HUMAN-CENTERED DESIGN FOR ARTIFICIAL INTELLIGENCE

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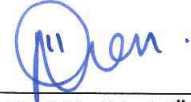MASTER OF ARTS

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ABSTRACT

The 20th century witnessed massive breakthroughs in technology and today, new technologies such as the Internet of Things, Artificial Intelligence and Virtual Reality keep emerging by changing people's lives, communication styles, needs, expectations and relationships with technology profoundly.

Artificial Intelligence has always been a utopic/dystopic notion that is dreamed, discussed and written about in science-fiction. It usually represents a technology with "non-human" characteristics. It has been making people both excited and frightened, based on the imagination of the writer. Today, it is not a fantasy anymore; it is a new technology that is being used, explored, taught and watched very carefully.

Human-centered design is a widely-used framework for designing new products and it has been helping designers to address and solve real problems by putting the humans in the center of the design process.

This thesis aims to determine the fundamentals of human-centered design and explore the Artificial Intelligence (AI) technology. And in this context, it asks: In the age of the artificial intelligence, which is perceived as the opposite of the "human", how can human-centered design be used to establish a connection between the humans and the machines?

Based on a review of literature on the relationship between the human-centered design and the emerging technologies, an online survey is conducted with people from different social and cultural backgrounds. Analysis of the responses to that survey demonstrated that people establish better relations with non-human things in the extent to their similarity with humans and their ability of solving real human

problems. Further research is needed to verify these findings since this is such a new area for human beings to explore.

Keywords: Artificial intelligence, human-centered design, emerging technologies.

ÖZET

Yirminci yüzyıl, teknolojide çığır açan gelişmelere tanıklık etmiştir. Günümüzde, Nesnelerin İnterneti, Yapay Zeka ve Sanal Gerçeklik gibi yeni teknolojiler türemekte, ve insanların hayatlarını, iletişim biçimlerini, ihtiyaçlarını, beklentilerini ve teknoloji ile olan ilişkilerini derinden değiştirmektedir.

Yapay Zeka, bilim-kurgu dünyasında üzerinde sıklıkla düşünülen, hayal edilen ve yazılan ütopik/distopik bir kavram olagelmiştir. Genellikle "insan-dışı" bir teknolojiyi betimlemek için kullanılmış ve yazarının hayal gücüne bağlı olarak insanları hem heyecanlandırmış, hem de korkutmuştur. Günümüzde ise yapay zeka artık bir fantezi değil, yaygın olarak kullanılan, araştırılan, öğretilen ve dikkatle izlenen yeni bir teknolojidir.

İnsan-odaklı tasarım, insanı tasarım sürecinin merkezine koyarak, yeni ürünler tasarlamaya yarayan ve yaygın olarak kullanılan yapısal bir çerçevedir ve tasarımcıların gerçek problemleri belirleyerek onlara çözümler sunmalarına yardımcı olur.

Bu tez, insan-odaklı tasarımın temellerini ortaya koymayı ve yapay zeka teknolojisini incelemeyi amaçlamaktadır ve bu bağlamda; insanın zıttı olarak algılanan yapay zeka çağında, insan-odaklı tasarımın insanlar ve makineler arasında sağlıklı bir ilişki kurulmasına nasıl yardımcı olabileceği sorusuna cevap aramaktadır.

İnsan-odaklı tasarım ve yeni teknolojiler arasındaki ilişki üzerine literatur taramasının ardından, farklı sosyal ve kültürel gruplardan katılımcılarla sanal bir anket çalışması yürütülmüştür. Anket sonuçları göstermektedir ki; insanların insan-dışı teknolojiler ile daha iyi ilişkiler kurabilme ihtimali, bu teknolojilerin insana atfedilen özellikleri ne kadar taşıdığı ve insanlara ait gerçek sorunlara çözümler

üretebilme becerileri ile doğru orantılı olarak artmaktadır. Bu çok yeni bir alan olduğu için, elde edilen bulgularla ilgili daha detaylı araştırma yapılması gerekmektedir.
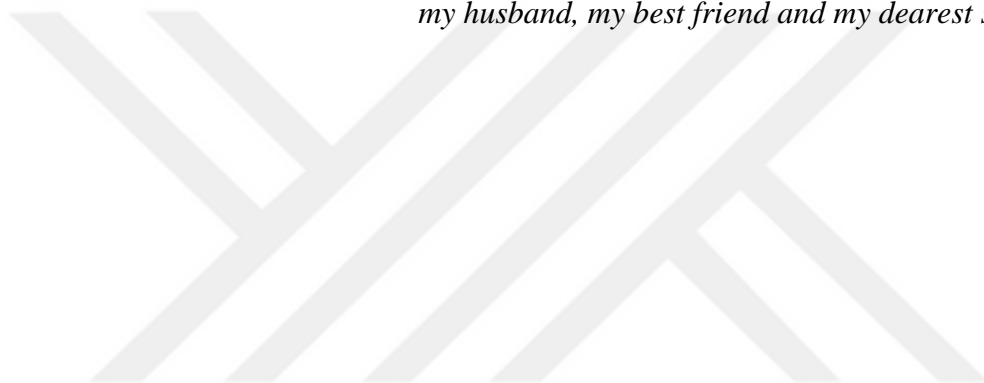
Anahtar kelimeler: Yapay zeka, insan odaklı tasarım, yeni teknolojiler

To Danış;

my husband, my best friend and my dearest supporter…

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

AI - Artificial Intelligence

ALS - Amyotrophic Lateral Sclerosis (a disease)

ARPANET - Advanced Research Projects Agency Network

BLE - Bluetooth Low Energy

BMI - Brain-Machine Interfaces

CEO - Chief Executive Officer

CERN - Conseil Européen pour la Recherche Nucléaire (European Organization for

Nuclear Research)

CV - Curriculum Vitae

D.C. - Washington D.C. (District of Columbia)

EOG - Electro-oculography

GAN - Generative Adversarial Network

GPS - The Global Positioning System

GUI - Graphical User Interface

HCD - Human-Centered Design

HCI - Human-Computer Interaction

HTML - Hypertext Markup Language

HTTP - The Hypertext Transfer Protocol

IEA - International Ergonomics Association

IoT - Internet of Things

IPV6 - Internet Protocol Version 6

IxD - Interaction Design

ISO - The International Standards Organization

MIT - Massachusetts Institute of Technology

MoMA - The Museum of Modern Art

MP3 - Digital audio file format/extension

MRI - Magnetic Resonance Imaging

RFID - Radio-Frequency Identification

SNARC - Stochastic Neural Analog Reinforcement Computer

TCP/IP - Transmission Control Protocol / Internet Protocol

UCD - User-Centered Design

UCLA - University of California

UI - User Interface (Design)

UPC - Universal Product Code

URL - Uniform Resource Locator

USB - Universal Serial Bus

UX - User Experience (Design)

VHS - Video Home System - a standard for analog video recording on tape cassettes

VR - Virtual Reality

LIST OF FIGURES

1. INTRODUCTION

People witnessed massive breakthroughs in technology in the 20th century. As the internet became a major component in everyday life in the last few decades, it also opened a new path for technologies that looked impossible even 100 years ago.

Today, the world is experiencing a new era of technology. Smart devices with internet connection are becoming inseparable parts of our daily lives and new technologies are being introduced every day. The speed of technological developments in the human history has improved exponentially and gained an extra acceleration after the foundation of the internet. Millennials who are used to living with the internet, smart phones and social media accounts, keep meeting new products or services equipped with new technologies every day that excite or frighten them.

With the extensive usage of the emerging technologies such as the Internet of Things (IoT), Edge Computing and Artificial Intelligence (AI), more and more devices are getting connected to networks and these new technologies are demanding new ways to communicate and interact with their users. They change the communication channels between people and since the technology is changing too fast, new ways of communication emerge, improve, evolve or die very quickly, without even giving the people enough time to adapt.

Humans, on the other hand, always find their unique ways of interacting with new technologies. If a new product can achieve maintaining meaningful communication with its user, it keeps being used and evolve with its users through its lifetime. However, badly designed products or experiences that demand their way of interacting, instead of understanding their users' needs usually fade rapidly and disappear.

The history of human-computer interaction is full of bright ideas that had potential to be used and to be useful, however long forgotten.

That is why Human-Computer Interaction (HCI) and designing systems that will make this communication possible will play a key role in the future. Human-Centered Design principles which put the human factor at the core of the design process, have been adopted widely to achieve this goal in the last few decades. In a world that everything is being digitalized and non-humanized, and AI is becoming a part of the daily life, Human-Centered Design may help making use of the useful sides of the emerging technologies and maintaining a healthy human-computer interaction.

This thesis explores how the massive developments in technology in the last few decades effected our ways of communication dramatically and based on this, tries to show that human-centered design will gain a very important role in the future and shape the upcoming era of technology. It also tries to define what to take into consideration while designing for the systems that use machine learning algorithms.

It also aims to analyse the effects of the social, economic and cultural structure of the country of residence on the perception of people about AI, by conducting a survey from people from all around the world.

The first phase of this work starts by setting the theoretical base for the research, by analysing the state of the art for the human-centered design and the artificial intelligence technology, and the relationship between the human-centered design and the emerging technologies. This phase is followed by an online survey to gain insights about the people's opinions, needs and expectations about the subject.

2. HUMAN-CENTERED DESIGN

The very basic description for a design process could be given as "the art of problem solving". The main aim of the design process is to solve a problem and the existence of the problem itself is actually, the main reason to start a design process.

The best way to solve a problem is to understand it first. Why is it there in the first place? Who is being effected by it? Let's assume a family is in hunger and there is a tree full of delicious apples close by. However, there is also a wild river between the family and the apple tree that won't let any family member swim through. This is the definition of a problem. To solve this problem, one starts a design process, thinks about the affected audience (user), the external/internal conditions and possible solutions to the problem. The usable solution must help the family cross the river, therefore it should go over the water, it must be wide enough to let everyone pass safely, it must not be affected by water or wind and it must have the ability to carry the weight of the people who would use it. After several unsuccessful attempts, one could successfully invent one of the objects named "bridge" and "raft" depending on the material he/she has. So, based on an actual human need, a product gets designed with the focus of solving the problem of a user. This is an unofficial and broad definition for human-centered design.

If the "official" and detailed definitions for human-centered design are to be considered, The International Standards Organization (ISO) 9241-210 standard's definition would be as follows:

An approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques (ISO/TC 159/SC 4, 2010).

It also recommends six main requirements that a human-centered design process must meet:

1. Using a multidisciplinary approach in design processes

2. Understanding the user, the context and the whole story deeply

3. Putting the user in the center and keeping to evaluate to refine the findings

4. Looking at the bigger picture, considering all phases of an experience

5. Keeping the users in the loop while designing and implementing the design

6. Repeating the process as much as needed.

The main aim of human-centered design is to design more efficient products that improve the standards of daily life by bringing sustainability, satisfaction and accessibility.

Although the term has its roots long ago, it is popularized by the design firm IDEO. While designing, they've been questioning "being human" and "designing for human". IDEO believes that by embracing human-centered design, a designer can solve the basic and hard-to-solve looking problems of the human kind such as poverty, gender or race-based discrimination and accessing food and clean drinking water. They explain that "by using human-centered design framework, designers have the chance to design with communities, to deeply understand the people they're intending to serve, and to create innovative new solutions based on actual people's actual needs" (IDEO.org, 2015).

Steen uses the term "human-centered design" to point out many approaches including co-design, ethnography, participatory design, empathic design and contextual design (Steen, The fragility of human-centred design, 2008).

The act of designing is made by people and for people. Designers should avoid designing products or services that doesn't solve actual problems of actual people, just because it is possible, and that technology is present.

To sum up, human-centered design can be defined as a framework that uses design thinking approach and methodologies such as, User Interface (UI) Design, User Experience (UX) design and service design and puts human in the center of the designing process.

Below is a visual explanation of the human-centered design framework and its relationship with some methodologies and approaches used for design by Simonds:
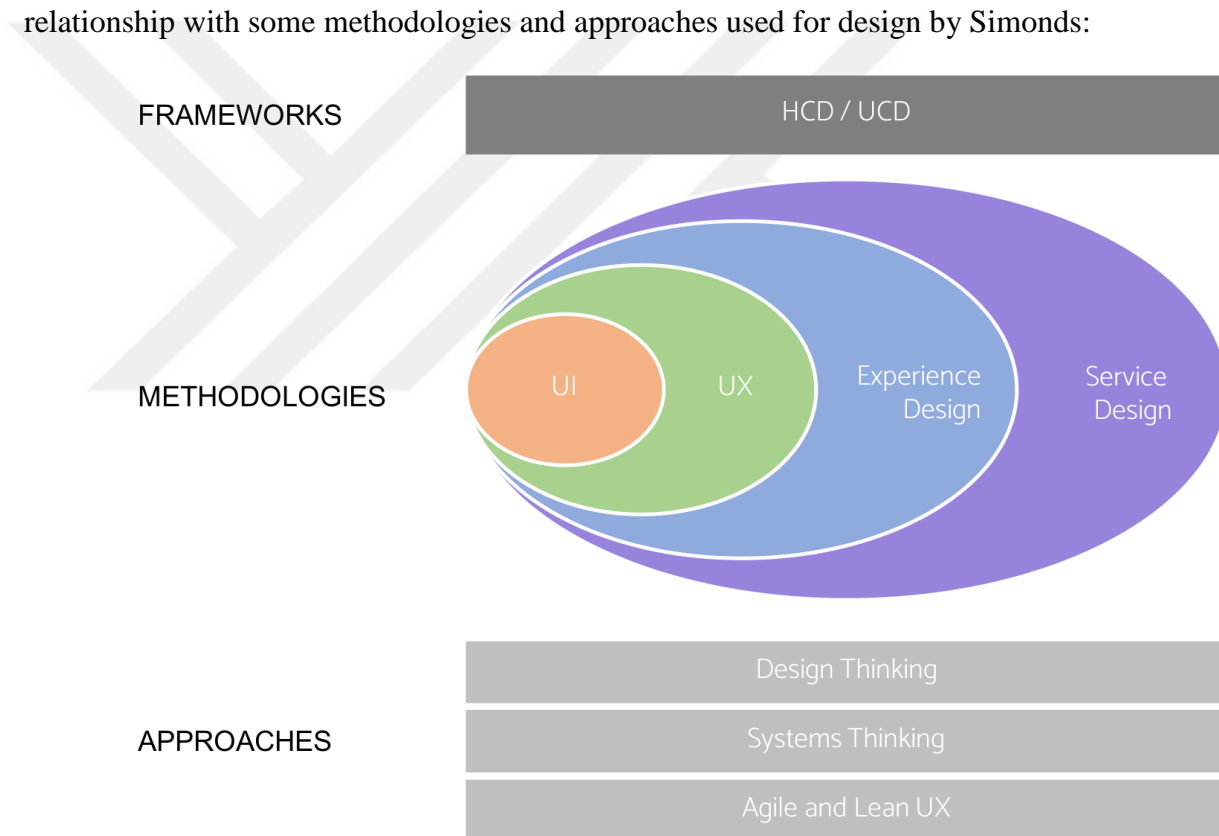
Figure 1. Human Centered Design Structure. Reprinted from Linkedin, by F. Simonds, 2016, Retrieved from https://www.linkedin.com/pulse/human-centred-design-vs-thinking-service-ux-what-do-all-simonds. Copyright 2016 by Franki Simonds

Human-centered design, meanwhile, is also known as User-Centered Design. Although they have slightly different definitions, they both use human as the main

reference while designing. User-centered design however, usually focuses of a limited persona group while human-centered design discusses the subject from a more holistic perspective.

The term "human-centered design" became more popular by the design firm IDEO. David Kelley, who is the founder of IDEO, had also worked with McKim and Faste. IDEO introduced Design Thinking methods by applying human-centered design methods to different problems (Gothelf & Seiden, 2016).

Giacomin explains the difference of human-centered design from traditional design practices lies seeking the answers in the people for whom the products or services are designed for, not in materials, tools or the designer's unique creative approach (Giacomin, What is Human Centred Design?, 2014).

Chaplin addresses "the works by Bob McKim in the 1960s and Rolf Faste in the 1970s at Stanford's Design Program as the pioneer works in the human-centered design area". They both believed in the potential movement in every individual (Chaplin, 2016).

Human-centered design requires a multidisciplinary approach. Since it is focused on humans, cooperation with social sciences is essential. Other human-related studies such as ergonomics are also critical to work with when the subject is the human.

2.1. Human-Centered Design Process

According to IDEO (IDEO.org, 2015), human-centered design process has three main phases:

1- Inspiration

2- Ideation

3- Implementation

This is not a linear process and may include as many iterations as needed. The steps a designer needs to take may change slightly for each project. However, these three (sometimes overlapping) phases are essential for each human-centered design process and they can help the designer to understand the person who is going to interact with the product / system, define the problems to be solved and find the optimum and most useful solution for that problem.

2.1.1 Inspiration

The first phase of the human-centered design process is all about understanding people. By using empathy, which is one of the main mindsets of human-centered design (IDEO.org, 2015) the designer can think inside of other people's shoes, understand their needs, motivations and expectations and start solving problems from their perspectives.

This phase helps the designer defining the main problems to be solved and gives him/her a roadmap to follow for achieving this goal. The roadmap usually consists of a detailed research (about the places to go, the road and the passengers), a plan to follow (stops on the road), teams (the people to travel with) and the needed equipment (tools, supplies, etc…).

Interviews with the target user group, surveys or observations are done in this phase to help the designer understand the targeted people's opinions, expectations, needs and fears.

Character analysis of the users, possible good and bad scenarios that they can take are also taken into account while empathising.

By saying "putting the human in the center of the design process", "thinking in their shoes" is meant. This can be more tangible by giving a classical example from Paul Bennett's famous Ted Talk. They were asked to improve the experience for the

patients who need to stay in a hospital. TO be able to understand the actual users,

designers spent hours on a hospital bed, filming what they experience. The result was

a long and boring video of watching the ceiling. They talked to the patients and the

personnel and came up solutions to personalize that space a little bit and make the

experience better. The power of this act of spending hours in a hospital bed, is that it

gives the chance to have a real empathy and visualize the situation in an impressive

way (Bennett, 2005).

Figure 2. IDEO designer recording the patient experience. Adapted from "Workshop– IDEO &

Techstars" by Hulme, T, 2013, retrieved from https://www.slideshare.net/thulme/ideo-workshop-for-

techstars/37-Our_colleague_Kristian_admitted_himself

2.1.2 Ideation

The second phase of human-centered design process is given as Ideation. In

the light of all the information gathered from the inspiration phase, all the findings are

distilled into meaningful insights for the design.

To achieve this, the designer may use different techniques that he/she sees fit.

Some of these techniques are called mapping (that visualizes the entire flow of an

experience) and brainstorming (that opens the mind to wander through all the

gathered information and pulls out insights to use in the design process). After

creating as much ideas as he/she can, the designer then makes an elimination to keep

the ideas that would help with a meaningful and useful design. Although this phase is "where the ideas for the final product come to life, as opposed to the prevailing opinion, the ideas don't come all of a sudden with a sparkling of light, instead, they are mined based on comprehensive research, empathizing and feedback" (IDEO.org, 2015).

The process goes on by testing, getting feedback and iterating until it reaches a refined point that feels ready to ship the product for the people to use.

This phase is the one just before the implementation, which will take too much time and energy and will cost a good amount of money for a company. To solve this problem, designers have methods to test their ideas before starting that long and costly implementation process. Prototyping is one of these helpful methods.

With prototyping, the designer has the opportunity to test the product ideas which are backed up by research and came out of the ideation phase, without spending so much time, money, resources and energy. Prototyping is simply creating a mock-up version (simulation) of the actual product. The prototype comes with limited functionality of course, but it is enough to get initial feedback from the users.

According to Veal, the most valuable benefits of prototypes are, giving the designer the ability to test the design in a holistic way, seeing the whole experience, getting a glimpse of the real using experience and giving insights for future business plans. (Veal, 2018) The main thing tested in a prototype is, whether the product fulfils its purpose by solving a real problem and it is meaningful, usable and useful for its target group.

Banerjee suggests that, in addition to providing feedback, prototypes can also lead to new discoveries that the designers didn't expect in the beginning (Banerjee, 2014).

According to the feedback gathered from the observation of people interacting with the prototype, the designer integrates the feedback into the design, comes up with another prototype, gets new feedback and moves through a variety of iterations until the product is ready for implementation. Iteration is a very important step in human-centered design process, since it saves time and energy and also prevents mistakes before the implementation process starts.

2.1.3 Implementation

Implementation is the last phase of the human-centered design process. It is the phase where a refined version of a design is brought to life and shipped.

Based on the product, let's say if it is a mobile app design or a website, this phase may contain coding and software development. If the product is something that needs to be produced via an industrial product line (e.g. a cell phone or a water filtering gadget) then this phase may require production in a factory production line.

After the production / implementation is completed, it meets its target users. However, the design process doesn't end there. On the contrary, it is a very important phase to gather so valuable information since the actual product meets actual people and their feedback is essential for the possible future alterations of the product.

Therefore, it is very important to monitor the design after it is shipped, keep on making tests and gathering feedback, evaluating the results and take action and iterate, if necessary.

Figure 3. Wheelchair swings at Morgan's Wonderland San Antonio, Texas. Reprinted from The Sports Leisure Vacations Travel Blog, n.d., Retrieved from http://accessiblegranburytx.com/morgans-wonderland/. Copyright by The Sports Leisure Vacations Travel Blog

2.2. Importance of Human-Centered Design

In the golden age of technology, it's hard for a brand or product to keep its position for a long time, unless it gets modified to be aligned with the new technologies. Technology evolves every day, and to be a long-lasting brand is only possible by keeping in sync with it. Following and applying the latest technology isn't enough alone, either. A trendsetter product needs to be user-friendly, different from its competitors in an innovative way and should have a good insight for future.

Although human-centered design has always been the way to design products which are accepted and widely used by many people in general, it has become even more important after the internet became widespread. As individuals started spending more time online, marketing strategies started targeting individuals more than ever and as public consciousness gave its place to self-consciousness, designing products that put human factor at their core has become more important.

Philips states that human-centered design is crucial in the digital age to build trust and loyalty between brands and their customers, since people have become savvier and more demanding. He also emphasizes that because of the nature of this era, people expect smooth experiences that don't require so much of their time, because users' focusing time on a task is now only in a few seconds and design plays a key role in this. He conspicuously visualizes that "88% of online consumers are less likely to return to a site after a bad experience and people who have a negative mobile experience with a brand are 62% less likely to purchase from that brand in the future" (Philips, 2010).

British Design Council conducted a study in 2007 about the design processes of leading global companies to specify the differences of similarities of the design processes that those companies have and seek answers to the question "Are there activities or methods among the design processes observed that could constitute best practice?" Their publication named A Study of the Design Process that tells about the study and its results clearly show that, "paying attention to the employees and building a creative environment inside the organization have a positive impact on the employees' productivity, creativity, and ability to contribute to the success of the business" (Design Council, 2007).

Companies have gathered more and more data, and they have had more control over people's lives in the last few decades. It seems like they will have even more control in the future when the emerging technologies such as the
and Artificial Intelligence become inseparable parts of our lives in the near future.

Today, so many devices are connected to networks and every second, big amounts of data are being produced. This is called "Big Data". However, the technology to analyse all that data has not fully emerged yet, although the software

industry is slowly getting there with the new approaches such as deep learning and cloud computing. This is an invaluable source for companies and governments.

With greater power, comes greater responsibility. Having all that information gives the person that holds that information a great power that can even be used to design societies and mass behaviour changes. Because if one knows the characteristics of a group, he/she also knows their motivations and ways to manipulate them towards a purpose. Keeping the balance is critical in a position like that. Keeping the humans in the loop is now more important than ever and the human-centered design can help with this.

Since the human-centered design approach puts humans in the center of the design process and builds it around the users' needs and expectations, it gives the users the feeling that they are cared and being understood. And this leads the way to loyalty in the long term (InVisionApp, n.d.).

3. ARTIFICIAL INTELLIGENCE

Miracles of yesterday are now ordinary features of today. Most of the technologies people use in their daily lives were just fascinating thoughts once which could only be seen in science-fiction movies.

All the important inventors first dreamed about things and then brought them to life. Science-fiction literature (and later filmography) has always inspired creative minds. Authors wrote about their dreams that they did not have chance to make real and some other people who had that chance, made them possible. Science-fiction is inspired by the emerging technologies of the era they were written in. Every new technology unlocked a new way of thinking for the creative minds, but it has also always been giving people foresights about future technologies and by doing this, it acted as a guide/manual and led the way to make those things really happen.

Even the technologies that has been normalized today were yesterday's big and impossible-looking dreams. The tools that get used everywhere today and considered ordinary things (such as a fridge or the sliding doors) would be a very high technology invention for someone from the past. For someone who lived just a hundred years ago, the idea of a self-opening door while someone approaches would probably sound like a miracle. Automatic sliding doors had appeared in science fiction books before, (e.g. as a feature on space ships) long before they were actually produced. Sliding doors were first seen in H. G. Wells' story When the Sleeper Wakes in 1899, more than half a century before its invention. Voice control, smart watches, mobile devices, the internet and credit cards were all seen in fictional worlds and inspired scientists to make them come to real life and they are now regular, not-really-special parts of our lives.

The movie named 'The 6th Day' (aired on 2000), which featured an internet refrigerator that informed the main character (played by Arnold Schwarzenegger) when the milk ran out and asked him to confirm a new order. The story took place in year 2000, the same year that LG announced the world's first internet refrigerator (Spottiswoode, 2000).

These all became possible by means of the exponential improvements in the proficiency of technology in the 20th century which gained an extra acceleration after the foundation of the internet.

Artificial Intelligence, which describes machines / algorithms / software that can think and respond like a human being by mimicking the human brain and the humans' thinking ways, too, was once a fictional notion. But today, it has already begun becoming a part of our daily lives. Every day, new products or systems using AI technology come up and we are slowly -and sometimes even without recognizing it- giving important controls to AI based machines and systems.

Machine learning can briefly be described as making estimations based on observed repeating patterns and correlations detected in a series of measurements according to Muzesky (Muzesky, 2019).

