order to get a good bonus.

Reflex2: The player needs to react as quickly as possible to the certain signals like haptic, audial or visual. When the dice starts to blink the player need to get it from the table immediately. With every short haptic feedback the player needs to rotate her/his harm 180 degree and throw and get the dice back with every beep signal. Finally the player need to roll the dice with a long continuous vibration feedback.

Concentration1: The player needs to rotate the dice by holding it two hands. By concentrating on it, player first need to find the correct speed of rotating and then maintain this until the dice roll signal is given with a long haptic feedback.

Concentration2: The player needs to rotate his arm checking the haptic signals from the wearable device while rotating the dice according to the vibration given by the dice.

Precision1: The player needs to check the LEDs on the device and keep the LEDs in a green area by moving her/his arm to the left or right. The more closer the LEDs to the green, the more precise the action will become.

Precision2: The player need to rotate her/his arm by keeping the track of tiny haptic ticks from the dice. During this rotation, in one point the wearable device and the dice will vibrate together. When this happens, the player needs to seek for the other tick as soon as possible by rotating her/his arm to the opposite direction.

Activation moves can be combined together. Some of the skills may require more than one activation moves. Therefore, more than one move can be performed at the same time or sequentially. GM can decide these.

Outcome: Dice + Ability + Weapon Attack/ Skill Modifier + Activation Bonus + Advantage

WEARPG quick start guide

introduction

WEARPG is a table top role playing game with an environment supported by the Elemental Gauntlet (one for each player) and a Luck Stone. This augmented environment aims to inspire players for new ways of role playing by embodying their fictional characters.

The Elemental Gauntlet coming out of the box will be the character sheet in your arm. The level of your character, her/his interaction with the environment will all be provided by this. As your character strengthens and levels up you need to upgrade your device accordingly. Moreover, you can customize the wearable according to your own will.

The other part of this interactive setting is the Luck Stone. It is always in connection with your Elemental Gauntlet and together they will be the representation of the fictional world.

fictional setting

WEARPG takes place in a realm where the five elements prevail the nature and all the living creatures. Every breathing has a penchant for one or more elements and has to live their lives with the weakness and the strength bestowed by these elements.

Fire, water, air, earth and electric are the five divine entities of the nature. Each of them has the curse and the bless of their own. None can defy or escape what is offered.

Still, world of WEARPG is ruled by one intelligent race albeit the divine elements. They are known as WEARERS by all other living creatures. They do not name themselves, though.

Even they had ruled and manipulated the nature however they preferred, Wearers were the only beings which were not granted with elemental enchantments. How they rule the nature simply do not matter, since they were defenseless against all living creatures which were armed with elemental abilities. Their blood might be at stake in that manner.

Still, Wearers were ambitious and they sought ways of acquiring the skills these elements will endow. Without knowing if it was a bless or curse!

Upon the years of research, Wearers, on the day which then will be remembered as the “Day of Leap”, discovered the ultimate substance scattered way down under the earth: Elemental Gems.

These gems were witnessed to affect the neutral materials with disparate virtues. An Air Gem, by its nature, were noticed to lighten the objects around it.

Wearer scientists, alchemists and technologists were assured that these gems will help them to capture elemental divinities. Yet, their exploration only revealed that single and light gems were not powerful enough to enhance a wearer’s body. Adversely, when tones of them clustered upon each other, the excessive power was observed to harm everyone who were nigh, causing thousands of casualties during the experiments.

The second milestone, “the Day of Morph” was the day when the famous scientist “Narut Zugo” discovered the utmost way of obtaining elemental divinities: “Being one with them”. An explosion in the chamber where Fire Gems were held resulted in many losses and injuries. However, Narut Zugo was among the lucky ones with his research team. They evaded the explosion with minor scratches. They were continuing experiments at the divinity laboratory after a few days.

Nonetheless, things were not the same anymore for him and his team. Everything in red was bright like a sun and the weather was always cold like winter. It was not long before Narut Zugo and his team noticed that this new way of perception was all about the tiny Fire Gem pieces stuck to their bodies.

This discovery, with a long years of research, led to the invention of a new equipment which is called the Elemental Gauntlet. With the help of this gauntlet, Wearers were able to attach elemental gems to their bodies and master the skills bestowed by these. Commemorated as "The Day of Invention", it was a new start for Wearers. From this day, they were blessed with elemental burden of the nature. From that day, they were the "Wearers."

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Power1: The player needs to squeeze the Luck Stone as strong as possible before rolling it.

Power2: The player needs to swing her/his arm as strong as possible by holding the Luck Stone.

Reflex1: The player needs to move her/his arm or body according to the haptic feedback given by the device. If device will This feedbacks will be casted in a fast sequence. The player need to react as fast as possible after the vibration stops and the blue light dims.

Reflex2: Player needs to grab the Luck Stone as soon as it flashes in her/his element color.

Concentration: The player needs to rotate the dice in certain pace. By concentrating on it, player first need to find the correct speed of rotating and then maintain this until the dice roll.

Precision1: The player needs to check the LEDs on the device and keep the LEDs in the blue area by moving her/his arm to the left or right. The more closer the LEDs to the blue, the more precise the action will be.

Precision2: The player need to rotate her/his arm by keeping the track of tiny haptic ticks from the dice. During this rotation, in one point the wearable device will vibrate with a long feedback When this happens, player needs to seek for the other tick as soon as possible by rotating her/his arm to the opposite direction.

Activation moves can be combined together. Some of the skills may require more than one activation moves. Therefore, more than one move can be performed at the same time or sequentially. GM can decide these.

The success of the activation move will determine the success rate of the Luck Stone. When the player is successful the Luck Stone will have more green (success) and purple (epic success) sides. Yet, if the player is not good enough, then it will be full of oranges and reds.

The difficulty of the activation moves will change depending on the character. If a player plays with a strong character such as an Earth/Fire wearer, than the strength related games such as power will be considerably easy for him. However, speed related tests such as reflex will be much harder for her/him compared to the other players.

character creation

WEARPG system builds the character creation system on elements. There is not any classes or different races. Players can choose two elements which is a primary and a secondary.

Primary element determines the primary skills and character abilities while the secondary element let players to choose hybrid skills. The abilities are represented by positive and negative dots. The character abilities granted by the elements are as follows:

	Fire	Water	Air	Earth	Electric
Power	+ +	-	- - -	+ + + +	+
Sustain	+ + + +	+ +	- -	+	- - -
Endurance	- - -	+	-	+ +	- -
Speed	- -	- -	+ + + +	- - -	+ +
Influence	+	- - -	+	-	+ + + +
Focus	-	+ + + +	+ +	- -	-

Power: This determines how powerful the character for physical tasks. Attacking with muscle power or carrying an object around can be the examples.

Sustain: This ability represents the effect duration on the enemies. For example, a fire attack will burn enemies for a specific time period which will inflict more damage. This also affects to the duration of characters' persistence to effects. For instance, a character with a high sustain ability would be exhausted later then the others.

Endurance: This ability represents the resistance ability of the body for any kinds of physical inflicting effects. Characters with high endurance are harder to hurt comparatively.

Speed: This ability shows how fast the character is in terms of physical and mental actions. Character with a high speed will not only move fast but also will be agile to perceive what is around and react to it.

Influence: Ability of manipulating other living creatures. Characters who are strong in influence can manipulate others' thoughts either through talking or elemental abilities.

Focus: Ability to concentrate on actions. Characters who have higher focus will easily perform the moves requiring concentration.

While defining the character abilities, subtract one dot from each ability of your secondary element whether it is a negative or a positive dot. If the trait has only one dot it will stay as it is. After calculating your overall stats, add two more positive or negative dot to the trait or traits of your preference. One positive dot will remove a negative dot and vice versa. Each trait can take maximum 5 dots.

Each element has different bonus levels for activation moves.

	Power	Reflex	Con	Prec.
Fire	Medium	Medium	Medium	Medium
Water	Weak	Weak	Strong	Medium
Air	Weak	Strong	Strong	Weak
Earth	Strong	Weak	Weak	Strong
Electric	Medium	Strong	Medium	Weak

Activation Move Bonuses for each element. (i.e. Water element will get a better maximum bonus for Concentration game)

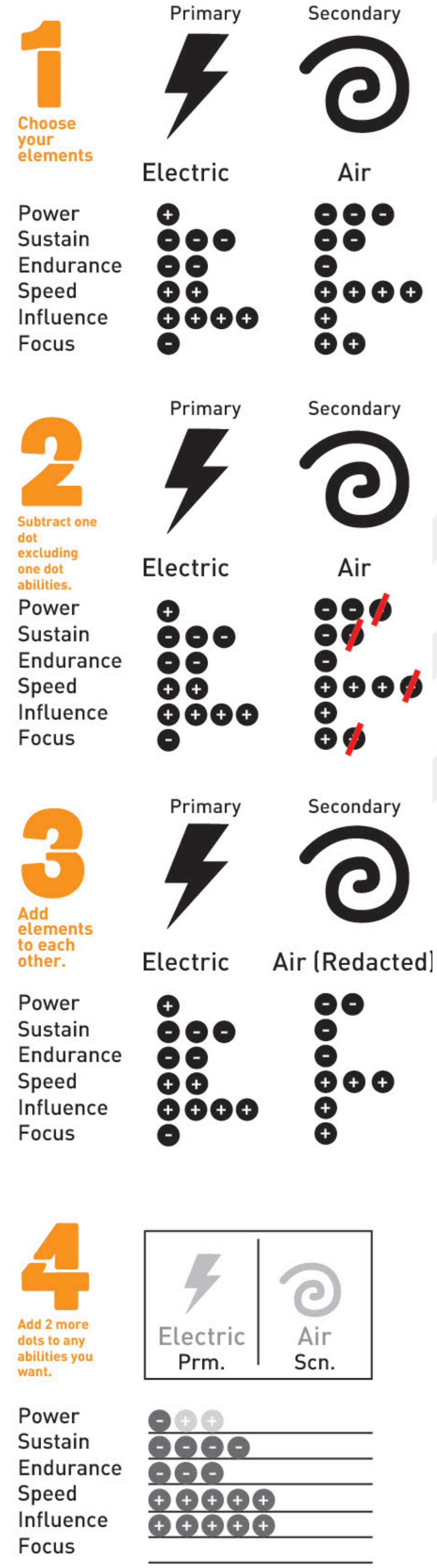


Figure 1: Character Creation Process

Figure 1 shows an example character creation process. After the element calculation characters will be granted the Health Point, Armor Class and Speed points according to the calculation method shown in the example character sheet.

These abilities will be the effectors of most of the character's physical and personal traits. These traits can be listed as:

Hit Point: Indicates the maximum damage that can be taken before being dead.

Toughness: Demonstrates the character's endurance rate to the damage until the hit point starts to decrease. If the damage is more than the toughness, the difference between damage and toughness will be subtracted from the hit point.

Quickness: Refers to character's ability to move quickly. This affects reflexes, attack and movement speed.

Analytic: This trait represents the characters' agility and pace in their thought flow.

Social: A social character is more likely to interact with others. However, this does not determine the character's ability to influence others. Leaning towards social interaction may be an advantage in some societies while some other may not be pleased about close relationships.

Intellect: This determined how knowledgeable the characters are about the world where they live and about themselves. One will gain more knowledge with age. Previous life also will have an effect on intellect level of the character. As character levels up, GM can add a bonus to intellect if the character dealt with any intellectual activities during the campaign.

Instinct: Ability of characters to give the right decision in the right time. Characters who are advantageous in Intellect and Analytic will also have better instincts by interpreting the world in a deeper manner.

