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YEDİTEPE UNIVERSITY
GRADUATE INSTITUTE OF SOCIAL SCIENCES

CYBERSPACE, CYBERCULTURE and CHANGING PARADIGMS

with

-Exploration of applications in Medicine -

by

Pınar ÇAMLIBEL

SOCIAL SCIENCES INSTITUTE: VCD

Submitted to the Graduate Institute of Social Sciences
In partial fulfillment to the degree of
Master of Arts

Istanbul 2005

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TUTANAK

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Pınar Çavuşoğlu, 01/08/2015 tarihinde "Cyber Space, Cyberwarfare" başlıklı tezini savunmuş ve başarılı olduğu oybirliği ile kabul edilmiştir.

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Üye Prof. Dr. Ahmet Levent Ozkan .....

Üye : .....

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ABSTRACT

The rapid development of Computer Mediated Communication systems in the late 20th century radically changed the ways of interaction, education, organization, team working, and social formations, and brought new meanings to the sense of time and space. Interaction through the technology of computers gave birth to a geography called *cyberspace* and created the civilisational revolution of "virtual societies". Established values such as identity, presence, knowledge, work, power are being redefined due to these new sense of space and time called cyberspace.Cyberspace platforms– the internet, virtual reality, augmented reality- has alreadybrought many innovations to many sectors already and with the increasing research in this field, decreasing costs and increasing computing power, they are in the midts of changing the paradigms of education, entertainment, architecture, medicine, the automotive industry, and bring invaluable benefits to these sectors.

Medicine and healthcare arena is one of the sectors that the cyber systems promise the most benefits for. This thesis involves the examination of the cyber systems from a psychological, sociological and a technological perspective, and the in depth examination of the cyber applications in the *medicine and healthcare* sector with specific examples.

ÖZ

20. yüzyılın sonlarında hızlı bir gelişme gösteren Bilgisayar İletişim Sistemleri sistemleri, beraberinde yeni bir yer ve zaman anlayışı doğurmuş ve toplumun bir takım yerleşmiş kavramlarını -etkileşim, eğitim-öğretim, organizasyon, ekip çalışması, gibi- köklü bir değişime götürmüştür. Bilgisayar teknolojilerine dayalı olan etkileşim ve iletişim sonucu ortaya çıkan "siberuzay" adı verilen bu yeni zaman ve mekan kavramı, zaman içerisinde ayrıca "sanal topluluklar" ın da doğmasına sebep olup yeni bir "toplum" kavramı getirmiştir.

Günümüzde, çeşitli siberuzay sistemleri- internet, sanal gerçeklik, "geliştirilmiş" gerçeklik-, bir çok sektöre şimdiden bir çok yenilikler getirmiş olup, ileride, bu alanlarda hızla süren araştırmalar sonucu teknolojinin daha gelişmesi ve ucuzlaşmasıyla eğitim-öğretim, mimari, tıp, eğlence, endüstri gibi bir çok alanda paha biçilmez avantajlar getirecektir ve bu alanlarda suregelen bazı paradigmaları devirecektir.

Tıp sektörü, siber sistemlerin en çok avantaj getirdiği ve getireceği sektörlerden biridir. Bu tez çalışması , siberuzay sistemlerini önce psikolojik, sosyolojik ve teknolojik boyutu ile incelenmesini ve spesifik örnekleriyle tıp sektöründeki siber sistemlerininin araştırmasını içerir.

LIST OF ABBREVIATIONS

VR	Virtual Reality
HCI	Human Computer Interface
CMC	Computer Mediated Communication
CMR	Computer Mediated Reality
ECT	Electronic Communication Technologies
F2f	Face to face
AR	Augmented Reality

KEYWORDS

Cyberrevolution, Cyberspace, Cyber community, Cyber identity, Cyber culture, Online Community, Virtual Reality, Telepresence,Telemedicine, Virtual Culture, Online Clinics, Remote Surgeries, Cybertheraphy

LIST OF FIGURES

1.CYBERSPACE and CYBERCULTURE -*New concepts of space and Social Formations*

1.1 Cyberspace

1.1.1 Definitions of Cyberspace

When users log in to the internet or play a computer game, they feel that they go "somewhere" other than their actual physical locations. We have come to call this place "cyberspace" complete with geographical metaphors such as "worlds" and "rooms" to express its interfaces.

Cyber-space is a perceptual space that emerges through people to people and people to computer interaction through huge computer networks with wires, telephone lines, undersea cables, fiber optic pipes, hardware and software.

The term "cyberspace" first originated in 1984 from author William Gibson's science fiction novel *Neuromancer.*

Aydın defines cyberspace as:

"The term that was first used in the famous science fiction author's book *Neuromancer.* It signifies a world of computers and the world the society has built around computers." (Aydın, 2000)

The term in the book was used to name a 21st century virtual dimension, where people connect their nervous systems to a global computer network via a neuro-electronic interface.

"Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation".

The line in the book implies that cyberspace was a product of an illusion of a mental space experienced in the mind via the human-computer merge. The illusion of feeling present at another location while physically remaining in the same environment is the so called 'hallucination' Gibson implies here.

Cyberspace today is no more the science-fiction of Gibson but an absolute reality, or we can say, along with the lines of Gibson's novel, it is the reality of the space perceived in the mind. The electronic media which remove both the need for human presence and physical transportation for communication, creates new forms of spatial relationships, and a whole new sense of a "place". (Strate, 2003)

- The current Barron's Dictionary of Computers and the Internet puts cyberspace as:

"The part of human society and culture that exists in networked computer systems rather than in any particular physical location."

- The online dictionary Webopedia describes it as:

"A metaphor for describing the non-physical terrain, created by computer systems. Online systems, for example, create a cyberspace within which people can communicate with one another (via e-mail), do research, or simply window shop. Like physical space, cyberspace contains *objects* (files, mail messages, graphics, etc.) and different modes of transportation and delivery. Unlike real space, though, exploring cyberspace does not require any physical movement other than pressing keys on a keyboard or moving a mouse." (Webopedia, 2004)

Cyberspace was first used in 1990 with the internet as a real term and as a science fiction one. Actually, until 1995, the terms *cyberspace* and the *internet* were used interchangeably. Now, with the advent of other digital communication systems, cyberspace is not only limited to the internet but also associated with many computer systems such as virtual reality systems , computer games and tele-conferencing.

With the spread of these new platforms, the description of the term *cyberspace* has also evolved in dictionaries.

- Spencer's recent Illustrated Computer Dictionary exhibits this as it describes *cyberspace* as:

"A world in which computers and people coexist. Cyberspace is where you go when you are online with a computer, and when you put on a Virtual Reality headset."

Programs like computer games, create cyberspace, one that resembles physical reality in many ways. In its extreme form, called *virtual reality* – which I will go more deeply into- users are presented with visual, auditory, and even tactile feedback that makes cyberspace feel almost real.

Cyberspace is perceived as a real place event hough it is not a physical landscape but mental one. What makes a user feel present somewhere else than his actual physical location? In other words how does he feel '*immersed*' at another place while physically present elsewhere?

1.1.2 Psychology of Cyberspace

To provide a good understanding of the computer immersion, i want to take a look on how people perceive presence in the real world by over viewing the relationship between perception and the mind.

1.1.2.1 Sensory stimulation from the environment

According to the clinical psychologist Suler (2002), there are various cues we rely on for perceiving presence within an environment:

Sensory stimulation makes us aware of the presence of matters. In order to immerse in a virtual environment, a we have to feel that environment with at least one of his five senses of seeing, hearing, touching, smelling and tasting. Various cyberspace environments have at least one of these sensory stimulation ; some virtual reality systems even have tactile simulation (touch) through complicated input devices which I will explore in later chapters. Even in simple text based online communication like chat and message boards, an overall inviting interface design of colors, text boxes, buttons and fonts can constitute a persuasive visual setting and create the illusion of a room like space walls and interior. (Suller 2002)

1.1.2.1.1 Interaction with the Environment and User Interface

The following figure is the world famous instant messaging (chatting) program MSN Messenger. The simple rectangular interface creates a visual sensation of place and particular visual features like the colors associated with universal meanings make it more meaningful of a location. a. The online friends are indicated with the color green and the unavailable are shown in red, just like in real life where green is meant to invite and red is to reject.

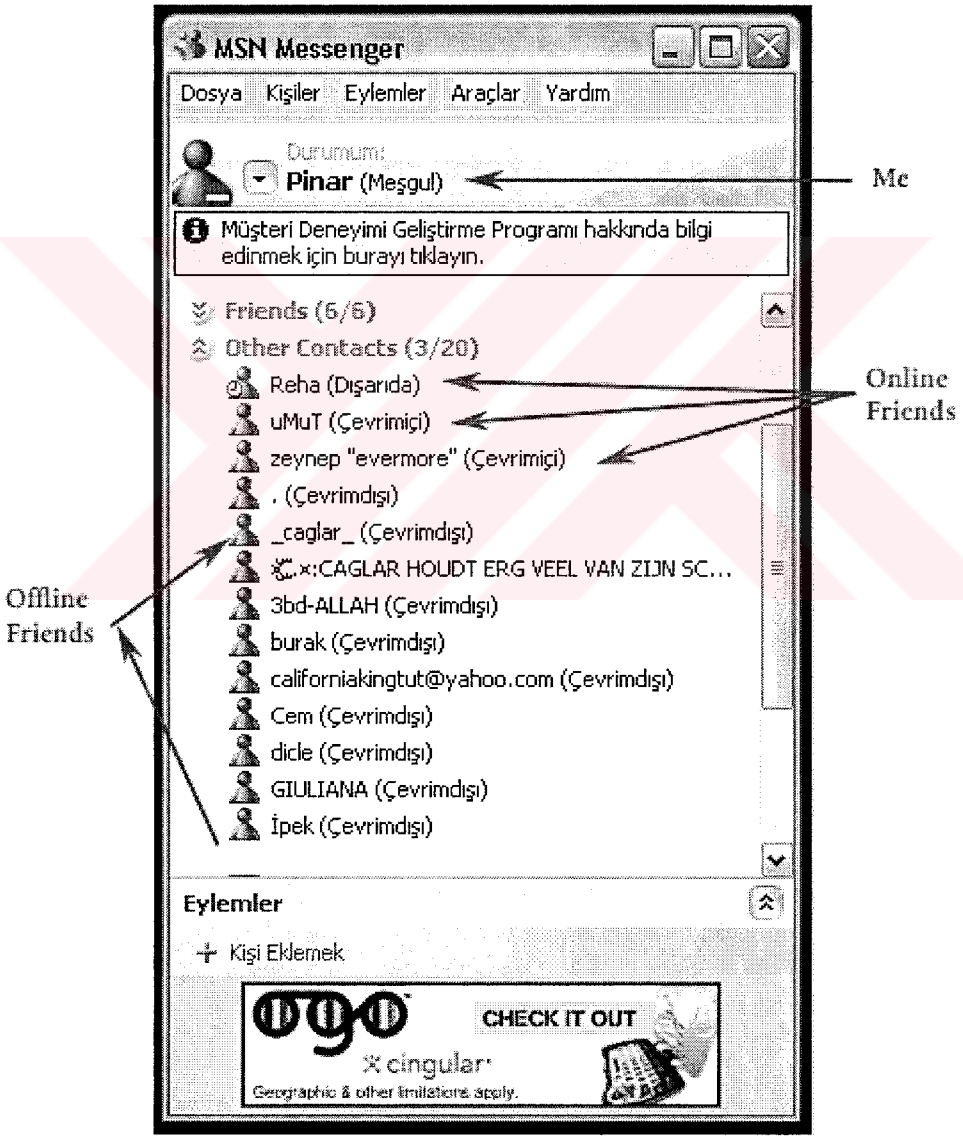


Fig. 1.1.2.1.1 User İnterface of MSN Messenger

This window is an example of a friendly user interface that provides us with the option to easily interact with the rest of the world. The interface provides us with the rooms that we go and meet others, play a game with other users or participate in an educational forum that gives a strong sensation of feeling present at another location besides where we already are.
Suller, says that the mind has the power to shape sensory inputs and interaction into a psychologically meaningful environment, and that, the worlds and relationships of cyberspace remind us that the being, here, and now of presence resides in the human mind.

Suller's statements are in line with Riva's, Davide's and Jsselsteijn's (2003) notion that the experience of presence is a product of the mind, an interplay of multi-sensory data. It is not relatively important where the sensory data come from; the real or the virtual world, no matter where, it creates a sense of presence.

" Mulit-sensory stimulation arises from both the physical environment as well as the mediated environment. There is no intrinsic difference in stimuli arising from the medium or the real world. We feel more present in the once that becomes dominant perception at the time."

Riva , Davide and Jsselsteijn (2003) also suggest that in order to experience a sense of presence, the sensory input has to go through various cognitive processes in which attentional factors play an essential role.

The most attention grabbing feature of a virtual environment can be to manipulate the contents of an environment. If we see that our presence can cause change in the environment, in other words, when we interact with it rather than passively watch it we have more sense of reality for an environment. Even a very basic interaction like clicking on a button to make something happen gives the feeling of being in that space.

In the figure 1.1.2.1.1, interaction occurs when two or more people meet at this "room" and talk and/or transfer files between each other. File transfer through this program happens when one person sends a file –picture, song..- into the room and the other person receives or rejects it. Clicking on a person's name in a *room* full filled with your friends and being able to talk to her/him is enough to create the illusion of a place. The ability of rejecting

the file through this interface makes the user feel a sense of self displacement.. There is also a recent addition of voice connection to MSN Messenger where people can talk as they are on the phone, however this has not become as popular as the text communication feature. Text messaging seems to be more preferable than a phone conversation as a recreational communication tool due to reasons explained later in the chapter.

The degree of the interactivity in the environment depends on the interface design of the particular program. A higher platform of cyberspace where people interact with more realistic feedback comes from teleconferencing systems (webconferencing) in which participants across countries see and talk to eachother in real time through webcams and microphones over the internet. The popularity of this system is increasing with more Web conferencing programs manufactured everyday : Genesys, and Microsoft Office Live Meeting, WebEx are the recent popular ones.

Teleconferencing is increasingly being preffered by large companies for distant corporate meetings with remote participants to reduce travel time and costs and to colaborate in real-time with clients around the world.

The famous American franchise 7-Eleven brings its field consultants together for weekly corporate webconferences through 2005 Microsoft Office Live Meeting program, in order to reduce travel time and costs for the the consultants located even as near as an hour from the closest office. The company XRT, which provides financial solutions for corporations' to control their cash flows. XRT also uses the Microsoft Office Live Meeting program to train the corporations on the softwares that will help them manage their cash flows more efficiently. XRT is able to remotely provide in-depth training sessions for their customers as efficient as face to face training, cutting travel costs by 60%. The Microsoft Office Live Meeting program has a recording feature by which the trainees can record the teleconference training sessions and watch it over whenever they need it. This ability of rewatching the unclear parts alone seems to overpower the face to face training.

Teleconferencing is an invaluable way of communication and a major time and money saver for busy working people who don't have the extra time to fly over for meetings.

As appealing as it may sound, teleconferencing has not get as popular among the regular public as a communication tool as it got among the coorparate world. Despite the real time

visual and audial feedback of webconferencing, text based chatting is preffered more as a way of communication for recreational purposes.

1.1.2.2 Online disinhibiton effect

Even with the advent of multimedia interaction like teleconferencing, text-based interaction like chatting remains to be the most preferred recreational interaction route. For Suller (2002), typing and reading thoughts is a different experience in terms of cognitive abilities.
Suller points out his theory of the *"online disinhibition effect"* as to why text based communication is still the most preferred mode of cyber communication:
Since people can't be seen or heard while chatting, they may open up and say things that they normally wouldn't say in-person, which leads to more intimacy with someone than would be in face to face interaction. So, a person's true self is more likely to appear online than in-person.

Along with the lines of the above theory, here is a look at some psychological aspects and hypotheses that takes place in Suller's study of the Psychology of Cyberspace on the text-based communication on the internet:(Suller 2002)

- Some people experience text relationships as safer and as inciting less anxiety than face-to-face relationships .

"You can respond to your net-mate whenever you wish, at whatever pace you wish. That gives you time to think about what you want to say and to compose your reply exactly the way you want. This comes in very handy for those awkward or emotional situations in a relationship."

- Intimacy develops more rapidly in text relationships than in face to face relationships.

"Lacking f2f cues, text communication disinhibits people, encouraging them to be more open and honest than usual."

- ❖ In text relationships one participates in the relationship while simultaneously

observing oneself in the relationship.

"Text-mediated relationships enable you to record the interactions by saving the typed-text messages. Essentially, you can preserve large chunks of the relationship with your online companion"

- ❖ Socially anxious people may enjoy and benefit from text relationships. Text relationships can be used to desensitize social anxieties and build social skills.

"The written dialogues may involve different mental mechanisms than face to face talk. It may reflect a distinct cognitive style that enables some people to be more expressive, subtle, organized, or creative in how they communicate. Some people feel that they can express themselves better in the written word."

1.1.2.3 Identity on cyberspace

The rapid development of the social relations in cyberspace, brought the need to announce some sense of self online while interacting with others. This was necessary not only for a person to get him self across but also for him to be aware of the existence of others in the collaborative environment online. When people play an online game or chat to each other , they leave their actual bodies of flesh and slip to their cyber identity.

Having cyber body through various modes of self representation gives more of a sense of realism when interacting in cyberspace.

Cyber identity is one's identity of presence online, his other existence while his body sits in a room, in front of a computer.

How do one use cyberspace to build an identity?

Cyber communication is a unique way to establish an identity. However, building an identity online is very different than real life identity experience because of the nature of cyberspace – it is formless, bodiless, and anonymous. Individuals exist as electronic information, as an illusional presence.

In real life, identity is built by the social situation one is in, whereas in the case of cyber identity, one chooses an identity he wants to pursue. In other words, real life identity is controlled by the social situation and established without one's control; cyber identity on the contrary, is totally directed by the person himself. A person decides how much of himself he wants to reveal while building a cyber identity. Since it is an anonymous mode of communication and one can chose to exist by his username instead of the real one and can be free and imaginative. Since they are not actually seen or heard, people of various backgrounds can gather and socialize in this space freely and equally because their cyber-identities are void of the real life prejudices such as social statue, gender, physical or mental disability.

Here is a paragraph at the "The Sims" game's website that justifies the above point:

"Take your Sims to an online world where you get to be yourself or whoever you want to be.Build a network of friends to enhance your power, wealth, reputation and social standing.Be a peacemaker or pest, a recluse or rabble-rouser. In this open-ended, online world, you choose your role, your attitude and your destiny."

Online identity and social status can be acquired through many mediums as text, symbols, pictures or graphics depending on the interface or the mode of the interaction. In applications where people can not be see or heard (like instant messaging-unlike teleconferencing) people can experiment with different identities such as choosing to be the opposite gender as his body of representation. In the popular online game "EverQuest", with more than 360,000 subscribers, thousands of gamers play characters of the opposite gender. As one participant in Turkle's study put it: " I feel more like who I wish I was" (Charles1995)

So, what are these modes of self representation to build an identity?

Experiences in a shared cyberspace, either on the internet or in a sophisticated Virtual Environment, require representations of the body to make the communication more realistic. Any representation can be deliberated, from one as simple as a photograph and to a live video of the person or one as complex as a 3D body scan of the user with a mouth that reshapes itself according to the user's speech patterns. The illustrated figures in the Vzones game above are examples of such identity representations of players.

These representations are called "*avatars*, a word adapted from Hindi, meaning:

"The earthly embodiment of a deity".

In cyber words:

"A virtual object used to represent a participant in a virtual world".

Avatars enable us to sense the existence of others in a virtual place, gives us an idea of what they look like, where they are looking, where they are and so on. Avatars hold more importance in sophisticated Virtual Reality environments, which I will explore further.

An interesting and challenging thought is that the percieving presence at a cyber environment and communication with non-human entities like avatars, as *reality* will open to doors to a new level of consciousness. The granted theorist Victoria Vesna said, "the internet will awaken all our potential and eventually enable people to teleport their bodies and telepathically communicate with each other." She even went as far as thinking of cyberspace as a digital afterlife where we will be able to live for ever as bits of information.

An avatar can be seen as the part of a person on an astral journey where the body remains at the same place but awareness is elsewhere. This in some ways resembles the east philosophy practices where the mind is forced to immerse into higher levels of consciousness through practices as meditation. Cyberpresence may evolve the human mind

in terms of the perceptive abilities, which can decline the concern of whether human intelligence is underway of diminution because of computerization.

1.2 Cyber Culture:

1.2.1 What is cyber culture?

Cyber culture is a socio-cultural phenomenon that refers to the culture that has been born by the relations on cyberspace. Chatting, e-mail, teleconference, cybernetics, cyborgization of the human body, etc. are some topics that relate to cyber culture.
Cyber culture is a subculture, expressed with real identities, norms, rules and its unique language including symbols and icons for self-expression.

Levy P. (2001), a French philosopher widely known as the founder of the concept of the *virtual*, argues that the increased use the Internet gives birth to new forms of information and its distribution, and consequently transform the society itself, bringing about social and cultural change. According to him, new forms of knowledge born with the spread of the Internet don't only transform the information itself, but causes new *social formations* in terms of change of values, habits, the way people do things, attitudes and ways of living. He says that cyber culture is a new socio-cultural formation which was born with the computer technologies. (Levy, 2001)

Hakken (1999), a cyberspace anthropologist, defines social formation as the "abstraction of preference in contemporary social thought with which we refer to social entities. From a 'social formation' perspective, the main concerns are how social entities are reproduced from one era to the next.

A social formation is basically a social change with new set of meanings, values, behaviors, language and new identities. Cyber culture, as mentioned, is nothing but a very good example of such formation with its unique language, norms, behavior and identities.

1.2.2 Elements of cyber culture:

1.2.2.1 Cyber-Language

Language, in its nature of creation manifests itself as an exclusive system of shared symbols that bonds a group of people into one culture. Such system is essential to the establishment of a cultural formation. Language defined by Webster's is:

"Any system of formalized symbols, signs, gestures, or the like, used or conceived as a means of communicating thought, emotion, etc."

According to Sherman and Craig, each medium develops its own language by time that people can use to communicate more efficiently.
In the context of internet and cyber culture, e-mailing, chatting, participating in discussion groups also over time created its own global creative communicating with text, which brought about "cyber language". Experienced chatters have developed a series of keyboard techniques to conquer the limitations of typed text – techniques that provide with a vocal quality. These typing techniques provide the e-mail or chat message with a face-to-face interaction resemblence. Without the ability to communicate using facial expressions or tonal inflections, people use keyboard symbols to convey what they mean on the internet.

Cyber language is a new language, with its own ways and symbols that is connecting millions of people online.