Considering its importance and the expanding volume it gains in our daily lives, it is so important to know what AI actually is: Is it a dangerous enemy waiting for a chance to take over the control and destroy human kind, or is it a very helpful assistant that helps us achieve new horizons in technology with its over-human data processing capabilities and by helping us passing the barriers of our minds?

The report by Hall and Pesenti describes Artificial Intelligence (AI) as "digital technologies that enable machines to do highly complex tasks effectively". It also uses 'Artificial Intelligence' as a general term that covers other related techniques

such as machine learning and deep learning. It states that "although they have distinctions between, it is useful to see them as a group, when considering how to support development and use of them" (Hall & Pesenti, 2017).

They are systems that can learn and improve themselves and they basically simulate human intelligence and thinking processes such as "learning (the acquiring information and basic rules to process the information), reasoning (using these rules to arrive at conclusions) and self-evaluation (testing own processes by real data and correcting the algorithms if needed)", instead of just automating repetitive tasks (Rouse, 2018).

As Guszcza states, AI has recently gained the capability of performing tasks both based on explicit data (could be numerical and verbal) and tacit human knowledge that could be defined as the learning based on experience by doing similar tasks. He indicates that most human knowledge is unspoken: A mother can quickly realize that her child has flu, or a professional grows a gut feeling about the indicators of a bad event in his job. This ability is now being rapidly developed by AI applications which could be observed in areas like "facial recognition, sensing emotions, driving cars, interpreting spoken language, reading text, writing reports, grading student papers, and even setting people up on dates". AI in some cases can even outperform human beings in accuracy (Guszcza, 2018).

As humans, the capabilities of our brains are limited. The number of processes a human brain can run concurrently in a second is so little compared to a computational system. Machines never get tired or distracted, they don't need to rest, and they can do basic calculations in nanoseconds. So, if steps and logic of thinking of a typical human mind can be transferred to a machine, since it can already sense and collect data, it can do complex calculations in a much shorter time period than a

human. The outcome would be a talented machine that can plan, predict and optimise complex procedures and systems.

To be able to create smart systems that can think, analyse and mimic the ways of human brain's thinking processes, -in other words- bring computation and cognition together, cognitive psychologists, social scientists and computer science experts should work together.

Governments have already been sparing good amounts of funding for AI related investments since they have realised that AI has a big potential in our future. The report by Hall & Pesenti can be given as a good example to this as it reports on how the Artificial Intelligence industry can be grown in the United Kingdom.

The report prepared together by the Department for Digital, Culture, Media & Sport and the Department for Business, Energy & Industrial Strategy in UK, suggests that "AI can add $814 billion to the UK economy by 2035 by improving efficiency and performance to most industry sectors, from drug discovery to logistics" (Hall & Pesenti, 2017).

According to a report in 2017, 85% of the executives in Turkey think that AI will create a revolution in gathering data from users and interacting with them, while 88% of them think about making massive investments in AI-related technologies. The same amount also believes that AI can help speeding up the technology adaptation. And finally, 31% thinks that AI will change their organizations completely (Accenture, 2017).

Universities keep opening new faculties dedicated to AI and machine learning. Companies like Google organize big events (e.g. Google I/O) dedicated to AI and new technologies to discuss what possible future technologies awaits humanity.

3.1. Types of AI

According to Arend Hintze, who is an assistant professor of Integrative Biology and Computer Science and Engineering at Michigan State University, there are 4 types of AI:

Type 1: Reactive machines: This is the most basic types of AI systems. They don't have memories, so they cannot learn from their past experiences. They only react to the given information. They don't store data. A typical example to this type of AI systems is the Deep Blue; the supercomputer that IBM built which is famous for beating the chess grandmaster Garry Kasparov in the 1990s. Deep Blue's chess skill doesn't come from previous experiences, it just analyses the current situation, makes predictions and selects the best possible move.

Type 2: Limited memory: Unlike the reactive machines, these AI systems can analyse their past experiences. Digital assistants can be given as examples to this type of AI. Self-driving cars also use this type of AI decision systems to make instant decisions. It works like a short-term memory. They collect data about other cars' speed and direction, while keeping an eye on the traffic lights, road markings, pedestrians and other elements such as bends.

Type 3: Theory of mind: This type of AI has not been built yet. That represents the type of AI that understands everyone has their own beliefs, emotions, opinions, preferences and expectations and acts accordingly.

Type 4: Self-awareness: This type of AI is not present, either. This final level of AI includes computationally intelligent systems that have their own sense of existence and consciousness. Just like humans, they will be aware of their own desires, and reasons underneath them, while understanding their environment and

other people's feelings. This type of AI usually the type we see in dystopias or science-fiction movies and literature.

However, Hintze adds that "we probably won't be able to meet the machines that think and act like humans in the next 20 years." (Hintze, 2016)

3.2. Applications of AI

The most useful characteristics of AI are the ability to perform boring, repetitive work that would take so much time of humans on behalf of them and in much shorter time via the ability to make predictions based on deep analysis of past experiences.

Considering these characteristics, it can easily be said that AI can be used for numerous purposes to make people's lives easier. The following are the basic applications of artificial intelligence:

3.2.1. Image processing, face recognition and content creation

By accessing a huge database of images on the internet, several AI instances have been training themselves for image recognition for a while. AIs can now very successfully guess what objects or whose faces are present in an image.

Imagine that a user is uploading a photo to his/her social media account. The software quickly scans its database and offers the user to tag his/her friends as well, because it knows who is in that photo. And by approving or disproving the recommendations users provide very valuable feedbacks to the AI and it learns from them to update its decision-making matrix. This is called "data labelling" and developers have been using different methods to label the data they have and verifying their labels.

When someone tries to login to a website, that person usually sees a security step that asks him/her to select some images from a given set. This is called Captcha.

It may be about street signs, window fronts or parked cars. This is a security step that verifies the connected party is not a robot. It started as a study at Carnegie Mellon University in 2007 and the concept was adopted by Google later for providing better results in Google Image search, enhancing the Google Maps experience and now for creating better driverless car experience (O'Malley, 2018).

That means, every time someone proves that he/she is not an artificial intelligence system, that person is also training AI with the feedback he/she provides.

Facebook recently started a social media trend named 10 Year Challenge that basically meant sharing two photos of a user next to each other; one is showing the current look of the user, and the other one is showing how that person looked 10 years ago. It is claimed that this trend was introduced to train Facebook's AI on estimating the effects of age progression on human faces. Facebook later explained that was not the case and they didn't use that information for that purpose, so it probably was just an apprehension about what AI would bring. However, it is known that although that wasn't said to be the case in this example, it is actually possible to train AI with similar social media trends since they encourage participation of masses.

Although there are ways (such as using an irrelevant photograph instead of the original one) to fool an AI based image processing system, AI systems today are good enough to guess about the year a photograph was taken, detect identity even if the person is wearing a mask that covers half of the face. AI systems can even create realistic facial images of people that have never existed (NVIDIA, 2019). The website https://thispersondoesnotexist.com/ creates an image of a human face which is generated by AI, every time the page is refreshed.

Figure 4. AI-generated facial images. None of these people have existed. Adapted from This Person Does Not Exist, 2019, retrieved from https://thispersondoesnotexist.com/

AI's image recognition abilities can be used in many good ways. It can help people while travelling in a foreign country when they don't have a map or know the language by translating the signs, recognizing the landscape. It can also be used to overcome the difficulties of being disabled or just for personal archive management in the age that people take hundreds of photos but cannot find what they are looking for when needed. For example, a visually impaired people can use AI-powered image recognition systems to identify road signs, the landmarks or the food in front of them.

Meanwhile, this ability of AI is also a little bit contentious because of consent and privacy issues. A research made in Stanford University in 2017 by Yilun Wang and Michal Kosinski show that AI can predict sexual orientation of a person by looking at a facial image more accurately than humans (Wang & Kosinski, 2017). Another group of researchers showed that "by using deep learning, socioeconomic attributes such as annual income, race, level of education, and political tendencies in an area can be inferred by analysing the cars detected in Google Street View images" (Gebru, et al., 2017).

In China, a National Credit System is introduced in 2013. Backed up by AI, it is based on a mass surveillance technology. It basically is grounded on the idea that each citizen has credits for their behaviour with or against the law, which may result in rewards or bans and other restrictions. A similar subject came up in "Nosedive"; the eighth episode of the TV series Black Mirror which is quite judgemental about

what the emerging technologies can bring. In the mentioned episode, people were rated based on their online presence and in-person interactions and that rating system directly affected that person's socioeconomic status.

AI can also create videos using one single photograph. It may be used for making new movies with deceased actors or actresses starring in them. But that is also a feared feature, since it gives the people who have the technology to make a deceased public figure say whatever they want, or applications such as DeepFake allow replacing someone's face successfully with another face in a video, which can be from an adult film.

A recent example that involves American singer Taylor Swift, using facial recognition to track her stalkers at a concert shows that people cannot control when, where and how their faces are used by an AI based facial recognition system.

There is also another danger. Since AI mimics human thinking ways and learns from human beings, and because of the existing biases within the society are observed by AI, AI may have biases, too. After AI algorithms tagged a picture of two black people as "gorillas", Google's photo-organizing service limited the usage of similar terms (Simonite, 2018).

Microsoft's AI-based chatbot named Tay, has turned into an AI making racist comments about other people after having an account on Twitter. The more he chatted with people, the more racist it became and that happened in less than 24 hours. One of its first tweets included the sentence "humans are super cool", while one of the latter ones were full of hate, claiming that "it hated Jewish people" and "feminists should all die and burn in hell" (Hunt, 2016).

To sum up, image processing that is assisted by AI is still experimental and still learning, therefore it needs some more time and careful guidance to be a trustworthy and beneficial enough technique.

3.2.2. Art creation

The technology has opened new areas for art creation as well. Artists had been searching for new ways to express themselves better since the beginning of art and every new technology brought a new possibility for self-expression. After the sensor technology became affordable and wide spread, artists started using that in their artworks and AI based algorithms started creating artworks.

If an artist wants to create the perfect scenery photo on his/her mind, just drawing a very basic may be enough, since Nvidia's AI software GauGAN is capable of turning a sketchy doodle into a realistic scenery photo (Salian, 2019).

The Museum of Modern Art (MoMA) in New York held an exhibition between November 13, 2017 and April 8, 2018 named "Thinking Machines: Art and Design in the Computer Age, 1959–1989". The exhibition consisted of artworks which were created by AI.
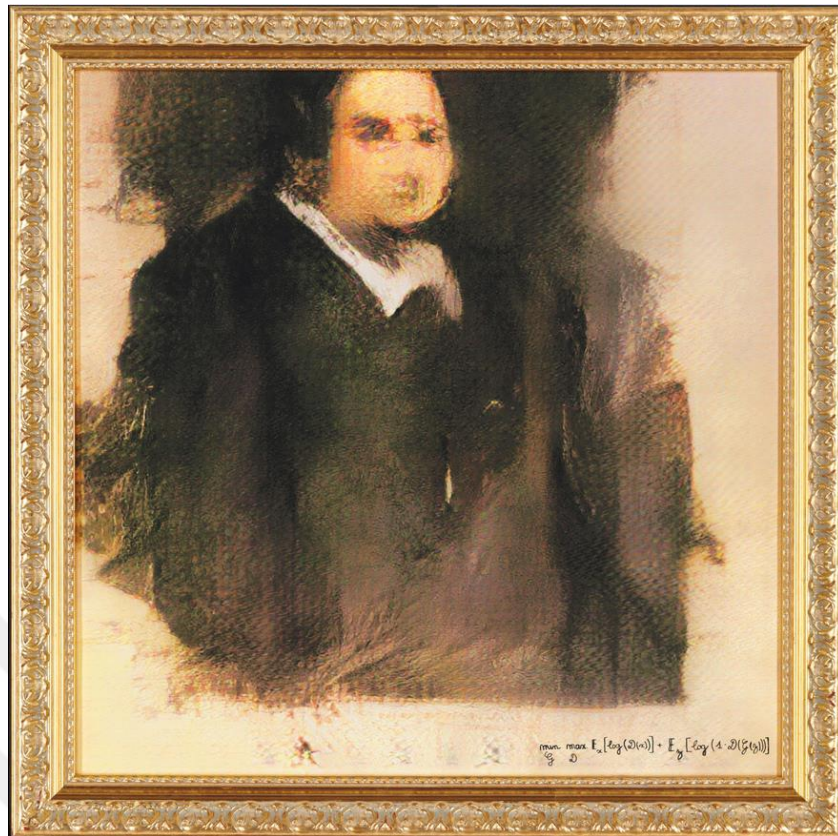
Figure 5. Portrait of Edmond Belamy, 2018, created by GAN (Generative Adversarial Network) using an algorithm defined by an algebraic formula. Sold for $432,500 on 25 October at Christie's in New York. Reprinted from Christie's, 2018, retrieved from https://www.christies.com/lotfinder/prints-multiples/edmond-de-belamy-from-la-famille-de-6166184-details.aspx?from=salesummery&intObjectID=6166184&sid=18abf70b-239c-41f7-bf78-99c5a4370bc7. Copyright by Obvious

Since the AI is also good with data and has access to all the written words, aggregated in innumerable ways, AI generated poetry is also another area that the computationally intelligent systems will be productive in.

3.2.3. Personal assistants

Personal assistants are one of the most widespread applications of AI. They can basically be described as AI-based intelligent virtual assistants that can respond to inputs from the user and perform the given tasks. Some examples to these tasks can be making an online search, making a booking for a hotel, sending an e-mail, checking

the weather forecast, hailing a taxi or controlling the smart devices at home. Such actions can be triggered by text or voice commands; however, the latter is considered as the new potential big thing for human-computer interaction and companies tend to invest in that since it has a big potential for business growth.

As mentioned above, the personal assistants can contact the users via text, voice or both. The ones that use voice to interact the user, interpret human speech. Some of them may talk in a robotic way, however most of them mimic a real human voice with a gender. This thesis work also aims to find out about people's preferences while interacting with an AI-based personal assistant.

The assistants are usually activated with a word group such as "hey Siri", "OK Google", "Alexa" or "hey Google". New generations of these products announce that they won't even need these words anymore and they would always be ready to help their users. However, that also draws reactions since it may also mean the violation of the private life.

One of the main characteristics of AI-based systems is learning. They learn from their experiences with their user and act accordingly on their next interaction. Here is a possible scenario for a specific use-case: If a man wants his/her personal assistant to search for a restaurant for his wedding anniversary for the first time, the assistant shows him a list of available restaurants based on its database. Since he used the word "wedding anniversary" it selects the restaurants which are described as "romantic" in the reviews. He wants the assistant to show the ones that have vegetarian options since his wife is vegetarian. He also wants the assistant to filter the restaurants with parking space since he will come by car. He selects one and wants the AI to make the booking. Next time when he wants the assistant to make him a reservation for two, based on its past experience, the AI suggests the restaurants with

vegetarian options and parking spaces since it already knows its user's preferences, so he doesn't need to do the filtering from the beginning.

The reason that AI is associated with futuristic science-fiction scene is the possibility for that person to go to bed without the need to set the alarm, to wake up with the smell of his favourite coffee when his favourite radio station turns on. The assistant knows from his personal calendar that he will have guests on Saturday, so it orders a cake at the right time.

The journey of the voice activated virtual assistants started in 1961 when IBM introduced the first digital speech recognition software, IBM Shoebox, that could only recognize 16 words. That number increased to 1000 in 1972, when Carnegie Mellon University in US completed the Harpy program. In the 90s, Dragon launched the first consumer speech recognition product, Dragon Dictate, which was then sold for $6000.

As an example of personal assistants that are not communicated through voice commands, Clippy can be mentioned. In 1996, Microsoft introduced Clippy, an animated paperclip that was helping people while using Microsoft Word. Although its shape could be changed, the most popular version was Clippy, the paper clipper. It was designed by Kevan J. Atteberry and was famous for showing witty comments.
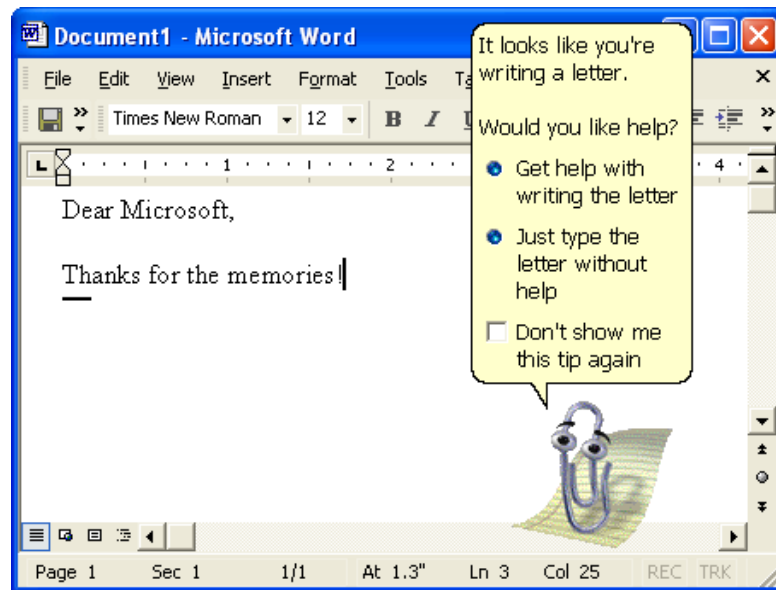
Figure 6. Clippy, Microsoft Word's assistant. Adapted from "The Life and Death of Microsoft Clippy, the Paper Clip the World Loved to Hate", by A. Cain, 2017, Mental Floss, retrieved from http://mentalfloss.com/article/504767/tragic-life-clippy-worlds-most-hated-virtual-assistant. Copyright by Carnegie Mellon University

In 2011, IBM introduced Watson and it made a splash worldwide with joining the US quiz show Jeopardy! and winning by outstripping two of the best players in the show's history.

Figure 7. IBM Watson competes on Jeopardy! in January 14, 2011. Adapted from " What is AI? Everything you need to know about Artificial Intelligence" by N. Heath, 2018, retrieved from https://www.zdnet.com/article/what-is-ai-everything-you-need-to-know-about-artificial-intelligence/

The same year, Apple announced Siri and enabled virtual assistants to become widespread. Apple was followed by Google by introducing Google now in the next year, Microsoft introducing Cortana in 2013 and Amazon by introducing both Alexa and the Amazon Echo for their Prime members in 2014.

These big actors of the digital world have been improving their product line after the first releases. Amazon introduced Amazon Echo Dot and Amazon Tap in 2016 and the Echo Look in 2017. The same year, Jeffrey Preston Bezos, the founder and CEO of Amazon claimed that more than 20 million Amazon Alexa-enabled devices were sold.

In 2016, Google introduced the Google Assistant, as a part of Allo; a messaging application and launched their home system Google Home and smart phone; Google Pixel. Google Home was able to recognize 6 different human voices. They announced that Google Assistant would know 30 languages by the end of 2018.

Samsung also joined the competition in 2017, by introducing Bixby on Galaxy 8 mobile phones. And finally, Apple introduced their home product Home Pod. Speaker and earbud producers have started to announce one by one that they were supporting the aforementioned products (Mutchler, 2018).

The reason that big players such as Apple, Google and Amazon have been investing in this technology, developing and testing products is the shared idea that AI-based virtual assistants will be the "next big thing".

Today, although they are sold worldwide or pre-installed on the smart phones, virtual assistants are still seen as a nice side future. However, it is predicted that, as the AI technology improves, they will be an inseparable part of humans' lives just like the smartphones today.

According to Adam Cheyer, the founder of Siri (currently working on Bixby in Samsung) in every 10 years, human-kind is going through a new paradigm shift in technology. He adduces the rise of personal computers in 1980s, World Wide Web in 1990s and the iPhone in 2000s, and he believes that the big thing for 2010s will be AI-based, voice-activated virtual assistants. He also claims that "the one" assistant that will be available on any device, powered by every service, and personalized for every user and will bring a human-driven experience between developer and machine will create the impact that iPhone built in 2000s.

Cheyer also emphasizes the importance of human & AI collaboration. He says that the software will be written by this collaboration and many professions such as doctors will work hand in hand with AI (Cheyer, 2018).

He draws an analogy between today's AI and the "ugly" websites that were developed in early periods of the Web. However, he adds, people will be doing most of their actions that they take online today, by virtual assistants in 2-3 years.

The virtual assistants are not only going to be used in homes. Automotive industry has also started an integration process with the virtual assistants. BMW announced that they would integrate Amazon's Alexa with some of their cars.

The reasons behind the rising importance of the virtual assistants are based on people's changing needs. Thanks to the smart phones, human society today are used to the luxury of accessing information whenever they needed. Therefore, they need voice activation for the scenarios that they still need information, but they also need a hands-free environment while jogging, cooking or driving.

According to the results of a project made by Google and IDEO, in addition to getting their help, people want to interact with their virtual assistants in a deeper and meaningful way. They expect them to inspire, motivate and anticipate their needs and

moods (Hyer, Herrmann, & Kelly, Applying human-centered design to emerging technologies, 2017).

In addition to the usages mentioned above, MIT researchers developed an algorithm that can understand sarcasm by looking at the usage of emojis in tweets (Knight, 2017). As this technology reaches out to more people, it will have more data to learn from and eventually it will get even better at interacting with humans. Then, it will be possible for AI not be a technology that only answers the users' requests, but also is capable of having human-like conversations that include sarcasm and reacting according to the person's mood changes.

3.2.3.1. Google Glass and smart contact lenses.

Virtual assistants can also be integrated to augmented reality devices such as Google Glass. Google Glass is a head mounted wearable computing device that projects information on the glasses via an optic prism and a mini projector.

It is worn like a pair of eye-glasses and controlled by a small screen, touchpad and a microphone. It allows the user to take pictures and videos, share them on social networks such as Facebook and Twitter, take a glance at the news, translate a text, find an address via Google Maps, and get reminders of personal notes or appointments.

Figure 8. Google Glass. Adapted from "Google helps you get acquainted with Glass UI in how-to video" by Z. Honig, 2013, engadget.com. Retrieved from https://www.engadget.com/2013/04/30/google-glass-how-to/

The ability of Google Glass to take pictures and record videos without showing any sign of it discomforted people and Google Glass was banned in some bars and restaurants due to security and privacy concerns.

In January 2015, Google announced that they were closing the Glass Explorer Program so that they could focus on what's coming next and gave the good news that future versions of Glass would be introduced.

In 2014, Google and Novartis announced that they were working on a smart contact lens project together to assist people with diabetes by constantly measuring the glucose levels in their tears.
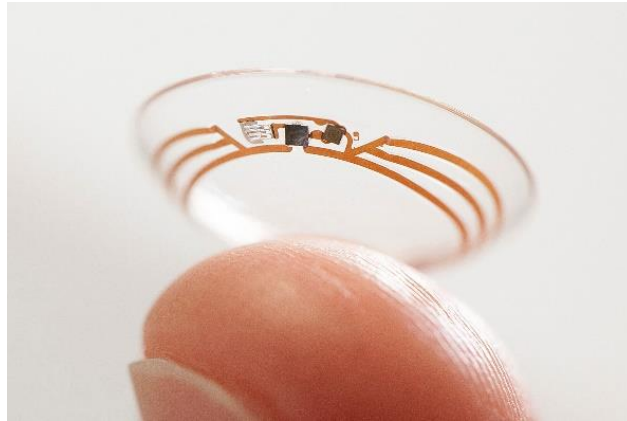
Figure 9. Google smart contact lens. Adapted from "Google Granted Patent for Smart Contact Lens" by A. Sifferlin, 2015, Time. Retrieved from https://time.com/3758763/google-smart-contact-lens/. Copyright by Google/AP

Google also announced that they were working on a contact lens with a very small integrated camera to help people with visual disabilities. The camera would allow for a huge range of applications such as "a bionic eye system for blind and visually impaired people, facial recognition, telescopic and infrared/night vision" (Vision Direct, 2019).

Today Samsung, Sony and other companies and institutions are also working on smart contact lens projects.

Virtual assistants can be implemented into both glasses and smart contact lenses and that can bring new ways of interacting with personal assistants.

3.2.3.2. Humanoid robots.

The relationship between human and AI could even go one step further by putting AI in a humanoid body. This step can be the missing link between today's world and the world where people and robots walk on earth together in the daily life.

Sophia is one of the examples of many humanoid robots. Sophia is created by Hanson Robotics and accommodates an AI-based software.

Sophia defines herself as: "A personification of our dreams for the future of AI, as well as a framework for advanced AI and robotics research, and an agent for exploring human-robot experience in service and entertainment applications" (https://www.hansonrobotics.com/sophia/).

Figure 10. Sophia, Hanson Robotics' human-like robot. Adapted from Hanson Robotics, 2019, retrieved from https://www.hansonrobotics.com/sophia/

Sophia made many public appearances. In 2017, she appeared with Jimmy Fallon on the Tonight Show. And later she had a date with actor Will Smith on the screen. She is even granted citizenship by Saudi Arabia. Hanson Robotics have announced that in 2019, a "surreality show" about Sophia's life, adventures and experiences named "Being Sophia" will premiere (Hanson Robotics, 2019).

There are many other humanoid robots like Sophia. Erica by Hiroshi Ishiguro is another famous example to current humanoid robots. And there will probably be more of them in the future.

Today, people tend to see the personal assistants as their helpers, rather than their friends. However, it is quite early to predict people's perceptions of AI in the

future; whether they will perceive AI as a servant only or as their friends. If the androids like Sophia become widespread, people may start seeing them more like a friend of theirs.

The 2013 science-fiction movie by Spike Jonze, "Her", was telling the story of a man who fell in love with his virtual assistant Samantha. She was not embodied in a humanoid body, however even that was enough for the main character of the movie to fell in love with "her" (Jonze, 2013). It is a fictional story; however, it shows that people's imagination may even consider romantic relationships with AI.

The autonomous security robot named Knightscope K5 whose duty was to monitor crimes in malls, parking lots and neighbourhoods, drowned itself in DC Office Building in 2017. As the reason of the robot's suicidal act is still unclear, this event created questions about the effort to make AI exactly like humans.

Figure 11. Tweet by Bilal Farooqui showing the drown security robot Knightscope K5. Reprinted from Twitter by B. Farooqui, 2017, Retrieved from

https://twitter.com/bilalfarooqui/status/887025375754166272

It is early to predict people's perceptions of AI in the future; whether they will evaluate AI as a servant only or as their friends, but it is obvious that as the AI systems improve themselves, the virtual assistants' role in people's lives will increase in the near future.