All these traits are mostly affected by elemental abilities. However, there are also parts which have considerable effects on these traits which are manner, profession and age. These will be chosen by the player, however one should consider advantages and disadvantages carefully.

Profession	Intellect	Tough	Quick	Dmg.
Farmer	-4	+4	0	+2
Scholar	+5	-3	-1	-1
Alchemist	+3	-1	0	-2
Scientist	+4	-2	-1	-1
Thief	-2	-1	+4	0
Thug	-5	+3	+2	+2
Officer	+2	+1	-1	0
Banker	+1	0	+1	0
Soldier	-1	+2	0	+1
Commander	+2	+1	-2	+1
Chef	+2	+1	-1	0
Worker	-2	+2	+1	+1
Chauffeur	+1	+1	0	0
Mercenary	-3	+2	+1	+1
Hunter	+1	-1	+1	+1
Athlete	-1	+1	+1	+1
Priest	+3	0	-1	-1
Blacksmith	-2	+2	0	+1
Student	+2	0	0	0

Age	Intellect	Tough	Quick	Dmg.
20	0	0	0	0
30	+1	0	-1	+1
40	+2	-1	-1	0
50	+4	-1	-2	-1
60	+7	-2	-3	-3
70	+8	-3	-3	-3
80	+9	-4	-4	-4
90	+9	-5	-4	-4
100	+10	-5	-5	-5

Manner	Intellect	Social	Quick	Instinct
Impulsive	0	+1	0	+1
Considerate	+1	+1	-1	0
Excitable	0	-1	+2	0
Introvert	+1	-2	+1	+1
Cold Blooded	0	-1	+1	+1
Easy Going	0	+5	-2	-3
Serene	+1	+2	-1	+1
Depressive	+1	-3	-2	+4

Characteristics

Fire Wearer

The wearers who master this element are able to inflict damages with their flammable bodies. A look from their burning eyes makes would impress anyone who is lucky or unlucky enough to get that close. Their intelligence also renders them capable of concentration loaded tasks. Their intimate relationship with fire grants them a dark skin, although legendary Blue Fire Wearers were speculated to be as white as snow.

Water Wearers

Purified with the water flowing through their bodies these wearers became extremely white in appearance. Yet, this color does not indicate a weakness, just the opposite an extremely healthy body with purified blood flows in veins. Although they are highly intelligent, their cold and tranquilized nature made them hard to socialize with others. Moreover, they do not tend to move fast due to their meditative tendency. Overtime, they can heal their or others wounded bodies.

Air Wearers

Replacing the part of their blood with the air, these wearers become very light, tiny and weak. However, they are incredibly fast and have ability to turn into pure air when they reach certain speeds. Being almost ethereal beings they are capable of thinking in a very fast manner and manipulate others with their mind-boggling conversations.

Earth Wearers

Fed with the minerals in the earth, these wearers are extremely tough and strong. They are extremely capable at hand to hand combat. Another intriguing thing about earth wearers is that they are closely related to nature and have a common understanding with plants and trees. They can turn their skin, which is already hard to pierce, into rock and became relentless statues. Although they are extremely strong, they are not good at socializing with others with their intimidating look. Moreover, they are more into the physical activities rather than the mental ones.

Electric Wearers

Fed with the energy flowing through the nature, these wearers are capable of storing and bursting the energy stored in their bodies. They can manipulate all energy filled objects, this even includes the brains of other beings. Skilled and experienced bearers of this element are masters at manipulating people and controlling their minds. Moreover, they can move fast, although not as fast as air wearers. In dense circumstances, their neurons will be in a fast interaction making them good thinkers. The electric wearers are pleased to have another electric wearer or wearers as a company since this makes them stronger and more peaceful by forming a thought hive.

Skills

The divine powers of the elements equip every wearer with unique abilities. Each wearer can master skills from their primary elements and the hybrids of their primary and secondary elements. (i.e. an Electric (Prm.) and Air (Scnd.) Wearer can only have electric and electric/air skills.)

Water

Level1

Bitter Droplets

Throw little droplets which inflict minor damage to a single enemy.

Type: Attack

Proposed Activation Move: Power (Pow) and Precision (Prec)

Water Spray

Spray water to the ground making it slippery for enemies. Enemies will be slowed and some may even be knocked down with a small chance.

Type: Inflict

Proposed Activation Move: Concentration (Conc)

Cleanse

Minor healing to the target or self. This effect will not remove any inflicting effect.

Type: **Enhance**

Proposed Activation Move: Conc

Level2

Bitter Rain

An intense rain which will inflict minor damage to enemies in an area. This rain also slow your enemies down.

Type: Attack/Area

Proposed Activation Move: Conc, Pow

Flood

Create a fierce flow of water which will severely slow your enemies.

Type: Inflict

Proposed Activation Move: Conc

Heal

Moderate healing to the target or self. This effect will not remove any inflicting effect.

Type: Enhance

Proposed Activation Move: Conc

Level3

Flowing Blood

Enemies healed wounds reopen with this attack. It will last for a medium period of time.

Type: Attack

Proposed Activation Move: Conc, Pow

Dry Eyes

Dry enemies' eyes until they recover back. Enemy will get minor damage and his/her vision will be effected.

Type: Inflict

Proposed Activation Move: Conc, Prec

Water/Air

Level1

Freeze

An ice spell which freezes the enemy by slowing him down and inflicting minor damage.

Type: Inflict

Proposed Activation Move: Conc

Ice Bolt

Throw ice pieces which inflicts minor damage to a single enemy

Type: Attack

Proposed Activation Move: Prec

Level2

Ice Cone

Burst a body of ice which will slow and inflict damage to enemies.

Type: Attack/Area

Proposed Activation Move: Conc, Pow

Decoy Fighter

Create a statue of yourself which will fool enemy to attack the wrong target. If successful enough you can buff the attack and get an advantage.

Type: Defense

Proposed Activation Move: Conc, Pow

Level3

Ice Cold

Freeze the water in the air instantly and capture the enemy. Enemy will be immobilized for a medium period of time.

Type: Inflict

Proposed Activation Move: Conc, Prec

Reverse Rain

All the water on the floor starts to rain to the sky at a great speed.It will inflict minor damage to everyone in a certain area.

Type: Attack/Area

Proposed Activation Move: Conc, Pow

Water/Earth

Level1

Mud Orbs

Throw muddy orbs which inflicts damage to a single enemy.

Type: Inflict

Proposed Activation Move: Conc, Pow, Prec

Swamp Area

You can create a sticky ground which severely slows the enemies. If you on soil, effect may increase.

Type: Inflict/Area

Proposed Activation Move: Conc

Silt Body

Cover your body with the layers of mud to increase your armor class slightly.

Type: Enhance

Proposed Activation Move: Pow

Level2

Sludge Shift

Your body will turn into mud with a chance of buffing an attack if the shift can be done successfully.

Type: Defense

Proposed Activation Move: Conc

Mud Balls

Send moderate sized mud shaped balls which will moderately damage and can knock down enemies for a moderate time.

Type: Attack

Proposed Activation Move: Conc, Pow, Prec

Level3

Geyser

Underground water explodes and burns the skin of the opponent.

Type: Attack

Proposed Activation Move: Pow, Prec

Waterize

Underground water and the earth switch places , the area will be water friendly

Type: Enhance

Proposed Activation Move: Conc, Pow

Water/Electric

Level1

Voltaic Drops

Throw electrified drops which inflicts electric damage. If the attack successful enemy will take minor damage for a moderate time period.

Type: Attack/Area

Proposed Activation Move: Prec

Shock Pond

Create wet surface which inflicts electric damage to enemies. Enemies who will stay in the are will be stunned for a brief time

Type: Inflict/Area

Proposed Activation Move: Conc

Level2

Voltaic Wall

A waterfall which emits electric around and inflicts minor damage and stuns enemies in this area for a brief time.

Type: Inflict/Area

Proposed Activation Move: Conc

Aquaelectro Body

Coat your body with a squashy electrified liquid which harms and stuns enemies for a average period of time if they hit you.

Type: Defense

Proposed Activation Move: Conc, Pow

Level3

Electric Balls

User will create giant electrified water balls and throw them onto enemies at great speed. They will bounce from each other in a collision so user can be affected if she/he cannot escape

Type: Attack

Proposed Activation Move: Conc, Reflex

Water Wall

User creates a giant electried water wall so that enemies cannot pass it. The wall will inflict minor damage.

Type: Defense

Proposed Activation Move: Conc, Prec

Air

Level1

Hasty Leap

Concentrating on your body, you will be able to move without touching the ground moderately increasing your speed for a brief time.

Type: Enhance

Proposed Activation Move: Reflex (Ref)

Hollow Evade

Turn your body into an airy existence just before a melee attack. If successful enough this may buff the attack by not taking any damage.

Type: Defense

Proposed Activation Move: Ref

Deflecting Cyclone

Create windy area around your body which will deflect light objects like arrows.

Type: Defense

Proposed Activation Move: Conc

Level2

Ethereal Torso

Turn your body into thin layer of air which will buff all the attacks.

Type: Defense

Proposed Activation Move: Conc, Ref

Cold Breeze

Blow the air coming from the coldest mountains which will faint an enemy in a close range. If the faint fails you can still have chance to panic the enemy.

Type: Inflict

Proposed Activation Move: Conc

Level3

Air Room

Creates a room around the user, user will be able to sense everything in the room. User cannot move while this spell is active and will heal each turn.

Type: Enhance

Proposed Activation Move: Conc, Prec

Vacuum

User will draw all the air from an area and everybody in that area will faint except the user. This spell will last for medium period of time.

Type: Attack

Proposed Activation Move: Conc

Air/Fire

Level1

Whirlflame

Send a tornado in flames which will inflict minor damage to enemies and put them in a crimson fog which slows their movement for a brief time.

Type: Inflict/Area

Proposed Activation Move: Conc, Pow

Dash Blaze

A flammy dash towards the enemy which inflict minor damage.

Type: Enhance

Proposed Activation Move: Ref

Level2

Fire Wall

Create wall of fire which will inflict moderate damage to enemies who step inside and slows them down slightly.

Type: Inflict

Proposed Activation Move: Conc, Pow

Floating Mines

Put floating mines to trapping enemies and other object who will step inside. Explosion will severely damage the beings around.

Type: Attack

Proposed Activation Move: Pow, Prec

Level3

Burning Lungs

The air in the enemy's lungs will turn into pure oxygen and burn for a while.

Type: Inflict

Proposed Activation Move: Conc, Prec

Fire Boots

User's speed increase with the explosion beneath its boots.

Type: Enhance

Proposed Activation Move: Prec, Reflex

Air/Earth

Level1

Dust Breeze

Send a small sand storm to enemy which slows and blinds them for a brief time.

Type: Inflict/Area

Proposed Activation Move: Conc

Flurry Stones

Throw a team of stones which inflict severe damage to multiple enemies.

Type: Attack/Area

Proposed Activation Move: Pow, Conc

Deflecting Stones

Create a body of whirling stones around you which will protect you from all kinds of damage.

Type: Defense

Proposed Activation Move: Conc

Level2

Stairway to Haven

Create a hollow rock stairs which you can climb and get advantage for ranged attacks. You can also use it to see far far away.

Type: Enhance

Proposed Activation Move: Conc, Reflex

Floating Mines

Evade enemies with a dash which also creates a wall which prevents arrows and enemies to pass.

Type: Enhance

Proposed Activation Move: Pow, Ref

Level3

Breezy Tunnel

Creates a tunnel that air is pumping inside constantly. User can escape to a different place in close range. Follower will freeze or be crushed if the user make tunnel collapse.