Below are some characteristics of keyboard techniques that have become the norms of communication on the internet:

1.2.2.1.1 Emoticons

The word emoticon is a word completely special to the text based interaction derived from the words "emotion" and "icon". Emoticons are icons that imitate real facial expressions. They are small pictures used to convey emotions with. Emoticons were first made by using a combination of keyboard letters but now the face icons actually exist in the interface of some text communication programs where you can chose between various samples and send it over. Here are some popular examples of emoticons:

:-O	Oops
:-)))	Laughing like crazy
:-P	Sticking Tongue Out
0:-)	User is an angel
:-@	User is shouting
$-$	User is super rich
:-/:-/	User is experiencing a dejavu

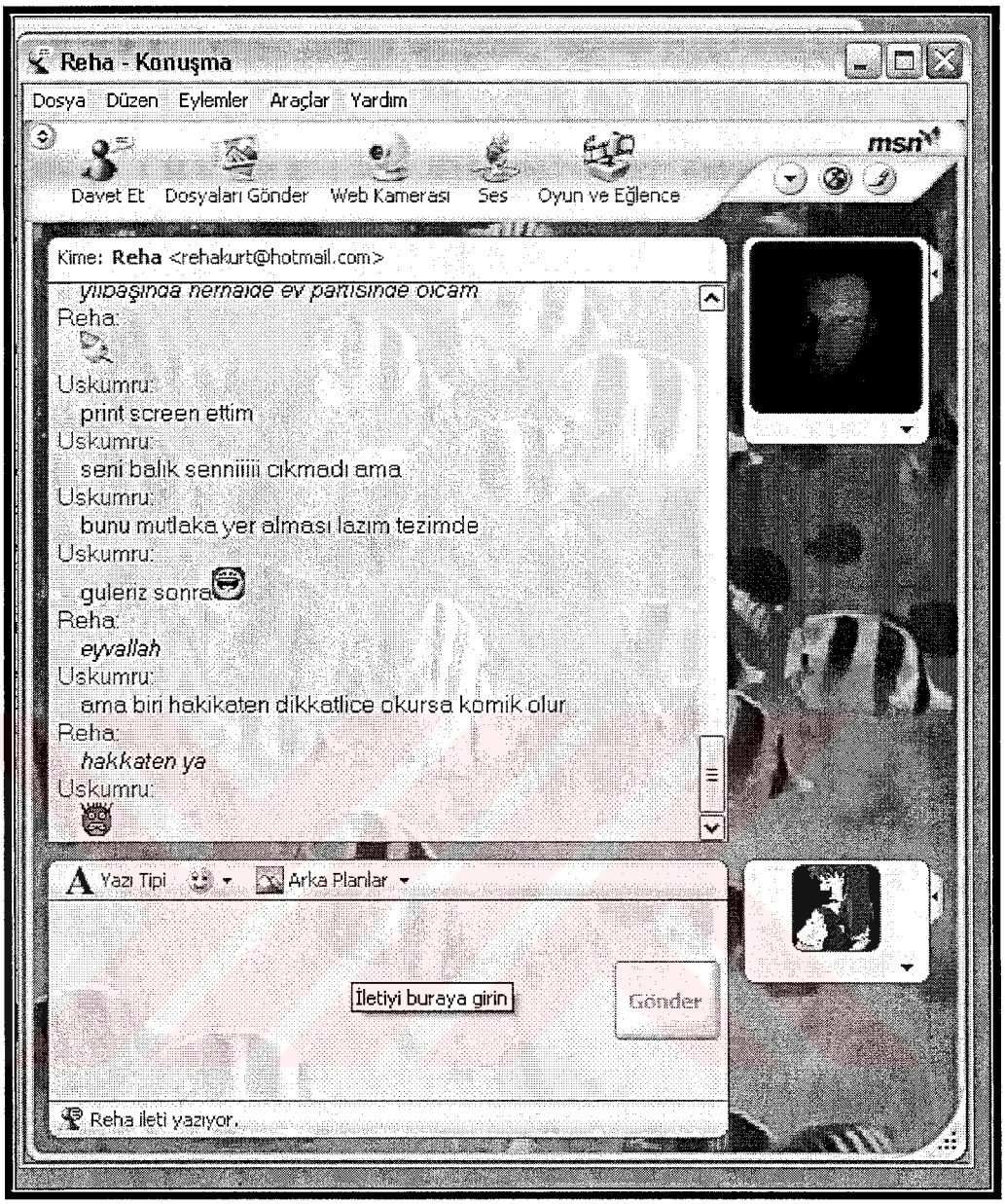


Fig. 1.2.2.1.1a Use of emoticons in the chatting program MSN Messenger

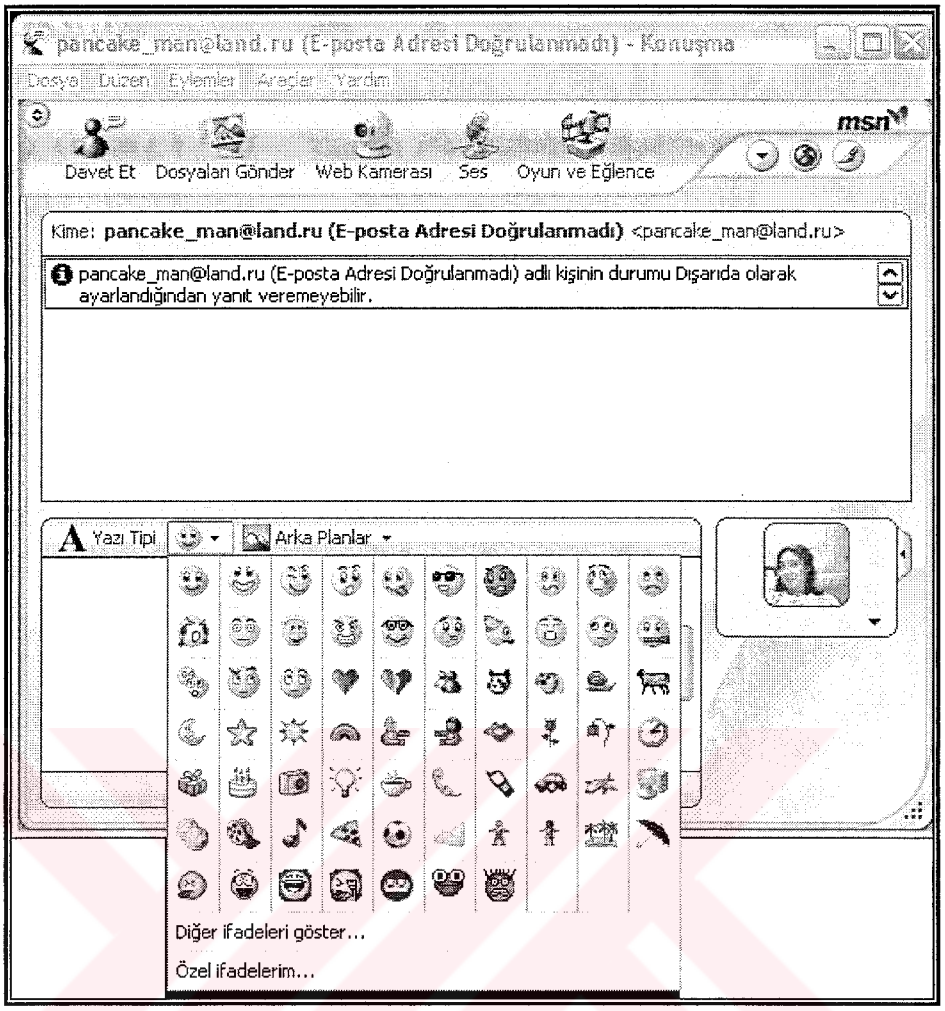


Fig. 1.2.2.1.1b List of emoticons in MSN Messenger

1.2.2.1.2 Abbreviations

Acronyms and abbreviations are other elements of the *cyber language* that are used to communicate common phrases. These abbreviations and acronyms are totally unique to the cyber talk, are not derived from the actual face to face conversation world and can be very confusing to a new user.

Some popular examples taken from the site Chat Abbreviations:

LOL - Laughing out loud

BRB - (I'll) be right back

BTW - by the way

K – okay

10x- Thanks

IAC-In any case

G2G-Got to go

121 - Short for "one-to-one." It means that you are communicating with someone personally

rather than talking to a whole group.

GAL- Get a Life

FYI- For your information

SOS- Same old stuff

OIC- Oh I see

LMAO- Laugh my ass of

B4N - Chat abbreviation for "Bye for now."

1.2.2.1.3 Voice accentuation

Since the text world is a silent one, special techniques to mimic the changes in voice have

developed over time. For example, using capital letters mimic shouting:

"NO I DIDN'T " may imply that the user is frustrated by a question where as "no I didn't"

shows no extra emotion.

1.2.2.1.4 Unique spelling and symbols

There are ways of spelling unique to the text based communication world that are different from the conventional spelling. This is sometimes in order to save keystrokes, and sometimes just to be different, either way, these spellings are a an important implication of a cyber culture formation through this new medium of communication.

There are words that any "chatter" would recognize which would be very strange for one new to cyber world.

KEWL- Cool

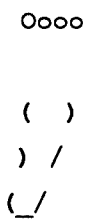
((XXX))- Hugs and Kisses

FAS - For a second

1.2.2.1.5 Doodles

Doodles are the visual figures and pictures made by combining a variety of keyboard characters. They are a bit more sophisticated version of smileys. Combination of keyboard characteristics can be used to form a single figure, or be as creative as making a whole picture.

- Footprints:



❖ Weightlifter:

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1.2.3 Cyber Communities:

"A community is a group of two or more people who have been able to accept and transcend their differences regardless of the diversity of their backgrounds (social, spiritual, educational, ethnic, economic, political, etc.). This enables them to communicate effectively and openly and to work together toward goals identified as being for their common good. "(Strate 2003)

In harmony with the definition of *community*, a *cyber community* is a group of people who exchange words and ideas through computer networks and bulletin boards. People chat, argue, gossip, exchange ideas, make friends, fall in love and make love online. They do everything people do when they meet face-to-face, but by using computers. Cyber-community -or online community- is the name given to any social formation such as organizations that is developed online without any geographic representation and without face-to-face contact.
Rheingold H. (1993), offered in his book, The Virtual Community:

"Virtual communities are social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace." (Rheingold, 1992)

All various definitions above concludes to the understanding that an online/virtual community is the gathering of people with a common interest, in an online "space" where they meet, communicate, get to know each other better over time and develop social ties.

Through interaction in an electronic environment, social ties develop overtime, resulting in virtual communities. (Strate 2002). People establish social circles, participate in discussion groups, join online activities without the need of transportation and face to face meetings.
Types of Virtual/Online Communities:

1.2.3.1 Virtual Recreational Communities:

Virtual recreational communities are online communities that have topical conversations about shared interests – gathered under various topics- in online saloons and discussion forums. Communities for meeting people, playing around, sharing jokes and stories fall under this category. An example of such a community is www.yonja.com which is a very popular match making and friend finding site with more than 600,000 members, where people sign up for free, build a profile with their pictures and build a network of friends online.

Another popular example is Electric Minds at http://www.electricminds.org founded in 1996 by Howard Rheingold, author of the book *The Virtual Community.* Electric Minds is known forhosting discussions of various topics of interest and holding conference hosts. Community members enter their input to the site in order to ensure the community's smooth functioning. People while conversing, meet at this site and over time the become so familiar with each other to the point of sending special gifts to their taste with actual physical post mail.

1.2.3.2 Virtual Business communities:

Work groups within companies and between companies collaborate in cyberspace with online communities that keep them in touch, provide them with the oppurtunity to work on projects together and practise their wisdom. Such sites as the popular E-Bay (www.ebay.com) and a recent Turkish Business site estore.com.tr purpose to work at the "the intersection of business, information technology, and the arts of community and spirit" as the site puts it.

The site describes its mission as :

- "publish our evolving knowledge, including lessons learned from projects, favorite papers, and slide presentations. Our wealth grows by giving away our knowledge."

❖ "support our collaborative exploration project work teams and knowledge

communities. This site is one small node in our emerging global brain that connects us to more people than any of us can handle. The paradox of this freedom is that it obliges each of us to choose only those few with whom we can make the greatest difference for the whole."

1.2.3.3 Virtual Educational Communities:

Online educational communities are large societies that provide educational information to its members through bulletin boards and discussion forums. Among the members are professionals, students, and people just interested in those particular educational topics. There are editors who work full time at such sites to provide feedback to the readers' questions. Readers post questions on bulletin boards for the editors or any member to answer it .This is a two-way interaction that provides the users to interact not only with the site and its editorial staff, but also directly with each other.

Educational communities enable professional networking and open the gates to the whole world of professionals about a particular topic thus, provide a better learning environment than a geographically limited institute. These sites also hold activities like competitions.

Until the arrival of the internet and www, explicit knowledge was limited to the elite society of scientists, experts and professors. Today it is available to everyone around the world with an internet connection.
Purser claimes that "*the information that we gain access through the medium of cyberspace is always a form of distanced, indirect knowledge*", and that "*tacit knowledge only comes from first hand teaching*" (1999).
However, today there is a quite a big amount of superior and first-hand knowledge on the internet concerning the cyber education communities with professors providing their information for the content of educational websites and ready to answer every question.

This is tacit knowledge that comes from first hand teaching right there. Cyber communities grants experts to learn from each other by providing a place for world's leading scientists to gather, share insights, exchange knowledge and work together on strategies also find many scholarly articles on nearly every subject. The internet provides routes to *many* first hand direct knowledge instead of only one.

One of great educational virtual communities is the Creative Planet Communities (CPC) http://www.uemedia.com/CPC. CPC is a giant community founded in 1997, offering online resources for the film and television production professional. Updated daily, the CPC sites offer news, articles, resources and discussion forums for the creative community of film makers, artists of digital cinema, directors, editors, computer artists... The company's network of sites includes 2-pop.com, VFXPro.com, Cinematographer.com, Editorsnet.com,
Postindustry.com Videography.com, DigitalCinemamag.com and DesigninMotion.com. Each of these sub-sites have 1,500,000 million page views per day from all over the world.

1.2.3.4 Game communities

The game industry was once divided into three categories: PC Games, TV Games, and Mobile Game. With the Internet a new sector was born, which is the Online Games. Online gaming has become so popular in the last decade that online game communities started to form.
Online Game Communities are one of the most popular of all communities online. What differs online game communities from others above is that the members virtually live in a graphical world where they chat, play, socialize and interact within that game world. The world they are supposed to live in is designed with 2D or 3D graphics and their identities are represented by *avatars* you chose from that will be your identity in this world.

A famous online game ,*VZones* is a game world where one can interact with the virtual world such as buying a coke from a vending machine and engage in plenty of social activities like playing bingo

Fig. 1.2.3.4a Buying from a vending machine

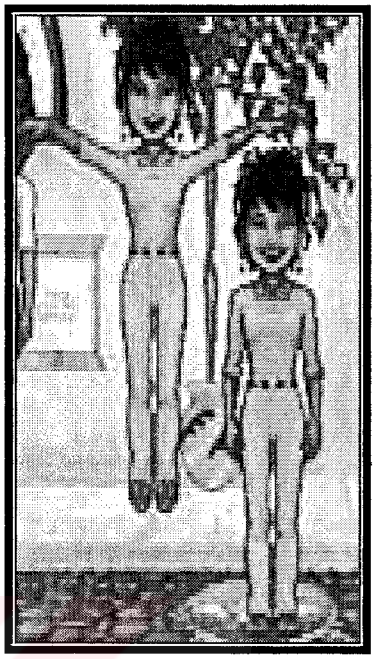


Fig. 1.2.3.4 Flying

Players actually live there, like they would in a real world; they earn virtual money, rent apartments to live in. They can jump, party, drink martinis, fly balloons…

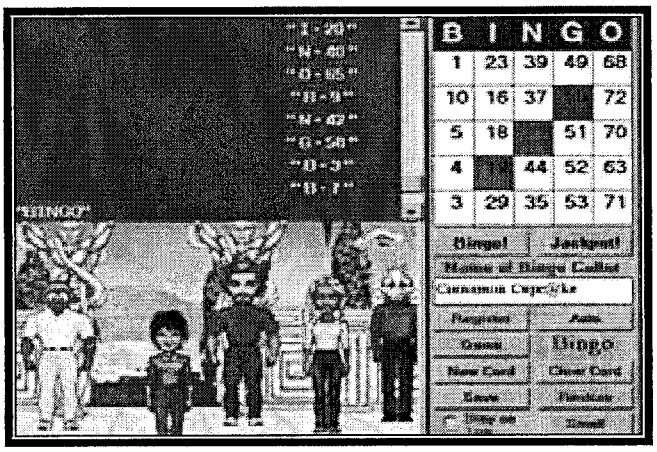


Fig. 1.2.3..4c Playing Bingo game

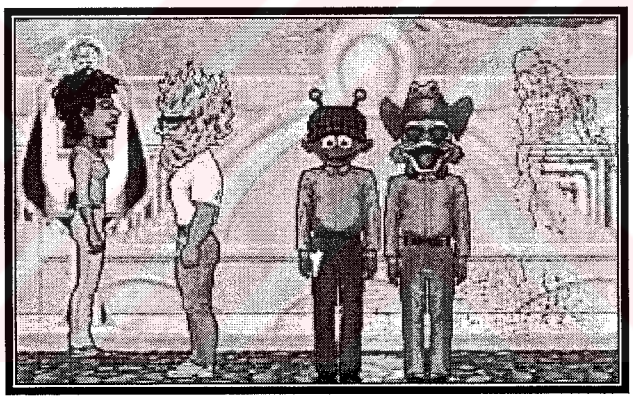


Fig. 1.2.3. 4 d VZones one year anniversary celebration

Cyberspace is a unique medium in the way that it has bred such communities. No other medium before like telephone, TV or radio have ever accomplished such a phenomenon. Cyberspace brought new meanings to the establishment of identity and has shown the natural formation of a new language.

Heim, claims that virtual world societies may endanger the real human relations and says that "the cyber bodies of VR may further upset an already precarious ontological balance" (Heim 1995).

Yet factors like the online anonymity seem to nurture the human relations not hinder them, since it gives the opportunity to people to discuss things that they will hesitate to in real life.

Cybersocities does not endanger in person human relationships because cybersocities does not have to replace the real ones. As Suller has envisioned, there are three kinds of societies, the in person ones, the online ones, and mixed ones where people interact both in person and online. These three kinds of societies can harmonically grow without having to have effects on each other.

Also, the people interacted in these cyber worlds are still *real* people which are capable of growing love and empathy.
It is common among people meeting in cyberspace extending their relations to real life. Cyber relations will not hinder real relations and emotions of humans, but open new doors of love and empathy in real life.

Members of a virtual community meet and develop strong relations with empathy online without ever seeing each other. A member of the an Electric Minds Community sent another member a *real* gift to show her/his empathy. The other member posted online:

"When I opened that box, I was hard pressed not to cry. What a sweet, sweet gesture.It's not so much receiving a thing in the mail. It's all the thought and effort behind the gesture for a person you've never met in real life. Sure dragons are something I collect and like. And this particular one is simply beautiful. To me the gift was a symbol from one Electric Minder to another of what this community is all about."

This is just an example that a virtual community is not just a gathering of some strangers made of electronic information but of a place capable of bearing love and empathy within its members.

Cybercommunities can be considered as a social revolution and missing out on being a part of a cyber community can also mean missing out on an ocean of educational, social ..opportunities and remaining limited to that within the limits of the close geography where it may be impossible to find such resources.

The internet can be considered as the birthplace *cyberspace,* bringing fantasies and science-fiction books into real life. Until now I have talked about cyberspace in terms of text-based communication through the t and teleconferencing, along with the cyber culture and cyber community phenomena born as a consequence. I have used the term cyberspace synonymously with its birth place, the internet.

Now, I will go into higher genres of cyberspace with much more sophisticated interfaces creating more bizarre sense of realities. Virtual Reality, Augmented Reality and Tele-presence as they are the sophisticated forms of cyberspace.

2. HIGHER GENRES OF CYBERSPACE

Virtual Reality, Augmented Reality and Telepresence

2.1 Virtual Reality

Virtual Reality, in common sense can be perceived as an umbrella term to define all kinds of non-physical mental places (like the cyberspace of internet) that allow many life activities through information. The below figure "*The Central Meaning of Virtual Reality*" as quoted in Heim's book Virtual Realism (1998), is an example of such generalization of the meaning Virtual Reality:

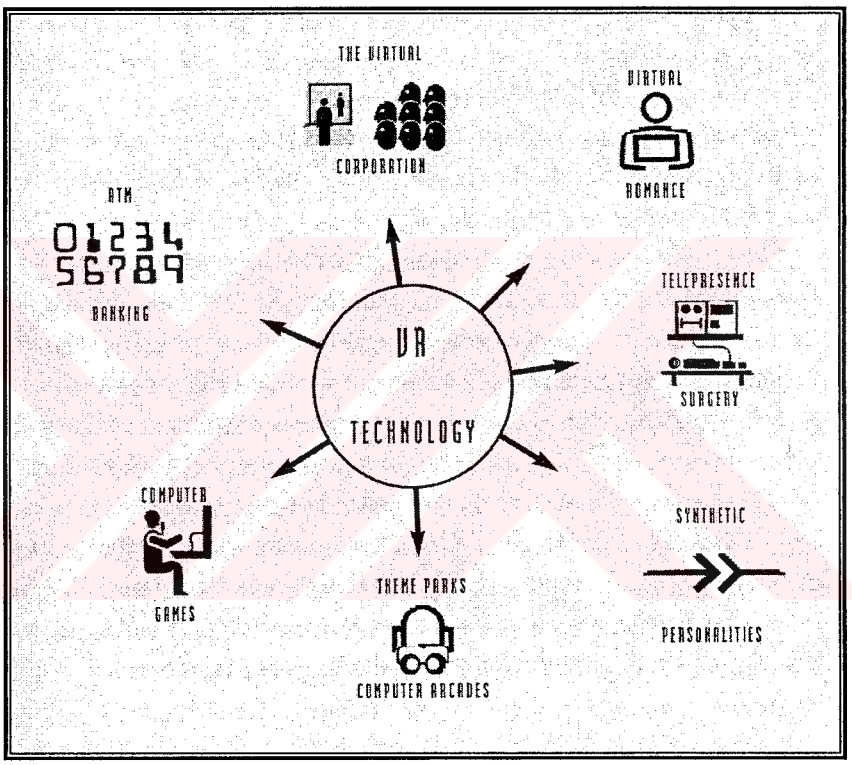


Fig.2-1 The Central Meaning of Virtual Reality and its Many Offshoots *(as named in the book)*

However today, VR is more of a term used to name a specific technology that provides that allows real time information flow between the computer and the user, enabling the experience of getting mentally and *bodily* immersed in an artificial environment. This environment is 3 dimensional and can be interacted in real-time. By wearing a head mounted audio visual display, position and orientation sensors and tactile interface devices, one can bodily inhabit a computer generated environment with realistic 3D graphics and

manipulate things such as lifting a chair and tossing it away, looking 360 degrees around a room, and to move around an object and see it from various angles. In other words, by VR eliminating the separation between the user and the medium, the human becomes a part of the cybernetic circuit which gives a life-like experience.
Virtual Reality is probably the ultimate mode of the effort people have been giving to communicate better through a medium. VR nearly removes the boundary between the medium and the person by placing the user *in* the medium.