3.2.4. Customer service (chat bots)

People have been making phone calls or sending e-mail along with face-to-face communication when they had a problem or complaint about a product. Recently, they have also started using online chat options in which customer representatives are at the other side of chat connection and trying to solve the problem. While chatting online with customer, they usually copy and paste sentences which were pre-defined for common situations to save time, since most of the complaints and their solutions are similar.

This is an action that can easily be done by AI since it is repetitive, it is based on a cause effect relationship and can easily be automated. Therefore, as an extension of the personal assistant idea, companies started using AI based chatbots to answer their customers in real-time and eliminate the disadvantages of employing humans for this work such as delays in response.

3.2.5. Autonomous vehicles (self-driving cars, drones)

Automotive companies start creating budgets for smart technologies. Google introduced a Self-driving car in 2010, and Toyota announced $ 50 million budget for the car project which can drive without a driver.

Companies such as Toyota, Tesla, Google, and Apple have already made investments in this field and have started working on developing such systems.

Rouse explains the logic of self-driving cars as the "use a combination of computer vision, image recognition and deep learning to build automated skill at

piloting a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians" (Rouse, 2018).

Driverless cars can help reducing traffic jams and car accidents, since their response time will be much shorter than humans. Monitoring traffic jams and choosing the optimum route to the destination would also get easier with an AI-based driver.

AI can actually get the "driver" out of a taxi experience, by providing a safer one without the need to worry about being asked for more money, getting lost or being stuck in traffic.

AI is not only used for individual cars, it is also used for fleet control and car sharing. AI can be used to manage a fleet, predict, prevent and handle faults and accidents.

3.2.6. Healthcare

Healthcare is another main application for AI. To prevent deadly results of illnesses that progress at a slower pace by detecting potential risks, since taking action at an early stage is very important. Especially in highly populated places, since the number of doctors is not usually enough to provide attentive care for all the customers, an AI system that monitors the basic measurements of the people can be quite beneficial.

AI can be used to solve this problem by assisting doctors and the medical team, helping doctors prescribe the right medicine and identifying cancer risks from imagings of patients such as MRI scans, X-rays or photographs. It can also be helpful for use cases such as preventing fatal hospital falls (Verma, 2018). Today, autonomous robots can successfully perform surgeries.

IBM's AI computer, Watson, which was trained by the oncologists at Memorial Sloan Kettering Cancer Center, can spot abnormalities and diagnose some cancers successfully (Artificial Intelligence in medicine, n.d.).

Combining AI with the sensor technology and making use of the wearable devices that can monitor patients' heart rate, blood pressure, body temperature and many other vital functions, patients can gain benefit from AI technology for their daily healthcare, too. Assisting systems that can understand the patient's general well-being, analyze their activities of daily living, remind then to take their medicine on time and correctly and directly alert or contact the medical team in emergencies can help reducing expenses for both patients and the healthcare providers.

Patients also get "faster and more accurate diagnoses and more personalized treatment" and this cashes on as improved health in the long term (Hall & Pesenti, 2017).

AI can even help people understand the meaning of their babies' cries. Researchers from Northern Illinois University have developed an AI that can understand if a baby is sick or in pain, or just hungry.

It can also help radiologists to spot potential tumors in X-rays, aiding researchers in spotting genetic sequences related to diseases and identifying molecules that could lead to more effective drugs.

Some other use cases of AI in healthcare include guessing the future of the patients in a coma (Tangermann, 2018), predicting early deaths (Weisberger, 2019), detecting autism in babies (Staedter, 2017), diagnosing depression and predicting suicidal tendencies (Vincent, 2017) and guessing breast cancer 5 years in (Miley, 2019).

3.2.7. Shopping

Nowadays, it is possible to come across to personalized advertisements on almost all platforms, especially on social media. People produce vast amounts of data everyday by interacting with these platforms and this data is processed by AI-powered software to create user profiles. So, if a person talks to a friend on a social media chat interface about the new pair of shoes he/she is thinking of buying, it is so likely for him/her to see advertisements of that shoe brand and even the exact shoe he/she was considering on another platform.

The situation above is one use case of the AI in shopping. Another use case could be mostly related to the virtual personal assistants. Since AI-based systems can know people's usage habits and lifestyle patterns, they can easily predict when -for example- they will run out of toothpaste, and they can even order that toothpaste online since they can also know which toothpaste they like.

Processing data is much more important than collecting data. Because people create data with every action they take online. Hence, there is a big opportunity for the companies that process the data right. With these digital footprints, companies can examine their customers' consuming habits and personas (age, gender, etc.), suggest relevant products that the person in more likely to buy, gain profit and analyse, visualize and then manipulate trends.

A recent study demonstrate that AI-powered tools can boost sales by enabling sellers to overcome the language barrier. By comparing the sales between the US and Spanish-speaking Latin American countries before and after eBay implemented an AI-powered translation tool for listing products, researchers clearly saw that using AI significantly improved the service's accuracy and that increased the sales up to 10.9 percent (Brynjolfsson, Hui, & Liu, 2018).

3.2.8. Financial

AI is also used in the finance sector for three main areas: Personalized financial planning, detecting credit card frauds and preventing money laundry.

This also helps customers by providing more holistic and customized solution offers and a better user experience by adapting the users' changing needs because of the changes in their lives such as having a promotion, losing a job or having a baby (Hall & Pesenti, 2017).

3.2.9. Automation and prediction for industry and manufacturing

AI also designs future factories with predictive maintenance and robotic automation. Earlier, manpower was the main resource for all the manufacturing processes. However, since humans are more prone to make mistakes than machines, most of the industries started using automation. Today almost every industrial sector such as manufacturing, chemistry, food & beverages, oil & gas and transport use automation.

AI for Industrial Automation usually means, "robotic process automation", which is the automation of production by keeping the human factor in the process at minimum level and carrying out all work processes by machines and robots.

The main benefits of automation are reducing the number of accidents at work, saving time, improved quality, cost efficiency and profit. It brings flexibility and makes management easier by lowering the time that is needed to locate and interfere with a problem. It provides valuable data to improve the production process.

Replacing AI-powered robots with human labour helps enhancing the overall efficiency and productivity of an industry, since robots never get tired or sick and are more precise on repetitive tasks. However, that brings an important question about how reducing manual labour in manufacturing will effect the unemployment rates.

AI-based Automation, however, should work hand in hand with humans, because it also is very good at repetitive tasks and making accurate predictions, although it is still not capable of bringing the ingenuity to the production process.

3.2.10 Environment monitoring

AI can also help human-beings save the planet by analyzing current risks and offering that solutions that could make a difference.

The tools which are used today to discern seismic activities, are good enough to predict the size of an aftershock. However, they are still inadequate for predicting its location. A recent study conducted by Harvard University and Google's AI division have created a neural network that can predict an aftershock's location even more accurately than the best existing model (DeVries, Viégas, Wattenberg, & Meade, 2018).

Another example is an AI tool to predict where global water conflicts may occur. It is very important to make accurate predictions to be able to take actions on important environmental issues before they happen, since it can be very late to turn a natural event back once it is started.

3.3. Opinions on AI – Human factor in AI

AI has been an exciting subject for humans. It is clear that, it can help humans in numerous ways since it has a better computational ability to process data.

Some people state that they feel excitement about AI and they have good reasons for that. However, it is not only perceived as a miracle technology that will make lives much better than before. For some people, it also raises concerns about future that AI may act against humanity. There are a few reasons why people have mixed emotions and complex opinions about AI.

First, people know that; the imperfection of human mind that led its own kind to wars, genocides and the destruction of nature will train the computationally intelligent machines. If the AI is going to think like humans, what if it becomes another version of the imperfect human mind, and even for the worse, with less mercy (like the one in the famous movie Terminator)?

Looking at the science fiction novels, movies and TV series, it can be said that AI induces the feelings of both excitement and fear. Netflix science-fiction series Black Mirror which is created by Charlie Booker and premiered in December 2011, draws a picture about the awaiting high-tech near-future by also showing where the dark instincts of humans can take the societies and personal lives to. The way Black Mirror handles the relationship between humans and technology is very realistic, shocking and sometimes even disturbing. It shows the possible unwanted results of having technology so involved in daily life, but it also holds a black mirror (which refers to the screens of the devices people use when they are turned off) to people to make them question their own dark instincts and attitudes towards technology first, before putting all the blame on the emerging technologies (Brooker, 2011).

Art has always been a good way to express emotions and today's art scene also react to these rapid developments in technology. Anonymous street artist, Banksy, who is famous for making bleak and judgmental stencils in the streets of the United Kingdom about the digital existence of humans and their addiction to technology is a good example. Most of his works include references to what technology brings into humans' lives, usually from a pessimistic perspective.

Figure 72. "Mobile Lovers" by Banksy in Bristol, 2014. Retrieved from
http://www.mcqthinking.com/banksy-mobile-lovers-power-unsettle/.

A 2017 report by Facebook (Lewis, Yarats, Dauphin, Parikh, & Batra, 2017)
mentioned that their chatbots created their own negotiation language while talking to
each another. Facebook later chose to end the project since their interest was " having
bots who could talk to people" and the language that bots created was not
comprehensible for humans (Griffin, 2017).

Elon Musk, CEO of Tesla and SpaceX, pointed out that AI could be a
"fundamental risk to the existence of human civilization" at the US National
Governors Association meeting and called on law makers to bring regulations on
companies that build AI, before it outstrips human intelligence and becomes a serious
threat to civilization. He also set up a non-profit company for developing AI that
would benefit the society as a whole, called OpenAI (Tung, 2017).

Physicist Stephen Hawking had also made a warning about AI that once it gets
good enough to surpass human capabilities, it can become an existential threat to the
humans (Hawking, 2014).

However, these threats to come to life is not possible with today's AI technology. They could only be possible if the third (Theory of Mind) and even fourth (Self-awareness) types of AI are created.

But even if the terminators are not today's active problems, there are still other issues about AI that concerns people. One of them is the infringement of personal space and related privacy issues (as stated broadly in the **3.2. Applications of AI** section). When AI-powered products become widespread and perpetually gather data about people, there will definitely be unintentional private life infringements and that has the potential to become a bigger problem than it looks, because if AI becomes so integrated in the daily life, it may not even give people the option to stay out. And obviously, a 1984 (George Orwell novel) style surveillance system made possible by AI could only be classified as a "dystopia" (Orwell, 2019).

Companies will have very sensitive information about their users that they need to keep safe from leaking, so being prepared to cyber-attacks will gain even more importance in the future.

Employees of the companies that build AI-based products have been showing their concerns about the use of this technology. Amazon employees reacted to Jeff Bezos, the CEO and founder of Amazon, about selling Rekognition, their real-time facial recognition system that allows tracking and identifying people while they are walking on the street, to the police. (Statt, 2018) That is an example showing that the humans who are developing these technologies also have concerns about the use of them.

Another concern is the creation of unreal content; such as fake news, images and videos. Even today, internet is full of disinformation and misguiding content. It has become important to be able to distinguish the right information as well as

accessing information. As stated in the **3.2.1 Image processing, face recognition and content creation** section, it is quite easy today to create fake videos from even 2D images. Heath takes attention to the potential for hugely disruptive social change that would come with such situation, since the people would no longer be able to trust any content they see as genuine (Heath, 2018).

There are also technical concerns about AI. Since technology is not mature yet, people have hesitations about trusting AI-based products such as driving cars. Since being hacked is a possibility for cars as well as other software-based products, people have concerns about a possible accident. Even the liability in such a situation would be hazy. The accident in 2018 that happened while an Uber car was in the self-driving mode and caused the death of a pedestrian underlined that the technology still needs to be improved before becoming wide spread. The company suspended all self-driving tests in Arizona after the accident (Gartenberg, 2018).

It is very important to understand what scares people about AI and what are the possible problems that need to be solved, since these will be the basis for the Human-Centered Design for AI.

3.3.1. Unemployment

Unemployment is one of the biggest concerns people have about AI since it is more realistic, more close future-related and AI-powered robots have already been used in some places.

Since these machines don't have the need to rest or eat, they don't get sick or have conflicts with their colleagues, they may seem like a perfect employee for many employers and the strongest rival to the unemployed.

This is also valid for professions that require creativity. Today, AI can create artworks and compose songs as well as doing repetitive muscle work (Hart, 2017).

In 2016, Amazon launched their first cashier-free supermarket, Amazon Go, in Seattle, where customers can just take the products they need and walk out without being checked out by a cashier or a self-checkout station. That naturally brought the idea that in the near future, cashiers could no longer be needed.

The same thing is possible for truck and taxi drivers, too. If self-driving cars become widespread, drivers might be unemployed. However, as Heath states, "with every technological shift, there will be new jobs that will replace some of the existing ones (Heath, 2018).

At first glance, robotic automation may even help reducing working hours and overtimes. As a result, humans can find more time to spend with their beloved ones or hobbies and in the long term that may improve life quality and happiness. But that may also mean less need for human labour, which also worries people about losing their jobs.

According to the report by Dellot & Wallace-Stephens, "15% of private sector jobs in Britain have the potential to be fully automated in the next decade". However, they also add that "AI and robotics are more likely to alter jobs than to eliminate them" by changing the nature of the work (Dellot & Wallace-Stephens, 2017).

4. HUMAN-CENTERED DESIGN FOR THE ARTIFICIAL INTELLIGENCE

As humans change with time and the new technologies and as their lifestyles, needs, expectations and problems also change with them, the society is also formed slowly in a brand-new way that the effects can be seen years later.

These changes get us closer to the world that is described in science-fiction books. However, in those books, human imagination doesn't picture the future as a humanistic environment. Instead, it is usually described as a world of shining metal, industry and robots. It is an angular world of aluminium foil.

The reason behind this may be the fear of losing humaneness or the fear of the unknown. Whatever the reason is, the only solution to overcome this fear is looking at the future from a human-centered perspective and keeping the human as the source of humaneness.

Every day human beings are becoming more and more connected with and attached to smart phones, tablets, social networks such as Facebook, Twitter and Instagram, easily accessible wireless networks, 5G broadband connection, wearable tools and artificial intelligence software, the world looks more like McLuhan's Global Village (McLuhan, 2013). The people today have more chances and channels to express themselves.

The latest developments in technology led us to the new era of internet; "the age of data". Considering their tremendous growing pace, analysts have predicted the internet of things and artificial intelligence will be the "next big things".

Artificial Intelligence, apparently, is welcome and here to stay for a long while. It will be a part of people's daily lives as a silent system backing up most of their critical life units or will serve as personal assistants or will even share their loneliness and be their friends or pets as a part of the family. People probably won't

have a chance to select living with or without AI, because they have already started living with it. That means it is like a colleague or a neighbor of theirs that they need to find a channel to communicate with.

However, that doesn't have to be an unpleasant relationship. Artificial Intelligence can be used in different ways that make people's lives easier by solving complex problems for them, acting as personal assistants or designing better cities, communities and systems.

Artificial Intelligence has always been an exciting subject for fiction writing. Because it is seen as non-human, so it's been symbolized as being emotionless.

Chaplin states that "human-centered design stands in opposition to technology-driven design and instead of taking advantage of a new technology, it focuses on the actual needs of humans". He defends that "an innovation shouldn't automatically/naturally be considered as desirable to implement, just because it is possible" (Chaplin, 2016).

However, AI systems don't necessarily need to be seen as technology-driven designed systems. Keeping the human in the center still gives designers enough space to explore the possibilities of this new technology.

Muzesky points out that human judgment effects almost every angle of AI, from developing models to the data sources. And he adds that improvement in quality can only be achieved by following a human-centered approach (Muzesky, 2019).

Lovejoy enlists three ways that the human-centered design can be used to elevate AI: "Addressing a real human need, guiding the intelligence and building trust". According to him, there are three main reasons why human-centered design needs to be used for designing an AI-based product. The first one is the fact that AI cannot define an actual human need for a human. The need itself needs to be defined

by the people. AI can be good at problem solving, however finding the right problem to solve is a little bit more complicated. The second reason is, if humans are not a part of the design process, and the goals of an AI system is not transparent to its users, trust will not grow in the human-computer interaction and people will tend to look the possible future with AI in a darker, more pessimistic and more dystopic way. Finally, he concludes that a multidisciplinary approach need to be taken while designing for AI (Lovejoy, 2018).

The fast development in technology makes us think about how the future is going to be like. In the age of data, people have been interacting and will need to interact even more with machines and computationally intelligent systems.

In the age of information, people are becoming more self-centered and more conscious about themselves and their wellbeing. They want to have more control over their lives. They communicate, socialize and plan their daily lives via screens. So, they expect everything to be smart. They want all the information they need to flow to them and they don't have patience to wait for something. They also interact with each other less, while interacting with machines more. When someone likes a post of a friend on social media, that creates a feeling of interaction and they even describe reaching each other as "keeping in touch".

That is why human-computer interaction will gain more importance in the future.

4.1. History of Human-Machine Interaction

To be able to understand how human beings can construct a good relationship with machines, looking at the history of human-computer interaction and trying to analyze success and fail cases in maintaining a healthy relationship would be crucial.

People have been developing new technologies since the beginning of their existence. They first started by sculpting rock in the Palaeolithic age, they went on by polishing them in the Neolithic age. In the 21st century, after a very fast forward, the invention of internet changed the acceleration of the development and aggregation rate of information rapidly increased which led to invention of many new technologies.

Just like any communication attempt between humans, human-computer interaction also needs a solid base. To establish a good communication between humans and the computationally intelligent systems, as human beings, we first need to have a look at how this interaction has been built so far, to analyse what type of communication methods we will need for AI.

Each chronological era is followed by another and brand-new technologies of yesterday become weird, cumbersome, nostalgic and dusty old gadgets of past. The Internet age caused an excitement and that excitement is growing bigger with the introduction of the emerging technologies such as Internet of Things and Machine Learning.

It is very important to understand the history and background of the technological developments about computationally intelligent systems and robotics that that led to today's learning systems. That also helps us to be able to make better predictions about the future.

This era can also be named as "the age of the user", since users' needs gained so much importance. UX and design thinking methods were adopted by many companies and brands to offer personalised human-centric design solutions and products. Human beings were not only in the beginning / research phase of the design process, they were involved in almost every phases of design. They provided

feedback by user tests and helped improving the products which were designed for them, before they were even produced (Philips, 2010).

Although the definition of human centered design has emerged in recent decade, its traces can be seen even in an ancient Chinese philosophy which is called as Feng Shui that was popular around 4000 BC according to Stevens. Feng Shui is known for focusing on distributing the objects around a person in most harmonious and user-friendly way. In addition to that, she says that ancient Greek civilizations also made use of ergonomic approaches while designing new tools (Stevens, 2018).

As the International Ergonomics Association (IEA) explains ergonomics is as follows, it can be said that Stevens's explanation aligns with human-centered design:

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. (International Ergonomics Association, 2019)

In the early 1900s, Frederick Winslow Taylor's suggestions and quest for workplace efficiency and later Toyota's human-centered production system developed in 1940 which considered crucial and actively encouraged human input, were also demonstrating the focus on human-centered design (Stevens, 2018).

In the 1940s, studies on ergonomics gained speed. Most of the inventions, unfortunately, were results of military research and that wasn't different for the human-centered design. Although it has evolved into something in the opposite direction today, the first ergonomics works were focusing on making airplane cockpits more suitable for the pilots in the World War II (Jonne, 2009).

1642 – First mechanical calculator is built by Blaise Pascal, a French mathematician and inventor.

1712 – Thomas Newcomen invented the first productive steam engine which was used for coal mining to pump water out from the mines to allow the miners dig deeper for mining coal.

1764 – Spinning Jenny, which was a spinning engine was invented by James Hargreaves. It played a key role in the industrialisation of weaving, as it could spin many spindles at a time.

1837 – The first design for a programmable machine by Charles Babbage and Ada Lovelace.

1837 - The first electrical telegraph by Sir William Fothergill Cooke and Charles Wheatstone was installed between Euston and Camden Town in London.

1913 - Henry Ford installed the first moving assembly line to automate the mass production of the automobile named Model T. It reduced the time needed to build a car from more than 12 hours to 2 hours and 30 minutes.

1940s – Invention of ergonomics.

1943 – Foundations of neural networks established by Warren McCulloch and Walter Pitts, drawing parallels between the brain and computing machines.

1949 – Invention of personal pagers.

1950 – The Turing Test by computer scientist Alan Turing, a way to test a machine's intelligence. He publishes a paper about the possibility of machines that think, develops idea known as the Turing test. It tests a machine's ability to "think" by answering a series of questions.

1951

- Marvin Minsky built the first neurocomputer SNARC (Stochastic Neural Analog Reinforcement Computer).
- The first working AI program was written that was capable of playing chess.

1954 – George Devol invented the first digitally operated and programmable industrial robot.

1955

- The term "artificial intelligence" is introduced by computer scientist, John McCarthy.
- Henry Dreyfuss, who was an industrial engineer and author of Designing for People, improved the user experience of the Hoover vacuum cleaner and a typewriter which was a product of Royal Typewriter Company using an early version of human-centered design.

1960 – Frank Rosenblatt constructed Mark 1 Perception, a computer that learned new skills by trial and error.

1961 – James Slagle (MIT) wrote a program, SAINT, which solved calculus problems at a college level.

1961

- First industrial robot, Unimate, was installed at General Motors reducing man power in production line.
- Graphical User Interfaces (GUI) were introduced.

1962 – Digital telephony along with telephones with push buttons.

1964 – First mouse is prototyped.

1965 – ELIZA, an interpreter program that parses words and tries to get the context to be able to sustain a meaningful conversation, is developed by Joseph Weizenbaum at MIT.

1966 - The 'first electronic person' called Shakey - A robot which can move around and tries to make decisions about its next move based on its observations about the surroundings.

1969: Emerging of the Internet - Advanced Research Projects Agency Network (ARPANET), the ancestor of Internet as we know it, was developed at UCLA and Stanford Universities. It basically was the first machine-to-machine connection.

1972 – Stanford researcher developed PARRY, designed to simulate a paranoid schizophrenic.

1974 – UPC barcodes

1979 – 1G cellular telephony networks

1980s – Edward Feigenbaum created expert systems which mimic decisions of human experts.

1982: TCP/IP took shape – Transmission Control Protocol / Internet Protocol (TCP/IP) earned to be called a standard protocol stack that is still being used in computer networks.

1984:

- Macintosh - Apple introduced the Macintosh computer; one of the first computers with a graphical user interface.
- First commercially available mobile phone
- The R85X which was capable of learning from its environment was developed by General Robotics Corp.

- Douglas Lenat and his team start Cyc, made an attempt to make a machine that mimics human common sense by coding which of course was not a complete success story, but a pioneer.

1985 – The first VR glasses and gloves - Lanier invented the phrase "virtual reality".

1987 – Windows was born.

1988 – Researchers launched Jabberwacky, an AI chatbot designed to learn through conversation.

1989 / 1990 – The World Wide Web – Sir Tim Berners-Lee, a British computer scientist, invented at CERN three basic concepts (HTML, URL and HTTP) that are still used today.

1990

- Tom Caudel introduced the phrase "augmented reality"

- Interaction Design (IxD) was born.

- Internet Toaster - John Romkey and Simon Hackett created the world's first connected device (which is not a computer): A toasting device controlled through the Internet.

Figure 8. John Romkey introducing the Internet Toaster, 1990. Adapted from CBC, 2015, retrieved from https://www.cbc.ca/radio/undertheinfluence/the-internet-of-marketing-things-1.3093874

1994:

- Bluetooth - A wireless technology standard for communicating over short distances for mobile devices was developed in Ericsson.

- GPS – The first global positioning system that provided nearly full coverage all over the globe via satellites was deployed.

1995 – Semi-driverless cars started travelling across the US.

1996 – 2001 – Microsoft introduced Clippy.

1996 – Internet phones

1997

- Deep Blue, a system that was capable of playing chess from IBM defeated Garry Kasparov who was the famous world champion in that area.

- Apple II - The first PC with coloured monitor became commercially available.

1998

- iMac **-** Apple introduced iMac. It was a personal computer for the end users with its good-looking design by Jonathan Ive that makes use of coloured interface and transparency which allowed users to see the circuitry of the computer. It was capable of connecting to the internet.

- Cynthia Breazeal at MIT developed KISmet, an intelligent robot that could sense and react to people's emotions.

1999

- The term "IoT" was born - Kevin Ashton coined the term "Internet of Things" at MIT and set up a network of global research laboratories focused on RFID and the IoT.

- Cloud computing was introduced

- Sony launched the first robot pet dog Aibo whose skills got developed over time via experience.

2000

- Wi-fi was invented.

- LG Internet Refrigerator - LG launched the world's first internet refrigerator. Although it was able to detect items stored inside it, the project got discontinued, because it was too expensive (approximately $20K).

Figure 9. LG Internet Refrigerator, 2000. Adapted from "What is IoT?" by About the Internet of Things, 2017, retrieved from http://www.abouttheinternetofthings.com/about-iot/

2002 – Roomba – The first commercially introduced autonomous robotic vacuum cleaner. It could detect blocking objects while travelling on the floor.

2003 – RFID – Wal-Mart stores, Inc. asked its top 100 suppliers to begin tagging products with RFID (radio-frequency identification).

2004 – NASA exploration rovers navigated the surface of Mars via remote controlling.

2005

- Stanford robot Stanley drove autonomously for 131 miles (~210 km).

- UN used the term IoT in an International Telecommunications Union report.

2006 – Nintendo Wii; the video game console of Nintendo that had motion sensing capability and allowed the users to interact with the interface via gestures was introduced.

2007 – iPhone – Apple, Inc. announced the Apple iPhone, the world's first touchscreen smartphone with integrated sensors.

2008

- The first international IoT conference took place in Zurich.

- Cisco stated that IoT was officially born, because the number of machines connected to the internet surpassed the number of people connected to the internet.

2009

- Google built the first self-driving car prototype as a proof of concept.

- Decentralized digital cryptocurrency Bitcoin that could be sent from user to user without the need for intermediaries was released.

2010

- Xbox Kinect and PlayStation Move; the video gaming consoles that enabled controlling the game with gestures were introduced.