Type: Defense

Proposed Activation Move: Conc, Pow

Tornado Mountain

User encapsulates himself/herself in a small mountain and creates tornado around the mountain to keep other away.

Type: Defence

Proposed Activation Move: Pow, Prec

Air/Electric

Level1

Lightning Strike

Cast a lightning to an enemy which will inflict damage and stun her/him for a brief period of time.

Type: Attack

Proposed Activation Move: Prec, Pow

Blink

Teleport your body to a close range of enemies. If successful enough you can buff the attack and gain an advantage for a counter-attack.

Type: Defense

Proposed Activation Move: Reflex, Conc

Flash Surge

Increase your speed severely.

Type: Enhance

Proposed Activation Move: Ref

Level2

False Dreams

Manipulate the enemies to attack everyone around in a random way.

Type: Attack

Proposed Activation Move: Prec, Pow

Blink

Attack enemies with great haste and reflexes for multiple times until they can see you.

Type: Attack

Proposed Activation Move: Ref, Prec

Level3

Exploding Air

Invisible explosive gas bubble will be created in the air and user can make them explode with a spark from static electricity.

Type: Attack

Proposed Activation Move: Conc, Prec

Fast as Lightning

User can create and be able to travel across dark clouds with lightnings.

Type: Enhance

Proposed Activation Move: Conc, Reflex

Fire

Level1

Burning Hands

Touch enemies with your melted hands to inflict minor damage which will last for 3 seconds.

Type: Attack

Proposed Activation Move: Conc, Pow

Burning Weapons

Cast a fire spell on your or other weapons to make it inflict additional fire damage.

Type: Enhance

Proposed Activation Move: Pow

Erupting Body

Increase the endurance of your body by also adding an exploding a trap for your enemies if they hit you.

Type: Defense

Proposed Activation Move: Pow

Level2

Melting Point

Turn your body into lava which will not only increase your AC, but also melt the enemy's weapons if casted successfully.

Type: Defense

Proposed Activation Move: Conc, Power

Sparkling Fist

A fist which will inflict moderate damage for a brief period of time and panic enemies.

Type: Attack

Proposed Activation Move: Pow

Level3

Desertify

A certain area will be cleared out of its water and this will increase the strength of user.

Type: Enhance

Proposed Activation Move: Conc, Pow

Hiken

An giant fire fist will be created with swing of user's arm. This will inflict major damage to opponent.

Type: Attack

Proposed Activation Move: Power, Prec

Fire/Earth

Level1

Fire Missile

Throw burning stones to a single enemy which will inflict serious damage.

Type: Attack

Proposed Activation Move: Pow

Scorch Armor

Cover your body with the layers of burning stones which will also inflict minor damage to your enemies. If successful enough you can disarm enemies by burning their limbs with your flammy body.

Type: Defense

Proposed Activation Move: Pow, Ref

Blazing Figure

Create a statue whose eyes blazing with anger and hate. Panic your enemies for a brief time.

Type: Defense

Proposed Activation Move: Conc

Level2

Fire Ball

A fireball which will inflict severe damage to an area for a brief period of time.

Type: Attack/Area

Proposed Activation Move: Prec, Power

Bush in Fire

Enemy is immobilized by creepers which will than burst into flames. Enemy will get minor damage for a time period.

Type: Inflict

Proposed Activation Move: Conc, Pow

Level3

Mirror Room

Opponent will be trapped in a mirror room, that will be reflect all of the attacks for a while. Then it will shatter and inflict minor damage.

Type: Attack

Proposed Activation Move: Conc, Pow

Magma Dogs

Dogs made of magma will chase the opponent and burn his/her skin while biting him for a while. This will inflict major damage.

Type: Attack

Proposed Activation Move: Conc, Pow

Fire/Electric

Level1

Volcanic Tornado

Create a storm of flaming thunder around your enemies which will stun and hurt them for a brief time period.

Type: Attack

Proposed Activation Move: Pow

Invisible Trace

Left a trace of fire by moving very fast which will inflict enemies if they step on it.

Type: Defense

Proposed Activation Move: Reflex

Level2

Combustion Flow

A touch which will burst a flaming energy which will burn the enemy and stun her/him for a brief period of time.

Type: Attack

Proposed Activation Move: Pow

Burning Cage

Trap enemy into a cage of fire and electric which will harm and stun her/him for a long period of time.

Type: Attack

Proposed Activation Move: Conc, Pow

Burning Flash

Dash through enemies by evading their attacks and inflict minor damage with a chance to stun.

Type: Enhance

Proposed Activation Move: Pow, Ref

Level3

Ultimate Trap

User take enemies into a fire circle. While circle is shrinking, user control enemies to stay where they are. User will pass out after usage for a medium period of time.

Type: Attack

Proposed Activation Move: Pow

Defensive Zone

User will burn the enemies and use them as shield with brain control. Long usage will cause fainting but if user faints spell will still be effective until all of the shield turn into ashes

Type: Defense

Proposed Activation Move: Conc, Pow

Earth

Level1

Rock Fist

A strong rock fist which will inflict serious damage to the enemies.

Type: Attack

Proposed Activation Move: Pow

Armors of Stone Age

Cover your body with rocks which will increase your armor class severely.

Type: Defense

Proposed Activation Move: Conc, Pow

Entangle

Old buddy helps you with its roots. Slow enemies by growing creepers to their legs.

Type: Inflict

Proposed Activation Move: Conc

Level2

Double Rock Fist

Hit enemies with both of your fists knocking them down for a brief period of time and inflicting great damage.

Type: Attack

Proposed Activation Move: Pow

Bracer Crust

Turn your arm into earth by increasing your toughness. Enemies' weapons may also get stuck into your arm with a chance to disarm.

Type: Defense

Proposed Activation Move: Pow, Ref

Level3

Castle Black

A giant castle will be created from ground and opponent will be crashed in it.

Type: Attack

Proposed Activation Move: Conc, Pow

Meteroid

A meteroid will crash into earth. User can also be effected if he/she cannot escape in time.

Type: Attack

Proposed Activation Move: Pow, Ref

Electric

Level1

Electrified Body

Cover your body with an electrified magnetic field which will slows weapons and inflict damage to enemies by also stunning them if they achieve to hit you.

Type: Defense

Proposed Activation Move: Conc

Touch Flow

A shocking touch which will inflict damage and stun enemies for a brief period of time.

Type: Attack

Proposed Activation Move: Pow

Lightning Reflex

Increase your reflexed for dodging the attacks. If successful enough your character may even buff the attack.

Type: Defense

Proposed Activation Move: Ref

Level2

Electric Cage

Create an electrified field which will prevent enemies to move for a long period of time.

Type: Inflict

Proposed Activation Move: Conc

Bolt

A moderately damaging bolt which will also stun the enemy for a brief time period.

Type: Attack

Proposed Activation Move: Pow, Prec

Magnetic Pulse

Create a magnetic pulse around you which will prevent enemies hitting you. This pulse also have a chance to disarm enemies.

Type: Defense

Proposed Activation Move: Conc, Pow

Level3

Magnetize The Enemy

Enemies will be magnetized and stick to each other. Greater the number of enemies , slower they are.

Type: Inflict

Proposed Activation Move: Conc, Ref

Brain Control

User will control the people in the minor distance and make them attack to only one target. User will faint after this for a long period of time.

Type: Attack

Proposed Activation Move: Conc, Prec

WEARPG. character sheet

Oğuz Turan Buruk	Lustin Tirauel Samlefoon	0	1
Player Name	Character Name	XP	Level

168 cm	55 kg	28	Farmer	Cold Blooded
Height	Weight	Age	Profession	Manner

	Fire	Water	Air	Earth	Electric	Electric Prm. / Air Scn.
Power	++	−	−−−	++++	+	−++
Sustain	++++	++	−−	+	−−−	−−−−
Endurance	−−−	+	−	++	−−	−−−
Speed	−−	−−	++++	−−−	++	+++++
Influence	+	−−−	+	−	++++	+++++
Focus	−	++++	++	−−	−	

Substract one dot from each trait of your secondary element whether it is negative or positive. If the trait has only one dot it will stay as it is. After calculating your overall stats, add two more positive dot to the trait or traits of your desire. One positive dot will remove a negative dot and vice versa. Each trait can take maximum 5 dots.

Background

Lustin was raised to be a cold blooded killer by the brotherhood. The skills and his elemental choices granted him with abilities letting him move around with a great haste and silence. One day he would use these skills to escape from brotherhood, resisting to kill living creatures in the name of contracts and rewards. After that moment he was a wanted traitor by the brotherhood. What brotherhood forgot was though, he was still the cold blooded killer once he was and would not hesitate to use his art when in need.

Skills

Name	Lv.	Act. Move
Blink	1	Cons + Ref
Touch Flow	1	Pow

Physical

Hit Point Max: 20 + (2x Endurance) = 10

Current:

Toughness: 20 + (End + Sus + Armor + Prof. Mod. + Age. Mod.) = 17

Damage: 20 + (2x Pow + Sus + Weapon + Prof. Mod. + Age. Mod.) = 22

Quickness: 20 + (2x Speed + Pow - Armor + Age Mod. + Prof. Mod + Manner Mod.) = 28

Personal

Analytic: 20 + (Focus + Speed) = 25

Social: 20 + (2x Infl. + Manner Mod.) = 29

Intellect: 20 + Age Modif.+ Focus + Prof. Mod. + GM Bonus/per.Level = 16

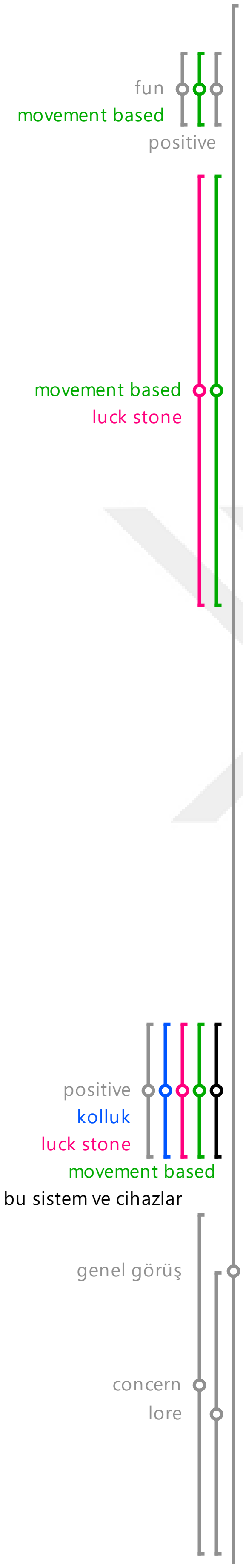
Instinct: Analytic + Intellect + Manner. Mod - 20 = 22

Weapon

Name	Atk. Bonus
Regular Dagger	+2

Armor

Name	AC. Bonus
Light Armor Set	+2



1 Interview 12

2 I: Genel olarak yorumlarını alayım ben bu yaptığımız şey ile ilgili.

3 P: Bence güzeldi, zevkliydi. Şey açısından çok hoşlandım, oyunların güzel olması ekstra bir şey kattı.

4 I: Ne kattı mesela? Nedir ekstra dediğimiz şeyler?

5 P: Çünkü zaten oturup zar atmak zevkli ama şey de zevkli böyle elle bir şeyler yapmaya çalışmak da zevkli. Hani böyle sadece zara dayalı değil. Zaten zardan gelen de sadece ona değil daha önce yaptığın şeylere +3 -1'leri falan da var ama. Hani yapamadım, kaçırdım mesela ve kırmızılarla dolu bir zar geldi. Hani böyle o komikti benim için. Çünkü gerçek hayatta da bir şey böyle mesela. Atıyorum, gözün bozuk olduğu zaman aim almak gerçekten daha zor oluyor benim için. O yüzden çabalama kısmı fiziksel olarak zevkliydi bence. Yani bence şey de hoşuma gitti, streetpunk(?) setting de hoşuma gitti. Sanırım biraz daha açık olsa sebepleri bazı şeylerin daha az havada olurdu. Hani mesela şey olmak zorunda değil, background story olarak işte nasıl bir ülkedeyiz, neredeyiz değil de. Hani dünya neden kötü oldu'nun sebebi sanki biraz daha iyi açıklanabilirdi.