In the Webster Dictionary, the word virtual, is described as an "illusion", a "misapprehension", a "hallucination" .

- *Virtual*:

"1 a the action of deceiving **b:** the state or fact of being intellectually deceived or misled **:** Misapprehension**:** an instance of such deception
2 a: a misleading image presented to the vision**:** something that deceives or misleads intellectually **b** perception of something objectively existing in such a way as to cause misinterpretation of its actual nature Hallucination 1**:** a pattern capable of reversible perspective" (Webster)"

- Webster online states virtual as:

"Being in essence or effect, but not in fact" (1989)
Naming a technology with a term made of combining "virtual" with "reality" brings the understanding that there is a *reality* involved and that it comes out of an illusion. This illusion is provided with specific human- computer interface technology that provides visual, audible and even tactile input to the computer and computer feedback to the person.

- Grigora and Coiffet (2003) describes Virtual Reality as:

".. a high end user computer interface that involves simulation and

interactions through multiple sensorial channels. These sensorial modalities are visual, auditory, tactile, smell and taste."

Grigora and Coiffet define VR as a technology system instead of as a concept here. As today, when we hear the term "Virtual Reality" we think of a technological system, a human-computer interface.

- Heim (1998) states that :

" Virtual Realism is an art form, a sensibility, a way of living with new technology. Virtual Realism requires the capacity to reconstitute the real through computers, and it also means the maintenance of human identity as we install the technology into our lives and our lives into technology. "

Heim takes virtual realism as an art form, making the real through computer. He claims that VR requires maintaining the human identity as we integrate our lives with technology -along with the lines of my earlier examples of the maintenance of the human identity on the internet; virtual identities and communities-.

All above descriptions are of Virtual Reality as it is known today; as a fully immersive 3D environment in which we can navigate and manipulate things. True VR is fully immersive VR. However VR also comes in many sub-types if you may, being partially immersive, non-immersive, VR combined with real environment and etc.

2.1.1 Fully Immersive VR:

Fully immersive VR, as its name implies, is the most immersive, highest experience of virtual reality. Compared to the experience in its lower forms such as desktop VR, in fully immersive VR, one is no longer an outside observer of an environment, but actually a part of the environment he "logs on" to. That's why, it's system is the most technologically demanding one. The elements of a fully immersive VR system mainly consists of : a Virtual Environment, Immersion , and Interaction.

2.1.1.1 Virtual Environment:

With the advancements in computer technology like fast processors and rapid rendering , computers are now designed to create virtual worlds that feels "real". Sophisticated 3D models, dynamic lighting, particle effects like fire and the ability to modify the environment add major sense of reality to the environment.

Virtual environments (VEs) are 3D processed environments simulated by the computer that can be stepped inside, be seen, touched, heard, wandered around and felt in real time. More than just looking at the environment, a person mentally and bodily immerses in the environment.

As Ellis (1994) puts it:

"Virtual environments can be defined as interactive, virtual image displays enhanced by special processing and by non visual display modalities, such as auditory and haptic, to convince users that they are immersed in a synthetic space"

Examples of a virtual world can be the 3D simulation of inside of a human cell, a dreamy outer space, or a an endless tunnel. Almost anything can be designed as a VE.

Collaborative VEs

A virtual environment can be located on multiple networked computers –collaborative VE- where numerous users can interact with each other through their bodily representations – avatars- and manipulate the objects together. *Collaborative VEs*

Sense of immersion to any medium increases with the presence of multiple users. Collaborative environments are used in the VR games, teleconferencing, telepresence surgeries are areas where mutual interaction is the purpose. Like in online forum rooms, people sharing VEs also use avatars to sense the neighbors' presence and communicate with each other. In fully immersive VEs, avatars is a must to perceive the sense of direction, to be able to navigate in the world, and to sense the other users' location.

In single user experiences only the limbs are displayed, where in multi user experiences the entire body is presented. Full body avatars can be as simple as a 2D picture or as complicated as a full body rendering that communicates facial and body gestures.

2.1.1.2 Immersion:

Immersion is the experience of feeling involved at the virtual environment, with high end immersion devices that connect the senses of a person with these elements, by providing with strong 3D graphics, surround audio system and sometimes tactile feedback.

Sherman and Craig divides immersion in two: Physical and mental immersion, and describe them as:

Mental immersion: State of being deeply engaged, suspension of disbelief, involvement.
Physical immersion: Bodily entering into the environment by artificial stimulus of the body's senses via the use of technology. users in the VE.

2.1.1.3 Interaction:

Sensory communication is essential to true virtual reality. In order to make human to computer interaction happen, it is necessary to use a specifically designed interface that enables information circulation in and out of the human body and the virtual environment. The interaction and immersion devices are the interface to the virtual environment. The fully immersive VR systems provide real time sensory feedback to the participant based on his input; the input being changes in the physical position or orientation of his head, body or hands. Interaction comes from the computer's ability to change the scene's point of view as soon as the human being alters his physical position and perspective. Let's say a person is walking through a virtual environment and he turns his head rapidly to another direction. The computer, in turn, instantly updates the graphical data with a complex rendering system and outputs it to the user's senses.

2.1.1.4 Interface of fully immersive VR:

The most common pieces of a fully immersive VR system are the head mounted display (HMD), the data glove, and a separate position tracker if not already embedded in the HMD.

2.1.1.4.1 Head Mounted Display (HMD)

HMDs are both visual output devices that places the VE directly in front of the eyes *and* may contain tracking devices to track the position and orientation of the head in order to accordingly update the angle of the VE . In order to perceive the sensory input of the person, a VR system measures the change in the position and orientation of the moving participant in real time by special purpose 3D position trackers. HMD is both an input and an output device. It is worn on the head to project images somewhere between 1-5 meters.

HMDs totally block out the real world and surrounds one with the virtual environment, making full immersion possible.

The concept of HMDs dates back to 1965 when Ivan Sutherland, the founder of the concept Virtual Realism, suggested that an "ultimate display" to the computer generated images could be built so that the display would be inseparable from real. He found the concept of the display unit in which the user can interact with objects in the presented environment. He described in his paper "A Head- Mounted Three -Dimensional Display", the development of his stereoscopic head-mounted display that uses miniature cathode ray tubes. These tubes presented separate images on each eye and an interface to mechanical and ultrasonic trackers (Sherman 2003).

Sutherland's technique is still used in today's high-end modern HMDs.

2.1.1.4.2 Data/Sensing gloves

Sensing gloves are 3D trackers worn on hands that have spines of fiber to measure the

changes in the position of the handsfingers. The primary purpose of these gloves is to navigate through and interact with the virtual world, manipulate objects there. The fibers connect to a "computer generated graphic- hand" in the VE which move moves in the same way as the real hand moves.

fig.2..1.1.4. Interface of fully immersive VR

Some sensing gloves have built in trackers in order to measure the user's wrist motion. To pick up a visual object, one uses the virtually touch the image of your hand over the object, and object sticks to his hand.

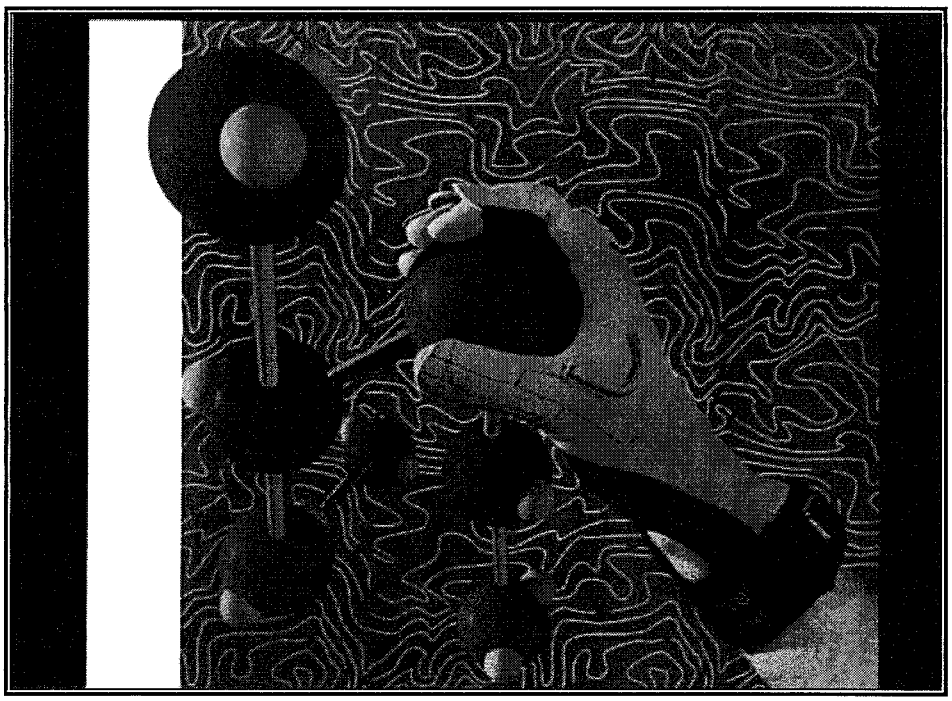


Fig. 2.1.1.4a Holding an object in a VE www.solidray.co.jp

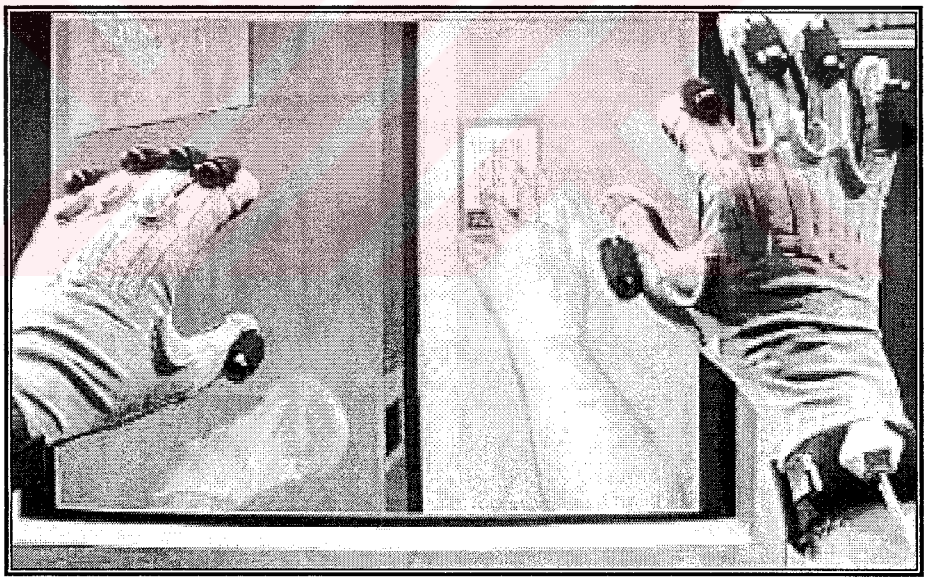


Fig. 2.1.1.4b The linkage of the data glove to the graphic hand

www.solidray.co.jp

Fully immersive VR systems which provide sensory feedback have high technological demands ,are expensive and not practical for consumer use.

As a more economical alternative, there are partially immersive VR systems which are more ideal for widespread use in terms of affordability and practicality.

Partial immersion places a 3D VE in front of the eyes rather than surronding the person. So the person doesn't completely feel like he is in the environment, yet stil gets a sense of realism.. Below are the types of this kind of of VR experiences:

2.1.2 Desktop VR

This weaker form of virtual reality is made possible by a special software that puts a 3D virtual world on to the computer screen. Two slightly different displays of the virtual environment are placed on each other, each intended for one eye, to mimic binocular human vision system.

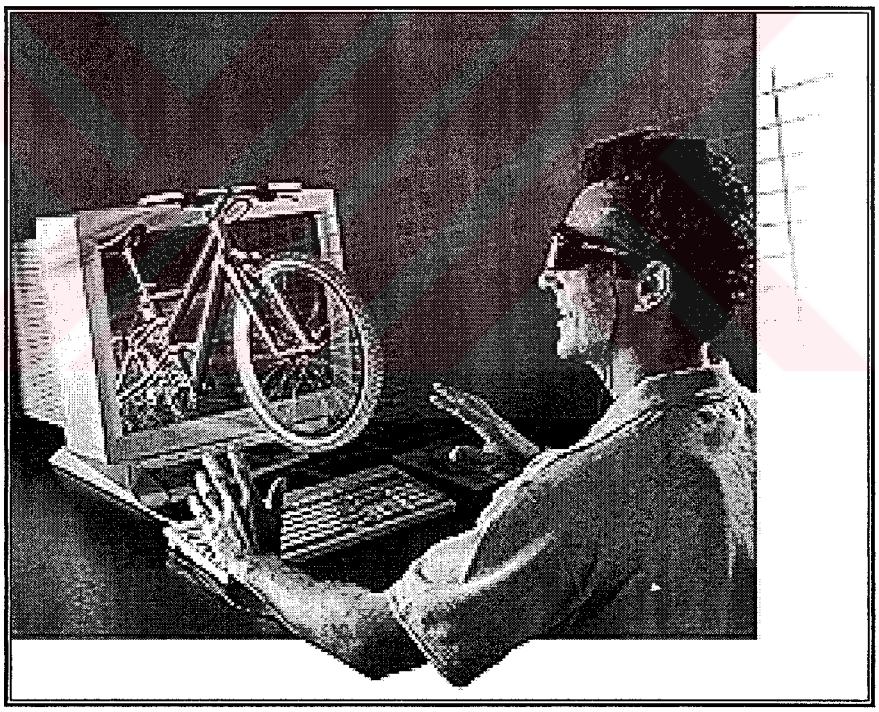


Fig.2.1.2a Desktop VR Image courtesy of www.macs.hw.ac.uk

Interface of Desktop VR:

The interface of the desktop VR is somewhat enhanced version of regular computer station. A

strong graphics hardware, screen, graphics card to process the stereographic images; shutter glasses to perceive the 3D environment; a track ball or a joy stick to navigate; and a camera to track head movements if desired.

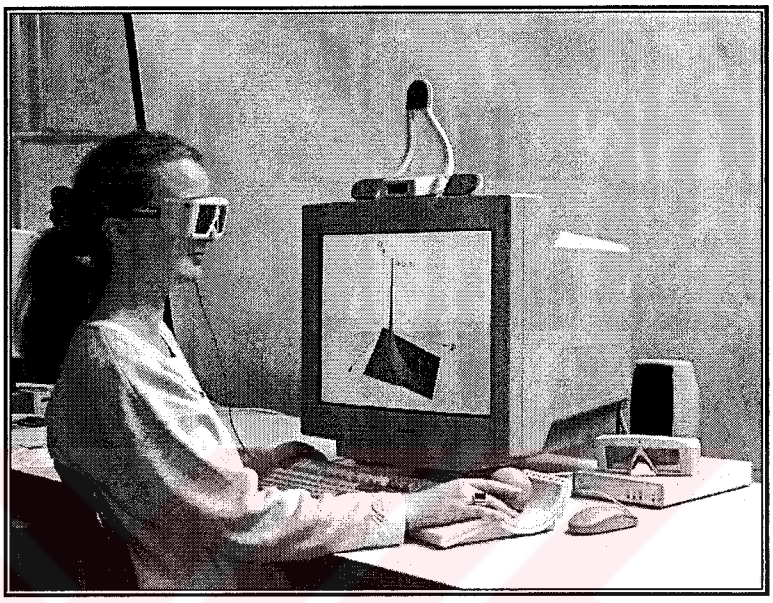


Fig. 2.1.2b Interface of Desktop VR (www.dfn-expo.de)

2.1.2.1 Shutter glasses:

Shutter glasses are used to perceive the two slightly different displays rendered by the hardware to as one world in 3D. Each of the two different views of the virtual environment is designed to be presented to one eye. The glasses pick up the infrared waves from the monitor so that each eye sees a different image, which are unified in the brain as a single 3D scene.

2.1.2.2 Trackballs:

Navigation and interaction in Desktop VR is done with trackballs and joysticks with single point interaction, which replace the sophisticated sensing gloves of fully immersive VR systems. Trackballs are moving cylinders that measure forces applied by the user's hand with special photo sensors. The user navigates through the world by moving this cylinder.

Several buttons are also usually located trackballs that can be programmed according to the VR application. For example, a button can be programmed to lift an object in the VR Environment, decrease the gravity of a VR object, start, stop the simulation.

Currently Desktop VR is mostly used in the game sector but has a potential for the education sector. It can provide affordable virtual worlds to the students where they can go in with their personal computers and explore the world with in.

2.1.2.3 Video Camera:

A video camera mounted on the monitor may be used for head tracking and inputting it to the computer. The display area is limited to a monitor and it is a world that is to look at rather than to be in it, which makes head tracking not much of a use.

2.1.3 VR on the WEB:

VR on the Web has most of the attributes of Desktop VR in terms of its presentation but it isexecuted in a different way. Virtual environments on the Web, based on their complexity, can be created using the virtual realtiy programming language VRML or panaromic photographic images. Web VR is currently used in a variety of situations including education, science, and the tourist and real estate business

2.1.3.1 VRML:

VRML is the virtual reality modeling language that produces 3D interactive

images on the net. Any user, with software that reads this language can go on to the net and

enter the virtual environment. Web VR also has the advantage of network connection,

so more than one user can go into the same VE and interact with each other.

2.1.3.2 Photographic Images:

VR created with photographic images is a 360° panaromic scene where the viewer is placed at the center and able to move around and zoom in and out to look at details. This kind of Web VR is mostly used for taking virtual tours of an hotel, a city, or a museum.

A rental apartment can be visited inside to the rooms from miles away, to make the best selection. The site www.sahibinden.com allows one to navigate inside various apartments around İstanbul, into the rooms, kitchens and bathrooms. An interesting example of a virtual tour is of the planet Mars in 2058! Which takes place at marsproject.com.The principle task in making the panorama scene is to take a number photographs in a 360° circle and stich them together with a VR software to simulate a 360° environment.

Navigation is done with the simple click and drag technique of the mouse. Users can move from one place to another with the help of special buttons on the web interface.

2.2 AUGMENTED REALITY (AR):

Augmented Reality is a relative to virtual reality however there is a big difference between the two concepts: Virtual reality aims to replace the real world where AR is aimed at enriching the information content of the *real environment* for better investigation. Augmented Reality is bred by superimposing computer generated information about the real environment on the actual world. For example, computer generated images of the inside of a car engine is placed on the actual car, with written information on how to fix the corresponding parts (fig2.5a). And, when the person turns his head to right, the computer generated data actually stays fixed on the car engine. This provides an incredible value of knowledge.

The superimposed information can be illustrations of objects not visible in normal viewing like the inner view of the physical material like a computer (fig.2.5b), or text boxes with explanations of particular areas of an object and directions on a task.

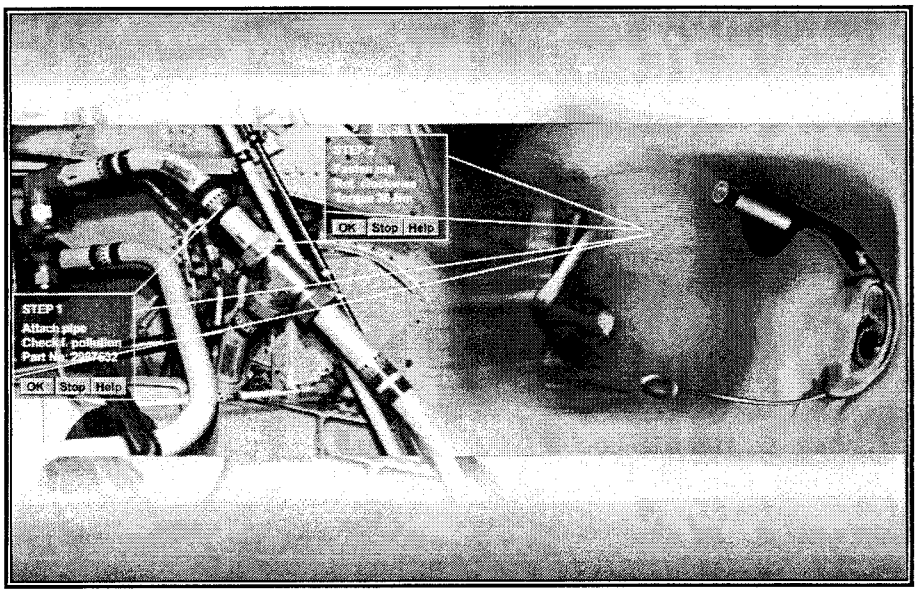


Fig. 2.2.a Computer generated info laid on a real car engine, seen through an HMD.

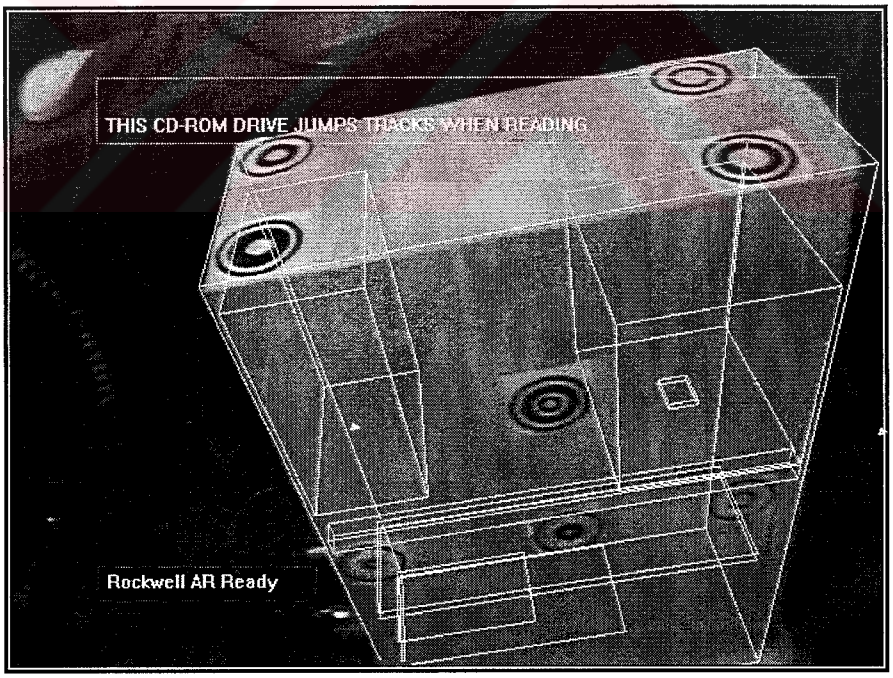


Fig.2.2.b Computer generated images of the internal parts of a computer, placed on the real one.

AR is currently used on living or non-living systems that need investigation or repair, such as a patient's internal organs for diagnosis, or a computer parts to be repaired.

Below are the creative ideas of a Scientific American journalist on what AR can do in future:

- Firefighters could see the layout of a burning building, allowing them to avoid hazards that would otherwise be invisible.

- Soldiers could see the positions of enemy snipers who had been spotted by unmanned reconnaissance planes.