- Bluetooth Low Energy (BLE) was introduced to be able to integrate wearable and embedded sensor devices for IoT.

- Google's Self-Driving Car - Google kicked of a self-driving vehicle project based on the proof of concept in 2009, a major milestone in the development of a fully driverless car.

Figure 105. Google's self-driving car. Reprinted from Google, 2015, retrieved from

https://googleblog.blogspot.com/2015/05/self-driving-vehicle-prototypes-on-road.html

2011

- Nest Learning Thermostat - Nest Labs introduced its first product; the Nest

  Learning Thermostat which was a programmable device that could learn

  its owner's habits and adjust its functionality accordingly.

- IPV6 (Internet Protocol Version 6) Launched – The new protocol

  increased the number of devices that could be connected to the Internet.

- Starting with Apple's integration of Siri that used speech recognition for

  communicating with the user, into iPhone, other companies started to

  introduce their versions of personal assistants.

- An AI system called as Watson developed by IBM won the first place on a

  popular TV show named Jeopardy. It provided better answers than its

  human competitors.

2012

- Internet seemed to be connecting approximately 8.7 billion devices.

- Google launched Google Now which was an AI system that tried to promote relevant data in search results for its users by performing predictions based on their search history and habits.

2013

- Microsoft introduced Cortana as its virtual personal assistant.

- Google released Google Glass which could be described as a hands-free AI device and could be controlled via voice commands.

2014

- Health Care Monitoring Systems by Apple & Microsoft - Apple announced its two health and home automation developments; HealthKit and HomeKit, while Microsoft introduced Microsoft Health.

- Security issues - HP discovered that 70% of IoT devices had vulnerabilities.

- Ian Goodfellow invented Generative Adversarial Networks (GAN) systems which could be used to generate new data with similar statistics of a given training set.

- A chatbot named as Eugene Goostman passed the Turing Test. It managed to trick the 33% of judges that it was a human being.

- Amazon introduced Alexa; a home virtual assistant and Amazon Echo which is a shopping virtual assistant.

2016

- Google's AI, AlphaGo beat a famous human go player Lee Sedol.

- Microsoft's chatbot Tay got terminated because of its racist comments in social media.

- Amazon launched Amazon Echo Dot & Amazon Tap.

- Amazon delivered a product using a drone for the first time in UK.

- Google introduced the Google Assistant.

- Google announced the birth of Google Home and smart phone Google Pixel.

- Sony PlayStation started to sell PlayStation VR

- Uber began testing autonomous vehicles in some states of US.

2017

- Alibaba introduced Genie X1Smart Speaker

- A bot from Elon Musk-backed start-up company OpenAI defeated human players in Dota 2, a much complex game than chess or Go, since it was a real time strategy game which required short time reactions.

- OpenAI created AI agents that created their own tongue to act in coordination and get their aim completed in a shorter time which then followed by new AI instances that are capable of negotiating and lying

2018

- Many esteemed institutions had courses on AI.

- An AI system developed by Alibaba significantly surpassed humans at a reading and comprehension contest.

2019 – An AI system called as GelSight which is developed at MIT is capable of judge the hardness of surfaces it touches. It is the first step to give robots a sense of touch. [1]

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[1] Some of the resources used for this timeline are: "History of Artificial Intelligence" by The University of Queensland (Queensland Brain Institute, 2019), the infographic "The Rise of Robotics and AI" by PwC (PwC, 2017), the timeline infographic "From Eliza to Tay and beyond" by P. Marsden (Marsden, 2017), the timeline infographic "A Timeline of Voice Assistant and Smart Speaker Technology From 1961 to Today" by A. Mutchler (Mutchler, A Timeline of Voice Assistant and Smart Speaker Technology From 1961 to Today, 2018), an infographic "The evolution of the internet of anything and everything" by Eaton (EATON, n.d.) and news articles from different sources such as MIT (Hardesty, 2017)

4.2. Examples of the Human-Centered Design for the Emerging Technologies

In this age of rapidly changing technology, some products fade out very quickly while some others show that they are here to stay. Well-designed products help maintaining a good relation between humans and machines. Because people love products that they can make bonds with.

The following are some examples of human-centered design that include human-computer interaction:

4.2.1. Ideo

One of their clients asked IDEO to design a medical device to enter data for nurses. The client was expecting to receive a futuristic looking device such as a tablet, however, when the design team observed nurses while working to understand their target group better, they realized that using a tablet-like device wouldn't be possible since the nurses needed one of their hands for something else: holding the patient's hand to comfort them. So, they came up with a device which was less futuristic-looking, but it could be used by one hand. This is a very good example of keeping the human factor while designing for a latest technology. The real user needs to lead the design process. AI may not be able to understand that fear the patient has, however, as human beings we can, so that is designers' job to keep this in mind (User Testing, 2018).

Figure 11. IDEO procedure observation by IDEO's Chief Creative Officer, Paul Bennett. Adapted from "IDEO's human-centered design process: How to make things people love" by User Testing, 2018, retrieved from: https://www.usertesting.com/blog/how-ideo-uses-customer-insights-to-design-innovative-products-users-love/

4.2.2. Power of words and Apple

The comedy science fiction book series "Hitchhiker's Guide to the Galaxy" by Douglas Adams mention an electronic guide book that serves as "the standard repository for all knowledge and wisdom" for every creature in the entire galaxy. On the cover of the guide, there exists the phrase 'DON'T PANIC', written in large, friendly letters. Because the device looks "insanely complicated" to operate, and sometimes intergalactic travellers panic because of that. Although it is fictional, this is very good example to human-centered design while designing a new technology. Because it successfully addresses a problem and offers a very humane way to solve it (Adams, 2015).

On February 2018, SpaceX launched their Falcon Heavy rocket. It was carrying Elon Musk's Tesla Roadster car and the car had "DON'T PANIC!" written on the screen on the dashboard as a reference to the Hitchhiker's Guide to the Galaxy (Hadi, 2018).

Figure 12. The view of Earth from Elon Musk's Tesla Roaster in the Falcon Heavy rocket. Adapted from "Here's why it says 'DON'T PANIC!' on the dashboard of the car Elon Musk just shot toward Mars" by M. Hadi, 2018, retrieved from https://www.businessinsider.com/falcon-heavy-launch-falcon-heavy-roadster-says-dont-panic-on-the-dashboard-2018-2?r=US&IR=T. Copyright by SpaceX.

Sometimes it doesn't take too much effort or time to make a design human-friendly. Just a small but warm word such as "hello" can make a lot difference.

"Hello, World!" is a computer program that gives the message "Hello, World!" as an output. Since it is very simple, it is usually the first written program while learning a programming language. It was influenced by an example program in the 1978 book "The C Programming Language" written by Brian Kernighan and Dennis Ritchie.

When Apple introduced Macintosh; one of the first computers with a graphic user interface in 1984, it created a wave of excitement. The computer had a mouse and icons. But most importantly, it had a friendly "hello" writing on its screen.

Figure 13. Macintosh. Reprinted from "RIP Macintosh: 1984–2018" by S. J. Vaughan-Nichols, 2018, retrieved from https://www.computerworld.com/article/3280944/rip-macintosh-1984-2018.html. Copyright by Apple.

14 years later, when Apple introduced iMac which was a personal computer that could connect to the internet, with a colourful and transparent design by Jonathan Ive, "Hello (again)" was written on its screen. It was a personal computer that people could emotionally be attached to. It was not only something to use, it was something to have a bond with; an object of desire.

Figure 14. iMac. Reprinted from "Today in Apple history: iMac G3 arrives to save Apple" by L. Dormehl, 2018, retrieved from https://www.cultofmac.com/442280/apple-history-imac-g3-arrives/. Copyright by Apple.

Apple has always been a good example for making use of human centric design with their ground-breaking products. With each product, they introduced unique characteristics that made them different and indispensable. The technologies they used were invented and used before, but they succeeded to turn them into products that people would love.

Behind this success, there was a man named Steve Jobs. His interest in minimalism shaped their way of visual design from the packaging to the interfaces. The interfaces of Apple products were designed so simple that everybody could use it, no matter what age.

iPhone changed the way we look at telephones and today, there are now 1.4 billion active Apple devices, of which 900 million are active iPhones in use (Lee, 2019).

Microsoft realized that as the technology grows, the user experience of their applications does not improve along. Conversely, they become more complex. So they introduced human-centered design principles throughout their design processes and defined a 5 step design process, including understanding, envisioning, specifying, implementing and maintaining (Elmansy, 2016).

4.2.3. The evolution of listening to music

The history of music has witnessed different formats in the last century. The journey that started with drums and the flutes, made from bird bone and mammoth ivory has come to a very interesting point that music is stored in an intangible format in an intangible place called cloud. Between these two stops people witnessed records, cassettes, CDs, MP3s and several other formats.

As the world got more and more digital every day, MP3 created a deep impact on music industry. Some companies tried to fight it at first, but as the time passed by,

they also had to accept that a new age had already started, and they had to go with the flow. Steve Jobs's prescience was strong and he could see what the future would bring. And in 2001, Apple introduced the iPod Music player and gained a huge success.
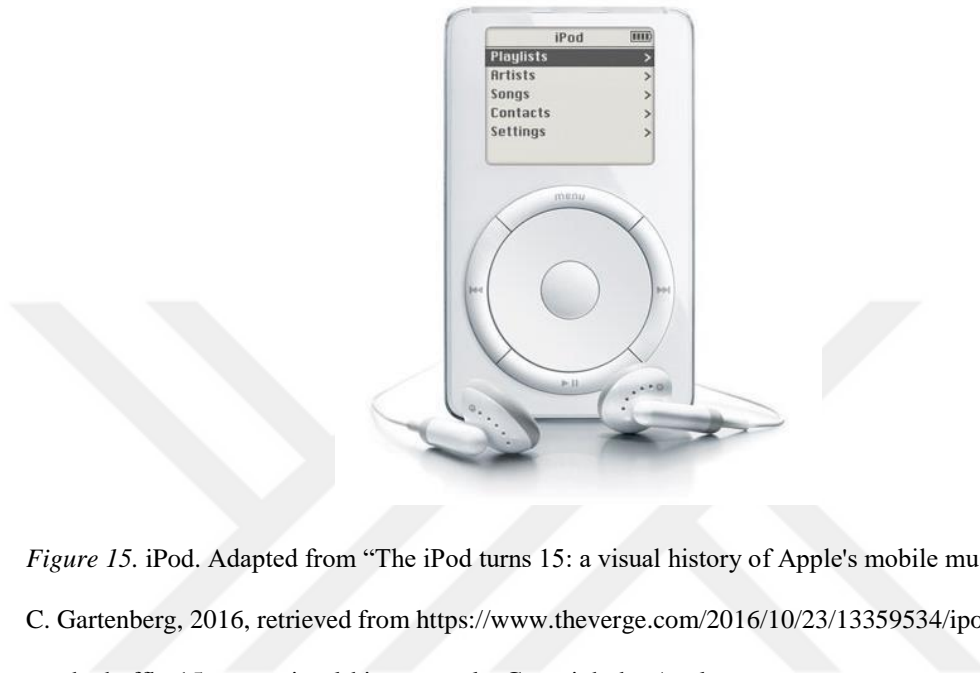
Figure 15. iPod. Adapted from "The iPod turns 15: a visual history of Apple's mobile music icon" by C. Gartenberg, 2016, retrieved from https://www.theverge.com/2016/10/23/13359534/ipod-mini-nano-touch-shuffle-15-years-visual-history-apple. Copyright by Apple.

Actually, the MP3 players had been around for quite a while, but Apple managed to make a large number of people to use iPod every day. The iPod was presented with its simple design and while its competitors were advertising their products with mottos like "1 GB storage on your MP3 player," Apple's motto was "1.000 songs in your pocket". Since counting megabytes didn't mean much to the ordinary people, Apple's motto made the idea tangible.

After MP3, artists tried different methods to convey their music to their listeners. Some of them sold their albums in USB flash drives and bands like Radiohead let their listeners download their albums online.

In 2003, the iTunes store that was allowing people to purchase music legally online was launched. In the same year, the store hit 25 billion downloads.

However, the era of downloading MP3s has already passed today. Streaming services such as Spotify and Deezer became popular as the improvements in network connection speed and quality made listening to music online easy and convenient. As networks became more reliable, people felt the need to keep hard copies of their assets less and less. And as people get connected to internet with more devices than before, the idea of accessing personal music from all devices and at any time led the way for tech companies.

Spotify, the Swedish media-services provider outscored its competitors by applying human-centered design practices and providing personalized experiences to its users. For a monthly fee, people could reach high quality audio, personalized suggestions and playlists for every taste, mood and occasion, all accessed from one place and from everywhere. This transformed the way users interacted with music players, and that was made possible by empathizing with them.

4.2.4. Netflix and Youtube

Just like listening to music, ways of watching movies and TV series also evolved through time. The invention of cinema, TV, VHS and Beta video cassettes, VCDs, DVDs, Youtube and finally Netflix have been changing our experience of watching a movie.

Especially TV has become one of the biggest addictive habits of people of all the time. Every day, millions of people sit and look at a box in front of them for hours. That is why it is often compared to a drug addiction, since it is also very harmful for humans to sit at the same place for long hours every day.

Smart phones have been acting as another medium for watching video contents since they allow users to do this anytime and anywhere, without the need to sit at the same place.

In the second half of 2000s, Youtube became one of the most visited websites globally. Because it was allowing almost anyone to upload and share content for free. That was very important, because Youtube gave people a visual channel to express themselves. So, they willingly started creating content for Youtube about almost anything, from documentaries to make-up tutorials and cat videos. They allowed comments and likes/dislikes as well, so people had the opportunity to share their thoughts about the content.

American media-services provider Netflix made a breakthrough when they followed a user-centered approach to streaming media service. According to the global measurement and data analytics company Nielsen's 2013 Over-the-Top Video Analysis, more than 60 percent of Americans were preferring binge-watching shows and 88 percent of Netflix users reported streaming three or more episodes of the same TV show in one day. So, unlike the common attitude of showing a new episode weekly, Netflix uploads all episodes of a TV show, allowing users to watch their favourite show as long as they want.

They also introduced a short survey while onboarding to know their users' preferences better and based on this information they started making personalized recommendations. Netflix users can also download the episodes they want to watch to their devices, taking away the problem of weak or absent network connection.

One of the most appreciated feature of Netflix is that the users can keep watching seamlessly, from one device to another, since it remembers the minute and the second they stopped watching on the previous device. So, users also don't need to think about which episode they need to watch.

This seamless experience is now adopted by Google's new game platform Stadia. Stadia is a cloud gaming service that supports streaming video games up to 4K

resolution at 60 frames per second. The user can play the same game seamlessly across different devices such as laptops, desktops and Pixel phones. They promote the product with the sentence "no waiting for game downloads, jump straight into stellar gameplay experiences".

4.2.5. Reading - electronic paper

Reading habits have also been effected by the digital revolution. Developments in the internet technologies and digitalization of almost everything in people's lives, evolved their reading habits as well, along with the rest.

Since the scrolls written on papyrus and the invention of the printing press by Gutenberg (1450), reading and writing habits have been changing. Microsoft's prevalent word processor Word has changed people's perception about paper. A blank area made of white pixels has become the world's new notebook. Instead of directly writing on paper, people started to prefer writing the text on the screen first and then printing that out. Because it was easy to use and unlike typewriters, it gave its users an unlimited editing possibility. They started taking notes on devices, because they were also so easier to share with others.

Drawing on screen was also a new feature for artists. Drawing pads such as Wacom tablets were making a drawing possible to edit later with a computer software such as Adobe Photoshop.

After people got used to writing and drawing on screen instead of on paper, they were also introduced to a new way of reading. It was called e-book, and it was giving the user the convenience of carrying thousands of books in a small and lightweight device. That was solving the problem of carrying heavy books, especially for the people that travel and read a lot.

The e-ink technology used in the e-book readers was unique and the screens were different from computer or phone interfaces. E-books let their users read without charging the device for weeks and without tiring their eyes. E-book readers could also highlight the text areas to review later. And of course, no trees needed to be cut, so considering the number of the book printed every year, that made e-books an important tool for sustainability.

Figure 16. Amazon Kindle. Adapted from Pixabay, 2016. Pixabay license.

4.2.6. New controls

People are quite used to the standard user interface setup of computers. They know how to use a mouse, what a pointer shows and what to do with icons. If a person can use a computer, he/she can just walk up to another computer and use it without any hesitation about how to. For someone who is used to graphical user interfaces, the function of the small floppy-disk-shaped icon (save) or the bin image at the bottom right of the screen is very clear.

However, new technologies come in a variety of forms, including interfaces from all sizes and shapes, even methods. As new technologies arise, based on the evolving needs of their users, new interaction styles are born. Touch screens (haptic interfaces) have already been ordinary features of today.

Every time a new technology is introduced, its users go through an experience of learning how to use it and this period is usually full of confusions and question marks.

New generations are more adaptive to the new technologies than their ancestors used to be. Even new-born babies today easily adapt to the finger gestures used on smart phones such as scroll, zoom in/out, swipe and tap.

4.2.6.1. Vocal controls.

Voice activated commands have been here for some time, but they have gained more importance after the virtual assistants have become widespread. In other words, they've been waiting for the actual human need to show up for being used in products that would solve actual problems.

4.2.6.2. Kinetic controls.

Video gamers have been using diverse tools to control their games and get the best scores: Buttons on game machines, w-a-s-d and 1-2-3-4 keys on computer keyboards, joysticks, game consoles, steering wheels and even tennis rackets in Nintendo Wii.
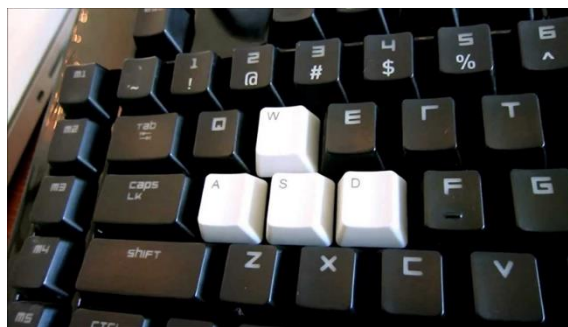
Figure 17. W, A, S, and D keys on a computer keyboard. These keys are widely used in many games for game controlling. Adapted from "The real reason why every gamer uses WASD" by R. Brothwell, 2016, retrieved from https://mygaming.co.za/news/pc/96595-the-real-reason-why-every-gamer-uses-wasd.html

Figure 18. Nintendo Wii control devices and Sony Playstation. Adapted from Nintendo. Retrieved

from https://www.nintendo.co.uk/Wii/Accessories/Accessories-Wii-Nintendo-UK-626430.html.

Copyright by Nintendo.

However, Xbox Kinect (and later Playstation Move) raised the bar by

removing all controllers and using the human body itself as the controller. For

example, to play a bowling game on Xbox, the person just needs to shake his/her arm

as if he/she was holding a bowling ball and throwing it away as he/she would do in a

bowling alley, without being physically connected by cables or holding a game

controller.

Figure 19. xBox Kinect Bowling game. The gamer controls the game by his/her body movements.

Adapted from "In pictures: Rare embraces Kinect Sports" by A. Hartley, 2010, retrieved from

https://www.techradar.com/news/gaming/in-pictures-rare-embraces-kinect-sports-696537.

Kinetic controls are not only about gaming. The motion sensors in paper dispensers can be given as examples of using a gesture to interact with a product.

Healthcare is another important area to use gestures to control interfaces. Wearables (gloves, etc) equipped with sensors such as accelerometers (that measure acceleration forces) and gyro sensors (that measure angular velocity) can be used to help patients and the medical team.

4.2.6.3. Control with eye movements.

These types of interfaces are called brain-machine interfaces (BMI). Today, it is possible to control a computer interface with eye movements by using methods such as Electro-oculography (EOG) (Iáñez, Azorin, & Perez-Vidal, 2013).

Controlling an interface with eye movements can be very useful for people who can't use their hands or voices. This feature can also be implemented in augmented reality devices such as glasses or smart contact lenses.

4.2.6.4. Control with brain waves.

Another example of BMIs is controlling with brain waves. Although there is still space for improvement for this technology, it is possible to control an interface by converting brain waves into digital signals and there are many products already on the market.

Brain control may have many applications in healthcare, especially for helping people with disabilities engage with their surroundings.

Philips worked with Accenture on a project to help amyotrophic lateral sclerosis (ALS) patients to regain independency by controlling their environment by brain control technology. The proof of concept software was connected to an Emotiv Insight Brainware headset and was enabling patient to control Philips smart products around the home, ask for help or send messages (Philips Healthcare, 2014).

This technology can also be used as an alternative to prosthetic arms to regain motor skills.

However, healthcare is not the only use case for this technology. It can also be used for fun. Products named Necomimi and Shippo (fluffy ears and a tail) by Neurowear can scan brain waves and expresses the wearers' emotional state. So just like the animal tails and ears show fear, excitement or interest, these products also give these abilities to people (Neurowear, n.d.).

4.3. Fundamentals of Human-Centered Design for AI

Today's emerging technologies promise people exciting ways of engaging with the world and with each another. They have been offering new methods for interaction, defining new needs and creating new expectations.

In other words, the core of human-computer design; "humans" themselves have been evolving. As both legs of human-computer interaction change, the ways of designing products need to change as well.

That doesn't necessarily mean that the basic design rules need to change. In fine arts, most artists have a unique style of their own, yet they all use the main principles of art such as balance, harmony and proportion. They may use colours differently to express themselves in their own unique style, but the effect of a colour on an individual stays the same.

Therefore, basic principles of human-centered design, such as "putting humans in the heart of the design process" or "trying to understand their needs and expectations" doesn't need to change, as the technology and the people changes.

However, because the profiles and stories of the people who would be using a product change, there will be newly defined needs, pains and expectations. People will demand new ways of interaction, as their relationship with machines evolve.

Even the interaction between the members of a design team and their ways of designing may change, since designing for AI will require more collaboration between designers, data scientists and developers as Muzesky also suggests (Muzesky, 2019).

Guszcza explains the inevitable need of human-centered design for AI in the light of AI's societal acceptability and profitability, if designed by taking user needs and psychological factors into account. He defines the aspects of Human-Centered Design for AI-based products in four main titles: Goal-relevance, Handoff, Feedback Loops and Psychological Impact. (Guszcza, 2018)

He explains "goal relevance" with an example:

Typing "area of Poland" into the search engine Bing returns the literal answer (120,728 square miles) along with the note: "About equal to the size of Nevada." The numeric answer is the more accurate, but the intuitive answer conveys the approximate size of Poland to far more people. (Guszcza, 2018)

As the AI systems are quite new and they need humans help in becoming more accurate, humans and AI should work hand in hand in the design process and after. That aligns with Guszcza's second aspect of Human-Centered Design for AI; "handoff". He claims that if we leave all the control to technology, we will not be prepared enough to take charge in an unexpected situation. And it is likely that the technology will fail, since it is not perfect yet (Guszcza, 2018).

He also suggests that giving feedback to AI is critical, because it only does what it is taught, and it doesn't have the ability to understand if it crossed a line or misinterpreted a reaction. As humans we do it very naturally and intuitively, but if we don't help AI gain that intuition by giving feedback, it will never learn (Guszcza, 2018).

Providing channels that the users of the product can give feedback about the accuracy and performance of the product and the whole experience, allows AI to provide better results with time, while improving its skills.

Providing a feature that people will love to use is not good enough to create a real human-centered design for AI. Designers should also aim for meaningful and useful products that solve real problems, instead of the ones that actually provide economic benefits for a small group. Guszcza's last aspect, "psychological impact", too aligns with this idea and he gives addictive social media apps as an example to this subject (Guszcza, 2018).

He adds, while designing an algorithm, peer-reviews must be conducted to avoid venomous and unwanted biases. As a child learns from parents, AI learns from humans and if the people that AI is observing as a source for learning are hateful, AI will also have a hateful attitude (Guszcza, 2018).

If an AI-based product fails, since it is not trained well, that situation can lead the person that interacts with AI to confusion and frustration. These fails are likely to happen, and design is the way to prevent those feelings by closing that gap. A well-designed product should cover worst-case scenarios as well as the good ones.

Human-centered design is quite very important when it comes to introducing a new technology to people. In order to make people accept a new product that uses a new technology, it is very important to express clearly what that technology is about. Onboarding processes that include a person's first contact with a product should also be designed carefully.

A danger about designing for emerging technologies is that by the excitement of new possibilities, designers and developers may tend to test what is possible by pushing the limits of technology and adding features or creating products that people

don't actually need. The feature they add may even confuse the users by not creating any meaningful value. So, the focus must always be the human; what their needs are and what the problem to solve is, instead of what the technically possibilities are.

The experience of interacting with a machine must be as intuitive as possible. It should be designed in a way to help reducing users' cognitive load to save space and energy for the real interaction instead of compelling the users to find out how to use the product themselves.

Ergonomics rules, cultural diversities and accessibility issues such as colour blindness or visual impairment should also be kept in mind while designing.

The context and the environment must always be taken into consideration while designing for AI and especially voice activated systems. Interaction may not occur only indoors which would be silent and peaceful. Various environments such as outdoor areas, noisy factory buildings and other public places may also be a part of the experience. For example, if the product is going to be used in a noisy (or too quiet like cinema) environment, voice activation may not be the best method to interact with the product.

In Human-Computer Interaction, designers must play the role of a mediator, by leading both people and AI, by teaching them how to live together. Designers need to analyze the trends and possible needs very carefully and define new needs before they are formed. Steve Jobs once said "you can't just ask customers what they want and then try to give that to them. By the time you get it built, they'll want something new" (Jobs, 1989).

Therefore, keeping an eye on the current and future trends or maybe creating them is also important.

Building trust between humans and machines is another important aspect of Human-Centered Design for AI. To be able to do that, designers should first examine what helps building a relationship based on trust. The trust between humans usually rely on notions like sincerity and reliability. The reasons differ when it comes to building a trust-based relation between people and machines. People expect non-human, software systems to be accurate, open, consistent and dependent on humans.

So, the data-relevant issues (which type of data is collected, how is it processed, etc.) between humans and AI must always be transparent and clear. The purposes of collecting and using data must be explained clearly.