6 02.22: I: En başta mı, daha sonra mı?

7 P: Daha sonra. Hani combat mekanikleri, işte A/M (?) seçme çok iyi, çok zevkli. Combat sistemi gerçekten çok zevkli. Şey de bu skill'ler nereden?

8 I: Biz yazdık.

9 P: Siz mi yazdınız?

10 I: Yani elbet bir yerlerden etkilenmişlik vardır zaman zaman ama.

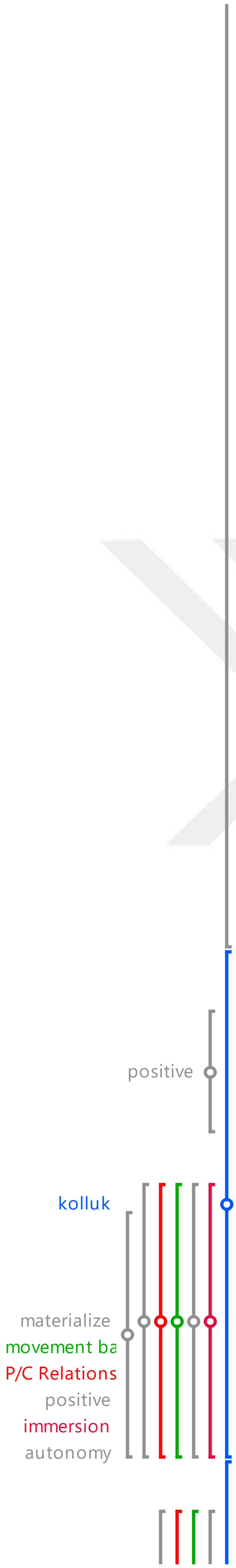
11 P: Bunlar çok güzel, benim hoşuma gitti hani.

12 I: Ama genel olarak biz yazdı. Hani böyle bir yerden almışlığımız yok.

13 P: Yani siz yazdıysanız daha güzel. O şey skiller(?) falan da o şey hoşuma iki tane ana fight(?) alıp bunu şey yapmak. Yani bir kere oyun sisteminin combat efektleri falan çok hoşuma gitti. Bunu kişisel olarak yaptım. Hikâye de zaten İhsan Bey'di değil mi?

14 I: Evet.

15 03.09: P: Bayağı güzel anlattı bunu. Dediğim gibi benim tek sıkıntım olacak. Çünkü ben böyle, yani genelde benim kendimden dolayı hani öbür insanlar bu kadar sıkıntı etmiyor ama. Böyle şey benim hoşuma gidiyor benim. Bir şeyin sebebini soyut bir şekilde bilince o oyunu oynamaya daha çok convinced oluyorum. Çünkü o zaman sadece böyle bir combat mekaniği için değil de bir de gerçekten hikâyede o kötü şeyi değiştirmek istiyorsun. Hani böyle mesela atıyorum; hani elektriğin icadından insan ve doğanın dengesi bozuldu ama hani niye bozuldu? İşte dünyanın manyetik alanını mı değiştirdik, deney yapmaya çalışırken yanlışlıkla uzay-zaman'da bir kıskançlık(?) bir yeri fazla charge edip.



16 I:

17 P: Şey bile mesela güzeldir; işte çok fazla egzoz yaptığımız için küresel ısınmadan dünya ısındı (?) bile bir sürü bilimkurgu için son derece mantıklı bir sebep. Hani bir tek battı tam demeyeyim de bir tek değişse daha çok hoşuma gidecek, daha beni saracak. Çünkü oynanışı zevkli. Anlatımı da zevkli. Hikayesi, karakterler falan da gayet hani relatable böyle. Hani boş karakterler değil mesela. Bay Emerson, işte Bay Troy falan şey tipler değiller, tamam hani zaten çok konuşmuyorsun ama çok da tek boyutlu tipler değiller. Zaten Troy tamamen devletin(?) plot device'ı ama. Ama Emerson karakterini de biraz daha görüyorsun. O da rahatsız etmiyor hani çoğu oyunlardaki tek boyutlu(?)(anlaşılmıyor) guide karakteri değil yani? Ama işte hani dünya; hani şey kişileri bunun içine girmek için hani karakterleri ikna edebilirsin işte şu an senin bulunduğun evrenden daha güçlü bir odadasın ama oyuncuyu ikna etmek için oyundaki amacın hani. Karakter ikna ediyor içinde bulunduğu durumdan orada olmasını çünkü yapabileceği hiçbir şey yok. Karakter çok güçsüz kendinden, çok daha ileri bir yüzyılda(?) o adamlara karşı. Ama oyuncunun o dünyayı iyileştirmek istemesi (anlaşılmıyor?) bir dünyayı iyileştirmesinden daha fazla olabilir yani. Hani mesela Fallout'ta nükleer patlama, işte, başka bakayım, Stalker: Shadows of Chernobyl'de Çernobil patlaması vardı. Mesela şeyde, demin onu konuşmuştuk. Dragon Age: Inquisition'da da mesela onun zayıf olmasının sebebi. İşte kötü yaratıklar olduğu için gökyüzünde bir tane yırtık(?) açıldı ve onu bir tek elimizde sen olduğun için sen durdurabilirsin diyorlar. Ve her ne kadar evren çok güzel olsa, combat çok güzel de olsa ben açıkçası oyunu bitirmedim yani. Fallout 4'ü de bitirmedim çünkü ana görev çok sıkıcıydı.

18 I: Tamam. Bunları anladım.

19 06.05: P: Ama yani ben çok keyifli vakit geçirdim. Teşekkürler.

20 I: Süper. Şimdi sana biraz daha detaylı sorular soracağım. Belki bazılarını söyledin ama yine de tekrar bir cümleyle ifade etmeye çalışırsan süper olur. Koluna taktığın şey, yani (anlaşılmıyor?) gauntlet oyun deneyimini nasıl etkiledi?

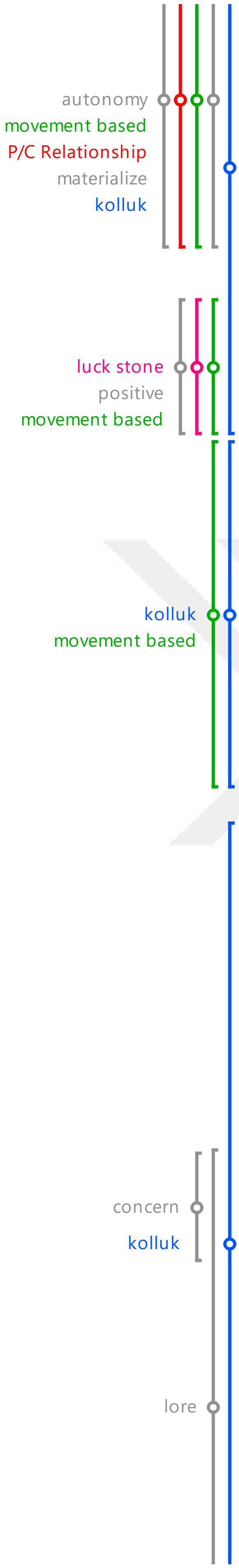
21 P: İyi.

22 I: Biraz açabilir misin bu iyiyi. Yani nasıl bir deneyim oldu?

23 P: Tabii, iyi çok aptal bir şey oldu. Nasıl oldu… Daha immersive oldu, daha içine çekti yani. Çünkü her ne kadar… Daha somutlaştırdı bir de başka bir oyun elemanı kattı. Bilgisayar oyunlarının FRP'den daha çok tutmasının sebebi biraz daha kişinin kendinin olan hareketin içinde, kontrol altında hissediyor ya. Hani, adamı şuraya dodgeladım, buraya dodgeladım. Bunda da biraz o var mesela. Küçük minigameler gibi. İşte aim almaya çalışıyorsun, bir şey yapıyorsun. Ve karakterle bağdaşmayı da çok daha kolaylaştırıyor.

24 07.14: I: Nasıl? Ne yaparak kolaylaştırıyor?

25 P: Mesela sen yapamıyorsun ve karakterinin başına kötü bir şey



geliyor ya da sen yapabiliyorsun ve karakterin de mutlu oluyor. Ya da işte şey mesela grup arkadaşını vurma ihtimalimiz var. Bence grubun içerisinde… Normalde de hep vurma ihtimalin var ama o kadar fiziksel düşünmüyorsun. Ama sen bunu yaparken hani sen bunu seyredersem diyorsun, hani bu küçük minigame'de seyredersem gerçekten grup arkadaşımı vuracağım diyorsun. Öbüründe zar atılıyor, zar düşük gelirse vururuz büyük gelirse vurmayız, statları uygunsa diyorsun.

26 07.54: I: Yani burada biraz daha sorumluluk mu hissediyorsun?

27 P: Evet daha çok sorumluluk hissediyorum. Mesela peki şey, statlar olayları çok değiştiriyor ama hani bunda yine zar atıyoruz, yine statlar var. O yüzden bir de küçük bir çaba unsuru katmanız hoşuma gitti yani.

28 I: Peki, mesela bu şeyden bağımsız düşünelim yani. Diyelim ki bu şey, kolluk, sadece taktık yani. Hareket falan yapmamış olsaydık: onu takmakla işte element taşlarını falan almak. Hani yapmamış olsaydık diye düşün demeyeyim de hani onları dışarıda bırakarak bir yorum yapmanı isteyeceğim. Kolluğu takmak, başlı başına oyunu nasıl etkiledi?

29 08.40: P: Yani o zaman şeye giriyor biraz. Hani Cosplay-FRP'ye giriyor. Cosplay-FRP'nin normalden farkı bir tık daha immersive hissediyorsun, o yani. Çünkü işte evet takıyorsun, evet taşım. Monopoly'de bile kendine özel taşını koyunca daha iyi hissediyor; insanlar customization seven canlılar.

30 I: Peki, yine benzer bir soru soracağım aslında. Ekleyebilirsin bir şey varsa ya da tekrar bir kez daha söyleyebilirsin. Kolluk peki oyunun hani deneyimini değil de oyunun hayali dünyasıyla olan ilişkini nasıl etkiledi.

31 P: Oyunun hayal dünyasıyla?

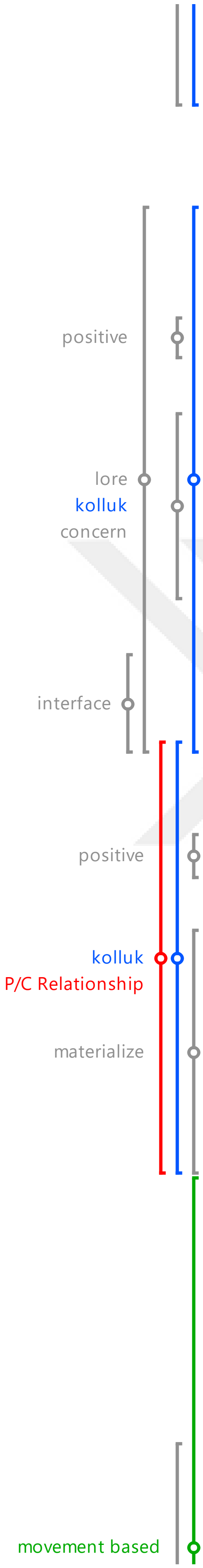
32 I: Ya işte oyunun içinde oynadığın o hayali dünya var ya işte gittiğiniz günden 1803'ten 2000 bilmem kaça.