- A tourist could glance down a street and see a review of each restaurant on the block.

Fig. 2.2c Overlaid info on the buildings of a street *(Scientific America.)*

Interface of AR:

2.2.1 See-through HMDs:

In augmented reality, the user's view of the world and the computer interface are represented together via a special "see-through" Head Mounted Display or a Hand-Held Display. See-through HMDs are worn on the head -or the eyes- to overlay graphics and text onto the user's vision of the real location. They also track the position of the user's head and update the overlaid data according the direction of the user's view.

2.2.2 3D position trackers:

Same with the ones in VR that are used to obtain the exact location and orientation of the user so that the graphic output changes according to that data. Instead of using an external device, the tracking system may also be built in the see through HMD.

2.3 TELEPRESENCE

The prefix tele comes from the Greek meaning "remote", "far", "at a distance". So tele presence is presence delivered at a distance. In other words, a user can influence and operate in a world that is real but in a different location.

If we think in literal ways, every collaborative cyberspace produces some degree of telepresence in the actual meaning of the term "presence at a distance". The internet chatting or teleconferencing where people see, hear and write to each other in real time with the help of the computer's microphone and camera, sharing charts, discussing and editing a document together, can be considered low degrees of telepresence in a way. However, the term telepresence is not used for these kinds of remote immersion, it is a term to specifically name the application that uses VR technology to remotely place the user somewhere else in *physical location.*

Contrary to Augmented Reality where physical reality is at the person's location, in tele

presence the reality is remote. The virtual environment is the real location afar.

Interface of Tele- presence:

2.3.1Cameras:

A number of cameras are used to get information of a remote environment to construct a virtual environment. This VE is then displayed in accordance with the participant's head orientation.

2.3.2HMD:

Users wear a head-mounted display to go to remote environments and interact with other remote human beings like they are actually in the same space.

2.3.3 Robotic arms:

Users interact with the real environment with robotic and electronic arms. Robots perform tasks under the supervision of humans located at a distance. To control a robot at a distance, the human operator inputs commands such as force and position to activate a master arm.

So, the representation of the body (avatar) in this case is the robots.

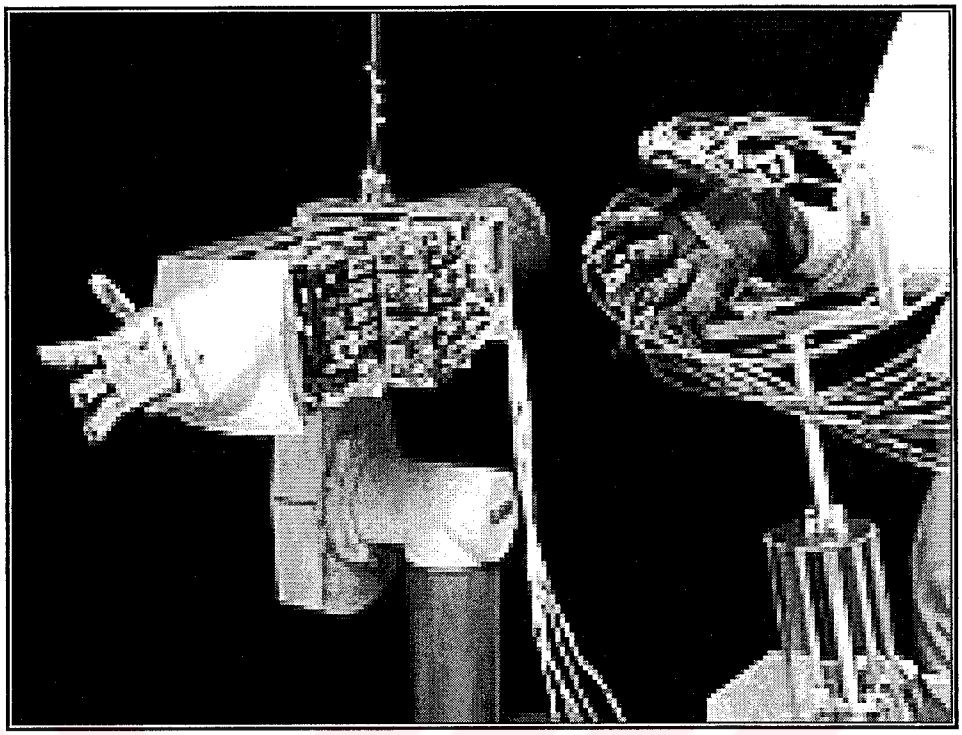


Fig.2..3.3 A Robotic arm used in telepresence (credit NASA)

The use of telepresence is most common in operations that need to be done remotely for safety reasons like exploration of dangerous environments like space and underwater and

would provide cost benefits and remove divers from hazardous environments.

Popular areas of telepresence applications are remote surgery, sub water work, education, real estate and entertainment.

2.4 Brief Overview of VR applications in various Sectors:

The fully immersive virtual reality technology is not yet perfect and still too expensive and bulky for commercial use. For now, this technology is limited to big companies and special areas like pilot and astronaut training and medical surgery.

Yet, the research of this technology for use by mainstream society is continuing with great enthusiasm while less immersive VR is already being used in many sectors already like education, entertainment, architecture, chemistry, space explorations and art.

2.4.1 VR in Entertainment:

Games:

In the last three years, a devoted subculture has developed in the area of gaming. Games can be on video, mobile or online, but all games provide with opportunities to develop and exercise skills and creativity. Online games – games played on the net- which became widespread recently enable people to meet and interact with others in both competitive and cooperative ways and be involved in a world-wide community.
An online game played among 3 people through the same program with the same interface,

provides with a sense of being present at the same room together. This kind of games are

called MUD, the abbreviation for Multi-User Dungeons; games played with multiple users in a cyber world at the same time. The world is mostly made up of an interface of inter-connected rooms to a large landscape. Players see each other's presence and can interact with one and other.

The worlds are persistive as in the case of if you cause a change in the world and then log off the computer, the change will still be there next time you log on.(Reynolds 2003)

The actual physical location of the users has not changed at all, however they are in one "room" interacting and playing with each other. (Suler 2002)

Second Life is a desktop VR game that makes the gamers almost feel like they live a second life via advanced communication software and real-time in-world building tools. Residents of Second Life chat, build, join groups, claim land, start businesses, visit distant locations, explore, and play games as they wish. (Secondlife 2005) Second Life depends strongly on player input

Fig. 2.4.1 An avatar from Second Life

2.4.2 VR in Education:

VR, adds the motivational value interactivity which "reality" does not, such as scaling, object penetration and reconfiguration. A student for example can walk around a DNA sized millions times larger than its actual size. Doing this would be impossible in real life for many fields. So, VR offers extraordinary learning opportunities by placing students in an environment where they can discover and experience the material to be learnt from within. Since any imaginable environment can be designed as a virtual environment like actual nature of landscapes, underwater shipwrecks, spacecrafts, archaeological excavation sites, human anatomy, sculptures, crime mscene reconstructions, applications have been developed for learning and teaching in many areas already including science, art, history, math...however many of these applications are note fully immersive yet, but partially immersive such as desktop VR.

Walczak D. (2002), co-founder of the Kleiser-Walczak Animation Studio, has some more explanations for why VR learning can be beneficial. She points out that traditional teaching focuses on the average students often ignoring the faster and slower learners. VR can be useful to build a custom learning environment for each category of student.

Secondly, she states that VR will awaken a sense of curiosity and interest about their learning by making the process much more fun.
However today fully immersive VR systems are just too expensive to build for commercial use in schools for now. A good alternative is the use of partially immersive desktop VR systems and tele-conferencing systems mentioned before .

CyberMath is a shared virtual environment for mathematics education In the CyberMath environment, students represented by avatars dwell together in actually experiencing mathematical objects as if the mathematical objects were in front of him. The student can easily interact with the objects via an input device like a mouse.

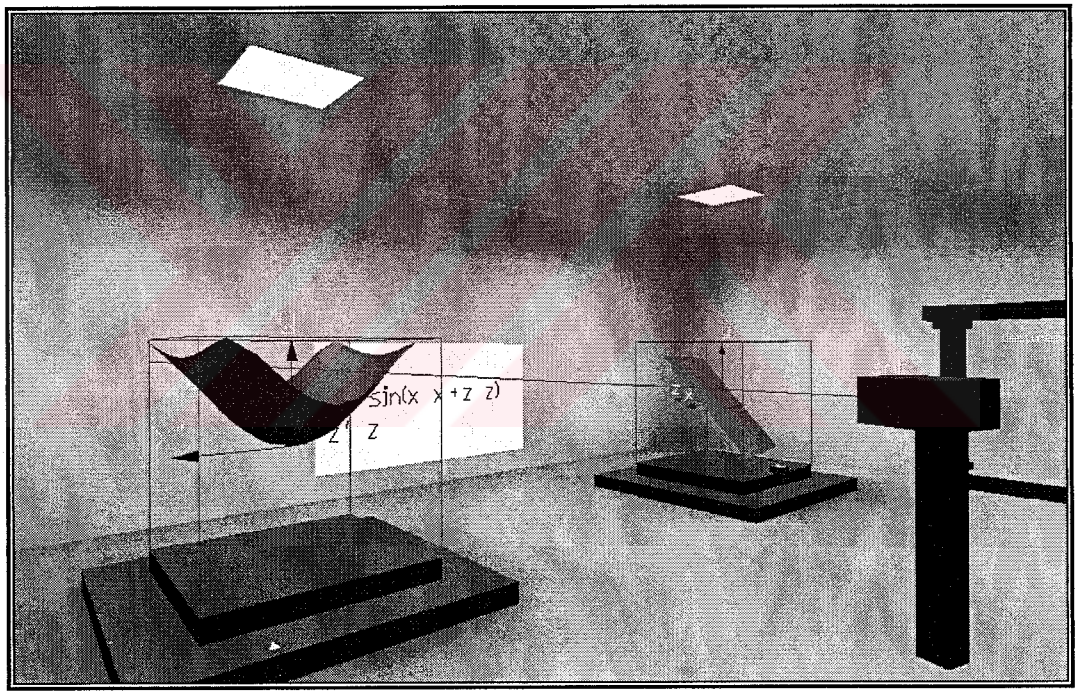


Fig.2.4.2a Cybermath

CyberMath is built like a museum with a virtual lecture hall in its center surrounded by a number of exhibition galleries, each containing an array of mathematical elements.

Fig.2.4.2b The transformations exhibit in CyberMath.

Neumann and Kyriakakis suggest that remote immersion systems like video conferencing bring interactive and simulating classroom experiences to students and teachers regardless of location. Students and teachers from around the world will be brought together by high resolution video and collaborative (shared) virtual environments that will provide a place to discuss and interact with one and other, and even visit virtual environments online like an archeology museum. (Conolly 2005)

Recently, video/computer games are also being recognised as a good option for education. It was figured out that the game "Second Life" mentioned above, was being used by a British organization called ARCI to help abused children in Portuguese. Children, who has been hiding away from their abusive parents, participate the game and learn life lessons such as socialization, collaboration, team building...(Wired 2005)

2.4.3 VR in Architecture:

The process of architecture includes planning, design, construction and maintenance. In the planning and design step, the designers has to brainstorm and trade ideas among many other groups as administrators, owners however, since these other groups lack adequate knowledge on architecture, it is often a difficult task for them to the modeling process. Moreover, when the design is completed, any needed change takes vast amounts of time and money.

This is where Virtual Reality comes in very handy. VR provides the real-time simulation of design prior to the construction with a very realistic 3D model of the building. It helps residents and administrator to understand design and gives the opportunity of instant correction of mistakes and unlimited number of trial options.

In 1999 the virtual reality group at Aachen University supported the faculty of architecture during the planning phase for a new building (RWTH) that should be located behind the Reiff museum, Schinkelstr. They created a 3-D model of the building before it was actually built where architects and planners could walk through -within the VE- in order to avoid any possible design and construction mistakes. The real building was completed in 2001. (RWTH 2005)

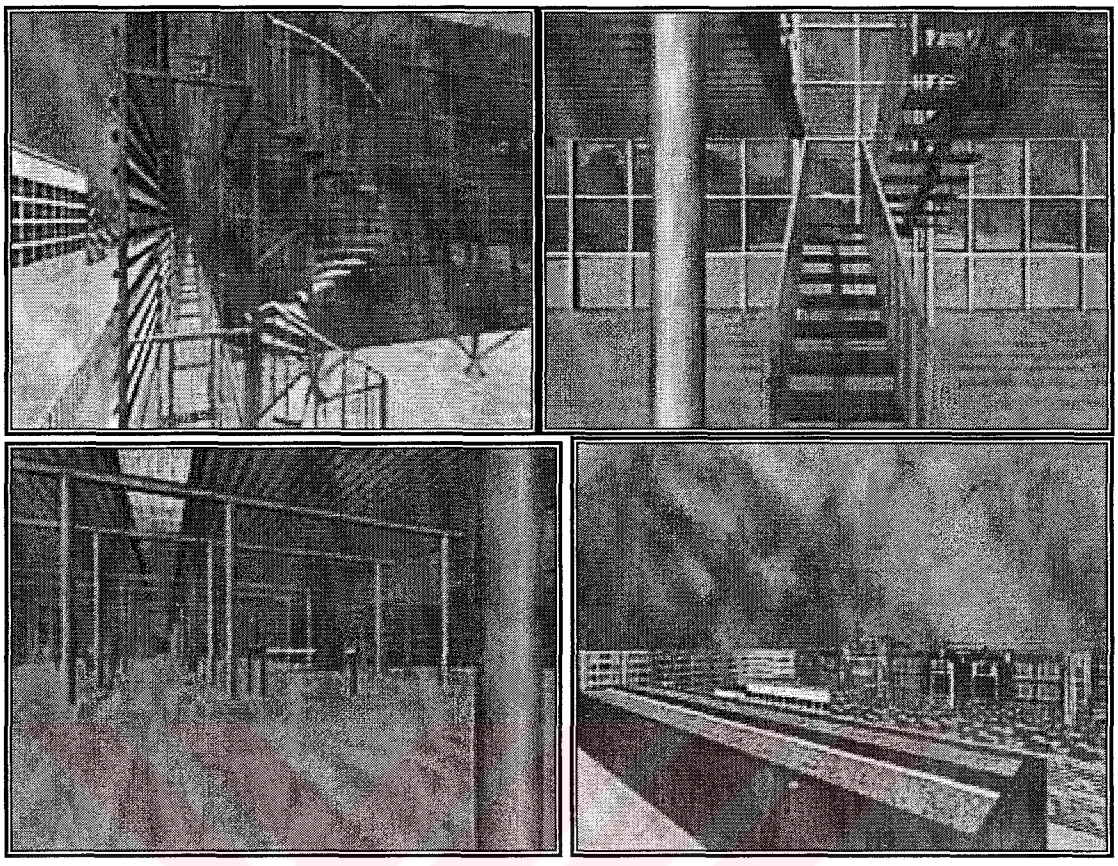


Fig.2.4.3VR in architecture

2.4.4 VR in Industrial Design

The Aertospace Industry is one of the first to take up Virtual Reality. Using VR opens up a whole new world of flexibility and interactivity where again there is the opportunity to freely explore and modify the design, in other words, experience the product way before than its actual production. Rolls Royce first used VR when designing their Trent 800 engine. Virtalis, one of the world's leading Virtual Reality (VR) and advanced visualization companies created a virtual model for them to conduct both high level reviews and detailed investigations into pipe clashes. (Virtalis 2005)

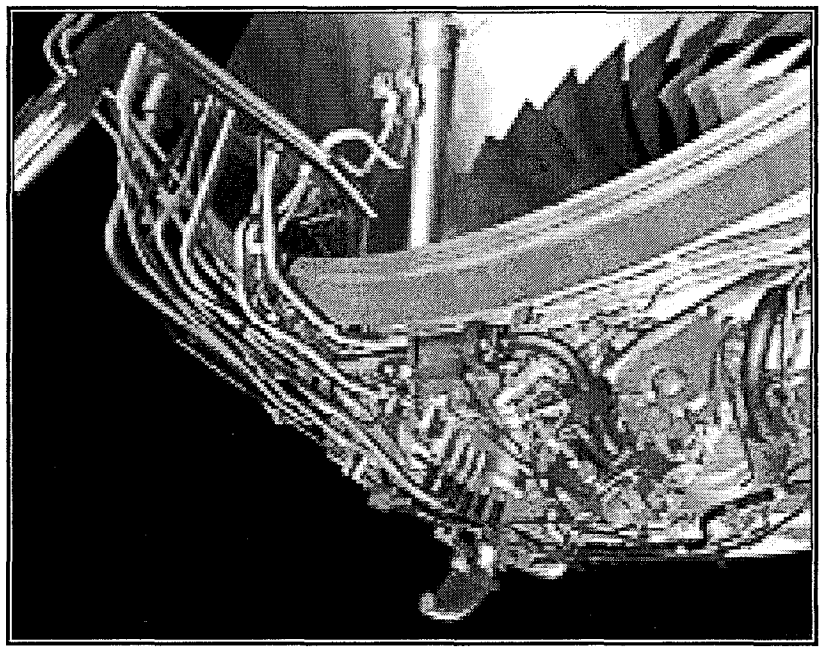


Fig. 2.4.4a Rolls Royce Trent engine for design and maintenance

In Fiat/Alfa Romeo's parametric car, a driver experiences the real spatial relationships in a car via the looking through the HMD and geting tactile feedback by touching.

Fig2.4.4b Combining real and virtual worlds

Besides planning and designing, there is also the presentation of these products. VR is considered the best way possible to present any kind of subject since it actually takes you in to the product and lets you explore it from within.

Barco and its Partners is a company focusing on immersive and stereoscopic display products for a variety of markets ranging from engineering to medicine. Below are example s of the displays they provide with.

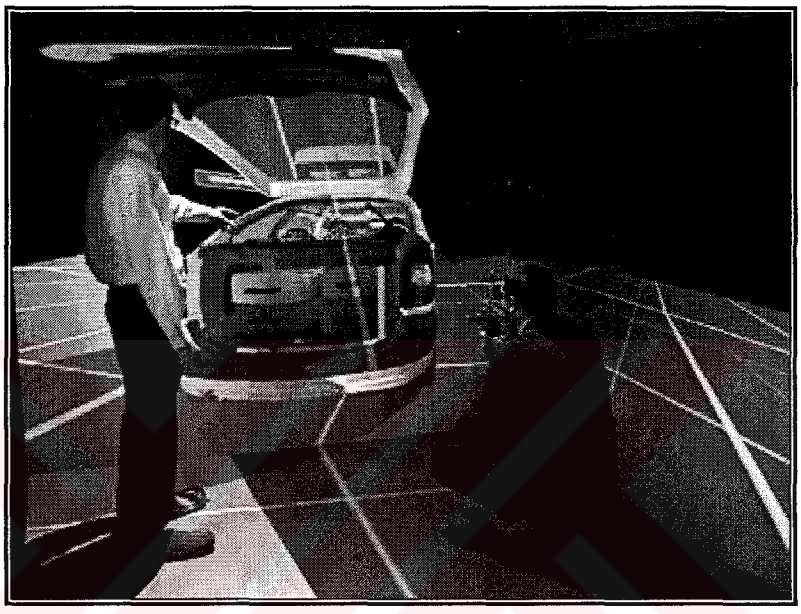


Fig.2.4.4c An immersive VR display system for an automobile design

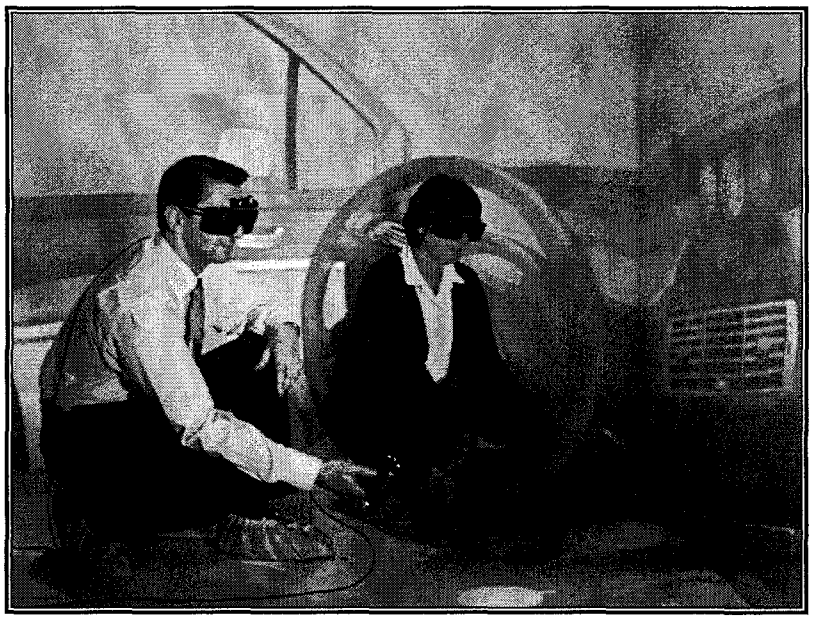


Fig.2.4.4dchannel MoVE with BarcoReality 909

As some critics think to the point that the emerging technologies will one day perfect the image production, and as a consequence that the virtual will appear to be more real than the actual object or the experience, causing a *"*reality inversion*" . For example, a person wanting to visit the Amazon Forests, will prefer to immerse into the virtual version of the forest looking and sounding even more real than its actual instead of bothering to go all the way there. He will actually appreciate the forest better in the VE since he'll have the opportunity to control the environment, fly through the trees, land on top of a tree, observe soil from within which would be impossible in the real one. An elderly man will prefer to have an artificial experience of the North Pole visit, without having to risk the cold temperature that can be a danger to his health.

Virtual reality holds great promises for the benefit of mankind in many areas. There is a growing number of research institutes devoted on the subject and an increasing public recognition obvious from numerous sectors' annual VR conferences held around the globe. The rising attendance at the annual meeting "Medicine Meets Virtual Reality" taking place each year in San Diego is one example that exhibits the high interest of the medical arena to the VR applications. Medicine is probably one of the areas that will benefit the most from VR , explored in depth at the following section.

3. VIRTUAL REALITY IN MEDICINE

Medicine and healthcare is probably the area which gets the biggest benefits from the various platforms of cyberspace as VR, AR, Telepresence and the Internet. The usage of such technology has massively added to the quality and speed of medical education and healthcare deliverance.

Applications have been developed in the following areas:
Surgical training and planning, remote consultation, psychological therapy, patient education; medical education and training, skill enhancement, disability solutions and rehabilitation.

VR for medicine is a very recent sector dating back around the last decade. The development of medical VR products and commercial usage is in its early stages at best, but research in this area and the number of prototypes are increasing at a big speed.

3.1 Medical education Applications

Current medical training involves cutting up cadavers, teaching on mechanical models, experimenting on animals; observing and performing supervised operations. In a recent report "To Err Is Human: Building a Safer Health System" released by the Institute of Medicine in Washington, DC, it was announced that medical errors cause 100,000 patient deaths each year in the United States alone. The integration of the VR Related technology in medical education will provide a much better education and outstandingly reduce the number of fatal mistakes. There will be no need for trying to find a cadaver or experimenting on a poor animal where the subject to be operated is neither dead nor an animal but a live human. Human anatomy will be comprehended much better since students will be able to travel in and around the 3D human organs and see how these organs are built from inside the actual organ.