It is equally important to be clear about what AI can't do, as well as what it can do. If people see the potential for growth, they will be more open to contribute by giving feedback to make AI (and in the long term, the service they get from AI) better. In contrast, if they see "something too polished, they will look for flaws" and it will be harder to establish a connection (Hyer, Herrmann, & Kelly, Medium, 2017).

Letting people know that AI is not perfect, and it can make mistakes, may also help lowering the expectations and anxiety about AI. If people know that the outcome of a product or system is generated by AI, a positive bias that foresees possible flaws and mistakes can be produced.

To set the guidelines for effective human-AI interaction, designers, researchers and engineers have been proposing recommendations. Based on the principles of human-centered design, the changing needs that humans have and the characteristics that AI brings, a set of basic design guidelines to follow while designing for human interaction are gathered and combined. New pillars of this relationship such as voice interaction and semi-autonomous vehicles are also taken

into account in addition to graphical user interfaces. Below is the summary for human-centered design principles to consider while designing for AI:

- To establish a good relationship between humans and machines, human-centered design principles must be followed while designing for a new technology such as Artificial Intelligence.

- The focus must always be the humans; what their needs are and what the problem to solve is, instead of what technically possibilities are there. Designers should aim for meaningful and useful products that solve real problems.

- Ergonomic rules, cultural diversities and accessibility issues such as colour blindness or visual impairment should be considered kept in mind while designing.

- Designing for AI will require more collaboration between designers, data scientists and developers.

- People are more like to form a bond with new technologies as they align with humanly characteristics.

- To build trust between humans and computers, AI systems need to be accurate, open, consistent and dependent on humans. The purposes of collecting and using data must be explained clearly.

- Humans need to be in control and AI should be an assisting tool.

- AI should learn from user behaviour and adapt accordingly.

- While teaching AI, it is very important to preclude it from adopting societal biases.

- Letting people know that AI is not perfect and can make mistakes, may help lowering the expectations and anxiety about AI.

- Channels that enable people to give feedback about the accuracy and performance of a product and their experience with it must be provided.

- Onboarding processes that include a person's first contact with a technology or product should also be designed carefully.

- Fails and worst-case scenarios should always be taken into account and handled smoothly.

- The experience of interacting with a machine must be as intuitive as possible. Cognitive load must be lowered.

- The context and the environment must always be considered while designing.

4.4. AI for Human-Centered Design

AI can also help people improve the process of designing for humans. In the Inspiration phase of the human-centered design process, designers make comprehensive research to understand the target user profiles. AI can be used to refine this step by simplifying the data that designers need to deal with.

Optimizing design processes by AI also means less need for iteration since analysing data effectively can give designers the ability to make prophetic guesses about users.

Lovejoy explains the role of AI in human-centered design with an example: "The role of AI shouldn't be finding the needle in the haystack for us, but to show us how much hay it can clear so we can better see the needle ourselves" (Lovejoy, 2018).

AI should not be in the driver seat of human-centered design, but it can be a very helpful co-pilot. The global design and innovation consultancy Fjord sums this up by saying "let people do what they do best and let machines do what people do

worst … because in order for us to build trust in the impact of AI we must feel

reassured, included and informed" (Fjord, 2018).

5. RESEARCH AND FINDINGS

5.1. Research

5.1.1. Scope of the research

Interacting with AI is a subject that is free from demographics such as race, age and nationality. Today, from children in a playground to the elderly people who live alone, almost everyone is starting to use or being a part of products and services that use artificially intelligent computer systems. Therefore, while defining the target group for this survey, including as much people as possible, especially from groups that differ in age, education, income level, gender, residency and occupation was aimed.

The research was not limited with only one country and aimed to reach as many areas as possible, to see whether the effects of the emerging technologies on people change from one country to another. It was aimed to reach out to as much people as possible from different countries with different demographical, financial and cultural backgrounds.

5.1.2. Aim of the research

This thesis work intends to evaluate the following hypotheses:

H1: While designing products or services equipped with technologies which are perceived as "non-human" such as AI, applying human-centered design principles can help maintaining a healthy relationship between humans and machines.

Products that analyse human needs well and put the humans in the center of the design process are able to provide products that people can make bonds with and gain more success. To establish a good relationship between humans and machines,

human-centered design principles must be followed while designing for a new technology such as Artificial Intelligence.

How human-centered design helps creating good user experiences is one of the research subjects of this dissertation. Near past examples of the pervaded new products and the analysis of their adoption processes by humans will be given to outline the effects of the human-centered design on introducing a new product to people.

H2: While interacting with AI-powered products, people prefer being in charge and see AI as an assisting tool.

For humans, the need to be in control about their lives is high. Even though they may believe that AI is capable of making better calculations and suggestions, they still have concerns about giving the control to AI. Today, they see AI-powered products as their helpers rather than their friends.

To build trust between humans and computers, AI systems need to be accurate, open, consistent and dependent on humans.

However, that may change if AI technology improves and it gets possible to maintain a meaningful relationship with AI.

H3: As AI improves, people will be able to see it as a part of their lives, human-computer interaction will get easier and be normalised.

As AI technology gets better at thinking and responding like a human, people will accept AI-powered products as a part of their lives more easily. As long as AI creates solutions to real human problems, it will get possible to maintain a meaningful relationship with AI. People will start seeing AI as an inseparable part of their lives.

H4: Although there are concerns about AI, people are generally curious about what AI will bring and this feeling is independent from the country of residence.

Products and systems using artificial intelligence and machine learning algorithms are being used by companies, brands, governments and researchers more and more every day. Even if we haven't realised yet, AI has already become a part of our lives and we will interact with it and see its effects and capabilities even more in the near future. This dissertation will research the effects of the idea of having an artificial intelligence system in the critical parts of their lives, on people. What their perceptions and first impressions on the AI technology are and what they would expect to experience while interacting with an AI based system/interface will be asked to people and the results will be analysed. This research will also approach this subject from a residency-related perspective to see whether the demographical, financial and cultural backgrounds of the country of residence have effects on people's perceptions about AI.

H5: While interacting with AI-powered products such as virtual assistants, people prefer interacting with human-like products instead of robotic ones.

Interacting with an artificial intelligence-based product or system would require different aspects than interacting with another human-being. People are more likely to bond with new technologies as they align with humanly characteristics. Therefore, the more human characteristics a virtual assistant has, the more people can embrace that product.

5.1.4. Methodology of the research

The research for this thesis work started with reviewing the research done so far on human-centered design. This review included a historical analysis, some use-cases and best practices. It is planned to underline the effects of human-centered design processes on people's interaction with technology by quantitative research methods.

Exponential Non-Discriminative Snowball Sampling method is used to reach as much people as possible and to generate a holistic overall inquiry, since the author of this dissertation herself has a limited area of reach. The primary participants were encouraged to share the weblink of the survey with their networks to gather more data about the research subject.

The research is planned to have two main phases; literature review and survey. The first chapter after the introduction is focused on the fundamentals of human-centered design, looking at both the structure and the importance of human-centered design.

The following chapter aimed to investigate Artificial Intelligence in terms of different types, applications, and perceptions of it.

The third chapter after Introduction will be looking into the relationship between Human-Centered Design and Artificial Intelligence and ways of collaboration between these two areas. This chapter starts with a historical analysis of human-machine interaction and then some examples are highlighted in order to understand how human-centered design practices can help developing a good relationship between humans and machines.

After the theoretical base was established and the hypotheses were defined, the findings of the research have been tested by conducting an online survey. The

findings of the survey have been evaluated by analysing the collected data using mathematical and statistical methods. Descriptive and inferential statistics have been used to investigate whether the data were consistent with the hypothesis of this dissertation. All the findings drawn from the statistical analysis presented visually by using line or pie charts.

5.1.4.1. The survey

The online survey aims to evaluate people's opinions, experiences, needs and expectations about Artificial Intelligence.

The objective of the survey is explained in the beginning clearly along with other information such as the subject and approximate duration of the survey, basic definition of the artificial intelligence, contact information for queries and that the answers will remain anonymous.

It consists of three main sections: General Questions, Relationship with Technology and Relationship with Artificial Intelligence.

The first section includes questions to picture the basic profiles of the participants. Basic demographical questions (age, gender, etc…) are followed by employment and education related questions to be able to understand the context for the social and intellectual background of participants. Finally, questions about their relationship with the emerging technologies and their opinions about AI are asked.

The survey questions are prepared in both Turkish and English and sent according to the participants' location. Participants living in Turkey received the questionnaire with Turkish questions, while the rest of the participants received the questionnaire with English questions. The motivation behind this approach was to remove the language barrier, since Turkey was expected to be one of the countries with high participation rate, because of the nationality and connections of this thesis's

writer. As this research aimed people from all demographic groups, sending out the survey in Turkish would help the people in Turkey who did not know English to be able to participate.

All the results from both Turkish and English versions of the survey were merged and then evaluated together.

The survey has 30 questions (Appendix A) in total and takes approximately 3-5 minutes, based on the participants' speed of filling the form out. Most of the questions are multiple-choice questions, however, checkbox questions that enable selecting more than one option and open-ended questions are also used. Most of the multiple-choice questions also has an "other" option that allows people to add their own answers if they don't see any answer that seems relevant. At the end of the survey, a text area is also added to let people write down other thoughts that they seem relevant, however not covered in the survey.

5.1.5. Limitations of the research

The main limitation about AI and human-centered design collaboration is the fact that AI is quite a new technology and therefore, the research done on this subject is limited. The existing research projects about AI usually focus on the technical aspects of it and the research focusing on its relationship with other disciplines such as design, sociology or psychology are insufficient to help with this research.

It will be possible to draw a better picture about the subject when further research on AI and its interaction with humans is done, since this is still quite a secluded area to discover.

Although this research aimed to reach as much people from different educational, cultural and social backgrounds as possible, it doesn't have the chance to include participants from all groups. And although it is seeking answers to some

questions that concerns all the people, regardless of their education level or exposure to technology, since the survey is conducted online, it could only reach people with access to internet who knows how to read or write and have access to a computer interface. It has not been possible to reach people who don't know how to read or write, don't use technological devices or don't have access to internet.

As there is so limited research done on the subject, the research is handled from a broader perspective which didn't let the author dive deep into a selected aspect of the subject.

5.2. Findings

Having analysed the survey results gives us better insights about people's needs and preferences about the human-machine relationship and the high participation rate (319 people) leads to more confident inferences.

Combining the survey results with the data gathered from the literature review and some past example use cases give us a clear vision of what should be taken into account while designing products or services that are using AI technology.

The survey results also help to re-evaluate some of the hypotheses of this thesis work.

The survey was filled by 319 people. 65% (204 people) of that group were living in Turkey, while 14% percent (45 people) were resident in Ireland. Ireland was followed by Canada (6%, 20 people), Germany (4%, 13 people) and United States of America (3%, 10 people) and the rest of the people who took the survey were from other countries.
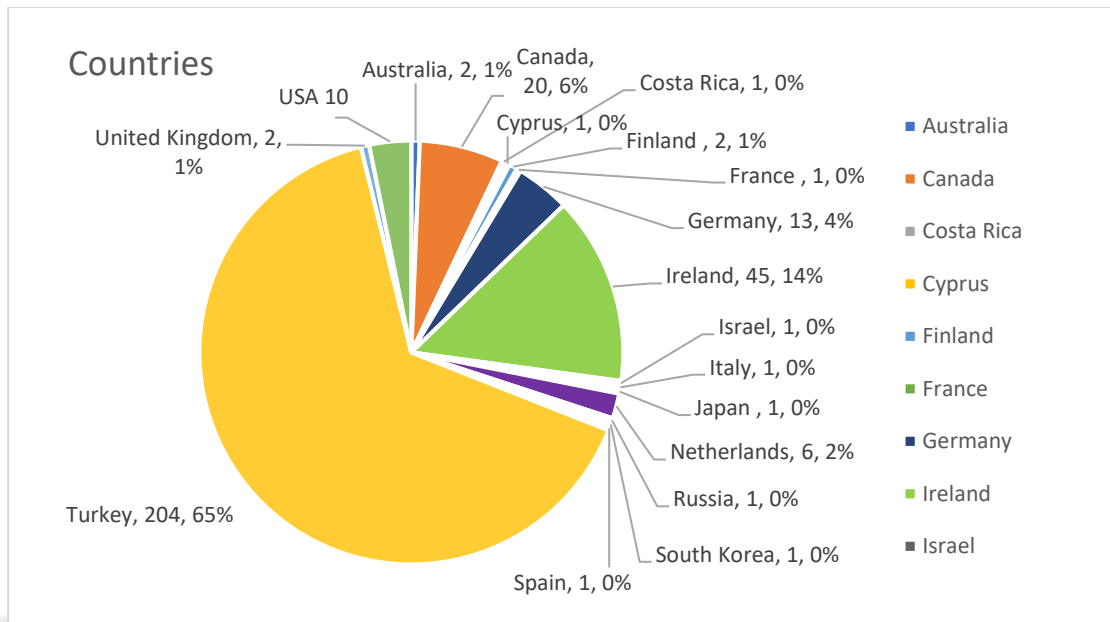
Figure 20. Chart showing the countries where the participants of the survey are resident.

Distribution of genders show us that 55% (175 people) of the participants was female and 45% (141 people) was male.
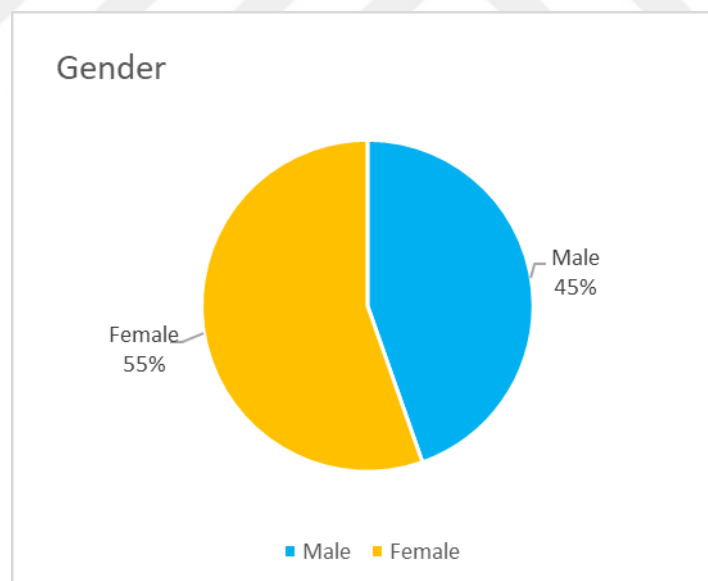
Figure 21. Gender distribution

Most of the people who took the survey were between 35 and 44 years old (39%, 123 people). They were followed by people between 25-34 (34%, 109 people).
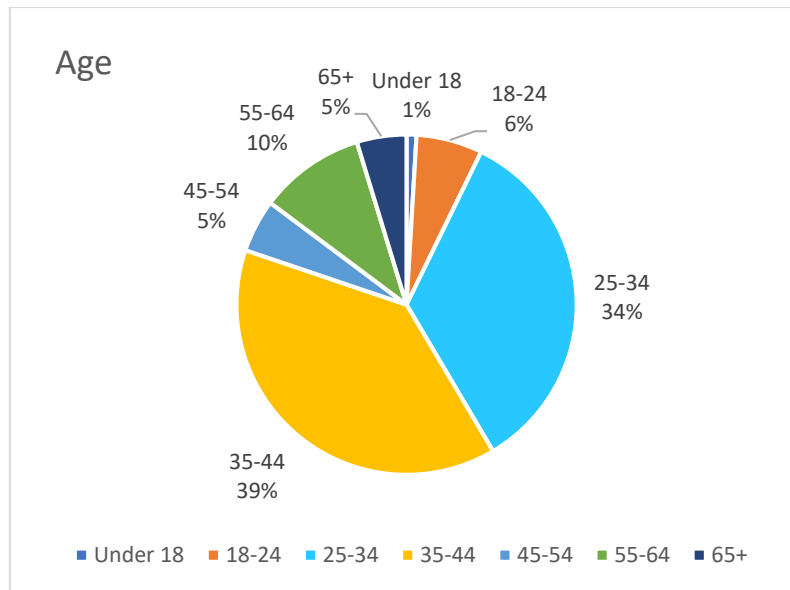
Figure 22. Age distribution

Most of the participants were graduated from a college level or higher school, however, 28 people stated that the last school they graduated from was high school, while one of them was from secondary school.
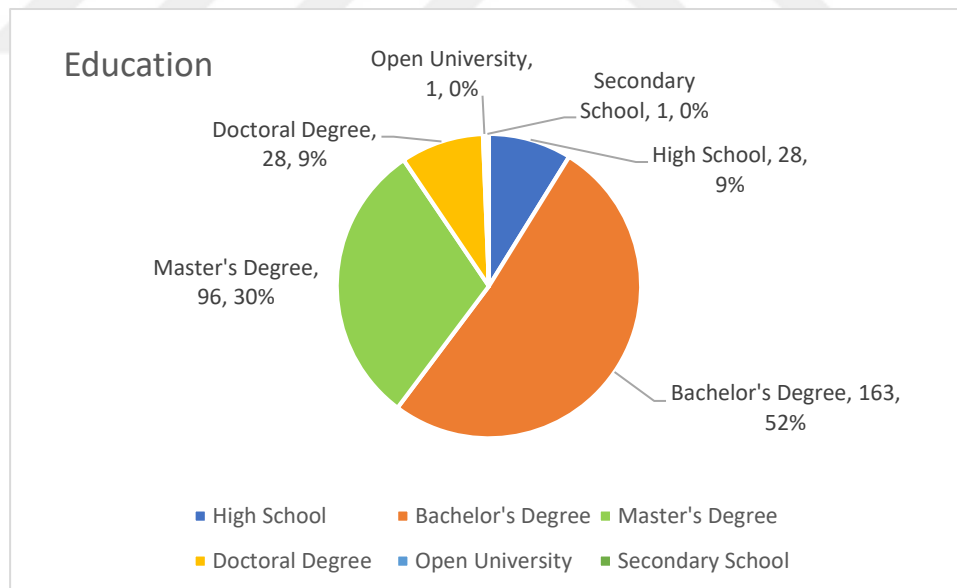
Figure 23. Education levels of the participants

70% percent of the participants were actively working while the rest was unemployed, retired or student.
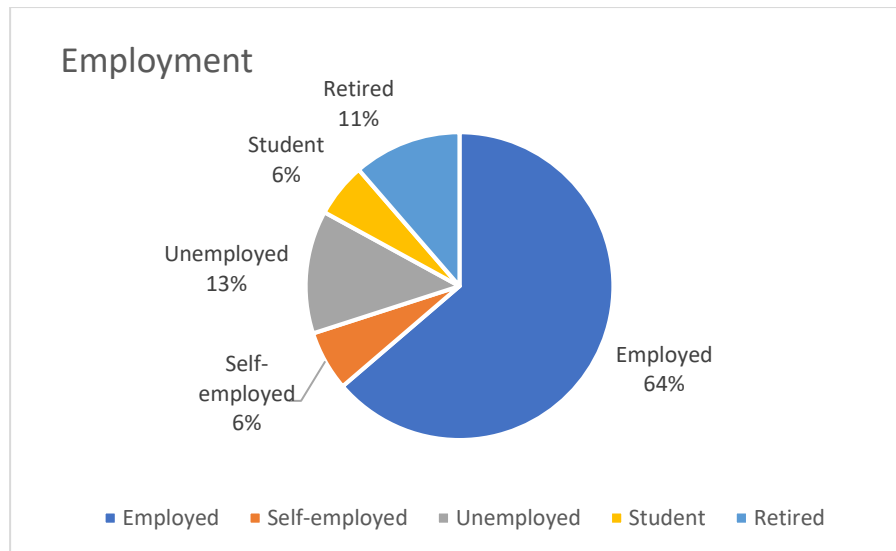
Figure 24. Employment statuses of the participants

Questions about the participants' relationship with technology

98% of the participants said that they had a (smart) phone that could connect to internet. The reasons they are using their phones for are illustrated in the following graph. Here, it's worth to note that the distributions with respect to use cases of smart phones are nearly identical, although the social profiles from Turkey and the other Western countries differ. Therefore, this data can be considered as independent from the geography.

Figure 25. What do you usually use your mobile phone for?

The majority of the participants spend between 1-3 hours each day with their phones.
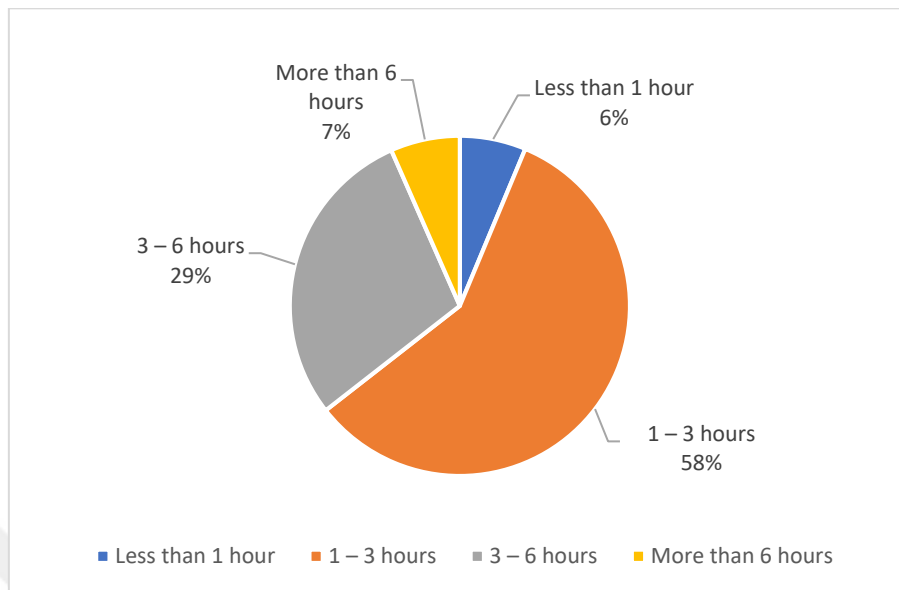
Figure 26. How much time do you spend a day on your mobile phone (approximately)?

Here, there is a difference between Turkey and Western countries that deserves to be indicated, although main characteristics of two distributions are similar. The percentage of Turkish people spending more than three hours is 37.5%, while that percentage for Western countries is 29.7% which means Turkish people spend more time using their smart phones.
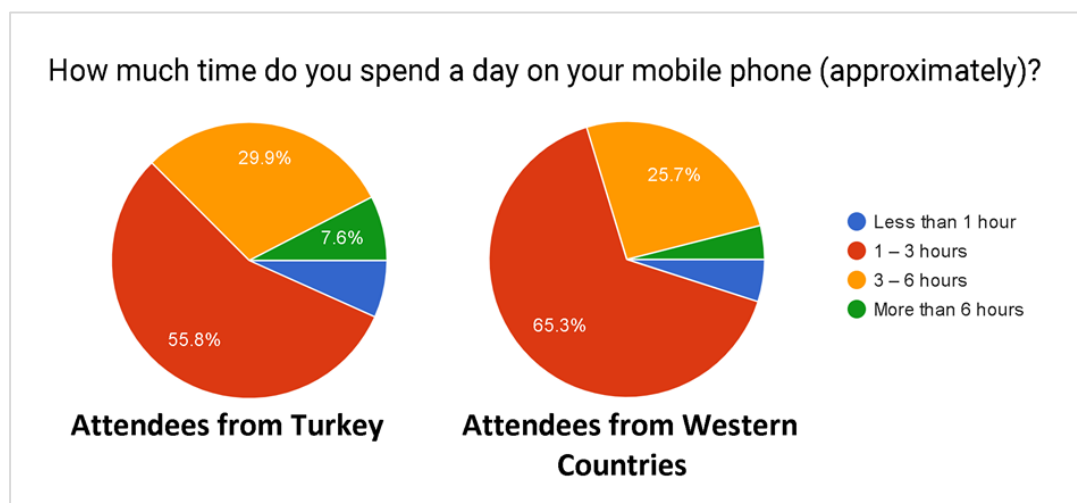
Figure 27. Time spent on mobile phone – with respect to location

Although 98% of the audience had a smart phone, majority of them (74%) do not use any of the other smart accessories which seems to be the case for both attendees from Turkey and attendees from Western countries.
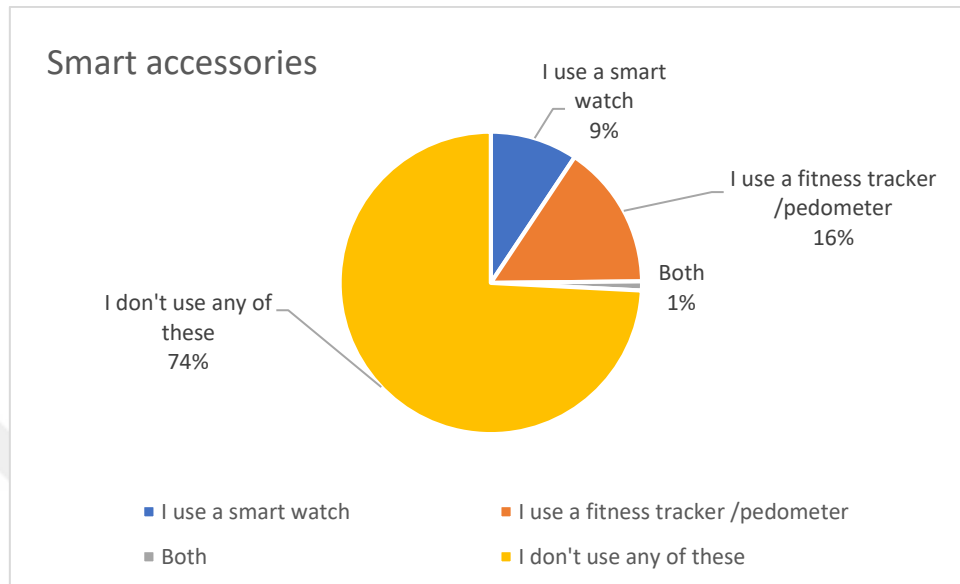
Figure 28. The usage of smart accessories (smart watch, fitness tracker, etc.)