33 P: Anladım, anladım.

34 09.37: I: Ana dünyayla ilişkini nasıl etkiledi bu kolluğu takmak?

35 P: Zor bir soru. Daha önce söylediklerim benim genel olarak oyuna daha çok kattı. Ama hani, mesela şey olsaydı da bilmiyorum. Bu oyunu kollukla medieval bir settingde yapsaydık nasıl fark ederdi; bu setting'e mi daha uygun? Yani hikâye gereği bizim özel güçler elde etmemiz gerekiyor. Bu özel güçleri de bir teknolojik device ile elde ediyoruz, o teknolojik device'da bu kolluk. O yüzden hani uygun bir kollukla mesela hani o eğer kendi artıları olmasaydı uygun bir cosplay vesaire(?) olurdu. Hayatta yine bahsedilen kolluk fiziksel olarak taktığımızın gibi bir şey olabilirdi. O yüzden oyunun hikayesi teknolojide uygun bence. Hani şey settingde daha farklı bir şey isterdim, medieval bir settingde. Hani şu an biraz daha Fallout gibi düşünüyorum o yüzden hani 1800'lerden kop geleceğe o zaman işte kolluk teknolojisi ne çok ileri ne çok geri o yüzden okay hani. Tutup da 2000 değil de 3000'lere gitmiş olsaydık da kolluk bana

3/15



gene garip gelirdi. Nasıl medieval'lar için bu fazla ileri teknolojiyse o zamanda da hani holografik(?) ya da komple kol takarlardı, cyborg kolu gibi yani.

36 I: Tamam.

37 P: O yüzden uygun bence.

38 11.16: I: Hikâyeye uygun olması… Anladım. Olmasaydı garip hissederdim diyorsun.

39 P: Evet. Yani garip hissetmezdim çünkü hani bazı şeyleri kabul ederek oynuyoruz ama bu zorluk yaşatmadı kabul etmemde.

40 I: Belki o zaman yaşayabilirdim diyorsun bu sefer yaşamadın.

41 P: Evet, evet. Ya ben yaşamazdım. Ben oyunlarda her şeyi kabul edebiliyorum ama yani tasarımı mesela farklı bir setting olsaydı, tasarıma göre setting'inin biraz değişmesi gerekirdi. Atıyorum mesela, işte medieval bir settingde olsaydı bunun biraz daha büyülüymüş gibi durması gerek ya da gelecekten gelmiş bir device olduğunu state etmeniz gerekirdi.

42 I: Anladım.

43 12.13: P: Çünkü dediğim gibi kablolar çok ortada. Ve işte şuralarının mesela tasarımı biraz daha hani bu şeye ait eskiden olsa böyle biraz daha büyülü zımbırtılar, biraz daha böyle farklı olurdu.

44 I: Anladım, tamam. Peki yine benzer bir soru soracağım: kolluk hayali karakterinle olan ilişkini nasıl etkiledi?

45 P: İyi.

46 I: Tamam. Tekrar açman mümkün mü?

47 P: Hani iyi dediğim mesela şöyle çünkü o da takıyor ben de takıyorum. Benim yaptıklarım... Hani şey beni etkilemedi şunu soruyorsanız, hayali karakterin orada ateş ediyor sen orada bir sensörü sallıyorsun, seni kötü etkiledi mi? Etkilemedi. Tam tersi, ben de burada küçük kendimce bir oyun oynuyorum, o da bir çaba yapıyor. O yüzden bu iyi. Oyunlardaki minigame'ler de böyle zaten. Ne bileyim, FIFA'da penaltı atarken yeşile dönünce vuruyorsun; kimse de demiyor ki öyle penaltı atılmaz. Ona alışıyorsun(?).

48 13.24: I: Peki bedensel o yanı? Ya yine benzer belki birazdan da söylemiş olabilirsin bunları ama hani tekrar düşünebilirsin üstünde. Bu sefer kolluktan bağımsız olarak bedensel bir şekilde bunu oynayabilmek, bu oyunu, oyun deneyimini nasıl etkiledi?

49 P: Yine iyi etkiledi. Dediğim gibi kolaylaştırdı. Şey hoşuma gitti, daha bile fazla bir şey olabilirdi. Atıyorum, ne bileyim… Daha ne kadar aslında fizikselleşse o kadar hoşuma giderdi hani. Paintball falan gibi olsa hoşuma giderdi yani. Mesela survivalist paintball oynasak.

50 I: LARP gibi mi mesela?

51 P: Galiba, onu hiç oynamadım.

52 I: Hmm, LARP'ta şey işte böyle kostümlerini falan giyip böyle alana çıkıyorsun; gerçekten savaşıyorsun.

LARP

53 P: Ha, LARP. Evet anladım. Evet ama onda çok şey yok ya. O daha… Yok ya, öyle değil. Çünkü LARP'ta gerçekten kılıç savaşı çok yapmıyorsun teknik olarak ya da okla gerçekten bir şey vurmaya çalışmıyorsun mesela. Ama mesela, onun yerine balon vursak mesela. Senin yaratığın…senin karakterin işte avlanmaya çalışıyor, biz de burada okla balon vuruyoruz. Ya da birbirimizle gerçekten sopa dövüşü yapıyoruz hani bunun gibi onu demek istedim. LARP daha çok, o da etkiliyor ama o hani ability kısmını etkilemiyor, hani ability testing boyutuyla.

54 I: Tamam. Ability testing. Peki bedensel oyun, oyun dünyasıyla ilişkini nasıl etkiliyordu. Yani oyunun hayali dünyasıyla.

55 P: Demiştim zaten.

56 I: Yani şunlar mı geçerli, tekrar söylediklerini okuyayım mesela. Daha immersive olduğu, somutlaştırdığı, karakterle bağdaştırmayı kolaylaştırdığı, minigame'ler kontrolü daha çok hissettirdi.

57 P: Sorumluluk demiştim ya.

58 I: Ha sorumluluğu arttırdı.

movement based

59 P: Sorumluluğu arttırdı gerçekten. Ya çünkü şey çok da alakasız şeyler değil. Yani atıyorum şey daha alakasız düşünürsek ama o bile hoşumuza gidiyor, işte tuşa ne kadar hızlı basarsan atıyorum o kadar kurtuluyor ya bilgisayar oyunlarındaki karakterler. Aslında düşününce o daha alakasız ve rahatsız edici kadar alakasız aslında. Bunda en azından topu sıkıyorsun, doğru anda atmaya çalışıyorsun falan o yüzden hani alakalı olması hoşuma gitti yani tam tersi. Her zaman küçük oyunlar…Bana burada kapların içine fındık koyup fındığı bul yapsaydınız o da hoşuma giderdi çünkü o da fiziksel bir oyundu ama alakalı olması kesinlikle çok daha önemli bence.

positive
immersion
materialize

60 I: Anladım. Yani fiziksel, içinde bulunmak her türlü arttırırdı ama oyunun o fiziksel hareketle relate etmesi daha da iyi oldu.

61 17.00: P: Fiziksel oyun, oyun experience'ımı ve zevkimi arttırıyor ama oyuna yaptığım hareketlerin oyun hikayesiyle alakalı olması hikâyenin içine girmemi ve o setting'e girmemi kolaylaştırıyor.

positive
lore

62 I: Anladım. Fiziksel olması eğlenceyi arttırıyor ama oyunların tasarımı diyeyim o zaman, oyunların bu şekilde tasarlanmış olması hikâyeye girmemi kolaylaştırıyor.

movement based

63 P: Evet hani sanırım. Daha farklı olsa işte orada atıyorum bulmaca çözmem gerekse ne kadar güçlü vuracağımı bulmak için. Şey yapabilirdim hani gene böyle gerçekten vuruyormuş gibi hissetmezdim de sadece bilgisayar oynuyormuş gibi hissederdim. Hani benim bir başka (anlaşılmıyor?) rakibim, karakterim, başka şekilde böyle şeyler oluyor.

64 I: Anladım. Evet, bilgisayarlardaki böyle hani şey vardı mesela.

65 P: A'ya hızlı basmak kılıç kullanmakla en ufak alakası olmayan bir

şey mesela.

66 I: Bioshock'ta da hacking için şey yapıyordun. Piping oyunu var ya onu oynuyordun. Onun gibi bir şeyden bahsediyorsun değil mi?

67 P: Evet ama galiba Bioshock'ta her şey

68 Mesela daha çok sevdiğim hacking, Fallout'ta hacking daha zevkliydi. Bazı çünkü şifre bulma… hani küçük bir minigame'di ve bir tık daha şifre bulmaya çalışıyor gibiydin.

69 I: Aynen hatırlıyorum. Böyle bir harfler falan vardı ve onları bulmaya çalışıyordun.

70 P: Evet, üç hakkın mı ne vardı ondan sonra böyle benzer kelimeler var ve o kelime…

71 I: Hah, tamam hatırladım. Bulmaca çözmekti o aslında ama şifre buluyor gibi hissettiriyordu.

72 P: Onu iyi yapıyordu mesela pipe o kadar iyi hissettirmiyordu öbürü daha iyi hissettiriyordu.

73 19.03: I: Peki yine benzer bir soru soracağım. Bedensel oyun oynamak karakterinle olan ilişkini nasıl etkiledi.

positive

concern

P/C Relationship
movement based

74 P: İyi yani çünkü sonuçta şeyde benim karakterim mesela çok şey bir karakter, fiziksel bir karakter. Thief olabilecek en klişe rol. Hani mesela atıyorum 100 yaşında bir student seçseydim bilmiyorum o zaman deneyimim daha farklı olabilirdi herhalde. Ben yine zevk alırdım çünkü oyunlar çok böyle 100 yaşında hareket etmek çok zor olacağı için ve düşünsel şeyleri böyle çat diye azıcık efor sarf etsen de yapabiliyorsun ya aslında onda da iyi olurdu yani. Mesela şey, Erhan Bey onu yaşadı karakterinin yavaş olmasından ötürü refleks oyunları çok zordu onun için ve o karakterinin yaşadığı refleks yapamama zorluğunu yaşadı yani.

75 I: Senin için de güç zordu mesela?

76 P: Evet, denemedim bile zaten.

77 I: Anladım, bir kere denedin sanırım sıkmayı.

78 P: Evet, kırmızı geldi.

79 I: Kırmızı geldi aynen.

positive
immersion

80 P: Evet, evet. Mesela şeydi, karakterim için precision kolaydı ama ben precision'ı beceremedim ya o mesela çok komik gelmişti bana hani böyle ben karakterimi yüzüstü bırakıyorum gibi.

81 I: Ama en sonunda yaptın neyse ki precision'ı.

82 P: Evet ama bayağı yardımcı oldunuz yani. Hadi bir daha hadi bir daha yapana kadar.

83 I: Ama işte öğrenme safhası enteresan.

P/C Relationship
movement based

84 P: Yani belki öğrensem bu kadar korkunç olmazdı ama hani gerçek hayatta bir thief'ın olacağı kadar şahin gözlü değilim ki yani kalan

oyunlardan anlaşıldığı üzere.

positive

85 I: Peki bu seni rahatsız etmedi mi mesela?

86 P: Yoo, etmedi. Çünkü biz hani mesela illa hani kendimiz gibi bir karakteri oynamak zorunda değiliz ki. Ayriyeten thief'in en büyük olayı precision. Bir de precision neye bağlı?