3.1.1 Anatomy Teaching

3.1.1.1 Virtual cadavers:

Cadavers have been the most essential part of medical training however they are very difficult and expensive to find, and do not accurately symbolize the *live* body. A virtual cadaver is a computer generated three-dimensional model of a human, complete with organs, cells, tissues and cellular structures. Contrary to a real cadaver, a virtual cadaver allows one to fly through cells, nerves, reproduce any pathology and disease on demand and allows repeated slicing and cutting.

The Visible Human Cadaver Project:

The creation of a "Visible Human" cadaver (Fig. 3.1.1.1.1) was completed at the University of Colorado's Health Sciences Centre, as a part of the National Library of Medicine's project to build a digital biomedical library of the human anatomy.

The anatomical data was collected by scanning milimetric slices of a frozen cadaver of a criminal who donated his body to this project in return of getting euphonized instead of an electric shock for his death penalty.

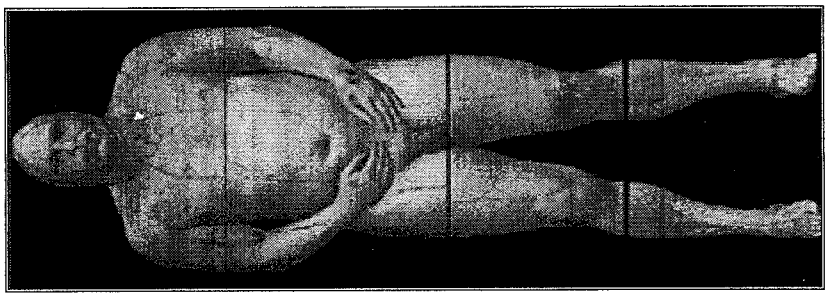


Fig. 3.1.1.1.a The Visible Human Cadavre

The milimetric data obtained to build the cadaver was volumetric and it was obtained with the Volume Imaging Technologies (Fig. 3.1.1.1.1b) which involves Computer Aided

Tomography (CT), Magnetic Resonance Imaging (MRI), (MRA), (MRV), Ultrasound; physiological Imaging (PET), SPECT, Fmri.

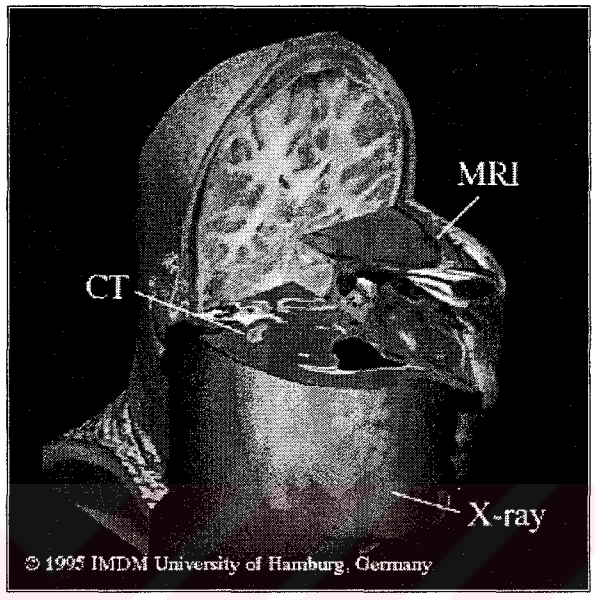


Fig. 3.1.1.1.b Voxelman showing registration of several data sources

The first two data sets were receieved with MRI and CT (Fig. 3.1.1.1.1.c) . Then the body was frozen and cut into 1,878 1mm thick slices parrallel to the MRI and CT images.

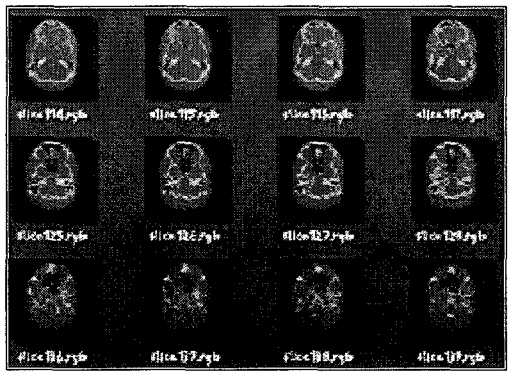


Fig. 3.1.1.1.c Slices of CT scans used for VH.

3.1.1.2 Functional Virtual Bodies

Virtual simulation of the human organ behavior (reaction of the organs to a cut, pinch etc..) was the next tremendous step in the evolution of medical education and surgical training.

Organ behavior simulation provides great advantages in training by allowing planning and predicting of final results of an operation such as simulating the biomechanics of muscles and joints to make more effective replacement joints.

To interact realistically with the virtual human organs, they have to act like real organs besides looking like them -they should bleed when cut, cram up when squeezed.- Simulating the function of an organ is done by digitally mapping an anatomical image (taken from a CT scan, x-ray, the Visible Human…) from a live person onto a polygonal mesh and assigning each vertex of the polygon to attributes like color and reflectivity from the image of the organ.

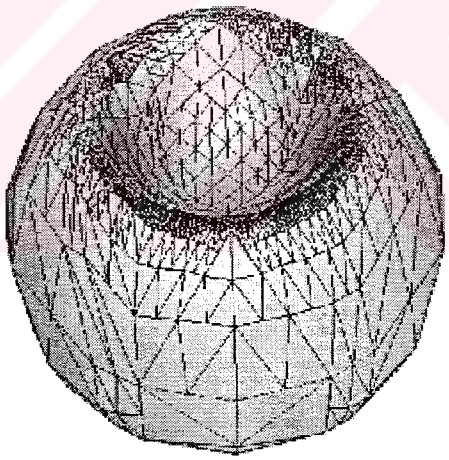


Fig.3.1.1.2a Digital Mapping wireframe

For the user to interact with the graphics, there must be a number of sources:

- First, there must be software that can determine whether virtual tool crashes another body part .
- Second, we need models of how various tissues behave when cut, punctured, squeezed.. VR designers make the tissue into a polygonal mesh that reacts like a

web of forms connected together where, if one little part changes, it effects the rest of the form.

- ❖ After building the mesh, the parameters of these models are arranged to match the experience of a real surgical procedure. Big computer power is necessary to quickly update the graphics on the monitor.Tissue deformation must be calculated at least 30 times per second for realistic viewing.

Once we have a functional body, it is also possible to produce any pathology -depending on the computer program- in order to see how certain illnesses form and how they behave.

3.1.2 Medical Multimedia

The digital library was built by taking high-resolution color digital photographs of each slice of the cadavre, taking up 15 gigabytes and storing them on an FTP site, with a free license to be downloaded directly from the Internet so the information is provided virtually instantly, throughout the world. The Visible Human Project was a true phenomenen that changed the way that anotomy is thought by being applied to a wide range of educational, diagnostic, treatment planning, virtual reality, artistic, mathematical, and industrial uses.

Many electronic computer-based training simulations -like body fly-through- exist today, mostly based on the Visible Human Cadaver: Digital Anatomist, Anatomic Visualize and

Animated Dissection Applied to Medicine (ADAM) are some of these anatomic simulations.

3.1.2.1 The Anatomic Visualizer

The Anatomic Visualizer is a VR-based environment for teaching and learning of clinical anatomy developed by the University of California, San Diego School of Medicine. It allows students to view and interact in real-time with teaching modules of various anatomy sections like the skull and the ear in a virtual room with 3D glasses. The 3D models of human

anatomy are done either in-house or taken from the Visible Human dataset mentioned above. Besides 3D, 2D images, videos are also integrated in this learning environment. This program provides with an excellent learning opportunity since students can explore inside of the human structure as hundreds of times magnified than in real world, have the ability to manipulate the structure for better exploration like turning the opacity of some organs for a better view of others, measure forms and so on (Grigore C 2003).

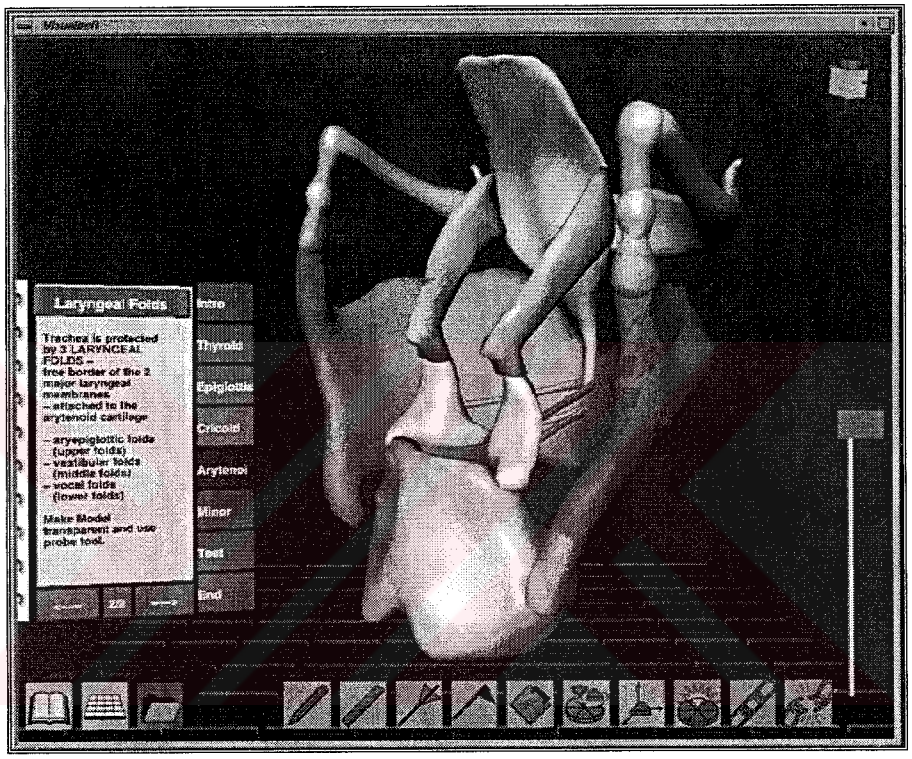


Figure 3.1.2.1 A screen capture taken from the Anatomic Visualizer

Students are also able to reconstruct any area from its component parts, measure sizes and distances with a virtual ruler and draw 3D lines using a space draw tool. Anatomic Visualizer supports many input options as gloves, 3D trackball and mouse. With these interaction tools, students get encouraged to discover, and experiment by trying to construct body parts from scratch for practice.

3.1.2.2 The Digital Anatomist Project

The Digital Anatomist project is an interactive anatomy education site consisting of sets of images and animations put into interactive tutorials and tests representing different body regions that is accessible from any desktop computer around the world.

This project is produced by the University of Washington, Structural Informatics Group, consisting of computer scientists, engineers and biologists. The visuals for representing anatomical information is built by:

a) The generation of graphical models derived from cadaver and clinical imaging data
b)Symbolic modeling of the structures and relationships that constitute the human body.
c) Interactive teaching modules placed on the Web, including textual description, 3D images and animations of the human internal systems, providing with an affordable and instantly accessible way of medical education from all around the world.

The site provides access to four on-line interactive atlases; interactive atlases of thoracic viscera, a neuroanatomy interactive syllabus, and a knee atlas. (Grigore C 2003).

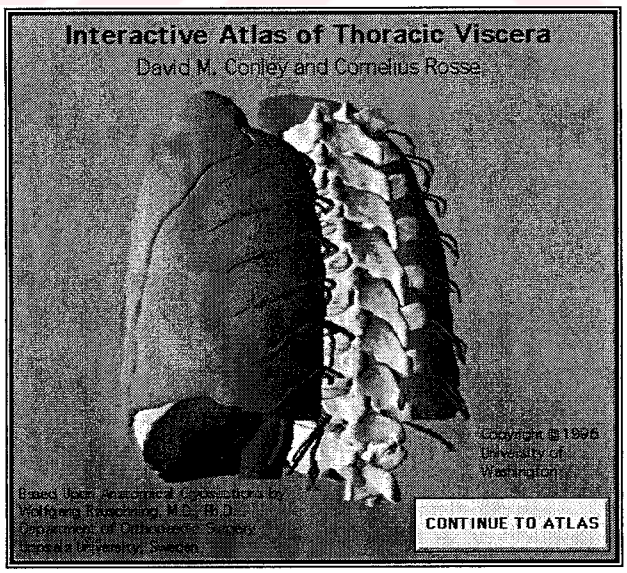


Fig.3.1.2.2 The Digital Anatomist

3.1.2.3 A Medical multimedia laboratory- Blaufuss

Blaufuss Media is an online medical multimedia laboratory combined of video, sound, and animation that offers the training in diagnosization of *heart sounds* and *cardiac arrhytmias*.

The trainee is presented with very realistic material and has exposure to a range of patient conditions from benign to life-threatening. Included in the site are interactive multimedia tutorials that allow one to examine actual patients with aortic, mitral valve disease, and for supraventricular tachycardias (SVTs), using actual patient sounds and video by capturing and digitizing real patients' classic cardiac physical findings.

Moving a virtual stethoscope over the chest lets one listen to the heart at different areas, while at the same time viewing a video of the patient's heart pulsations in different locations like the neck, pericardium, wrists and ankles . The site also tests for efficiency and reports the results. The results are given in text, illustration, animation and phonocardiogram format.

Interactive heart sounds quizzes test the user's ability to spot various types of heart sounds taught in the tutorials like first and second heart sounds, extra sounds, diastolic and systolic murmurs in recordings of actual patients.

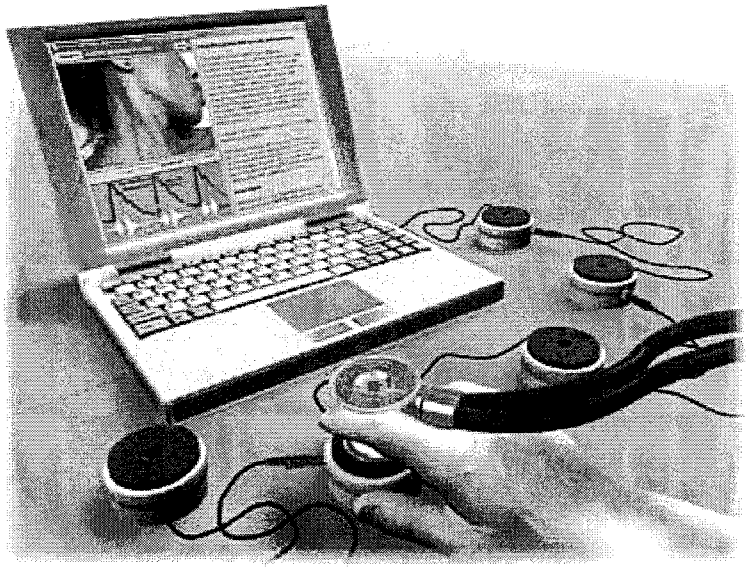


Fig. 3.1.2.3 Training of *cardiac arrhytmias* (Blaufuss,2004)

The site offers particular hardware and software for further training on heart beats.
The hardware consists of the Sonitors™ and the Pulsators™.
Sonitors™ send out sounds and murmurs from the computer directly and to the ears through the stethoscope, and are compatible with any kind of heart sounds software.

Pulsators™ allows a trainee to get a tactile feedback by offering him feel a diagnostic carotid pulse, apex beat, or right ventricular lift.

The greatest software they offer is the " *The Heart Sounds Proficiency Test*" which is currently used to test medical trainees and physicians at teaching institutions on over 400 participants. "Combining video and sounds from actual patients, and interactive computer animation, it is the most realistic test of physical examination to date". (Blaufluss, 2004)

3.1.3 Medical simulation video games

In May 2003, a study on whether good video game skills of a surgeon has any effect on his surgical skills showed that surgeons who spent at least three hours a week playing video games made about 37 percent less mistakes in laparoscopic surgery and performed the task 27 percent faster than the ones who did not play video games. The study was done with Beth Israel and the National Institute on Media and the Family at Iowa State University.

The results say that playing video games in general improves hand and eye coordination since one has to control a joy stick while watching very carefully the game on the screen. Since surgical operations require excellent hand and eye coordination, it is concluded that playing games is very advantageous to a surgeon's surgical skills (hand and eye coordination). So, there emerged the recognition of the potential for training medical students and surgeons using games, and not only regular games but *medical games*, with content related to healthcare.

There are numerous medical simulation games available on the market today, however these games are not particularly intended for medical education or surgical skill enhancing

but intended solely for entertainment purposes. Exploring these games one by one would be a waste of time since nearly all the medical simulation games available on the market resemble each other based on the same principles, rules, methods and choices they present.

These games can be on video or on the net and most of the time very realistic and anyone without any medical training can play them with the training section in the game.

The *ER Sim* game for example, is an online medical simulation game, placing the user in the middle of the ER room with the role of a doctor. The user can choose his patient's case from the menu -there are cases ranging from traffic accidents to heart attacks-, take his blood test, CT scans, MR, choose specific tools among trays of diagnostic, treatment, and imaging tools, and operates the patient.

Every decision is critical in the game leading you to the road to become a chief or the road to get fired. Some games also consider ethical issues in the hospital, like the ER game, which is based on the TV series "ER", reducing the player's points if a decision he took does not fit the ethics, such as an illegal decision like euthanizing the patient in a state where it is yet unlawful. (Charles R, 2004)

Another one, called the *Emergency Room*, puts the player as a doctor in a busy emergency room where he examines, tests, diagnoses, and treats 50 patients, suffering from gun fire, bruises, premature labor, hallucinations and so on, choosing among 50 medical tools.

Some medical simulation games available on the market are:

Emergency Room: Life or Death

Emergency Room Collector's Edition

Emergency Room Code Red

Emergency Room: Disaster Strikes

911 Paramedic / ER Code Red (Jewel Case)

These games are not prepared for medical students or doctors but intended for the general public who just wants to get a glimpse of the medical world. However, taking into consideration the study of Beth Israel mentioned above, games can be a treasure for medical schools to practice students' surgical skills in a competitive and fun environment.

*

We have talked about the importance of virtual cadavers in anatomy teaching and now we will explore the opportunities that VR provides in surgical training. A real cadaver is not suitable at all for repeating a process because a mistake will permanently alter the organs, and animals and mechanical puppets are simply are not adequate to provide good training because they are not humans! Even after going through these trainings, it still takes many repetitions on real patients before a surgeons perfectly performs a procedure, mostly harming the patients. A VR-based training is of vast value since it gives the opportunity to undo a mistake, repeat the operation and produce any kind of illness and pathology on demand for practicing purposes.

3.1.4 Surgical Stimulators

Traditional surgical training is done with experienced surgeons teaching surgeon-to-bes over a period of years in the operating room, and then practising on real patients for a while. These skills are hard and take a long time to develop and the patients become victims in order for a surgeon to gain good practise.

Surgery simulators are alternative systems that very realisticly mimmick the look and feel of performing an operation, consisting of a haptic interface, a monitor with necessary graphics (like a virtual inner ear) that we interact through the haptic interface, and a processing gcomputer. These simulators allow trainees to practise their surgical techniques in a short while, and before touching a patient, also ensure patient safety. Surgery Simulators are priceless devices in training surgeon to-bes more precisely and in a shorter time, for testing a surgeon's skills and to show the patient beforehand the exact surgical procedures that will take place in his body.

There are a good number of virtual reality surgical simulators already available for prostate, eye, leg, and cholycystectomy procedures.
Since haptic feedback is the key element in VR surgical systems, it is essential to mention it:

3.1.4.1 Haptic Feedback

Haptic feedback is the sense of touch in the digital world.
The word haptic, coming from Greek, relates to the sense of touch. Our haptic perception refers to our perception of touch. When we touch objects in the real world we feel qualities like texture, temperature, mass, and movement. The sense of touch is maybe the strongest element in knowing we are present in that environment since we actually come to physical contact with that environment.

Physicians greatly rely on their sense of touch for everything from routine diagnosis to sophisticated surgical operations. It is possible to experience these elements of touch in a virtual environment with haptic feedback technology.

The haptic system provides us with both sensing the real environment and *manipulating* it. Say we scratch a balloon, it deflates, or if we squeeze a gum it stays that way. Squeezing the gum makes us sense the gum's texture and it also affects the shape of the gum. More

technically, there is both an input from the environment and output to the environment. So the haptic system is both an input device that we feel and manipulate the world with.

A haptic interface/display of a VR system is a system that mimics the real haptic system to *touch* and feel the objects and manipulate them. Although we can feel with every part of our skin, haptic displays are limited to the fingers, hands and the limbs (arms, sometimes legs).

Burdea and Coiffet divides the human haptic system into two modalities:
Tactile (touch) Feedback and Force Feedback (Grigore C, 2003).

3.1.4.1.1 Touch feedback

Touch feedback conveys real-time information on contact surface geometry, virtual object's surface material, roughness, slippage, and temperature. It does not actively resist the user's contact motion and cannot stop the user from moving through virtual surfaces.

3.1.4.1.2 Force feedback

Force feedback provides real time information on virtual object surface compliance, object weight, inertia. It actively resists the user's contact motion and can stop it. The forces result from muscle exertion.

In this case, touch feedback is the input data gathered from the environment and the force feedback is the output data that can manipulate that environment.

Simulating an internal organ is done bu digitally mapping the anatomical images onto a polygonal mesh representing and assigning each vertex of the polygon to attributes like color and reflectivity from the image of the organ.

3.1.4.1.3 Tactile Interfaces:

Tactile information is perceived by the simulation of the skin tactile receptors, both in real and virtual haptic interface. The skin's tactile receptors can be stimulated in many ways in the tactile interface (Grigore C 2003):

- Vibrotactile feedback: Vibration with electric actuators mouse.
- Temperature feedback: Provides with distinguishing objects according to their

thermal characteristics such as surface temperature, thermal conductivity and diffusivity.

- ❖ Direct electrical stimulation: Electrical pulses to the skin
- ❖ Functional neuromuscular stimulations: Provides signal directly to the user's primary cortex.

3.1.4.1.4 Force feedback Interfaces

The haptic interface provides forces to the user to give him the feel that an object is harder or softer. HT Medical's latest product, a virtual sigmoidoscope, is designed to simulate such an interaction. The user grabs the handle of the sigmoidoscope, which simulates the real tool that inflate the colon and sucks matter in the colon. The instrument leads to a model of a patient's buttocks and delivers a feedback force to the user, with actuators and brakes that limit the user's hand movements. The software includes graphical and haptic information representing the colon. Graphical info can be the deformation of tissues or bleeding of the inside of the wall.