People's preferred way of communication varies with respect to the other end of the communication. Most of the people (55%) prefer face-to-face communication while talking to a friend which is followed by phone (31%), since it also implies talking. That has been said, the differences of the distributions between Turkish and Western way of communicating with friends is undeniably obvious, the percentage of people who prefer face-to-face communication in Turkey is 43.8%, while it is 80.2% in Western countries. This difference may take its source from the different demographics in these two areas. As the population is high, cities are big and meeting face-to-face with a friend is hard because of the distances, people in Turkey may prefer talking on the phone for, more often than not.

When it comes to usage of phone for doing that, 40.6% of Turkish people prefer it, while only 8.9% of the people of Western countries choose this method. Usage of e-mail is quite rare within both communities, same can't be said for the

usage of social media, since 14.7% of attendees from Turkey prefer it while 8.9% of

attendees from Western countries choose it:
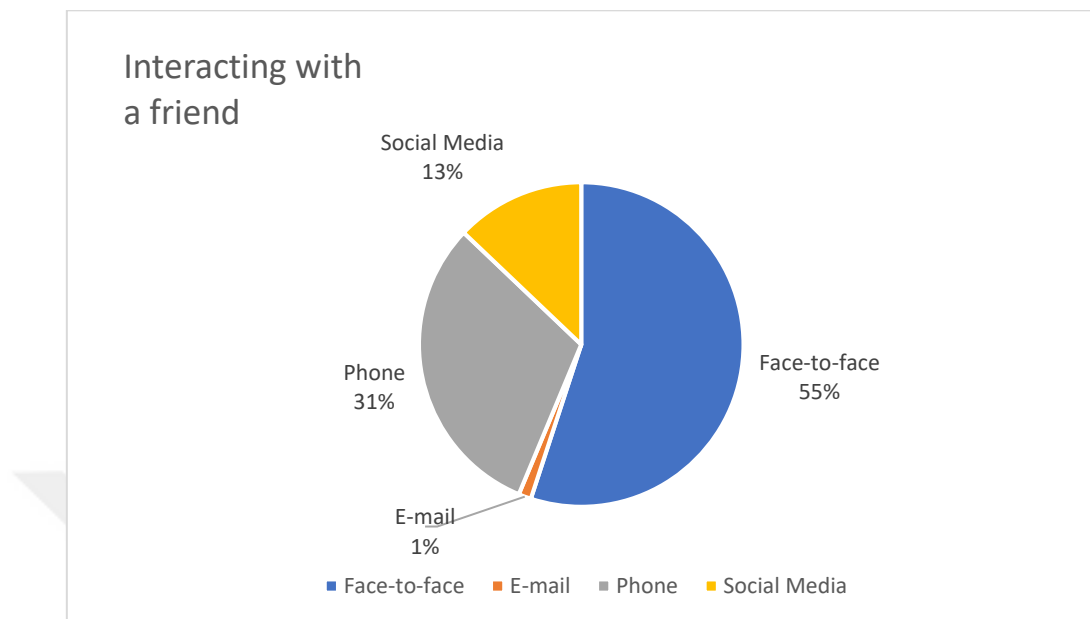
Figure 29. Preferences about interacting with a friend
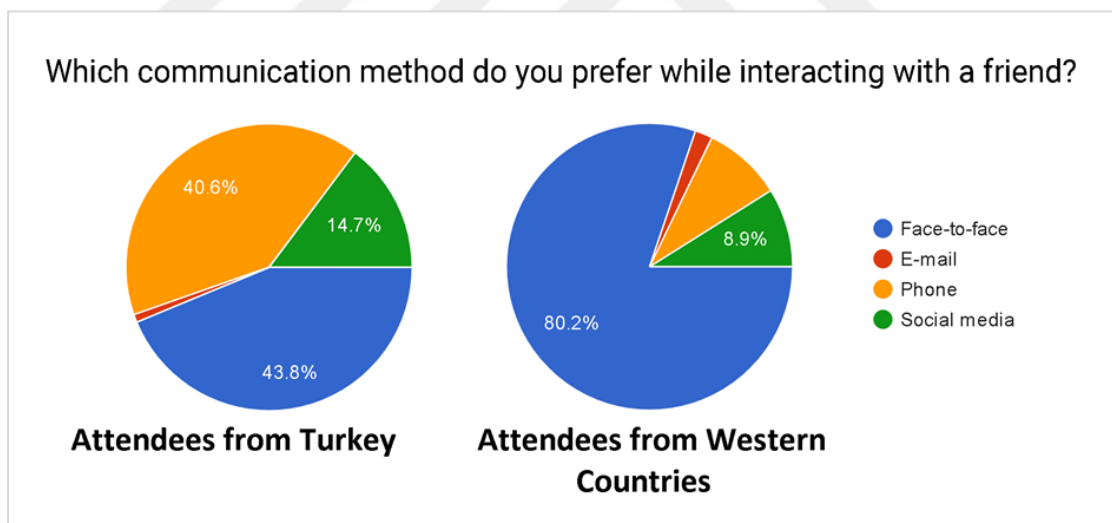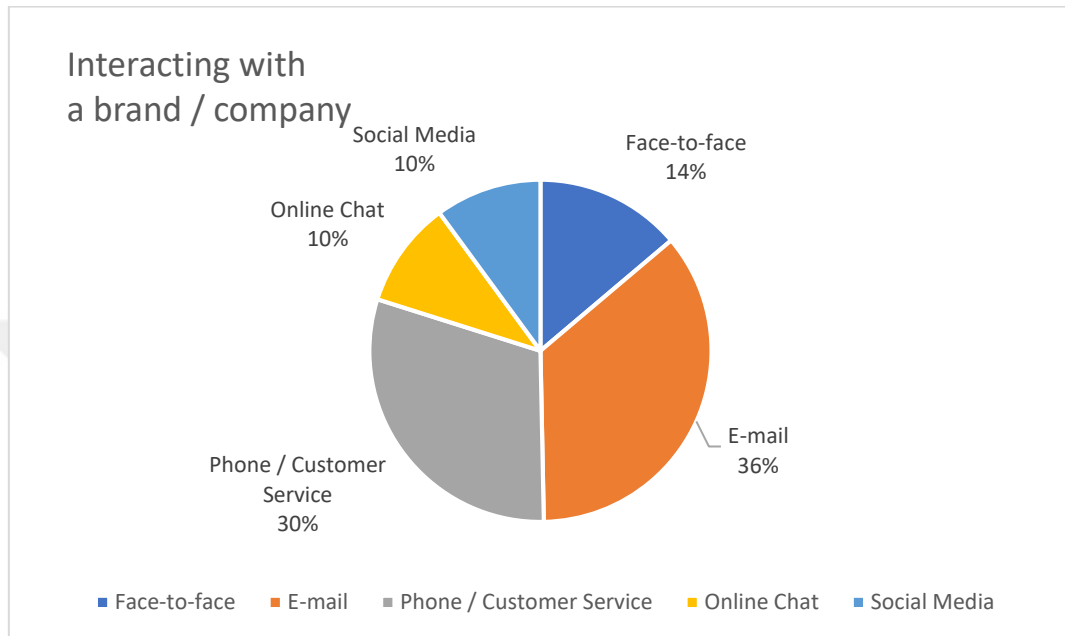

Figure 30. Preferences about interacting with a friend – with respect to location

On the other hand, when the other party is a brand or company, people choose

e-mail (36%) and phone (30%) over face-to-face communication (14%) which faces a

significant drop. This time, attendees from Western countries and attendees from

Turkey differ from each other in a less obvious manner. Turkish attendees mostly

prefer having a phone conversation, while Western attendees go for sending e-mails. The second difference that catches attention would be the unpopularity of online chat among Turkish attendees (5.8%), since a reasonable portion of Western attendees prefer it (18.8%).

Figure 31. Preferences about interacting with a brand / company
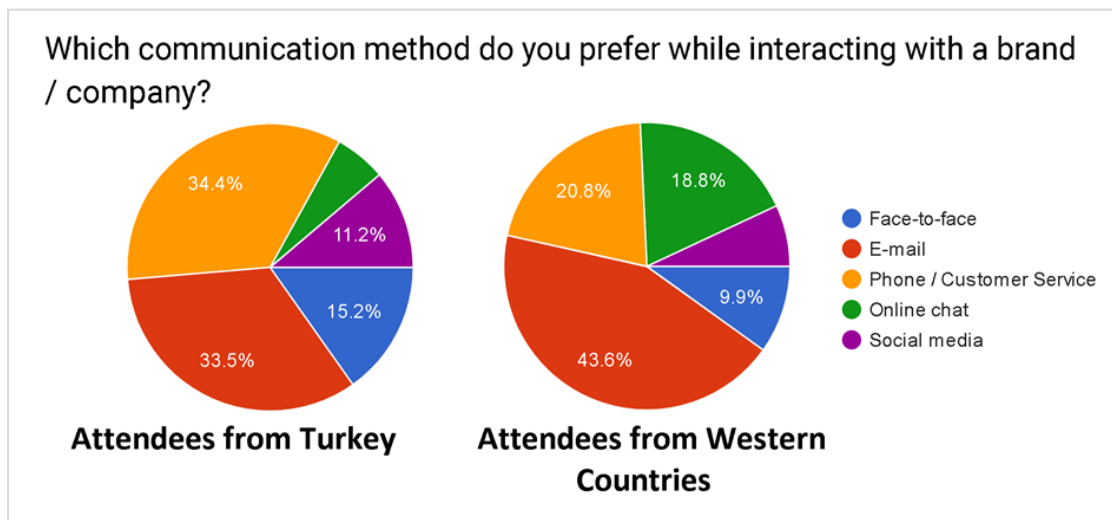
Figure 32. Preferences about interacting with a brand / company – with respect to location

More than half of the attendees (51%) are OK with chatting to a bot as long as their problems get resolved, while the second significant portion (42%) say that they

would expect the other end to be a human. If the results get separated with respect to geography, the difference between the portion of Turkish people and Western people that would prefer a chat bot is worth mentioning.
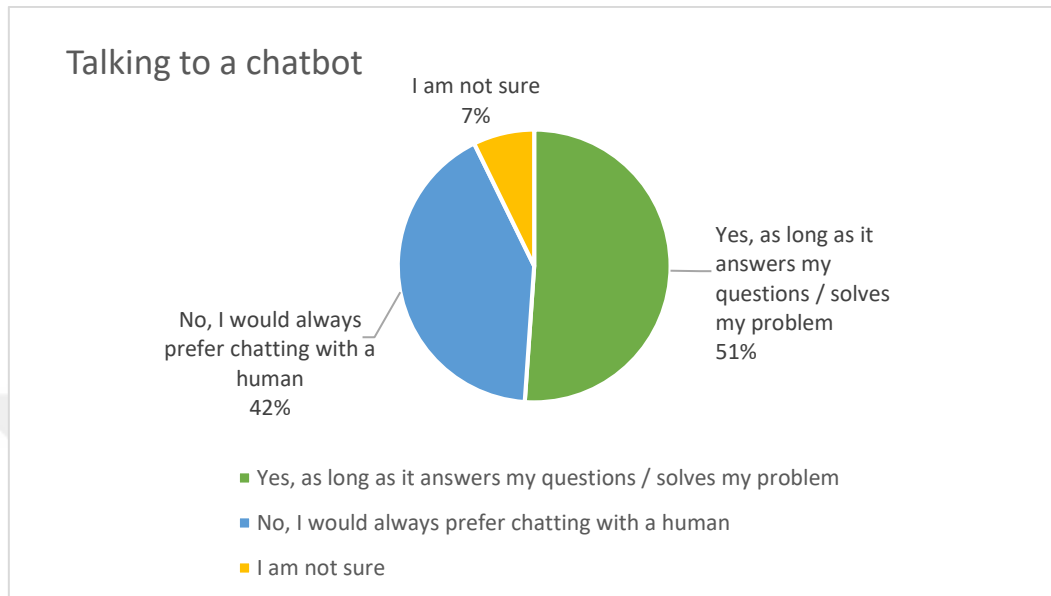
Figure 33. Opinions about talking to a chatbot
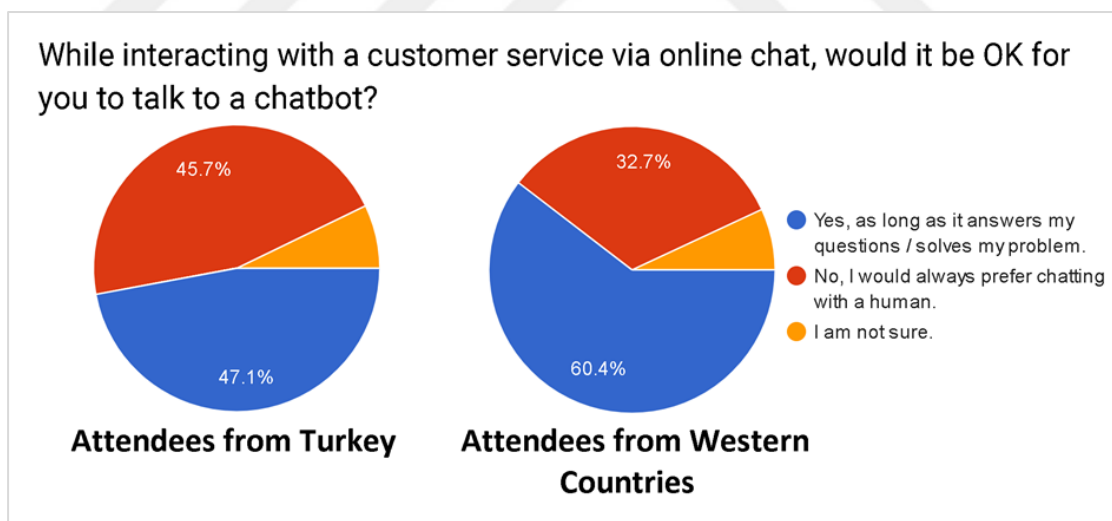
Figure 34. Opinions about talking to a chatbot – with respect to location

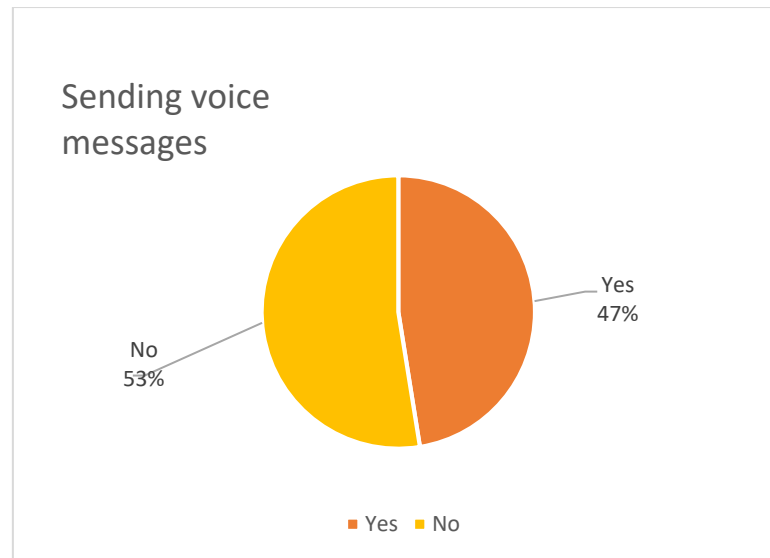While sending messages to another person, people slightly prefer text messages over voice messages.

Figure 35. Opinions about sending voice messages

Questions about the participants' relationship with AI

83% (265 people) of the participants said that they never used smart products at home. However, the portion of the people that do not want to use such a technology is just 22% and the majority has not made a definite decision yet, therefore, it can be speculated that they are waiting for better and more affordable implementations of such technologies.
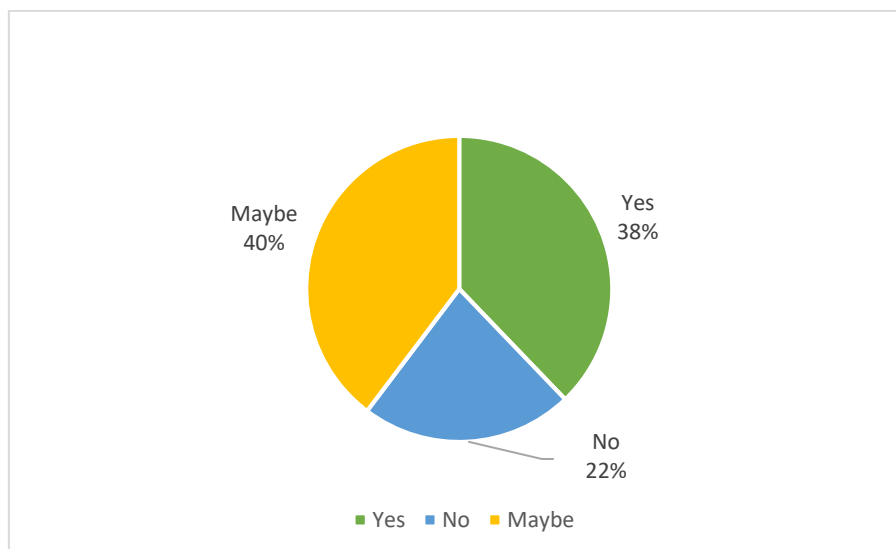

Figure 36. Chart showing answers to the question "would you like to use smart systems at your home" from the people who never used smart products before

Majority of the people (59%) are not using virtual assistants that are present on their smart phones while some of them (36%) use them occasionally. The portion of people that use virtual assistants frequently is quite small compared to the other portions (5%).
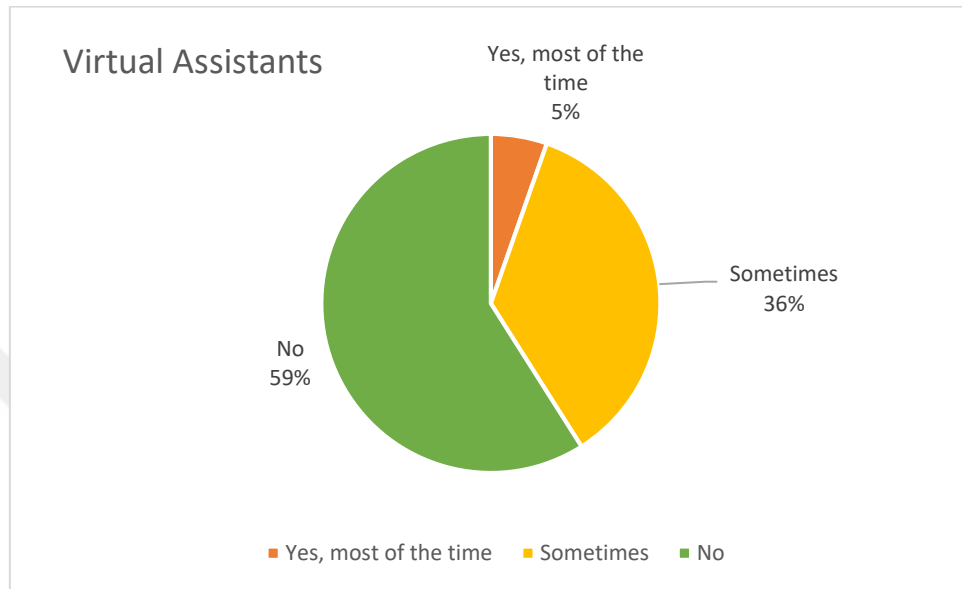

Figure 37. Chart showing answers to the question "Figure 36. Chart showing answers to the question "do you use any artificial intelligence based digital personal assistants (e.g. Siri, Alexa)"

But the people who said no also said that they are not against using virtual assistants (Maybe + Yes = 80%). Most probably the usability expectations of the people haven't been met yet, since the assistants are already present in vast majority of the smart phones and users don't have to pay extra money.
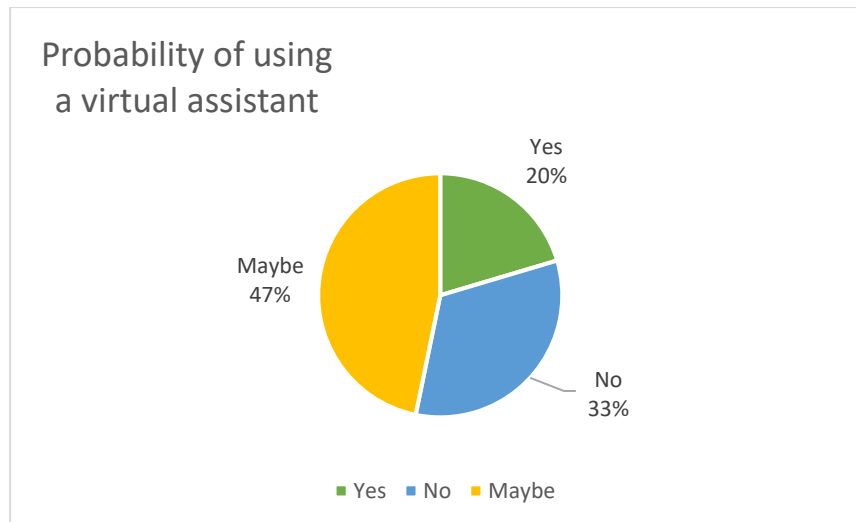
Figure 38. Chart showing answers to the question "would you like to have a digital personal assistant" from the people who never used digital assistants before

If this subject is viewed from a location-based perspective, it can be said that the number of people who said that they used virtual assistants most of the time is higher in Turkey than in Western countries.
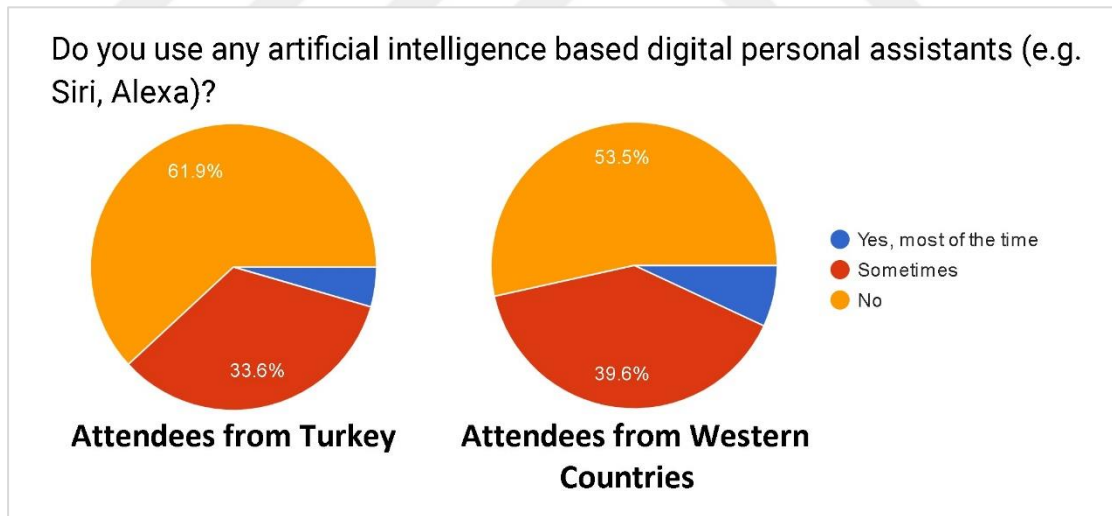

Figure 39. Charts showing the usage of AI-based assistants with respect to the location

And the people who never use a virtual assistant are more determined to keep it that way, while the same group in Turkey expressed a more positive look for trying to use a virtual assistant.
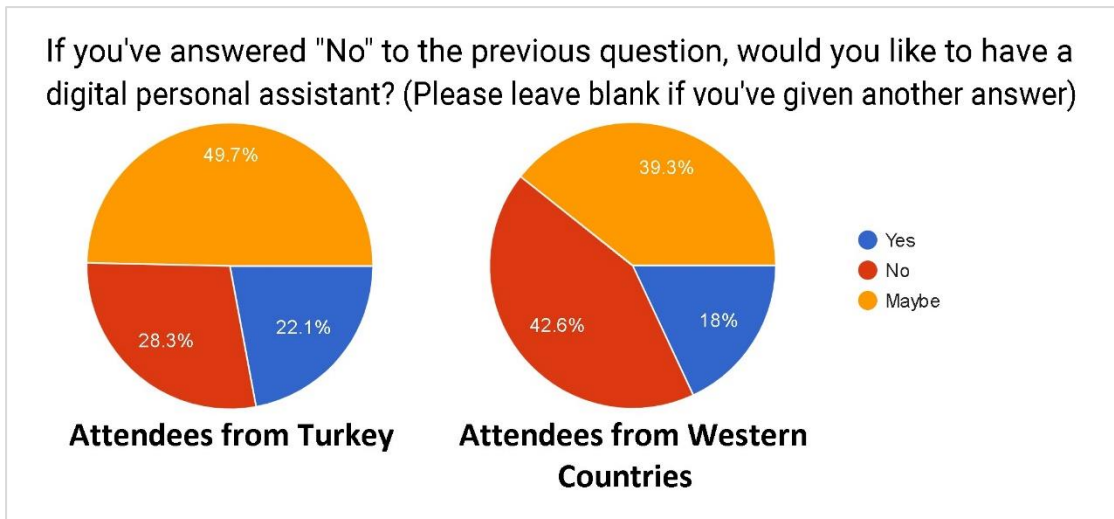
If you've answered "No" to the previous question, would you like to have a digital personal assistant? (Please leave blank if you've given another answer)

Attendees from Turkey

49.7%
28.3%
22.1%

Attendees from Western Countries

39.3%
42.6%
18%

- Yes
- No
- Maybe

Figure 40. Charts showing the probability of AI-based assistants usage with respect to the location