87 I: Precision şeye instinct'e falan bağlı.

88 P: Instinct'e bağlı.

89 I: Focus'un eğer… çok yüksek değildi galiba değil mi?

90 P: Yok zaten benim karakterim de çok…

91 I: Ama quickness'a da bağlı precision.

92 P: İşte oradan biraz kolaylık sağlanıyordu ama mesela hunter'ın daha fazladır?

93 I: Evet hunter'ın precision'ı daha fazla.

94 P: Ama şey herhalde aynen ilk başta quickness ile alakalı öbüründe de instinct'le mi alakalı.

95 I: Bakayım hatta.

96 P: Merak ettim de kendi kendime. Precision'ı karakterimin iyi miydi?

97 I: Senin karakterinin precision'ı iyiydi onu söyleyebilirim. Ama ilk başta seçtiğin hedefler çok zordu.

98 21.46: P: Öyle bir şey de var ama sonuçta yine de hani şey olsa yapardı. Benim yerime gerçekten böyle şahin gözlü ve motor yetenekleri süper iyi olan bir insan olsa yapardı.

P/C Relationship
movement based

99 I: Ya pekâlâ o şey sorusu çok ilginç geliyor da bana o yüzden. Yani sonuçta tabii ki sen kendin gibi bir karakteri oynamak zorunda değilsin hatta muhtemelen oynamazsın da genel olarak insanlar kendilerinden farklı karakterler seçip oynarlar. Ama zarda mesela hani hiçbir şekilde kendi skill'lerine bağlı değilsin o durumda. Şimdi burada kendi skill'lerine bağlı olman o karakterinin rolüne girmesini zorlaştırdı mı?

100 P: Evet, evet. Ben de onu düşündüm şimdi. Yani bir nebze. Ben mesela onu düşündüm kendimden çok farklı bir karakter keşke oynasaydım diye düşündüm. Hani gerçekten çünkü 100 yaşında bir priest oynasam o zaman çok farklı olurdu. Şu anda ilk defa oynadığım için oyunu çok zorlanmamak için hep oynadığım, hep kendime yakın bulduğum thief şeyini gördüm. Normalde mesela challenge istediğimde gidip priest oynuyorum zaten.

101 22.51: I: Peki işte o zaman tekrar o soruyu soracağım. Orada hedef alamıyor olman senin roleplaying yapmanı zorlaştırdı mı thief ile?

102 P: Yok. Hatta sanırım şöyle oldu. Normalde işte mesela thief ile… Thief deyince şey değil illa hani sharpshooter değil o yüzden o kadar zorlanmadım. Benim düşündüğüm thief de zaten, hayal ettiğim

P/C Relationship
immersion
movement based

genel olarak çok şey değildi sharpshooter bir tip değil de daha çok swindler. Hani cat burglar ve swindler bir tipti. O yüzden çok da uç, çok da zaten şahin gözlü bir şey hayal etmemiştim. Hatta gözleri bozuk bile olabilirdi yani.

103 23.32: I: Peki etmiş olsaydın sence zorlaştırır mıydı? Gerçi bu farazi bir soru ama… Deneyebilirsin.

104 P: Etmiş olsa mıydım?

105 I: Öyle bir karakter, diyelim ki karakterin sharpshooter'dı. Sekileri(?) de hayal ettin ve yapamadın bunları iki üç defa.

106 P: O zaman komik olurdu benim için.

107 I: Komik…

concern

materialize
immersion

luck stone
interface
movement based
P/C Relationship

108 P: Ben çok gülerdim o zaman. Hani onu düşünüyorum ben de işte atıyorum mesela gerçekten hunter seçseydim ya da böyle assassin falan seçseydim böyle uzaktan bir an hiçbir şey vuramasaydım komik olurdu biraz. O zaman biraz sıkıntı çıkabilirdi. Ama zaten mesela atıyorum hunter olduğumda oyunun seviyesi çok kolaylaşacağı için otomatik olarak yapacaktım ve daha da kötüsü böyle ister istemez hani oyunlarda mesela insanlar kazanınca böyle bir egolanıyorlar ya. Gayet de böyle bir ne vurdum be diye egolanabilirdim ama aslında kavanoz gibiyim yani. Sanırım oyunun en kolay yanı o şey olması bilgisayarda zorluk ayarlama kısmı ben kendimden çok farklı bir karakter oynamamı kolaylaştırıyor mesela. Dedim ya 100 yaşında bir priest'te de mesela hani 100 yaşındaki kadından da daha güçlüyüm yani. Ama ben onun yaşadığı zorluğu yaşayacaktım burada. Sıkacaktım sıkacaktım hani ki gene aynı şey, kırmızı oldu. Sıkacaktım sıkacaktım kırmızı olacaktı ya da başka bir şeyde böyle elim titriyor olduğu için böyle inanılmaz hızlı yanacaktı sönecekti sonra tutamayacaktım falan o yaşlılığı yaşayacaktım yani.

109 I: Peki mesela şeyde o egoyu hissedebildin mi? Bu soru üzerinde bayağı durdukta çünkü şey böyle bayağı açabileceğim şeyler söylüyorsun. Diyelim, hızlı oyunları özellikle başardın genelde: refleksti bilmem neydi falan hani o oyunlarda.

110 P: Yani o egoyu şöyle hissetmedim çünkü bunun kolaylaştırılmış olduğunu biliyordum.

111 25.31: I: Anladım.

112 P: Ki şeyi de sevmiyorum biraz o egoyu hani. Sevmediğim bir şey olduğu için hani kapılsan kapılırsın. Küçük telefon oyununda bile "Congratulations, You're the Best" yazınca bile bir mutlu hissediyorsun. Ama hani onun çok kolaylaştırılmış olduğunu biliyordum yani.

113 I: Anladım, anladım. Söylemese daha ilginç olabilirdi o zaman senin için.

movement based

114 P: Anlardım belli bir yerden sonra. Hani bugün anlamazdım ama mesela oyunu sürekli oynuyor olsam anlardım. Ya mesela ikinci bir karakter açsam anlarım herhalde. İkinci karakteri değil de üçüncü karakterde anlarım. Ama bilmiyorum söylemeseniz nasıl olurdu. Ama

söylemeseniz de hani şöyle tahmin ediyordum ben zarın yanması zorluğu değişmeyecek aynı olacak ama üstüne puanından hesap için yuvarlanan statlar eklenecek diye düşünüyordum. Hani ben zaten yine avantajlı olacağım yine diye düşünüyordum. Atıyorum normal (anlaşılmıyor?) onun karakterine -2 quickness gelecek, benimkine +4 gelecek zaten benim otomatik olarak sonunda yüksek olacak.

115 26.42: I: Aslında şöyle oluyor senin oradaki statların oyunun zorluğunu etkiliyor direk.

116 P: Ha işte aynen, kolay geliyor oradan.

117 I: Evet o şekilde oluyor ama oyunu kolay olmasına rağmen fail edersen +4'ün falan değeri artık pek bir önemi kalmıyor orada zara bağlı kalıyorsun.

118 P: Evet o yüzden aslında o daha çok daha güzel bir sistemmiş. Benim hani aklıma gelmemişti ama o şey çok daha güzelmiş, kolaylık zorluk arttırma ve hani yapamaman çok daha komik bence. Çünkü böyle biz daha ne yapalım sana. Belli ki yapamıyorsun.

119 27.23: I: Peki yine bununla ilgili bir soru sorayım o zaman. En sonunda şey getirdin ya böyle epic getirdin ya precision'ı.

120 P: Epic mi getirdim? Ha, getirdim ama…

121 I: En son yaptığın precision epic'ti.

122 P: Getirdim getirdim sarı çıktı.

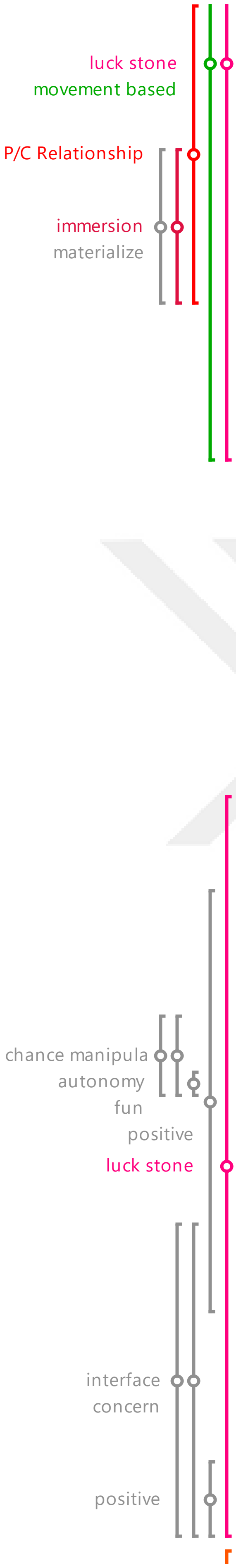
123 I: Evet sarı çıktı ama o epic getirdiğin zaman şey oldu mu böyle bir hani başarmış hissettin mi o zaman o anlamda?

124 P: Şeyi başarmış hissettim hani oyunun kurallarına göre doğru bir hareket yaptığımı hissettim. Ben başardım gibi hissetmedim çünkü şeyi biliyorum hani zar farklı şey yapıyor bilmem ne o yüzden hani bunun da… Yine bir nebze gerçekten precision var işin içinde çünkü sonuçta indiriyorsun, kaldırıyorsun, bir şey yapıyorsun ama hani mesela bilmiyorum hani gerçekten precision'ım ne kadar iyi bilmiyorum. Gerçekten sonuçta böyle bir kurtla savaşmak zorunda kalmadım ya da hani okçuluk yaptım ama hiçbirini vurmak zorunda kalmadım. O yüzden gerçekten ne kadar işte… mesela iğneden geçiriyorsun ama hani rahat ortamda oturuyorsun geçiriyorsun.

125 I: Anladım.

126 P: Ama hani nasıl hissettim. Hani o gelince mor oluyor bir sevindim; mutlu oluyorsun ya ama şey mutlu oluyorsun hani ki iyi bir şey bence bu ki bu kişilikle de alakalı olabilir bilmiyorum. Biraz daha egomu pohpohlama ihtiyacı olan bir insan olsam büyük ihtimal ne iyi oynadın be derdim. Çünkü bu Candy Crush üstünden yapılabilen bir şey olduğuna göre bu oyunda katbekat yapılabilirdi çünkü sen yapıyorsun diye(?) büyük ihtimal. Ki insanlar iyi oynadıkları oyunları daha çok severler. O zaman mesela ben böyle kas çalışan bir çocuk olsam gelsem burada bir de şey seçsem böyle en kaslı ne var?

127 29.12: I: Fire earth işte şeyin Emrah'ın karakteri.



128 P: Aynen. Blacksmith seçsem üstüne bir de başka yaş aralığı olarak 30 ya da 20 seçsem ondan sonra bütün oyunlar kolay gelecek; ben de çat çat çat yapacağım ve yani ben çok kaslı olduğum için kolay yaptım diyeceğim yani bunu. Karşımda bir kız olsa derim. Ben çünkü çok kaslıyım o yüzden kolaylar. Ya da benden daha az kaslı bir insan olsa derim. Gerçekten iyi yapacağıma inandığım bir şeyi iyi yaptığım zaman büyük ihtimal insan psikolojik olarak oyuna değil de kendine… Zaten böyle bir şey varmış hani iyi olan şeyleri kendine, kötü olan şeyleri dışardan bir sebep olduğuna düşünmek şeklindeymiş insan psikolojisi okuduğum kadarıyla.