Fig.3.1.4.1.4 Virtual Sigmoidoscope

3.1.4.2 Virtual Endoscopies

Virtual endoscope is a technique of diagnosis using 3D images like CT Vand MRI scans to provide simulations of patient's specific organs providing screenings of the

internal body that is not possible with traditional endoscope procedures. In traditional endoscope, visual feedback is provided on the monitor from a tube-like device inserted in the body cavities. The surgeon orients medical devices in the patient's body by looking back and forth to the monitor where he sees the inside of the internal organ. This procedure can be dangerous as it can cut the walls of the body cavities with a wrong maneuver so good manual skills and repetition to practice this are a must.

Currently, endoscope training is done on animals and mechanical models which are far from truly representing a live human thus misleading to practice with. Virtual training holds the opportunity for numerous repetitions to sharpen skills without ever harming a patient.
Virtual endoscope training is done with surgical simulators which consist of a simulated body part into which a number of handles of the endoscope or laparoscopic instruments are mounted and that provide force feedback. An example is the virtual abdomen by Stava that is viewed through a head-mounted display (HMD) and be interacted with a DatagloveTM by which a surgeon can grab a virtual scalpel and clamps in a very natural way to operate the abdominal organs.

A recent study made in March 2005, to test whether laparoscopy skills learned in VR is transferable to physical reality showed that the simulation trains surgeons in basic laparoscopic skills learned in years of practice and training with a computer simulator skills learned in virtual reality are transferable to the physical reality. (Lehmann,2005)

3.1.4.3 Plastic Surgery Training

The Department of Plastic Surgery, Hand and Burn Surgery at Aachen University together with Center for Computing and Communication, Virtual Reality Group created a virtual operating room in which it is possible to place a virtual patient on an operating table and simulate the breast reduction or abdominoplasty surgeries.

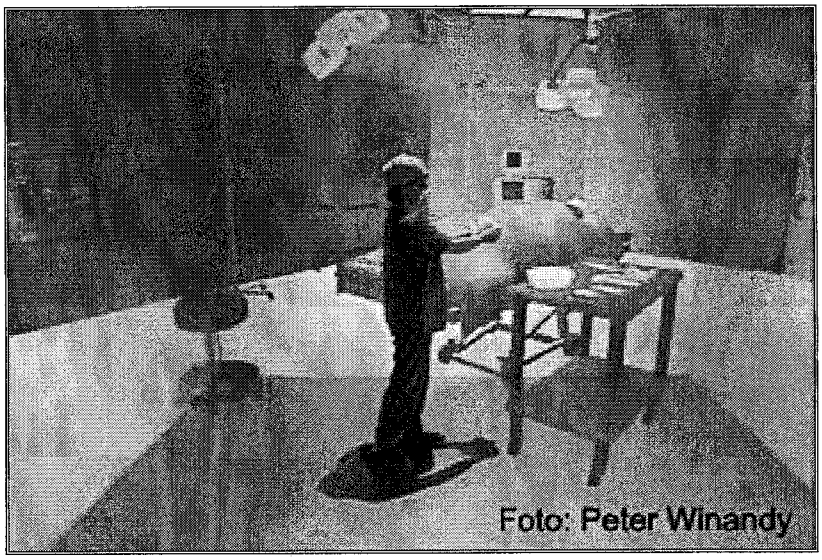


Fig.3.1.4.3a The virtual operating room

The data is processed using the CT scans of healthy patients.

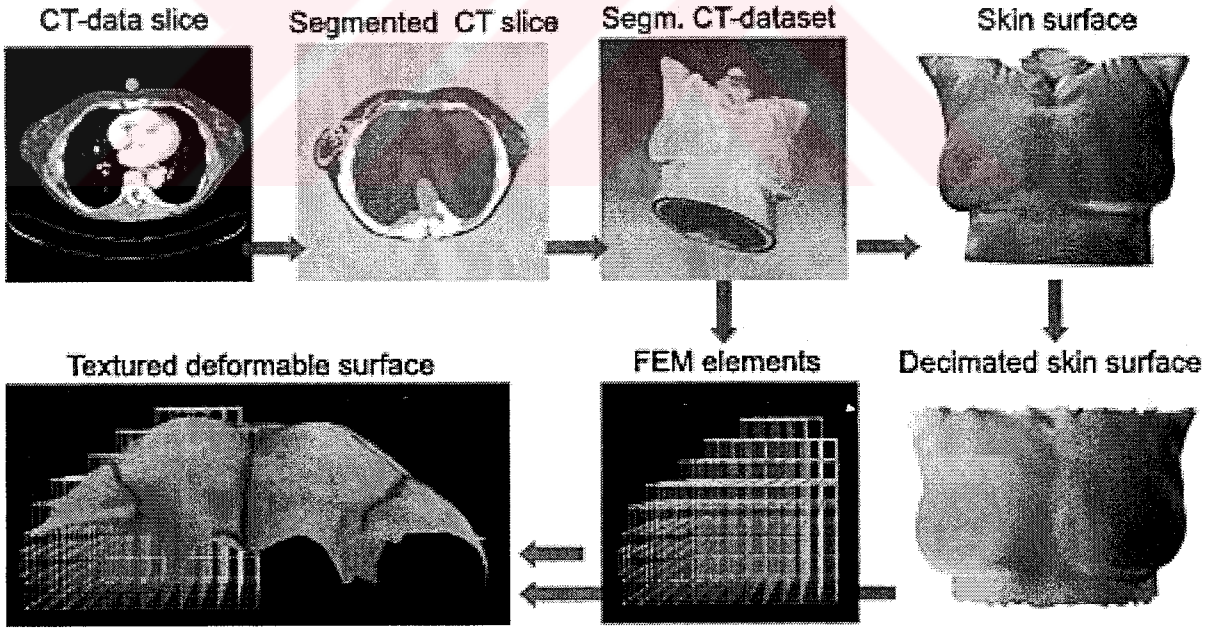


Fig. 3.1.4.3b Data Processing

Manipulations like pinching, cutting and dissecting to be performed with force feedback in real time.

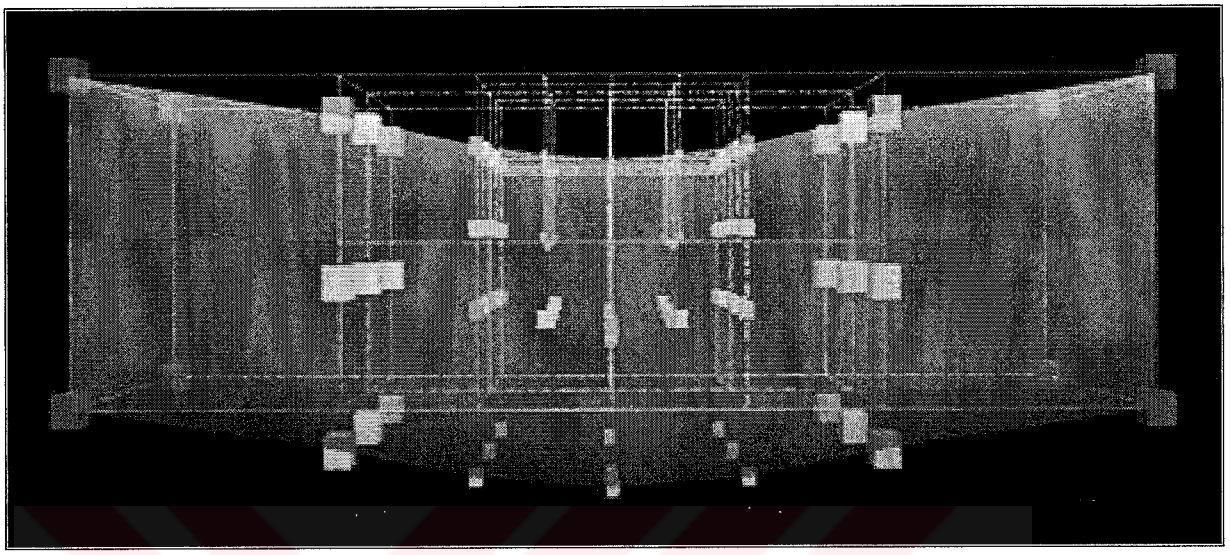


Fig. 3.1.4.3c Multiresolution deformation

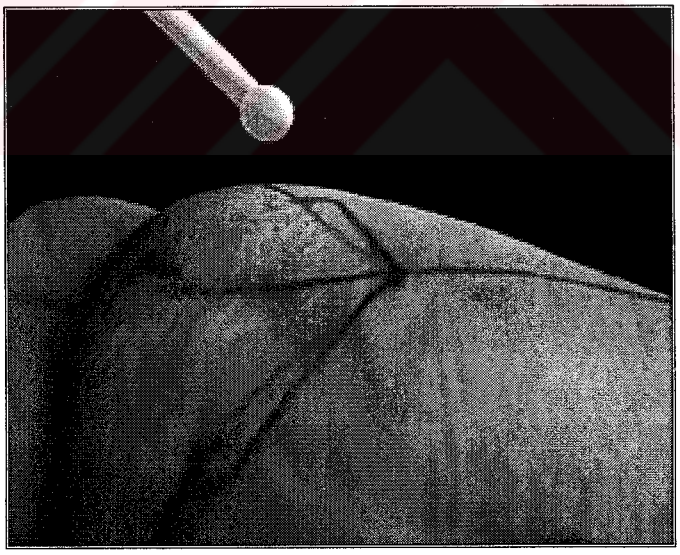
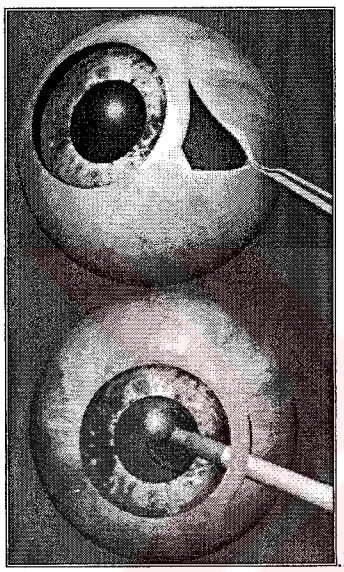


Fig.3.1.4.3d Interactive deformation of a female breast

3.1.4.4 Eye Surgery Simulator

The traditional eye surgery training is done on animal eyes or a cadaver eye which turn softer after being touched for a number of times. With the eye-surgery simulator, the surgeon peers through an operating microscope-like tool just as in real eye surgery. This microscope-like tool is attached to a Silicon Graphics workstation. The haptic feedback comes into importance here: The surgeon holds a stylus in one hand that gives him the feel of a real eyeball. The virtual eye ball also is functional in the sense that it bleeds, gains pressure inside and so on.



3.1.4.4 Graphics from the eye surgery simulator of Georgia Institute of Technology.

3.1.4.5 Virtual IV (Intravenous) Training

IV procedures are the simplest but most widely used procedures for various medical purposes ranging from injection for catheterization, anesthesia, blood drawing... The traditional way to learn IV skills is repeating the procedure a number of times on a plastic model, on an orange or practicing on real patients. As simple as it may seem, this procedure may cause infection and even death if done wrong.

To provide better IV training for nurses, Immersion Medical produced an IV catheterization simulator which consists of an haptic interface, a PC and a

monitor. The haptic interface has two handles, the left one is a mechanical arm representing the arm of the patient and the other is an actual syringe assemblage attached to the computer.

The syringe is linked to its graphical image on the monitor. So whenever the real syringe is moved, the graphical needle on the screen moves also the image The handle mimicking the arm is also linked to a graphical image on the monitor. When a trainee pushes the syringe into the mechanical arm, the virtual needle presses against the skin of the virtual patient, which is texture mapped and deforms (SFC, 2003). This gives a great sense of realism to the injection simulation. At the moment of the insertion to the "skin", there is a gentle resistance to mimic the matter of the flesh. The resistance is provided by forces applied by the computer. When the needle is finally inserted into the flesh, a release is felt on the right hand which holds the needle, giving the feeling that the needle has finally gone into the vein. With the insertion of the needle, graphical blood appears to flow from the vein on the screen, just like it would be in actual life. If a trainee goes wrong, he gets auditory feedback by the virtual patient starting to complain.

The types of the virtual patients in this simulator are not limited to only one type but range from a new born to an old man, from a skinny person to an obese one.

3.2 Practical Cyber Medical Applications:

3.2.1 Surgical planning :

In the traditional setting, a doctor, after examining a patient, gives her an operation date. When that day comes, the patient arrives to the hospital, goes through some medical tests and lays on the surgery bed and begins to get operated.

In the revolutionary "AR and VR" setting, a doctor gives the patient an operation date and till the actual surgery day, the surgeon has the opportunity to rehearse or try hundreds of procedures prior as to find out which procedure would be best for this patient or to practice that particular surgical procedure on the patient *without actually coming into any contact*

with her.

The ability to rehearse on a patient in such a way is achieved with a *surgical planning device* which takes actual physical records from a patient and combines it with computer-generated data; and allows real-time interaction with computer graphics mimicking the patient's anatomy. With all this in hand, the computer creates a simulation that will help plan and rehearse a surgical procedure.

An example is a virtual model of a lower leg upon which he can practice a tendon transplant operation and then 'walk' the leg to make guesses of the consequences of the surgery.

3.2.2 AR-based Surgeries

As mentioned in the previous chapter, augmented reality is the superimposition of computer generated information about the real world on the real world. In medicine, augmented reality is achieved by laying data from different sources like CT, MRI, MRA, X-ray, on real anatomy (fig. 3.3.2). Traditional 3D imaging procedures like MR, CT and ultrasound force

the physician to look at an x-ray or a monitor (in the case of an endoscopy for example) while operating a patient. The doctor's hands and eyes are in two different places, causing the physician to look back and forth between the patient and the monitor.

The advantage that AR provides here is that the overlaid information combines with the real anatomy in the same 3D direction and allows the doctor to see everything in one view. The surgeon feels as if he is looking through the patient seeing his internal organs as if he is transparent. The superimposed images can be still images, video and text.

One way to lay computer data on a patient's body parts is by using the HMD.

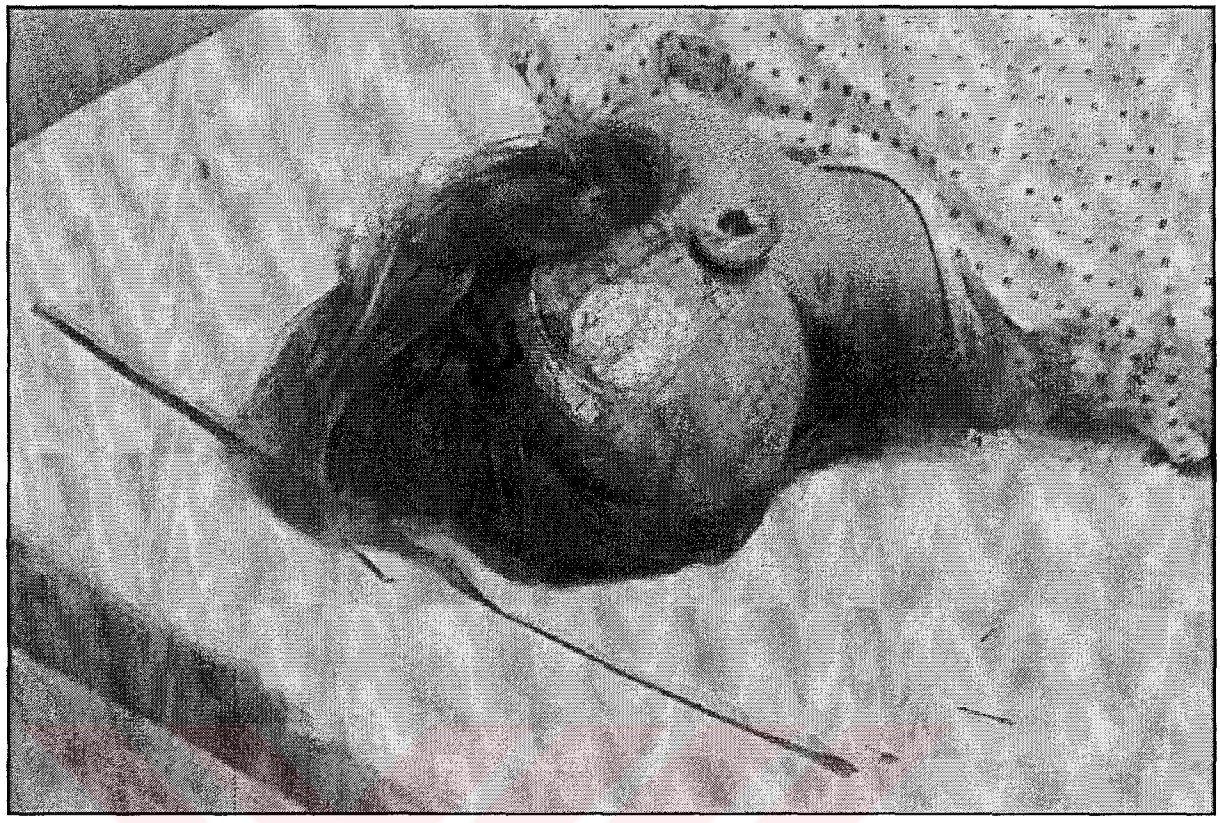


Fig. 3.2.2a Brain surgery: MRI overlaid on a video image of the patient's head

Siemens Corporate Research developed an HMD for medical applications in 2002 which has three mini-video cameras, two color and one black&white video camera(Manuf.Cent,2005) .

The two color cameras record the scene (the patient) in real-time through the surgeon's eyes and the third one is used to track the position and orientation of the surgeon's head. The tracking is achieved with the use of optical markers as cues for the scene changes with the surgeon's head movements. These markers stay fixed in the scene and the location of the markers in the tracker camera's image, allows for the combination of the live video with computer graphics in a way that the computer objects appear as a natural part of the scene.

This way, when the surgeon moves and looks at the patient from a different angle, the computer images will change according to his viewpoint. The three video streams coming

from these three cameras are fused together in an advanced computer station and sent back to the HMD for the surgeon.

Fig.3.3.2b Brain surgery: MRI overlaid on a video image of the patient's head

In 1993, surgeons at Brigham Women's Hospital, Boston collaborating with engineers at General Electric Co.'s imaging and visualization laboratory began modeling work to assist operations in real time. In late 1993, 17 operations were performed with the surgeons using overlaid video images. In one example, an MRI taken earlier was overlaid on a real time video image of the patient's head. This technique provides the greatest advantage of an X-ray view of a tumor that might otherwise not be visible if it is deeply embedded in the brain tissue.

Augmented Reality is most widely being used in minimally invasive surgery like endoscope, neurosurgical procedures, and orthopedics providing great advantages by nearly making the patient see-through.

3.2.3 Cybertherapy, VR-based / VR-augmented Rehabilitation

Therapy is another healthcare area where VR based applications are proving to be very benefitable and even replace the traditional ways of therapy in some cases. There is also a growing interest among psychiatrists in the field of cyber therapy which can be exhibited by the annual symposiums "Cyber Therapy" that bring together researchers, to share innovative ideas of Cyber Therapy solutions.

The areas are:

- Phobias (Fear of height, claustrophobia, acrophobia, fear of public speaking...)
- Patient distraction during painful medical treatment
- Rehabilitation of disabled people (Providing an environment for physical exercise
- Providing an environment for relaxation
- Training autistic children

VR-based and augmented rehabilitation has advantages over the traditional rehabilitation explored in the following few areas :

3.2.3.1 VR In the Treatment of Phobias :

Phobic disorders include fear of flying, fear of driving, fear of heights, fear of public speaking, fear of thunderstorms, claustrophobia, agoraphobia, social phobia and so on. Traditional treatment for phobias involves applying behavioral therapy techniques to help clients overcome their fears. Often, the technique is systematic desensitization meaning graded exposure of the patient to anxiety-producing stimuli or having him/her imagine it.

The stimuli is presented on location by taking the patient to an environment phobic to the patient -i.e. taking a patient who has fear of heights to the top of a skyscraper. therapy. The person with a phobia has weekly therapy sessions, either with a professional therapist or a recovered phobic during which the client learns new skills to

cope with the phobic situation –like holding a spider.

Most phobic people hardly ever look for a treatment for their problem because they want to avoid the event or object they are phobic towards. What is good about the VR treatment is that it encourages patients to seek for help. Plus, the VE is totally controllable and programmable to the person.

"VR treatment tends to be more attractive to patients because they don't have to actually face the feared object, such as a live spider, Hoffman said. "So VR is likely to increase the proportion of phobia sufferers who seek treatment." (www.washington.edu, 2005) Virtual reality therapy provides a real looking environment to the patient through the computer and a head-mounted display with monitors and stereo where they get the chance to experience whatever causes their phobia.

SpiderWorld, a VR environment developed for people with anarchaphobia. The phobic person will be immersed in a computer-generated world full of realistic spider models and animations through an HMD . Virtual spiders climb up and down the walls, drop from the ceiling to the kitchen floor, emerge out of the cupboard in SpiderWorld. The system is supported with a toy-like device that the patient holds which has the feel of a spider and vibrates each time the patient touches a virtual spider in the VR world.

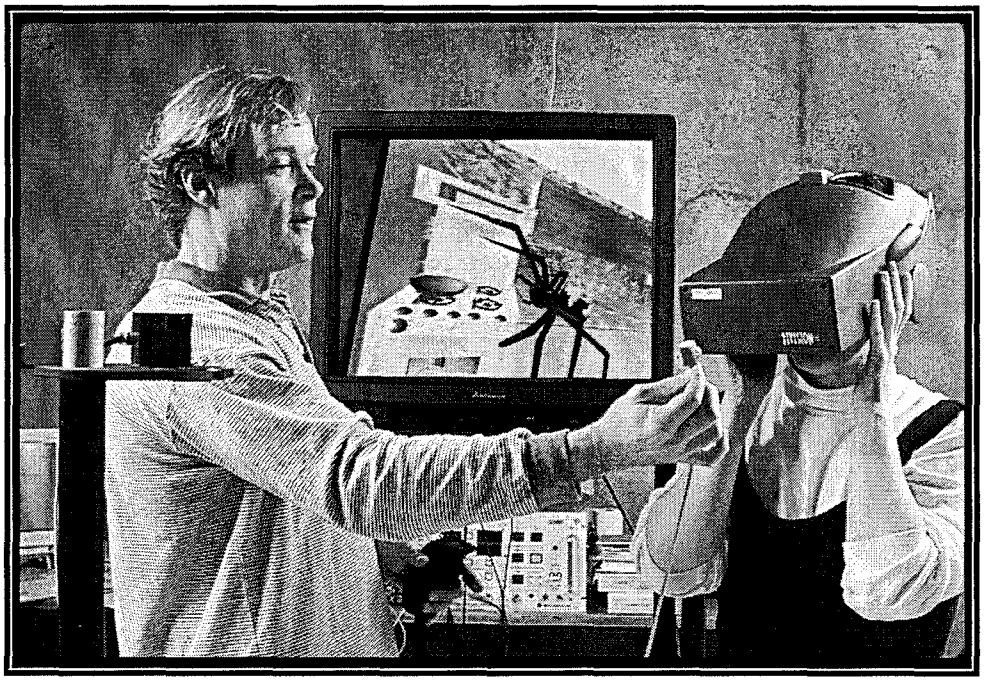


Fig.3.2.3.1a SpiderWorld -VR Treatment of Spider Phobia

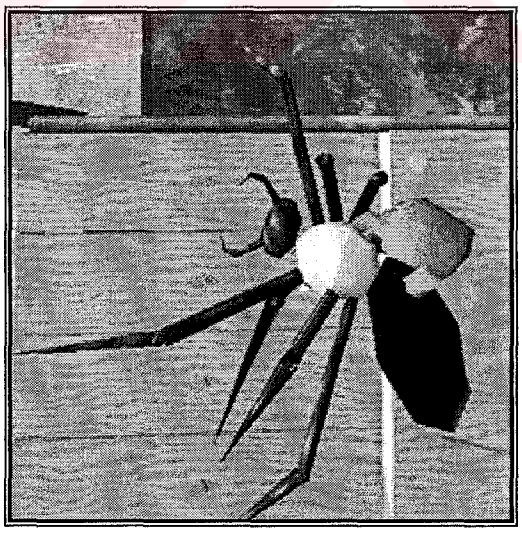


Fig.3.2.3.1b Spider Graphic

Researchers at the University of Washington's Human Interface Technology (HIT) Lab

measured aversion and anxiety responses of students, before and after undergoing VR therapy. During the therapy, some of the subjects touched a realistic model of a spider while grabbing a virtual one. The ones who touched the spider could come twice as close to a real spider after three therapy sessions, and reported a greater decrease in anxiety during treatment.