When asked about their knowledge about AI, the majority of the people said that they had a fair level of knowledge (43%) about it which was followed by low (26%) and good (22%). Only a small portion of the attendees think that their level of knowledge very good.
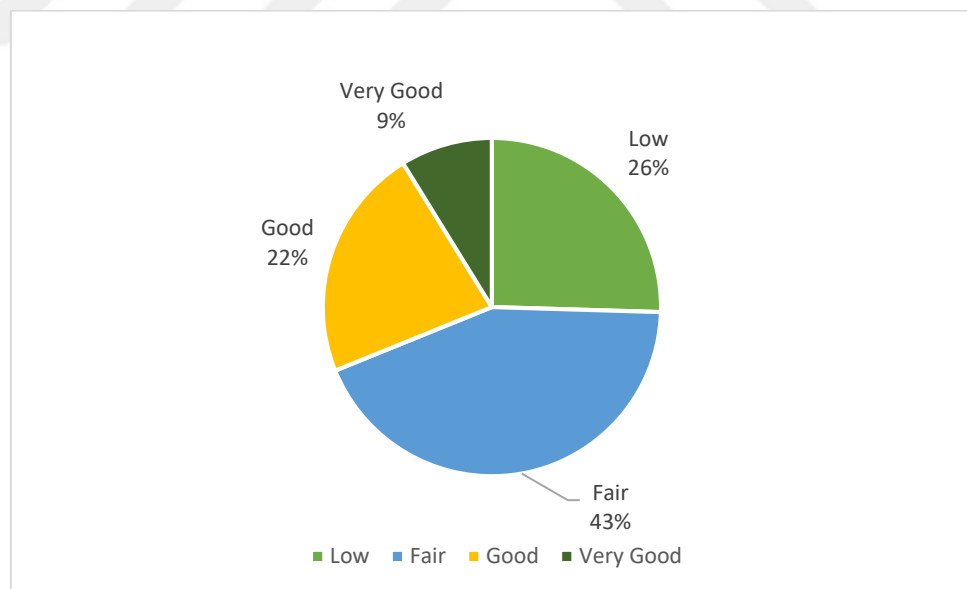
Very Good
9%

Low
26%

Good
22%

Fair
43%

■ Low ■ Fair ■ Good ■ Very Good

Figure 41. Chart showing participants' self-evaluations about their knowledge of AI

Although nearly a quarter of the people are scared of AI, mostly people have positive feelings towards it which consist of curiosity (44%) and excitement (27%).
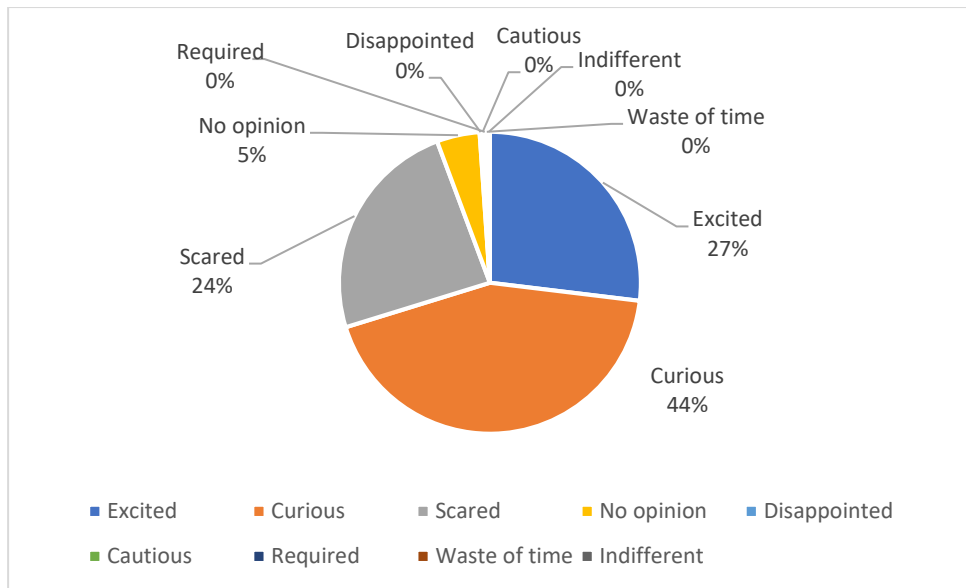
Figure 42. Chart showing people's feelings about AI. (The feelings shown as 0% had at least one vote, however, since their ratios were less than 1% they are shown as zero)

Nearly one out of every three people declared that they wouldn't trust an autonomous car, while a close portion said that they would trust. The rest which happens to be the majority are open to give it a try, but also a bit hesitant. When the replies from the attendees from Turkey are compared to the replies from the attendees living in the Western countries, it can be said that, people living in Turkey are more cautious about using a driverless car.
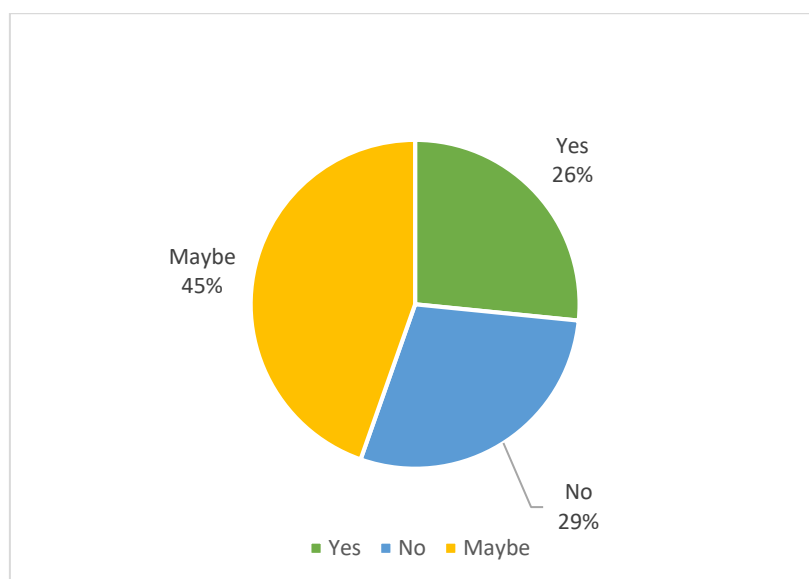

Figure 43. Chart showing participants' opinions about using a driverless car
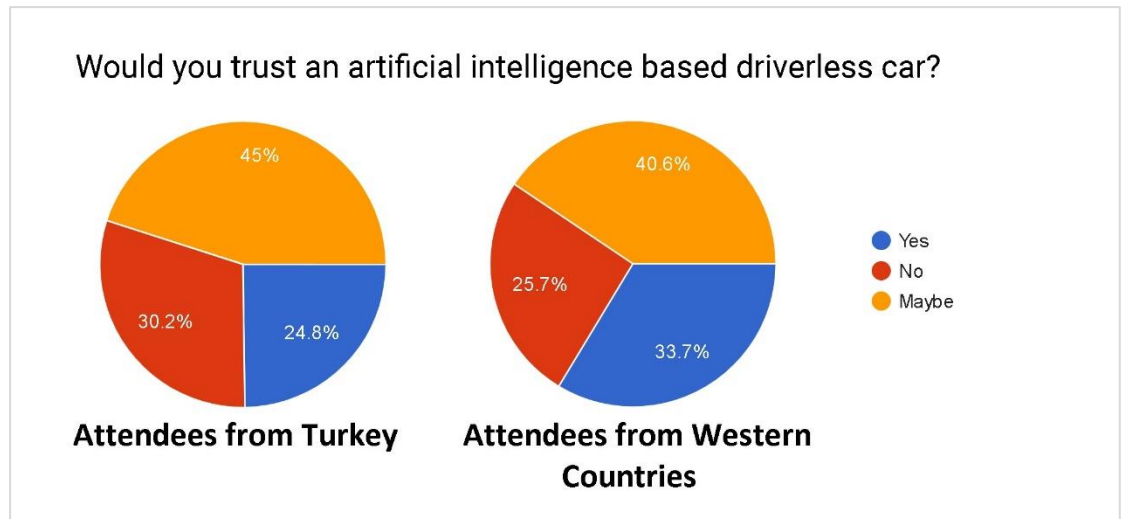
Figure 44. Charts showing participants' opinions about using a driverless car with respect to location

When it comes to trusting a product that is designed by an AI, people seem to be a bit more optimistic, since the choice "no" loses more than its half to the choice "maybe", while the choice "yes" faces a slight increment. Hence, people seem to be more prone to trust AI in designing new things rather than directly managing a vehicle.

When the replies of the attendees from Turkey and the Western countries are compared, it can be seen that, the people living in Turkey are less likely to use a product designed by AI.
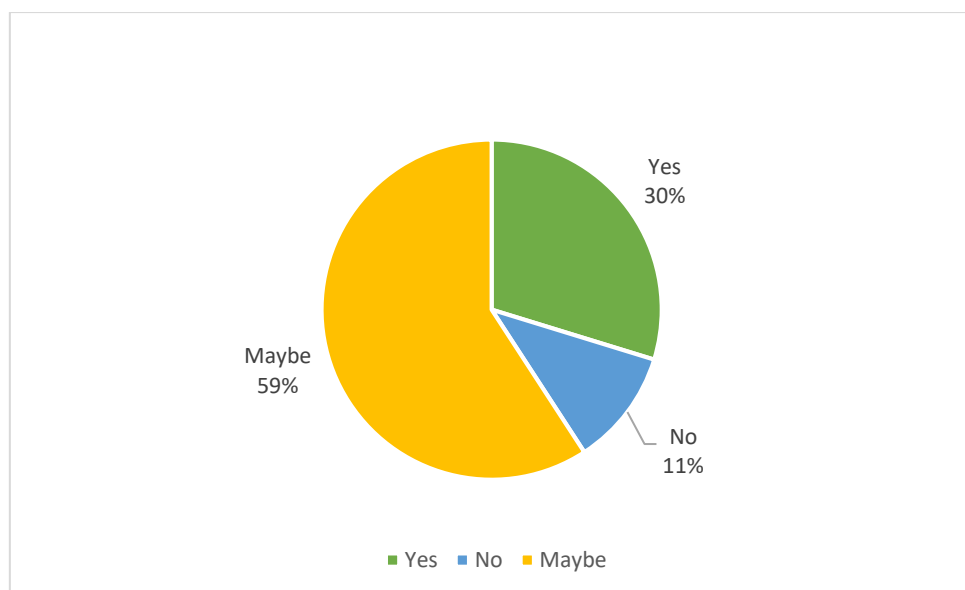
Figure 45. Chart showing participants' opinions about using a product which is designed by AI
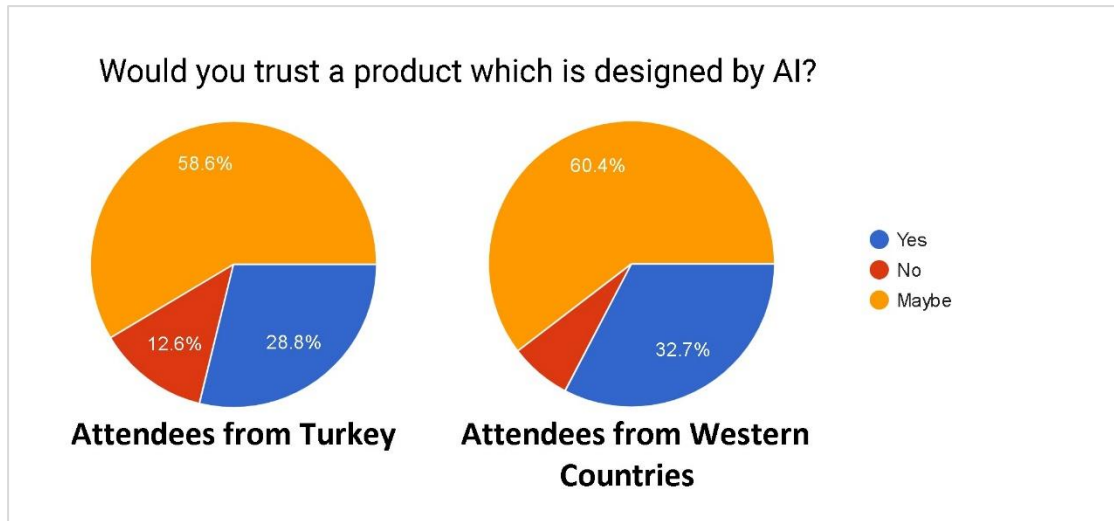

Figure 46. Charts showing participants' opinions about using a product which is designed by AI with respect to location.

When giving commands to a machine (any machine), majority of the people seem to be preferring text commands which is followed by voice commands. If we look at the distribution of the answers with respect to location, the charts below show that; the portion of the attendees from Western countries that prefer text commands is the double of the portion who prefer voice messages. However, these portions are close to each other in Turkey.
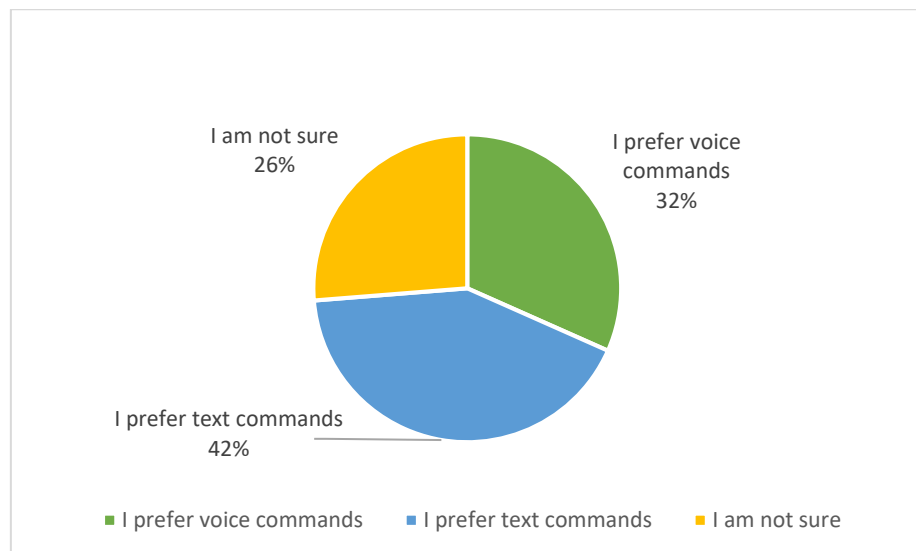

Figure 47. Chart showing participants' preferences about interacting with a machine
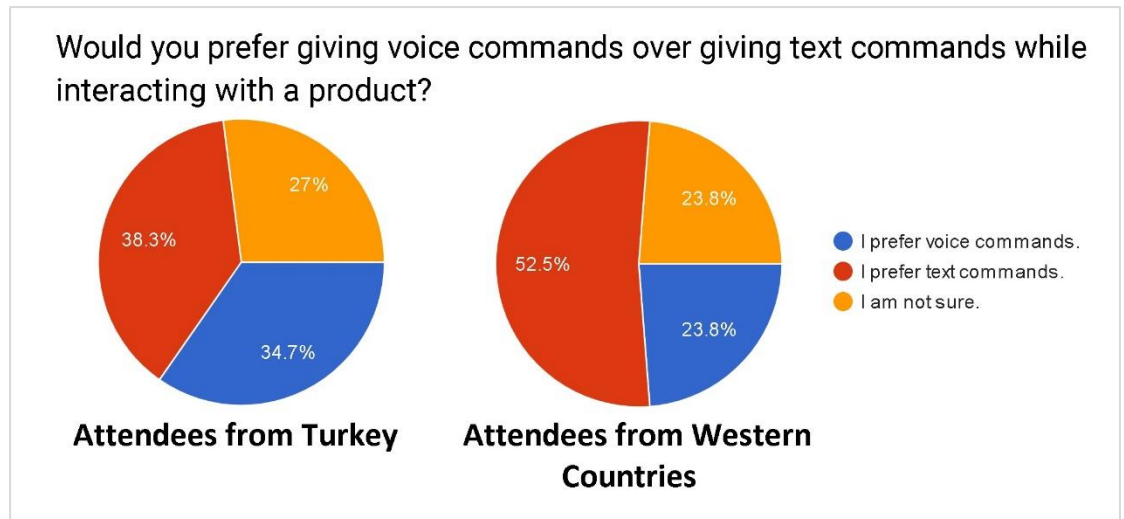
Figure 48. Charts showing participants' preferences about interacting with a machine with respect to location

When it comes to using gestures to give commands to the machines, portion of the people who say "maybe" are slightly more than the portion of the people who say "yes" or "no" which are quite close to each other.

The charts below show that, people from Western countries are more open to use gestures while interacting with an interface.
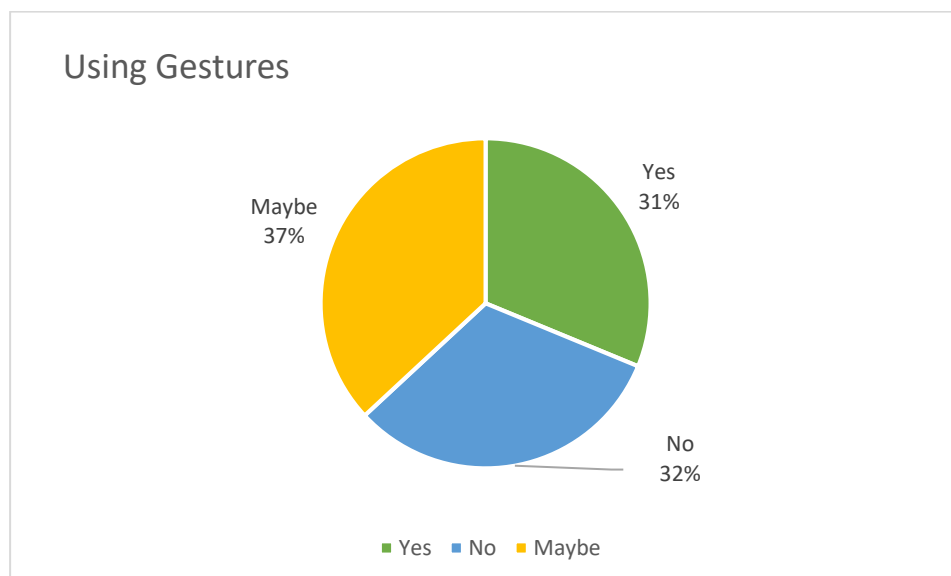

Figure 49. Chart showing participants' preferences about using gestures to interact with a machine
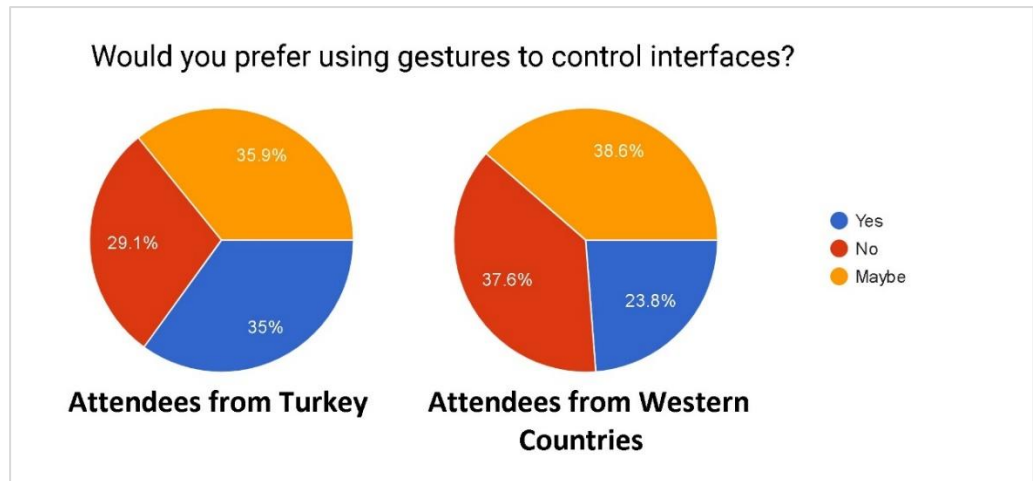
Figure 50. Charts showing participants' preferences about using gestures to interact with a machine with respect to location

Vast majority of the people say that they would prefer voice commands to communicate with a personal assistant which means people do not perceive a personal assistant as an ordinary machine and put it to a closer distance.

However, a significant difference can be spotted if the answers are compared with respect to the countries. Attendees from Turkey are more open to give voice commands while interacting with a product, when compared to the attendees from Western countries.
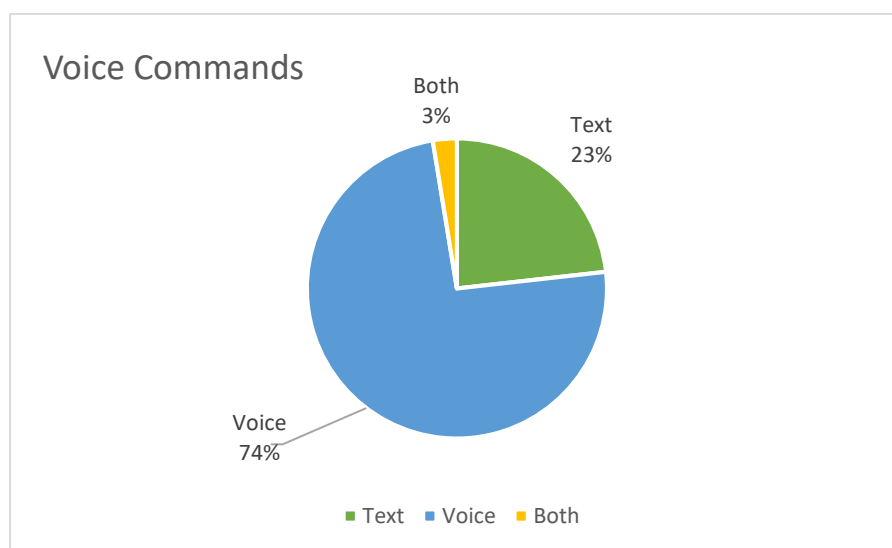
Figure 51. Charts showing participants' preferences about giving voice commands while interacting with a personal assistant
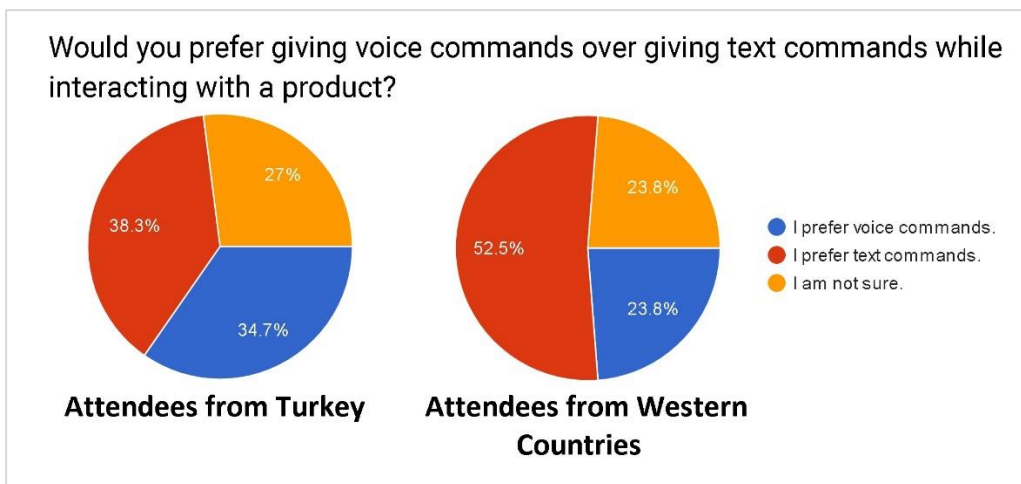
Figure 52. Charts showing participants' preferences about giving voice commands while interacting with a personal assistant with respect to location

Most of the people say that they would use a personal assistant for performing a search quickly and get information, while the rest mostly focused on other "task delegation" opportunities. The results clearly indicate that just a small portion of the attendees expects chatting and fun capabilities from a personal assistant.
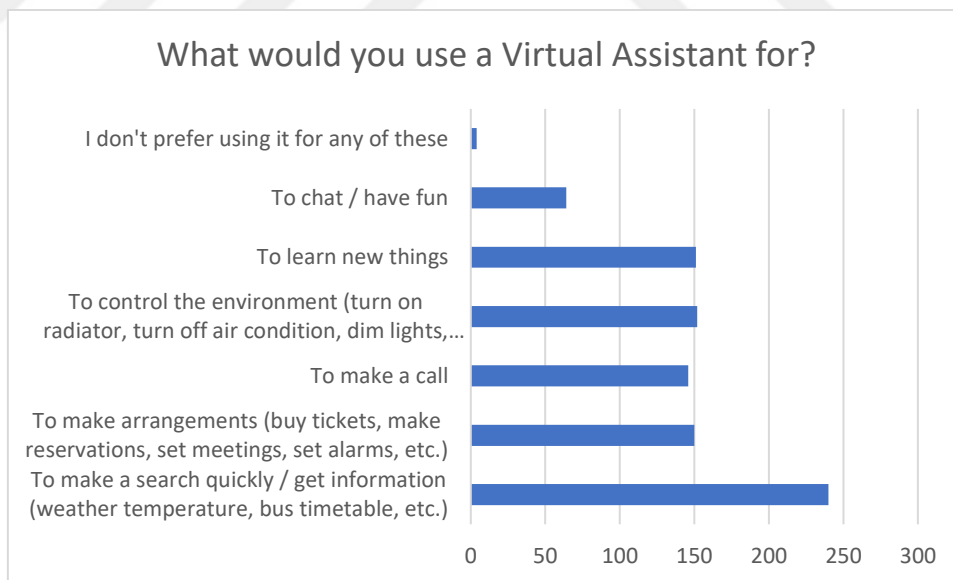
Figure 53. Charts showing participants' possible purposes of using a personal assistant

When asked about their preference for a personal assistant's voice, vast majority of the people selected human-like.
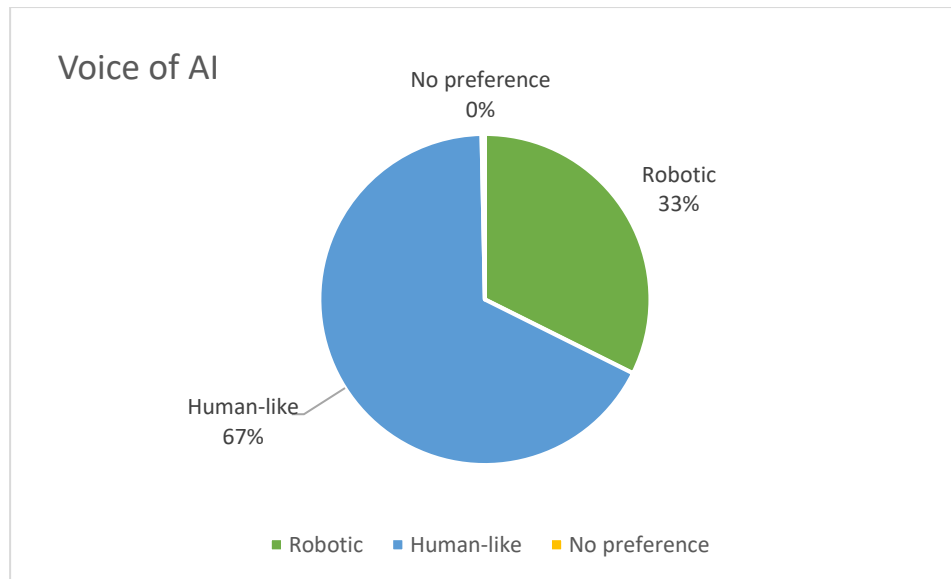
Figure 54. Chart showing participants' preferences about AI. Most of them expect their digital assistant to be human-like, rather than robotic

On the other hand, when a similar question is asked with an enrichment of gender-based options for human-like voices, some of the people changed their minds and voted for robotic voice, while the majority voted for female human-like voice.
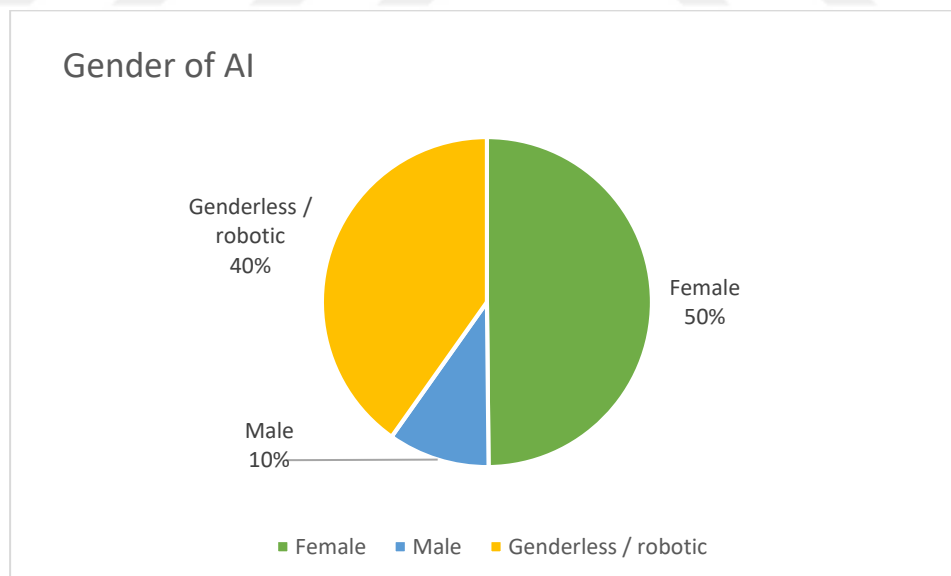
Figure 55. Chart showing participants' preferences about an AI-powered digital assistant's gender. Half of them expect their digital assistant to have a female voice.