129 I: Tamam.

130 30.04: P: Hani ben iyi olduğumu düşünmediğim için belki fiziksel özelliklerde böyle bir şey hissettim. Ama bilmiyorum çok konuştuk ama güzeldi bence.

131 I: Tamam.

132 P: Çok konuştum. Uzattım, neler anlattım ya.

133 I: Yok, yok. Ben soruyorum zaten.

134 P: Ama ben böyle çok konudan uzaklaşırsam haber verin.

135 I: Tamam.

136 P: Ben böyle laf lafı açıyor ve kendi kendime konuşuyorum gidiyorum.

137 30.32: I: Yok, yok. Benim için iyi öyle olması. Daha çok data geliyor bana. Peki şu luckstone nasıl etkiledi; onun hakkında ne düşünüyorsun?

138 P: Genel olarak 20'lik zar görünce mutlu oldum. 20'lik zar değil mi o?

139 I: 12.

140 P: 12 mi. Tamam. Zar görünce hoşuma gitti hani. İyi etkiliyor hani. Zaten sistemi ben beğendiğimi söylemiştim ben yapıp yapamamana göre zarın iyi ya da kötü gelme olasılığının değişmesi çok güzel bence. Dengeli yani. Zevkli bayağı. Hani şey kötü mesela aynen kötü yaptım kolay bölümü kıpkırmızı bir zar geldi ve şunu görüyorsun ne yapsan olmayacak ya da böyle çok iyi yaptın hepsi yemyeşil, oh oh oh diye sallıyorsun yani, o çok güzel. Tam şans değil biraz o artık sarı da gelebilir o da şans kısmı ona da gülüyorsun hani bu kadar uğraştık, bu kadar statları kastık, kendimiz kastık zarın insafına sarı geldi diyorsun. Ama yüzleri değişmese daha kötü olurdu mesela.

141 I: O zaman şey…

142 P: Aynen üzerinin değişmesi çok daha adil hissettiriyor.

143 I: Adil hissettiriyor.

144 31.59: P: Evet, yaptığın hani ne yaptıysan onun sonucunu aldığını hissettiriyor.

145 I: Tamamdır. Peki en sevdiğin oyun hangisi oldu bu oynadıkların arasında?

positive

146 P: En sevdiğim oyun…İkisi arasında kaldım. Ya aslında normal şartlarda en sevdiğim şey olurdu, kolu çekmek olurdu.

147 I: Şey mi…

148 P: Precision değil de o nedir? Refleks mi?

149 I: Evet refleks aynen.

negative

150 P: Refleks game'leri en çok sevdim. Kolu çekmek. Ama bu oyunda en çok o yakalamayı sevdim. Çünkü bir tık delay'i vardı kolu çekmenin onu çok anlayamadım. Anlayamadım değil de hani böyle şey olsa daha hoşuma giderdi, hani böyle kolun yanınca çekersin ya dızladıktan sonra çekmen gerekiyor ya o sistem vücuduma bir tık daha ters geldi. Çünkü böyle hani darbe yedikten sonra çekmezsin darbe yiyince çekersin ya.

151 I: Anladım aslında oradaki olay biraz da şey böyle hani karşındaki hamleyi yaptı, yaptıktan sonra oynadın gibi bir mantığı var ama tamam anladım.

152 33.26: P: Madem hani olayı biz şeye döküyoruz. Mesela şey de olurdu benim için atıyorum hani bu aparat yerine iğne batırıp kaç santim sıçradığımı ölçseniz de aynı şekilde zevk alırdım.

153 I: Kaç santim ne olduğunu?

154 P: Oynadığımı.

minigame

155 I: Anladım.

concern

P/C Relationship

positive

immersion

156 P: Ne kadar oynadığımı ve zaman tutsalar hani elimi ne kadar çektim. Öyle bir durumda kaçmayı daha çok severdim çünkü oyunda daha çok kaçıyorsun ama biraz da thief olduğum için parlak bir objeyi grab etmek hoşuma gitti. Hani şey böyle hoşuma gitti. Minigame'de sürekli bir şey çaldığımı hayal ederek hani böyle kasadan bir şeyler aldığımı hayal ederek yaptığım için bu oyunda ve bu karakterde ikinci refleksi daha çok sevdim ama savaşın doğasına daha yakın olduğu için birinci game çok iyiydi. Ama birinci game sanki gerçek zamanlı olsa hep daha havalı. Zaten eleştirilerimi yanlış anlamayın.

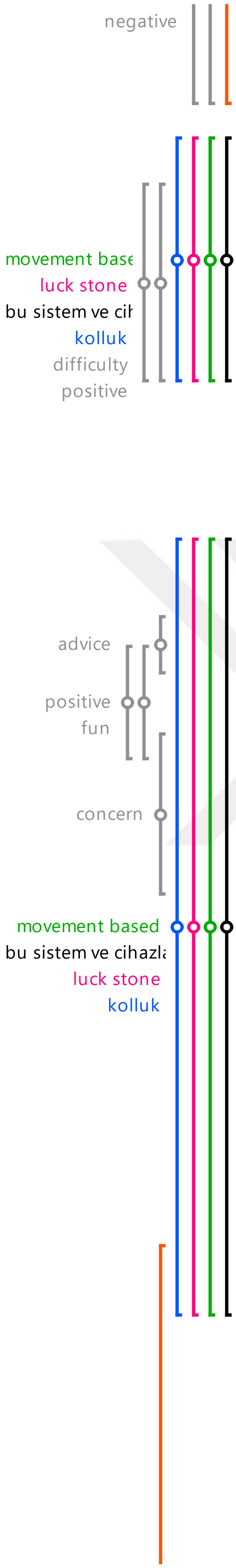
157 I: Yok, yok. Yanlış anlayacağım bir şey yok.

158 P: Belli ki böyle bir oyunu siz yapmışsınız

159 I: Ben tamamen ne kadar şey duyabilirsem o kadar iyi. Şey olarak da söylememin sebebi savunmak için değil sadece hani mantığının nasıl işlediğini anlatmak için. Senin için şey olsaydı tam titrediği anda çekiyor olsaydın vücuduna daha uygun olduğunu hissediyorsun böyle bir şeyin?

160 34.55: P: Evet. Sanki şey olsa rengi kırmızıya dönse ben hareket edince maviye dönse ve ne kadar süre kırmızı kaldığını hesaplayıp hani toplamda atıyorum 5 saniyenin altındaysa üç seanstaki kırmızı,

interface



5-10 arasıysa orta ve böyle bir şey gerçekten elim acıdığında çekmeye bana daha yakın gelirdi bana ama FRP mantığı sağlık olsun.

161 I: Yok, anladım. İlginç bir şey yani belki de değiştirilebilir gerçekten. Peki genel olarak sence bu sistemin kullanımı zorluğu nasıldı?

162 P: Çok güzel, gayet kolaydı.

163 I: Oyunları öğrenmekte sorun oldu mu?

164 P: Yok, yok. Hani ilk başta bir anlamadım da o da olur yani. Yok, yok. Bence gayet kolaydı hani. Şey değildi kompleks ve insanı oynatmak istemeyecek bir şey değildi, doğaldı yani.

165 36.04: I: Peki şey soracağım şimdi oyun iki safhaya ayrıldı: bir cihazlardan önce diyeyim bir de cihazlardan sonra. Sence bu iki safha arasındaki en büyük fark neydi?

166 P: Cihazlar.

167 I: Cihazlar…Yani deneyim olarak söyle bana. Bu ikisi arasındaki en büyük fark ne oldu?

168 P: Yani birincisi klasik FRP'ydi. Keşke birincisinde de kolla bir encounter olsa o zaman belki daha kolay oynarım. Ama yani dediğim gibi şey şöyle fark ediyor elinde bir aparatı sallayınca otomatik olarak daha çok eğleniyorsun. Birincisi de çok güzel, FRP çok zevkli bir şey. Hikâye de çok güzeldi. Hani sırf zarlı düz combat encounter'ı olsaydı da zevkli olurdu ama yaptığım her şeyi yine aparatlı yapsam, birincinin hikayesini de aparatlı oynasam biraz farklı, FRP'den farklı bir oyuna kaçıyor bence. O zaman başka bir çeşit oyuna dönüşüyor.

169 I: Ne gibi bir oyuna dönüşüyor mesela? İsimlendirebilir misin?

170 37.22: P: Hani bir tık böyle board game gibi çünkü fiziksel olarak uğraştığın şeyler var ya. Hani board game'in işte atıyorum karakterini köprüden geçirebilmek için inceden(?) geçirebilsen mesela o buna daha yakın olurdu. Hani biraz daha affinity/ability(?) game'e dönüyor. Hem üst oyunu oluyor mesela. FRP'nin üstü üst oyunu değil ya. O yüzden hani ben 100 yaşındayken benim yaşımda bir er çocuğunu da canlandırabilirim ya da 13 yaşında biri olsam 20'lik bir orc'u da canlandırabilirim. Ama mesela bu onu çok şey yapmıyor etkilemiyor bu onu ama. Ya bilmiyorum, FRP hani daha oturduğun yerden oynamaya müsait. Çaba harcamak falan tabii insanı daha çok bağlıyor, daha mutlu ediyor. Ama FRP'ye dayalı artı içinde küçük minigame'ler olan bir oyun gibi daha çok.

171 I: Anladım. FRP'ye dayalı, tam olarak FRP olmasa da.

172 P: Tam olarak FRP artı minigame'ler olduğu için işte şey mesela havuç tek başına havuç, havuç artı kabak artık havuç olmaktan çıkıyor havuç artı kabak oluyor.

173 38.52: I: Anladım aslında FRP var.

174 P: Var var bayağı var.

175 I: Ama minigame'ler olunca yine de bu normal FRP'den daha farklı bir şey olmuş oluyor.

176 P: Hani şeyin bile farkı var kostümlü kostümsüz FRP'nin bile farkı var ki fark ekstra minigame'ler olması kötü olduğu anlamına gelmez. Sadece ne bileyim bazen çünkü, bilmiyorum. Benim için pozitif ama bazı insanlar da çaba harcamaktan hoşlanmayabilirler. O zaman daha klasik tercih ederler. Bütün minigame'ler zevkli yani ki herkesin yapabileceği kadar kolay ve karaktere göre kolaylaştırılıp zorlaştırılabilen bir şey olduğu için çok da insanı yoracak ya da olayın dışına çıkaracak bir şey değil yani. Aslında FRP.

177 I: Ama aradayım diyorsun tam da emin değilim ne olacağından?

178 P: Şey sadece, kesinlikle FRP var ama başka bir şey daha var.

179 I: O ikisinin birleşimi de aslında yeni bir şey oluşturuyor?

180 P: Bir versiyonu gibi FRP'nin mesela LARP tam FRP değil. Onun gibi hani bu da öyle değil bu içinde oynayabileceğimiz hani biraz daha.

181 40.23: I: Peki LARP'a göre FRP'ye daha mı yakın daha mı uzak?

182 P: Daha yakın. LARP'ta zar atılıyor mu?

183 I: Sanırım versiyonlarına göre değişiyor. Çok şey LARP'ların genelde böyle her event'e göre farklı farklı kuralları oluyor.