Another example is the fear of speech which is one of the most widespread phobias. In a VE, patients can practice giving a speech in front of a virtuaL group.(VRphobia.com,2005)

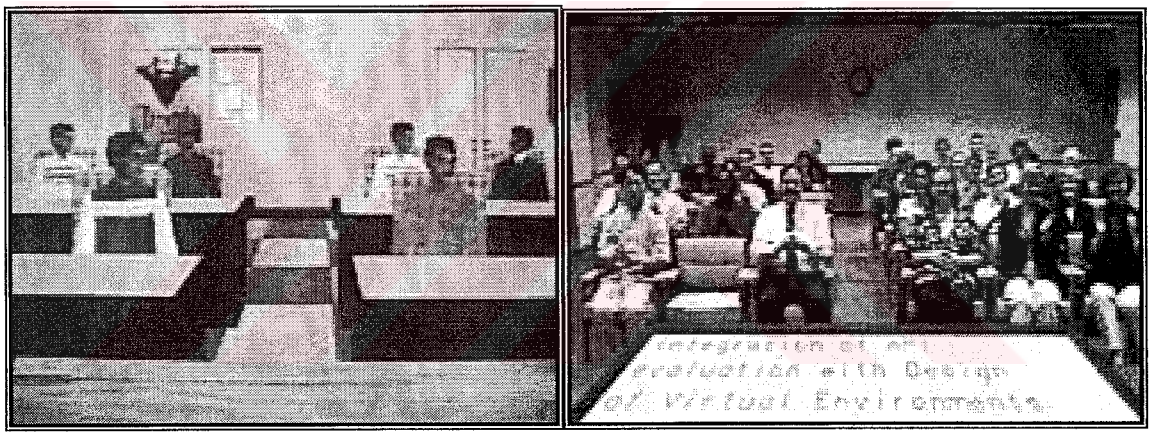


Fig.3.2.3.1c Virtual speech in front of a group

The characteristic and mood of the virtual audiences can be modified from being attentive or nonattentive creating practising options for the patient with the public speech phobia in many different circumstances.

VR a allows patients to face fears that aren't easy to simulate in real world because of geographical or financial limitations; and is safer since there is complete control over the

feared object. At every step, the therapist can see and hear what the client is experiencing in the virtual world. If the level of anxiety becomes overwhelming, the client can return to a less stressful level of treatment, or simply remove the head-mounted display and exit the virtual world.

3.2.3.2 VR Applications to Reduce Pain

Pain distraction during painful medical procedures is probably the area that VR proves to work more than any other medical area. VR distraction is when patients undergoing a painful medical procedure wear an HMD and immerse in a virtual world in order to shift their concentration from the pain. The perception of pain is scientfically proven to decrease if the concentration is given elsewhere, and increase if the patietn constantly thinks about only the pain.

One of the most painful medical treatments is the treatment of sever burn wounds, which usually consists of daily bandage removal to clean to prevent infection and monitor the healing process and bandaging again. Snowworld is the first virtual world created the psychologists, Hunter Hoffman and David Patterson. for distracting severly burned victims during their treatment. SnowWorld was tested on burn patients at Harborview Burn Center (The Daily, 2004) During the severely painful burn treatment,70 tients wore and HMD to get immersed in an icy and snowy environment where they can play snowball with the snowmen and penguins. Majority of the patients reported up to 50% reduction in the time they spent thinking of their pain.

Patterson says that pain requires conscious attention and when patients get so captivated by the virtual world that their attention shifts toward this artifical reality than that of the pain, so they actually can not process the pain signals they are receiving.

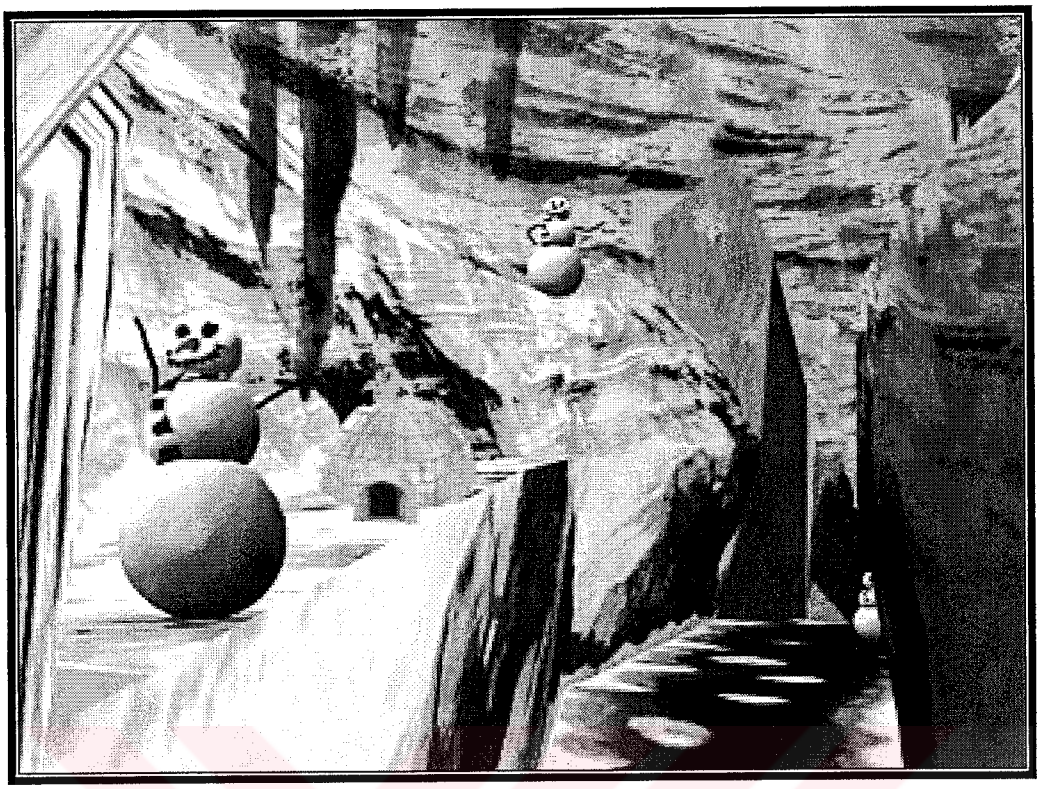


Fig.3.2.3.2a SnowWorld virtual world

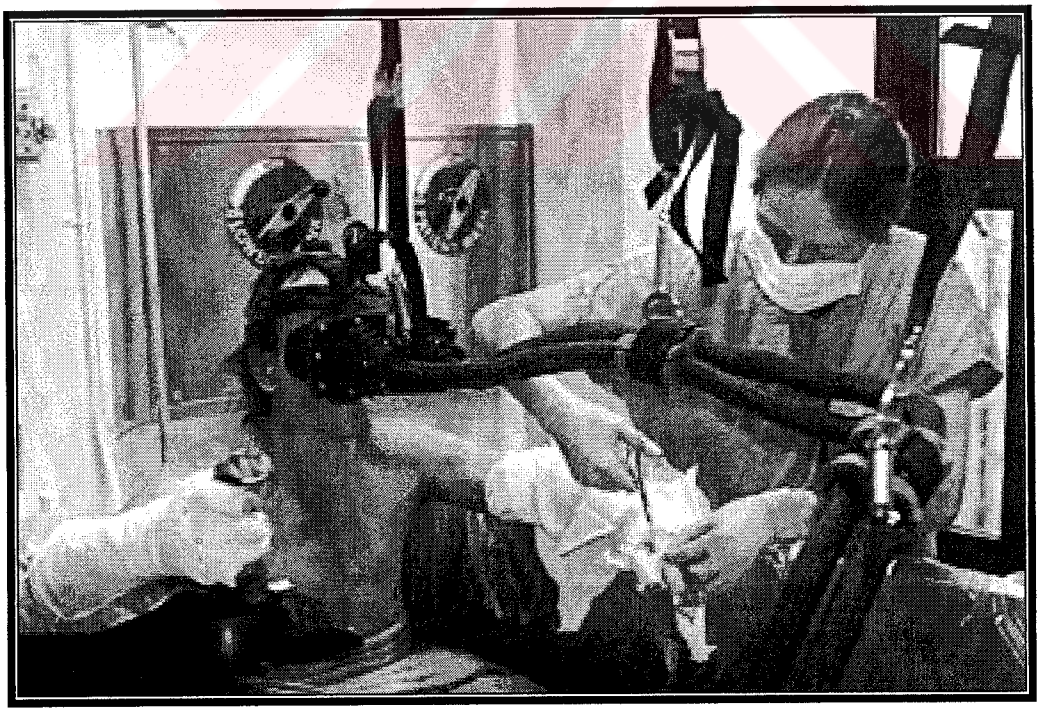


Fig.3.2.3.2b SnowWorld Interface

According to a recent study by a group of University of Washington researchers VR distraction not only reduces the psychological perception of pain, but actually reduces the pain related physiological brain activity to 50% to 97%! (*Hoffman, 2004PhD)*

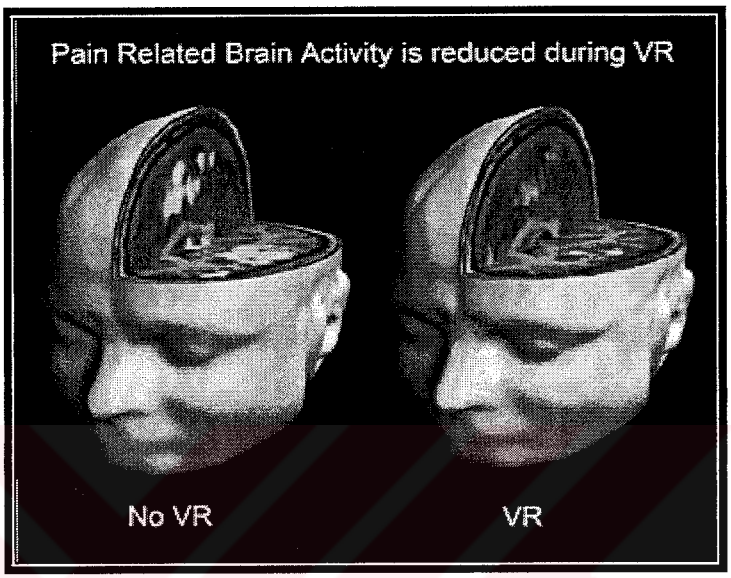


Fig.3.2.3.2c Hoffman's , studies (Richards, (2004) showed VR distraction significantly reducesthe pain-related brain activity during painful treatment.

Immersion into a virtual environment has proven to alter the perception of pain both psychologically and physiologically. This is a great promise for study of VR applications for the relief os many other painful medical treatments.

The professor of radiology in the UW Medical Center puts in a nice way: " the VR treatment reduced pain both in the mind and the brain." (Medical News Today, 2005)

The study results of the bodily immersion and interaction in the SnowWorld, demonstrates that the feeling of another reality is straightly correlated with the amount of stimulation we get from this environment ; that the mind's elasticity to perceive reality is based on the input to the sensory systems.

3.2.3.3 Video Games for Psychological Therapy

The Journey to Wild Divine

Wild Divine is a video game to enhance mind and body wellness that is scientifically proven to decrease stress and have a strong positive outcome on emotional and physical health by educating users to control their heart rate, blood pressure, muscle tension and brain activity with *bio-feedback*. The bio-feedback feature of the game is what makes it so innovative and special to mention it here since it is the only game currently on the market offering a biofeedback component. The game's biofeedback hardware platform measures skin conductance level (SCL) and changes in the heart rate through the three "Magic Ring" sensors to be attached to users' fingers. The measurements are registered to the computer and fed back to the user through game graphics.

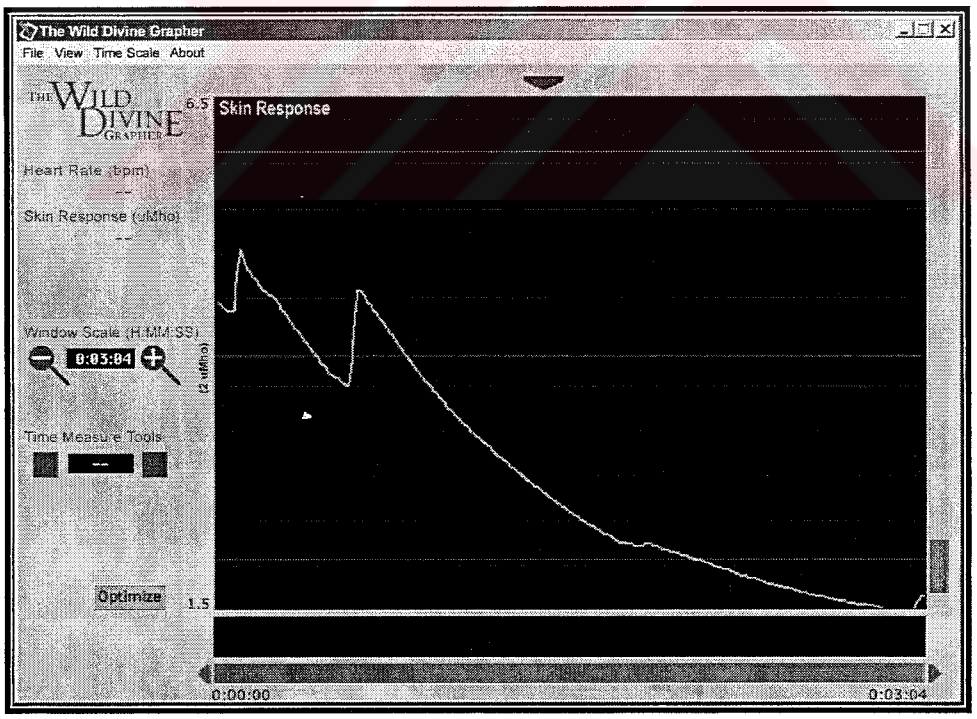


Fig. 3.2.3.3a The Journey to Wild Divine- A bio-measurement being fed back to the user.-A graph showing the decrease in SCL.

Journey to the Wild Divine was created by a scientist specializing in biomedical engineering and has a good background of medical care. This is a biofeedback-controlled video-game that requires users to manipulate their heart rate and other body functions to navigate, promising the users to gain excellent skills of mental and physical processes.

In order to be able to navigate between areas, players have to be successful in biofeedback terms. They have to decrease their heart rate or sweat gland activity to move to the next level in the game (fig. 3.2.3.3b Entrance to the Heart of the Temple)

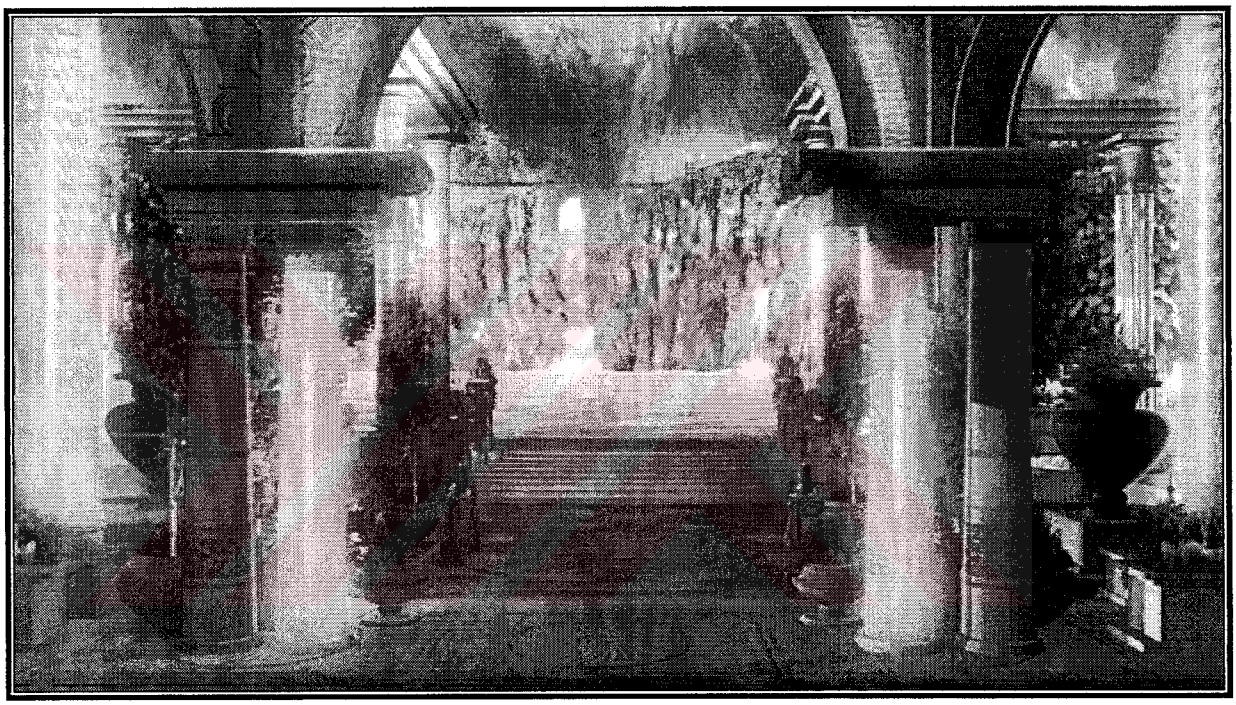


Fig.3.2.3.3b Graphic from a level named "Entrance to the Heart of the Temple"

In January 2005, The Wild Divine Project announced a partnership with Deepak Chopra, M.D., to develop a trilogy of computer games focused on enhancing mind and body wellness.

The technology of biofeedback will help people understand the mind-body connection to inner healing like never before, resulting in more motivation.

3.2.4 VR for Physical Rehabilitation

The research and development of VR applications for physical rehabilitation is increasing in number. So far, there has been various applications successfully used for improving balance problems, upper and lower extremity dysfunctions, poor locomotion due to brain injury, diseases like Parkinson's, spinal cord injury and such.

VR applications are engaging, fun and rewarding for both the patient and the therapist. (www.jneuroengrehab.com) Recovering the physical functional abilities of patients is commonly achieved by repeating certain physical tasks with increasing levels of difficulty. So the major objective of rehabilitation is to identify the means to provide repeated opportunities for tasks using tasks of increasing difficulty. VR provides the patient with a life-like "virtual task" that he has to perform with the ability to modify the level of difficulty modified by increasing the number of virtual objects to contact, increasing the speed at which the objects or environment move.

In many applications of VR/AR for balance training video capture technology was used to take a video image of the user and insert the user into a virtual environment with the use of a keying software to remove the background. The user can now feel beter immersed in the VE while interacting with virtual objects.

Some examples of tasks used in physical rehabilitation now are:

- a biking task where the participant is required to bike with increasing levels of difficulty.
- a conveyer belt task where the participant is required to turn sideways, pick up a virtual box from a virtual conveyer belt, turn and put it on a second virtual conveyer belt; and
- a snowboard task where the user is required to lean sideways to avoid hitting virtual trees while going down the hill.

In a virtual bike example, a HMD display system was combined with a fixed bicycle, with 3D visual information. In a report " A new rehabilitation training system for postural balance control using virtual reality technology" , healthy adults using a bicycle linked to a virtual environment showed that this rehabilitation system is beneficial for postural balance control. Among the reported data were decreases in cycling path deviation and increases in cycling velocity following a short training and offered that these variables may be useful for determining a training effect on balance rehabilitation.

Fig.3.2.4a Disabled man taking advantage of VR rehab.

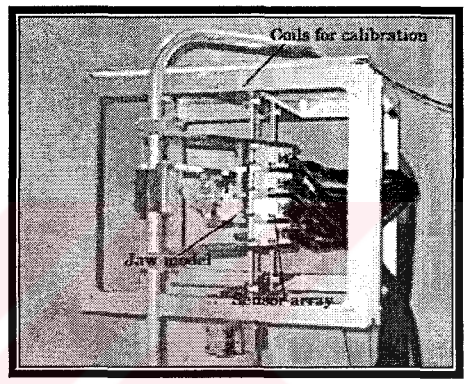


Fig.3.2.4b Magnetic sensor unit

In order for the rehabilitation to be efficient, detection of the body movement has to be done in real time. In order to do so, a japanese company has produced a system for this purpose which is a magnetic motion capture. This system can detect the position of the the body parts even with a magnetic sensor unit shown above.

3.2.5 Telemedicine

Telemedicine refers to the use of information technologies like the internet, video conferencing and virtual reality for healthcare consultation and delivery for remote areas. Telemedicine uses electronic transmission of medical images from one site to another for interpretation and consultation instead of the face to face appointments and in some cases

performs surgical procedures through robotic hands using very high speed transmission treatment.

Telemedicine eliminates the need for patients to travel to medical specialists and makes health services available directly to the patient's home. This is immensely benefitable to areas with limited health care delivery like rural areas where it is often hard to find a medical specialist, and for home care patients with chronic ilnesses. (Norris, 2001)

The most popular application areas of telemedicine are diagnosis, radiology, ultrasound, surgery and ophthalmology. Going into detail of every arena will exceed the purpose of this paper; several specific examples of telemedicine within a variety of applications will exemplify in its best how cyber revolution has achieved to enhance the healthcare sector. So I will just briefly overview some applications to provide good examples of the use of the internet and VR in this area.

3.2.5.1 Tele-care and Online Clinics :

Telecare is healthcare provided through online health clinics to patients worldwide. A typical online clinic online clinic provides with telediagnosis, telemonitoring, and usually there is a forum for patient support groups.

3.2.5.1.1 Telediagnosis

Obtains medical data like ultrasound from the patients and sends them to the big network of healthcare specialists for diagnosis and treatment. The remote doctors' will be able to view these data and get in touch with the patient through a teleconferencing system built in the unit. Telediagnosis is the detection of a disease by a visual examination of a remote patient.