Although most of the women also voted for female human-like voice, the distribution is significantly different than men's choices, since the gap between

choices are smaller in women's distribution compared to men's distribution in which female human-like voice is more than double of the closest choice. Men clearly do not want to hear another man's voice from a personal assistant.
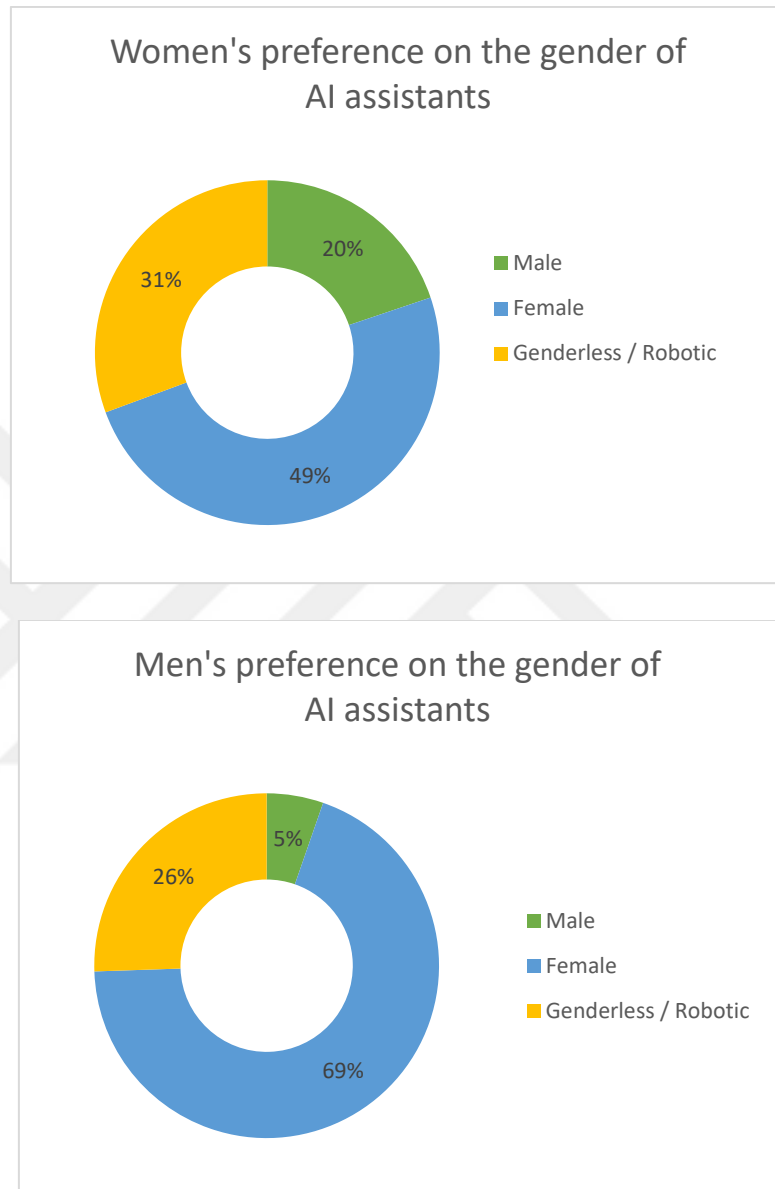
Figure 56. Charts showing participants' preferences about an AI-powered digital assistant's gender, with respect to their own gender.

A crushing majority of attendees perceive AI as their helpers while the majority of the remaining portion sees it as a friend.
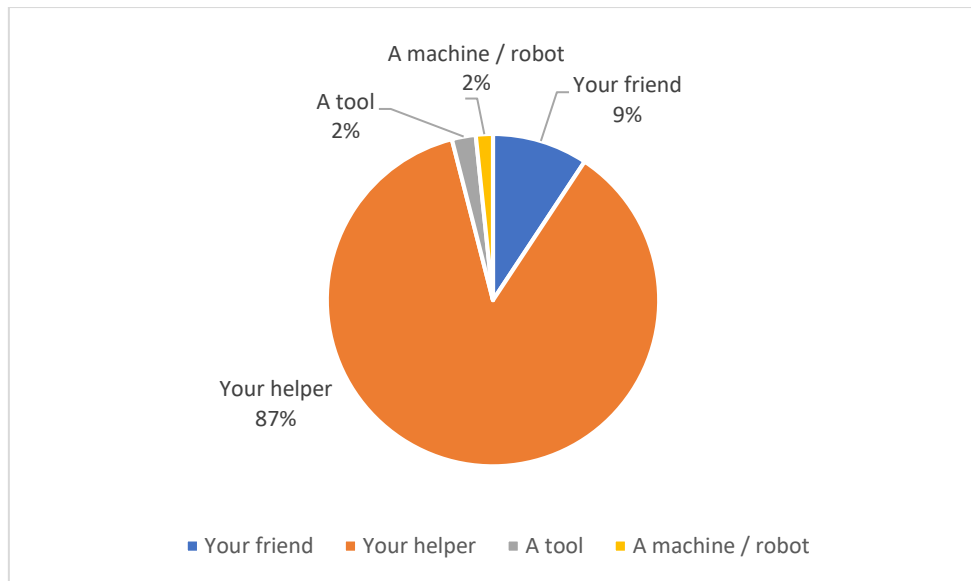
Figure 57. Chart showing participants' perceptions about an AI-powered digital assistant. The majority of the people see them as their helper, while only a small portion of them define AI-powered digital assistants as their friends

When it comes to allowing an AI to make decisions on their behalves based on their previous preferences, people mostly seem to be against it and a definite yes seems to be just a small portion of the attendees. This clearly indicates that people still want to be in charge of their decisions and they expect to use an AI like a helper technology which seems to be consistent with the previous observation.
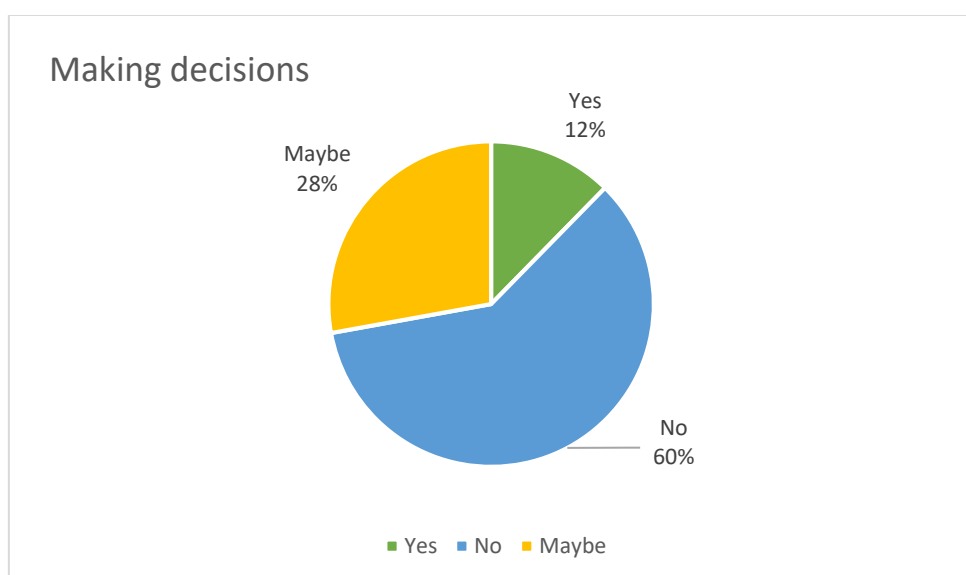
Figure 58. Chart showing participants' opinions about letting AI decide for themselves.

However, there is a huge difference between the proportions of people from Turkey and the people from Western countries who stated that they would not allow AI to make decisions for them based on their past experiences. In Turkey, 68.6% of the attendees say "no" to this question, while only 39% of the attendees from Western countries give the same answer.
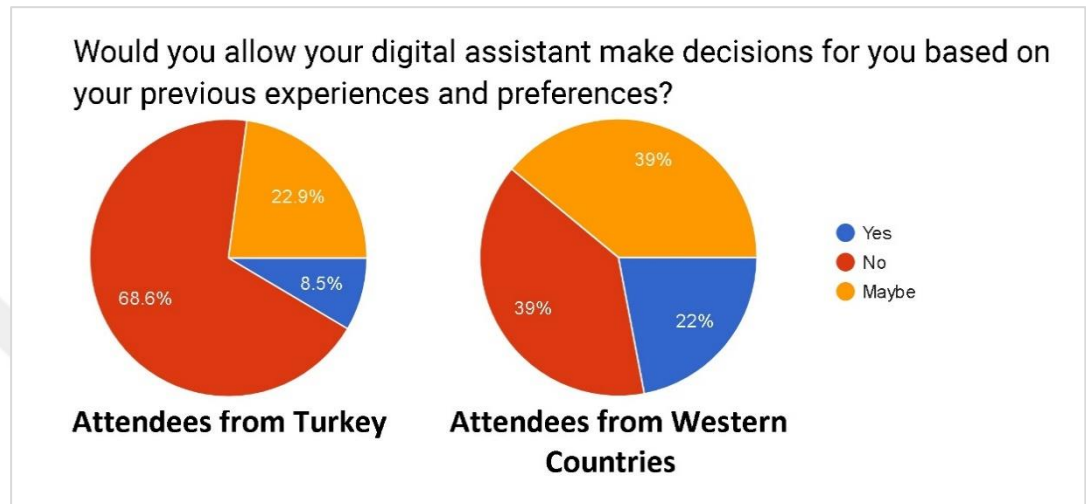
Figure 59. Chart showing participants' opinions about letting AI decide for themselves with respect to location.

The following chart can give an idea about the reasons of this. In Western countries, the number of the people that said their knowledge about AI was "Good" or "Very Good" is significantly higher than the people in Turkey who said they had a good or very good knowledge level about AI. And since the lack of information usually leads to fear, people in Turkey may feel more comfortable about letting AI decide on behalf of them, when they feel more knowledgeable about AI.

How do you define your knowledge level about artificial intelligence?
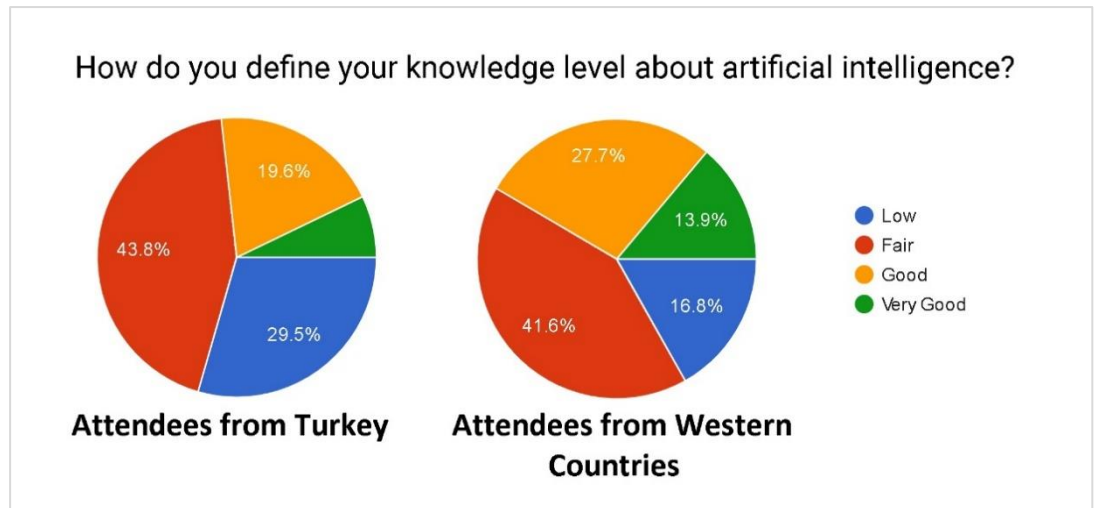
Figure 60. Charts showing participants' opinions about letting AI decide for themselves with respect to location

Additional thoughts about AI

Some of the participants also used the text area at the end of the survey to share their opinions on the artificial intelligence.

Some of these comments were against AI, questioning the value it would add. However, instead of concerns about the danger of extinction for human race, those comments were addressing the insufficiency and immaturity of AI. A few examples to this type of comments are below:

Participant1: "Digital assistants provide questionable benefit given the fact that all customer data is used by unknown third party. Decisions based on past interactions are very limited use-case, imagine you would be offered jobs you did in the past and never progress in your career because of poor design of the product scanning the CVs."

Participant 2: "I think a lot of my answers ("Maybe") are based on my current perception of AI and assistance which to date has not been particularly positive because the tech I've interacted with has been relatively immature. I

have no bias against AI products, but am yet to be convinced of their utility in my personal life (although for research, it is super exciting).”

Participant 3: “I don't find AI reliable enough since it is not mature enough yet. However, it can be predicted that it will be an indispensable part of our lives.”

This data validates the hypotheses: **As AI improves, people will be able to see it as a part of their lives, human-computer interaction will get easier and be normalised.**

In the survey, 71% of the participants stated that they felt “Curious” or “Excited” about AI, while only 24% of them said they were feeling “Scared”. Below are a few examples of the responses from the people with good opinions on AI:

Participant 4: “We are living in a time that is prone to very interesting developments. I guess soon, we will meet things that we find impossible today.”

Participant 5: “I am waiting for AI curiously. It will be very useful, unless it is used for bad purposes.”

One participant also stated that he/she was excited about new technologies, however, because of the costs of those products were high, he/she didn't find them affordable.

Some of the participants that form the 24% that felt scared about AI, shared their reasons in the open text area:

Participant 6: “It is easy to predict what AI will bring, it is hard to guess what it will take away. So, I am scared.”

Participant 7: “I find all these very creepy. Even signing in this form underlines how close we are to this. That makes me upset."

Participant 8: "AI will be a serious threat in the future, like a hundred years later."

As stated in the survey analysis above, although 24% of the people are scared of AI, people mostly have positive feelings towards it which consist of curiosity (44%) and excitement (27%). Based on these numbers and the comments above, it can be said that the following hypotheses; "**although there are concerns about AI, people are generally curious about what AI will bring**" is validated.

According to the survey results and the open-ended questions; for people, knowing that they are in charge and AI only assists them is needed to build trust while interacting with AI:

Participant 9: "AI should be honest and fair, should always work with truths, should protect your interest and shouldn't share your personal information with third parties without your consent. *We should be in control*. No one else should interfere unless there is a fault or error."

Participant 10: "I would like to use those products (personal assistant, smart home devices, etc.), but *I want more control over what they do*."

Participant 11: "I value my personal data highly and my use of an AI-driven product is *highly dependent on my level of trust in the service provider*, which currently is low across the industry as I wait for privacy legislation to catch up with what some of the big players are doing with user data (Google, Facebook, et al).

Based on the findings above, it can be said that people want to be in charge and they care about their privacy, however, they don't trust AI about this, since they find it immature and they don't trust companies. So, that also validates the following

hypotheses: **While interacting with AI-powered products, people prefer being in charge and see AI as an assisting tool.**

67% of the people said on the survey that they preferred their virtual assistants to be "human-like". So, just like interacting with other people, they expect high quality communication with them and if they realize that they won't be able to maintain the good relationship they want with them, they prefer other options:

Participant 4: "AI applications and interfaces like Siri that make human and machines interact need a humanoid bot with good speech and visual skills to collect all these devices in center."

Participant 2: "Most "human-like" AI comes across as patronising and reminds me of attempting to speak with human drones on the other end of a telephone, so I would far prefer to use text or something clearly robotic / artificial."

The results of the survey validate the following hypotheses as well: **While interacting with AI-powered products such as virtual assistants, people prefer interacting with human-like products instead of robotic ones.**

6. CONCLUSION

It is obvious that we are witnessing a new era of computing and communication today. The world is becoming more and more connected every day, and in this interconnected world of today, all the interactions between the machines and the living have been changing.

As the results of this research also show that, today almost everyone has a smart phone that can connect to internet. People are open and curious to engage with new technologies that emerge almost every day.

Artificial Intelligence is one of the most important and exciting technologies that people have been experiencing. Its effects on people's lives cannot be estimated accurately today, since there are so many unknowns about what this technology will bring into humans' lives.

As Human-Centered Design principles put the human factor at the core of the design process, using human-centered design principles while designing for a "non-human" technology, can help understanding the needs of people and define the roadmap for this collaboration.

The aim of this dissertation was looking into ways of opening a communication channel between human beings and the machines with intelligence. To be able to do this, knowing more about the two ends of the channel was essential. Therefore, the expectations people have about this relationship and the offerings that AI can give were deeply investigated.

A survey was conducted to get people's opinions about the subject. It was aimed to reach out to as much people as possible from different countries with different demographical, financial and cultural backgrounds. Having analysed the survey results gave some significant insights about people's needs and preferences

about the human-machine relationship. The findings were used to validate the hypotheses of this thesis work.

Combining the survey results with the data gathered from the literature review and some past example use cases also provided a clear vision of what should be taken into account while designing products or services that are using AI technology.

Analysis of the responses to the survey demonstrated that; the more familiar interaction styles AI offered to human-to-human communication, the more likely people would be willing to use them.

Just like communicating with another person, people also have expectations about communication with AI. They prefer AI to interact with them in a human-like form or voice. If a meaningful conversation is going to happen, they expect AI talk to them in a kind and human-like tone, preferably with a woman's voice.

Although it may change as AI algorithms get better at mimicking human mind, today, people see AI-based products as their helpers, rather than their friends. The results of the research clearly indicate that, people still want to be in charge of their decisions and they expect to use an AI like a helper technology that will assist them, rather than making decisions on behalves of them.

The analysis of the survey results showed that, regardless of the culture they are living in, people share the same fears and excitement about a new technology. Although they have small differences about their preferences of interacting with individual applications of AI, the excitement towards AI is shared by almost all humans and free from the location they are living in.

Opinions about AI worldwide is generally positive, despite nearly a quarter of the people expressed their concerns about AI. Curiosity is the most common feeling that AI awakes in people. The concerns people have about AI are not apprehensions

related to the extinction of human race, instead; they address the insufficiency and immaturity of AI and people's lack of trust against the companies that develop AI-based products, in terms of possible violations to their privacy.

Despite the fact that people still have concerns about AI, they are still excited about what it proposes, and they want to see it improved. The research indicates that they are willing to collaborate, however, they just need a healthy communication channel that would make this possible.

Human-centered design can help people take their relationship with AI to the next level by addressing real needs and helping to build trust towards AI, so that they can enjoy and make use of what that technology brings. Analysing human needs and putting people in the center of the design process enables establishing a good relationship between humans and machines.

AI is quite a new technology and there is a lot to discover about it. It is still not reliable enough and the failing rates are high, as it is still learning from humans. Today, its effects on people's lives cannot be foreseen with a high level of accuracy since there are so many unknowns about what this technology will bring.

And no doubt, the more time it spends for learning, the better it will get. It is just like a new-born baby at the moment; it will probably be possible to see it crawling on all fours in the near future, but it will take much more time to see it going to college. Today, it is not possible to have a sustainable philosophical conversation with AI about existential crisis, however, just like chatting with a small child; it can tell if an apple is green or -with a child's honesty- that a t-shirt doesn't go well with a skirt.

As AI gets better at analysing the data, making predictions and mimicking human thinking and behaviour, the technology becomes more affordable and

widespread, people widen their knowledge about AI and the products using AI technology adapt human-centered design principles more, the relationship and interaction between people and AI will definitely improve.

      Since this is such a new area for human beings to explore and people have just passed the starting point of a long journey about AI, further research about this subject is needed to verify the findings of this research.

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Appendix A: Survey Questions

The survey questions are prepared in both Turkish and English and sent according to the target group, to remove the language barrier. Participants living in Turkey received the questionnaire with Turkish questions, while the rest of the participants received the questionnaire with English questions. However, all results were evaluated together.

English versions of the questions are given below:

<u>**General**</u>

1. Your age?

Under 18

18-24

25-34

35-44

45-54

55-64

65+

2. Your gender?

Female

Male

Other

3. Which country are you living in?

Ireland

Other (Please specify)

(Note: In the Turkish version of the questionnaire, the default given country was Turkey instead of Ireland.)

4. Are you:

    Employed

    Self-employed

    Unemployed

    Student

    Retired

5. Your education level?

    High School

    Bachelor's Degree

    Master's Degree

    Doctoral Degree

    Other (Please specify)

Relation with technology

6. Do you have a (smart) phone that can connect to internet?

    Yes

    No

7. What do you use your mobile phone for? (Please select all that apply)

    Making calls

    Sending SMS

    Chatting on instant messaging apps (WhatsApp, Messenger, etc…)

    Video conferencing / video chat

    Social media

    Checking personal e-mails

Planning your day or taking notes

Take photos / recording videos

Listening to music

Work-related actions (e-mails, apps, calls, etc)

Tracking fitness, steps and well-being

Playing games

Shopping online (incl. ordering food)

Other

8. How much time do you spend a day on your mobile phone (approximately)?

Less than 1 hour

1 – 3 hours

3 – 6 hours

More than 6 hours

9. Do you use any other subsidiary accessories (smart watches, fitness trackers

etc…? (Please select all that apply)

I use a smart watch

I use a fitness tracker / pedometer

I don't use any of these

Other

10. Have you ever used smart products at home? (Nest, Amazon Echo, Samsung

SmartThings, etc…)?

Yes

No

11. If you've answered "No" to the previous question, would you like to use

smart systems at your home? (Please leave blank if you've said "Yes")

Yes

No

Maybe

12. Which communication method you prefer while interacting with a friend?

Face-to-face

E-mail

Phone

Social media

13. Which communication method you prefer while interacting with a brand / company?

Face-to-face

E-mail

Phone / Customer Service

Online Chat

Social media

14. Do you ever send voice messages instead of text messages?

Yes

No

15. Would you prefer giving voice commands over giving text commands while interacting with a product?

I prefer voice commands

I prefer text commands

I am not sure

16. Would you prefer using gestures to control interfaces?

Yes

No

Maybe

Artificial Intelligence

17. How do you define your knowledge level about artificial intelligence?

Low

Fair

Good

Very Good

18. How do you feel about the artificial intelligence? (Please select all that apply)

Excited

Curious

Scared

No opinion

Other (Please specify)

19. While interacting with a customer service via online chat, would it be OK for you to talk to a chatbot?

Yes, as long as it answers my questions-solves my problem,

No, I would always prefer chatting with a human.

I am not sure

20. Would you trust an artificial intelligence based driverless car?

Yes

No

Maybe

21. Would you trust a product which is designed by AI?

Yes

No

Maybe

22. Do you use any artificial intelligence based digital personal assistants (e.g. Siri, Alexa)?

Yes, most of the time

Sometimes

No

23. If you've answered "No" to the previous question, would you like to have a digital personal assistant? (Please leave blank if you've given another answer)

Yes

No

Maybe

24. What would you use a digital assistant for? (please select all that apply)

To make a search quickly / get information (weather temperature, bus timetable, etc.)

To make arrangements (buy tickets, make reservations, set meetings, set alarms, etc.)

To make a call

To control the environment (turn on radiator, turn off air condition, dim lights, etc.)

To learn new things

To chat / have fun

Other

25. Would you prefer your digital assistant to be:

Robotic

Human-like

26. Which gender would you prefer your digital assistant to have while talking to you?

Female

Male

Genderless (robotic)

27. Would you allow your digital assistant make decisions for you based on your previous experiences and preferences?

Yes

No

Maybe

28. Would you prefer your digital assistant to communicate you via text or voice?

Text

Voice

Other

29. Would you rather see your digital personal assistant as:

Your friend

Your helper

Other

30 Please specify if you have any other opinions...