184 P: Anladım. Zaten yakın olmasının sebebi hani (anlaşılmıyor?)

185 I: Tamamdır.

186 P: Bilemiyorum biraz buralarda kafam karıştı düşünmem gerek. Bir de LARP'ta ability testing hiç yok ama bunda da var gibi görünüyor ama yok aslında. Aslında yok. Çünkü o aralıklar eşek gözü kadar olduktan sonra precision'ı haydi haydi yaparsın yani sonuçta. Hani şu kâğıdı okuyabiliyorsan düşünebiliyorsan senin karakterinin precision'ı işte çok yüksek olduktan sonra da hani ben de tek attım. Ben normalde uzaktan böyle bir yaratığı tüfekle vurabilir miyim? Vuramam. Ama o bu oyunda vurabilir mi vurabilir demek ki oyun benim için bunu mümkün kılmış hissetmiştim. Hani ben ısınamamıştım. O yüzden aslında FRP'si var ama fiziksel bir eylem(?) de var ya hani benim farklı yanı dediğim FRP'ten tamamen bağımsız olarak ışığı ışığa oturtma gibi küçük bir oyun da var içinde. Hani böyle bütün hikâyeden bütün her şeyden bağımsız olarak da küçük bir minigame var. Hani şey de olabilirdi bu ne bileyim iki tane çubuğu üst üste tutmaya çalışmak. Böyle bir oyun da oynayabilirdik, o da benim için küçük bir minigame olurdu, mutlu olurdum, severdim bir de oynardım normalde hikâyeyi(?).

187 I: Anladım. Yani bu kendi kendine bir şey de olabilirdi diyorsun?

188 P: Evet, evet. Hani şeyi düşündüm aynen bu gauntlet'ler kendi kendine de bir oyun olabilir.

189 42.29: I: Tamamdır. Peki en etkilendiğin kısım hangisi oldu bu

süreçte? Tüm oyunu düşün yani en başından en sonuna kadar, en etkilendiğin yer neresiydi?

190 P: Combat bence.

movement based

191 I: Combat. O şekilde, bedensel bir şekilde bir şeyler yapabilmek mi?

positive

fun

192 P: Evet şey yani, ben zaten combat'ı seviyorum genelde, FRP'lerde de seviyorum. Bu daha da hani hem combat çok zevkliydi hem minigame'ler zaten zevkli o yüzden tadındaydı yani. Hikâye falan da çok güzeldi yanlış anlamayın ama hani hatta zevkli.

193 I: Yok, yok önemli değil hiçbir şeyi yanlış anlayacak bir durumum yok zaten.

194 P: Ekleyecek bir şeyim yok.

195 I: Zaten araştırmacı olduğum için sen ne söylersen benim için o eşit değerde bir data.

196 P: Hani şey anlamında söylemedim ben. Hikâyesi falan da mesela hani…

197 43.19: I: Peki, combat'ı yani combat olduğu için, combat'ın hikâye tarafını mı sevdin yine sonuçta combat'ta bir hikâye tarafı var. Anlatıyor o geliyor buradan zıplıyor şunu falan diye.

198 P: Ha, var. Onu yaptır, bunu yaptır.

199 I: Yoksa orada onu şey olarak oynamayı mı sevdin, bedensel bir şekilde oynamak mı seni etkiledi?

200 P: Yok. Combat'ın hikâye tarafı, şurada şey taktiksel kararlar veriyorsun ya onu sevdim.

movement based

201 I: Anladım. Combat'ta anladım.

positive

202 P: Seri olarak taktiksel karar vermen en çok combat'ta gerek oluyor. Öbüründe de hani veriyorsun ama mesela atıyorum üç line'da bir veriyorsun. Combat'ta sürekli hani taktiksel kararlar verilen bir yan var ya. Hani bu hele taktiksel kararlarının belli bir nebze elinle, ben yapıyormuşum gibi hissettirmesi de ayrı bir zevk oluyor. Bir de şey komik oluyor işte yapamadım yaptım falan. Şey komik yani bir zarı gördüm kıpkırmızı, e yapmayayım durayım o zaman. Komikti orası benim için.

203 44.23: I: Tamamdır. Son sorumu soracağım. Bu cihazla başka oyun sistemlerinde yani bu sistem diyeyim bu cihazla demeyeyim de tüm bu sistem başka oyunlarda nasıl kullanılabilir?

204 P: Yani zaten şey kullanılır. Bütün sistemlerde hani precision bilmem ne, [bayrak ayrılma](anlaşılmıyor?) FRP'de de kullanılabilir. Ayrı bir şekilde bunun olasılıklarını falan hep tamamen farklı refleks oyunu başka bir şey olabilir hani bütün hikayelerde refleks gerecek, bütün hikayelerde güç gerecek, bütün hikayelerde işte konsantrasyon gerecek ya zaten. O yüzden her şekilde kullanılabilir aşağı yukarı hani tasarımını biraz değiştiririz ona kumaş kaplarsın falan bir şey olur. Ki dediğim gibi hani böyle bir şey taksan sana oyun içi device

movement ba
positive
bu sistem ve
kolluk

luck stone
lore
customize

olarak introduce etmeyip oyun dışı olarak etsen de mağara adamı olsan ve [uyuyacı?](anlaşılmıyor?)[45:29] olsan ve hem oyun dışında koluna taksan zaten konsol sonuçta ne kadar yabancı buluyoruz ki bunu da yabancılamayız yani. O yüzden hani oyun içi artifact olarak değil de oyun dışı olarak takarsın o zaman medieval'da da olur, mağara adamı da olur, dinozorlar da.

205 45.46: I: Yani oyun dışında böyle bir şey taksan görünüşü nasıl olursa olsun onu yine roleplay edebilirim sanki o zamanın şeyiymiş gibi.

positive

206 P: Evet, evet ben ederim. O araçtan değilmiş de gerçekten işte ben bunu prove etmek için hani bu benim elimi görmemi sağlıyor hani aslında amaç orada hani küçük bir minigame'i başarmak o yüzden hani her türlü şeyde kullanılabilir yani. Tamamen şey ölçüyor senin o task'i bir de elle yapmaya çalışmanı ölçüyor.

lore

207 46.17: I: Ama daha önce söylediğin gibi şey eğer o setting'e uygun bir görselliği olursa alışması daha kolay olur.

208 P: Daha kolay olur ama eğer o zaman ingame introduce edilecekse bana.

movement based
luck stone
kolluk
adaptability
bu sistem ve ciha

209 I: Anladım. Outgame'i unintroduce edebildiğimiz sürece.

210 P: Outgame'i bir konsolmuş hani oyunu oynamanın bir parçasıymış gibi anlatırsanız o zaman rahatsız olmam zaten.

211 I: Anladım.

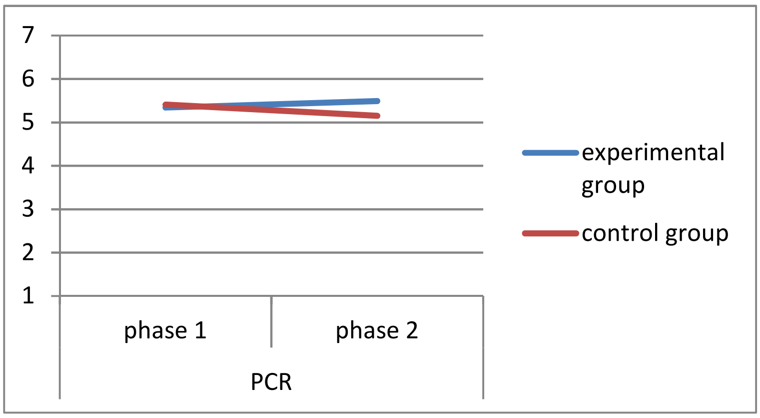
lore
concern

212 P: Ama hani ingame olarak işte atıyorum haçlı seferlerine gidiyoruz bu da işte sana Papa'nın okunmuş kolluğu diye verilse o zaman bir beş saniye garipserim. Kabullenirim sonra hayal kurarım üstüne. Ama bunda direk kabul ettim çünkü biz böyle bir teknoloji yapmaya çalıştık, bu bir teknoloji ürünü dediniz tamam dedim. Hani şey olsa gelecekten gelmiş bir kol deseniz de tamam kabul ederim ama o hani era'ya ait bir şeymiş gibi verseniz üç dört saniye garipserim. Ama hiç böyle bir şeyin talk'u geçmese en başından beri biz zaten oyunu böyle oynasak bunu da garipsemem.

213 I: Tamam. Teşekkür ederim.

214 P: Ben teşekkür ederim.

215 I: Böyleydi sorularım. Hem zaman ayırdığın için hem de…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phase 1
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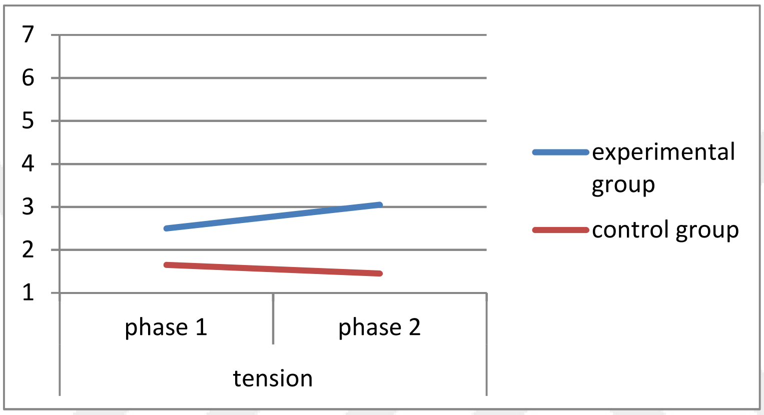
control group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phase 1
phase 2
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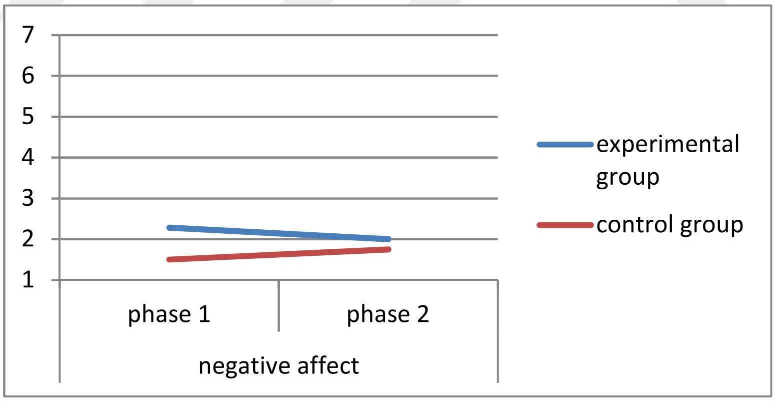
experimental group
control group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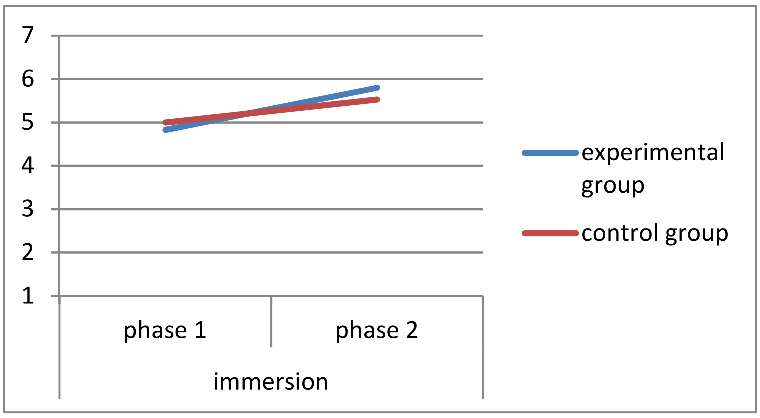
phase 1
phase 2
negative affect
experimental group
control group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phase 1
phase 2
immersion
experimental group
control group