Telediagnosis systems require communication and monitoring (telemonitoring) units placed at both the doctor's and the patient's place to be. These systems are conveyed in two formats:

a) Real-tme, interactive video: The patient and the doctor interact through live videoconferencing via satellite or fiberoptic technology. A remote monitoring system may be put at the patient's home for the physician to check the physiologic parameters such as blood glucose, blood pressure, or pulmonary function tests, and synchronous videoconferencing between the patient and the doctor.

b) Static One-way transmission: The patient sends the doctor a still image -like the photographs of the sick body part- using different telecommunication venues like e-mail. The doctor checks the picture and sends her the right treatment through various telecommunication venues.

For example, in the case of tele psychiatry, a patient fills a web form about her discomforts, and the doctor sends her a graphical visual therapy session through the net, which the patient can perform looking at the monitor. This is a low grade telemedicine system that takes place at e-health sites. www.jinemed.com.tr and http://www.tele-diagnosis.com are good examples for such sites. The site at www.tele-diagnosis.com is an e-health site that was established by Dr. Dinesh Verma (M.B.B.S, M.D (Ophth), DO(London), F.R.C.SEd, FRCOphth), Dr Somdutt Prasad (MS(Cal.), FRCS (Edin), and Gaurav Verma, B.Tech, with the purpose of " harnessing the power of current and emerging Information technologies in providing second opinions for serious, complex and / or medico-legal (negligence) cases from the top super-specialists to patients through their local referring doctors anywhere the world,.." in their own words.

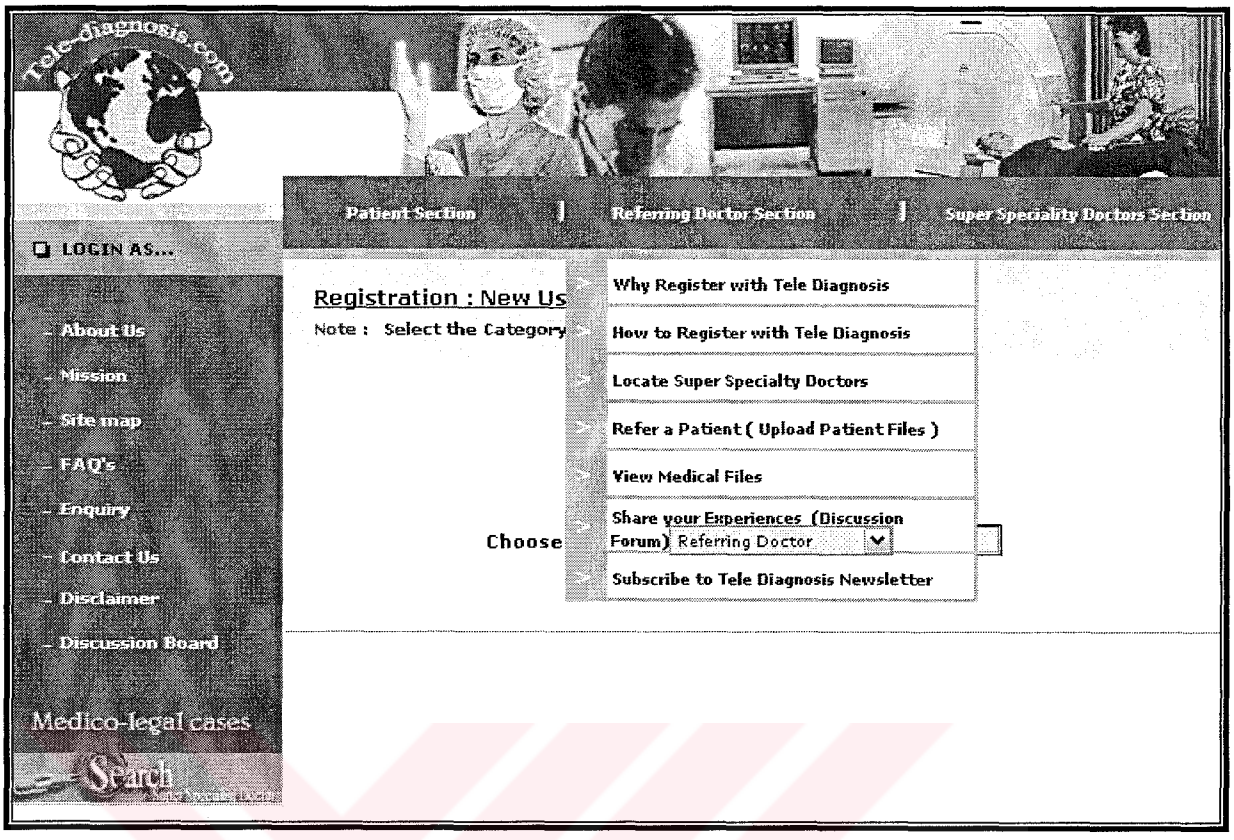


Fig.3.2.5.1.1a www.tele-diagnosis.com

Here, patients can upload their radiology files such as an X-ray, an ultrasound picture or an MR image to be viewed by the super-specialists from all over the world for a diagnose. The patients can search for a specialty physician by his name, location, area of practice and by specialty and asynchronously discuss issues in the embedded forums at the site. Patients, referring doctors, super specialty doctors all have to register in order to benefit from it. Below is the form that a super-specialty doctor has to fill in before registering the site. The doctor's – thus the site's- credibility and trustworthiness is guaranteed by the requirement to fill in the medical registration/ License number in the form.

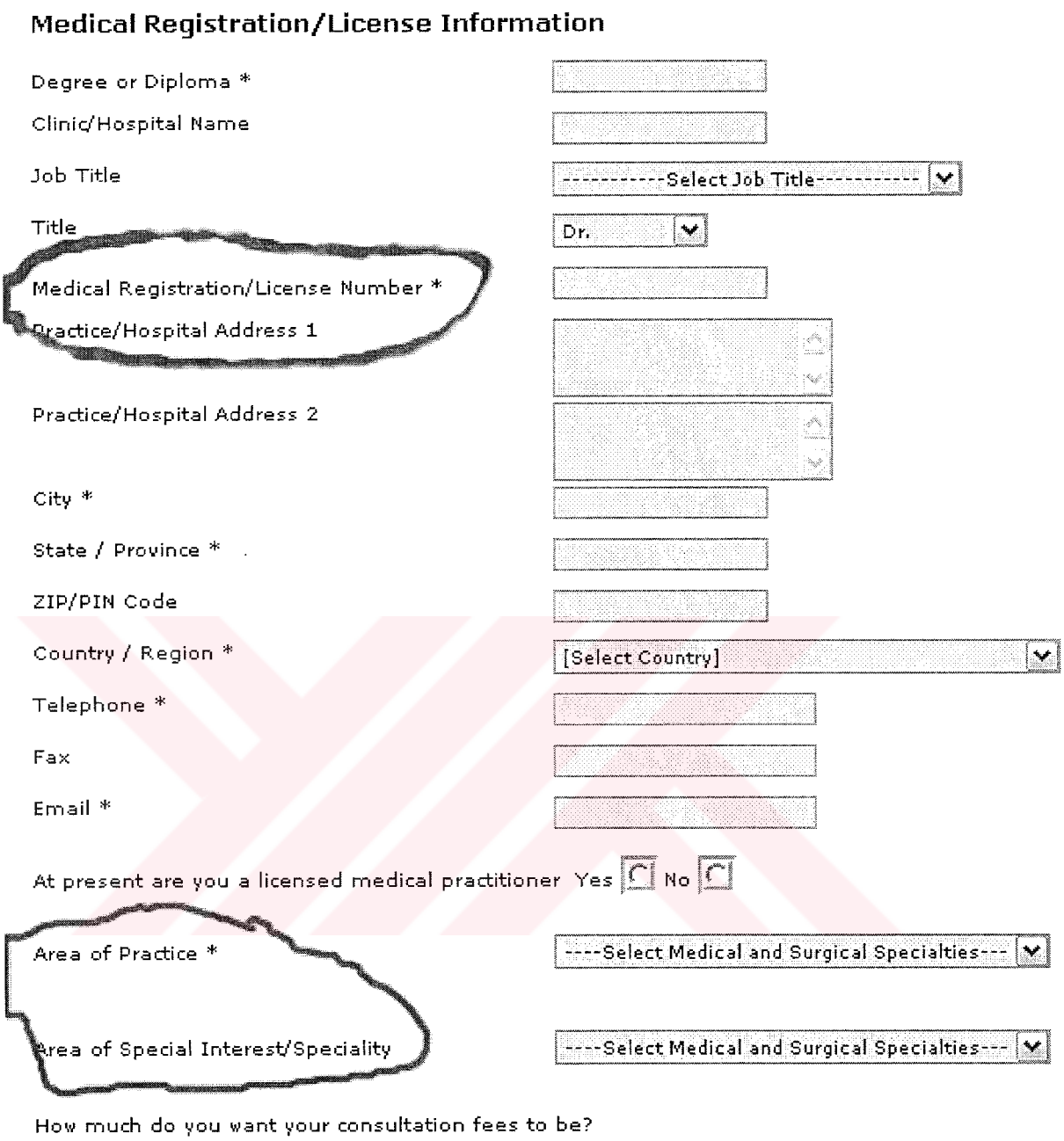


Fig.3.2.5.1.1b Super-specialty doctor registration form on www.tele-diognosis.com

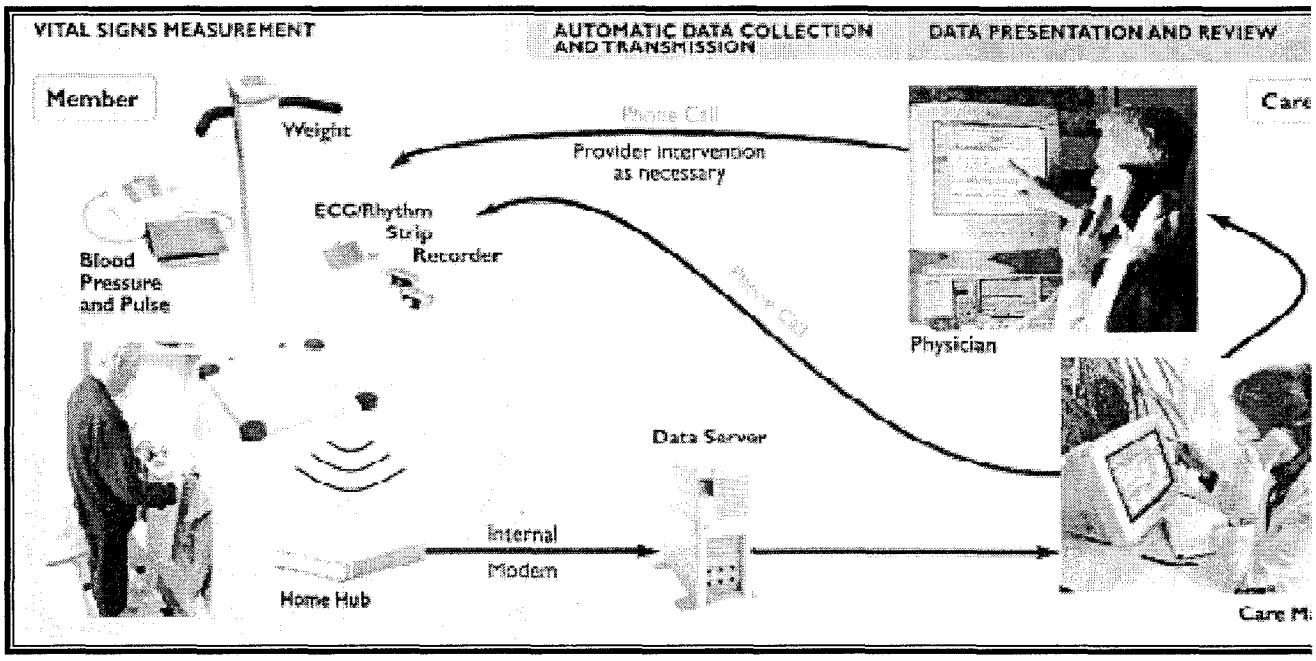
3.2.5.1.2 Telemonitoring

Extensive hospital stay is both expensive, emotionally alienating and takes up place for other needy patients so home healthcare with the nurse living with the patient has become as an alternative route. Considering also that elderly people need health monitoring more than any other age group to ensure their health and most indeed prefer to stay in their homes for healthcare, a good alternative can be "home telecare stations" which provide the

doctors with routine necessary medical information on the patient's health. The doctors monitor a patient through the medical data capturing devices built in the patient's house. Telemonitoring, is the use of information technology to monitor the patients health at a distance. "Telemonitoring is the use of a telecommunications system link to gather routine and repeated data on a patient's condition" (Norris, 2001). The doctor receives data stored by the patient . For patients with chronic health conditions such as the elderly, the tele monitoring can be automated so that the doctor receives continuous data on the patient's health from a remote site. The patient may be at home or in a hospital, even on a satellite wearing a medical monitoring devices such as a blood pressure cuff that sends info to a central unit through various connection systems and the doctor gathers routine data on a patient's condition from his own site. The data obtained in these centers can be text, audio (heart beat through a stethoscope..), still images (X-Ray..) and video (fetal ultrasound..) transmitted to a video conference system Some common instruments used in telemonitoring are stethoscope, otoscope, ECG, ultrasound, microscope and angiogram. . For minimum best image acquisition, the necessary components of such a system are: a digitizer to transfer hardcopy images into digital images, 2K X 2K X 2K 12 bits resolution, and clever data compressor to reduce transmission time between the patient and the doctor. Satellite transmission is the best route for real quality transmission however regular phone lines can even work at the lowest extreme.

Telemonitoring provides health care services without having to stay in a hospital, reduces travel and costs, and most importantly saves lives by getting data ahead of a life threatening situation such as heart failure. An example of a telemonitoring system is that of the HomMed.

Health telemonitoring devices do some tests to a patient at home and sends the results to a home care agency through a monitoring service. It comes with a blood-pressure cuff, fingertip pulse, a scale, and an oxygen saturation monitor. More sophisticated devices can be mounted for heart ECG readings,blood glucose levels and blood clotting. An example of such system is below. (Norris, 2001)



3.2.5.1.2 A Telemonitoring System for remotely monitoring ECG

3.2.5.2 Online patient support groups

Patient support groups are online health communities where people dealing with the same health problem find emotional support by sharing their stories, talk openly about their condition with the a network healthcare specialist hiding behind the anonymity of the internet, can get quick and valuable second opinions anytime anywhere around the world.

Many health sites provide with patient support, or doctor support communities. Some even provide with communities where the families of the patient share their stories for emotional support.

Patient support communities are the places where the online disinhibiton effect mentioned in the 1st chapter shows its empathy-wise capabilities. A large scale survey made by the Harris and Associates revealed that 25% of the patients avoided to go to a doctor's office for info because of embarrassment, %8 because they felt they would be wasting the doctor's time, %11 because they felt that their condition was not important enough. (Rice and Katz, 2000). The lack of visual presence in online patient support groups encourages

patients talk openly about sensitive health topics with doctors, that they normally would be embarrassed to discuss.
Patients with common problems find emotional support by joining a group of patients with same health conditions, share their stories, talk about how they feel, get data about how they are dealing with their own situation. This is an invaluable way of gaining insights on their condition, get empathy and support which can be difficult to find in real life since a person is typically not surrounded by people with the same condition.

Patient/doctor support groups act with the purpose of uplifting the health care conditions by: a) Making specialists worldwide virtually available in an instant to the patient, thus making more specialist advice available for the patient c) Connecting prime specialists to each other for better consulting d) reducing the time and money wasted on the travel to visit a good doctor in a big city, thus helping people in rural areas, in underdeveloped countries, and the elderly people in urban areas.

PsychCafe is an internet based cybertheraphy site that provides with a variety of services, including support groups to allow patients to share their stories with eachother, individual and group counseling online, virtual offices for clinicians. Individual sessions may be done ext based communication, video e-mail, and even teleconference. A message I have found on a bulletin board at this *café* reveals the level of empathy that can be produced online:
"Dear Crystal, I hear your pain. And I keep searching for a way out of my pain.
I've read and reread books by Alice Miller. She has all the answers, but has decididely gave up her campaign for the use of primal therapy to releive past traumas. But, she mentioned, EMDR, a new therapy. It may be worth checking into. None of this helps I am sure.
I feel like everything is so hard to accomplish and get involved with people. Maybe you do too? I just do not understand - why everything is so hard? These are my attempts to feel what you feel, to be beside you in spirit."

3.2.5.3 Telesurgery (Remote Surgery):

Telesurgery gives doctors the ability to remotely operate a patient through the VR and robotics technology. This can be considered as the use of VR at the maximum level. Telesurgery is done on a remote *real* patient by a doctor from afar by robotic instruments. A doctor in Chicago can operate a patient in New York with a robotic hand linked to a computer via fiber optic in the doctor's office. Telepresence technology lets the physician to project himself to another location via video and audio monitors, and control the operating instruments (like robots) at that remote place. The robotic arm can be resembled to the graphical hand present in the VEs used for navigation. In this case, the robotic hand provides more than navigational purposes through the remote environment. The hand also provides the surgeon with tactile info of the organ such as its thickness. The surgeon gets "force feedback" through handles which he controls the operation with. A number of surgeons can also project themselves in the same remote area through a network from different geographical locations, so that they can collaborate on the operation together. As Thomas J. Csordas from Case Western Reserve University says:

"....a major paradigm shift in which the blood and guts of conventional surgery is replaced by the bits and bytes that will facilitate the work of a new generation of "digital physicians" and "Nintendo surgeons."

General Architecture for Remote Surgery

The figure below is a sketch of the architecture of a telesurgery system produced by West Virginia University. This architecture has a patient facility, surgeon facility and processing facility.

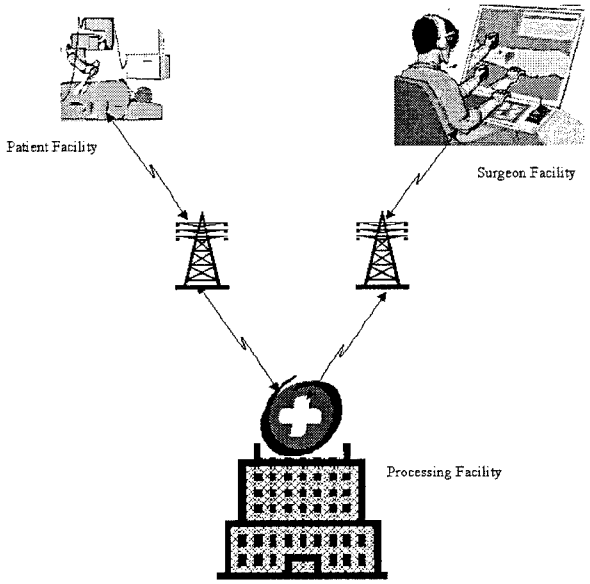


Fig.3.2.5.3 **a** A telesurgery system

The patient facility has:

- Medical image capturing equipments such as MRI which are needed during in the

diagnosis phase.

- The robotic surgeon, which will perform the surgical operations under the control of the remote surgeon. Viewing and measuring equipment are necessary to transmit the video images and information like blood pressure and heartbeat to the remote surgeon at the same time with the operation.

The surgeon facility has:

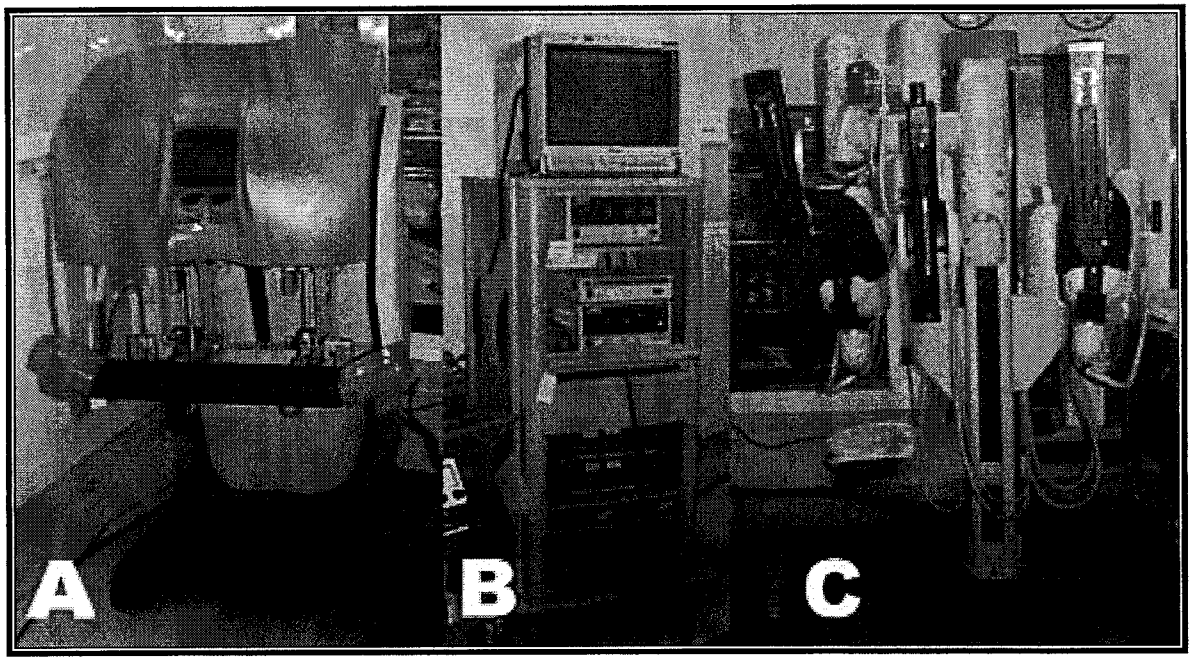
- An operation display system, to show step by step how the actual operation goes on in the patient facility.

- A diagnostic image display to show diagnostic images taken from patient during the diagnostic phase.

- Interaction staff including gloves, masks.. which provide better reality for the surgeon in the surgeon facility. (Savilampi, 2005)

The most popular usage area of telepresence is the minimally invasive surgery technique laparoscopy . Laparosopy benefits the patient in number of ways as faster recovery time, more affordability, less tissue damage however it is harder than to perform than open surgery since it requires very good hand and eye .Telepresence surgery can be an alternative to maintain the patient benefits without risking the surgeon's laparoscopic skills since the robots are more precise as they work with measurements.

One of the first examples of telepresence technology is the Green Teleprescence Surgery System, which consists of a surgical work station with a 3-D monitor and dexterous handles with force feedback and the remote work site with a 3-D camera system and reactive manipulators with sensory input.
The systems used for telepresence now are the DaVinci Telerobodtic Surgical System and SRI International's remote telepresence surgery system.



3.2.5.3b A typical telepresence system

The telepresence systems consist of a surgeon console (A), a central video unit(B), and the robot to operate the patient (C). The surgeon sits in the surgeon console, wears goggles and immerses in a high resolution stereographic 3D image of the patient that is produced with advanced video monitors cameras and mirrors.

Fig.3.2.5.3c Surgeon Console

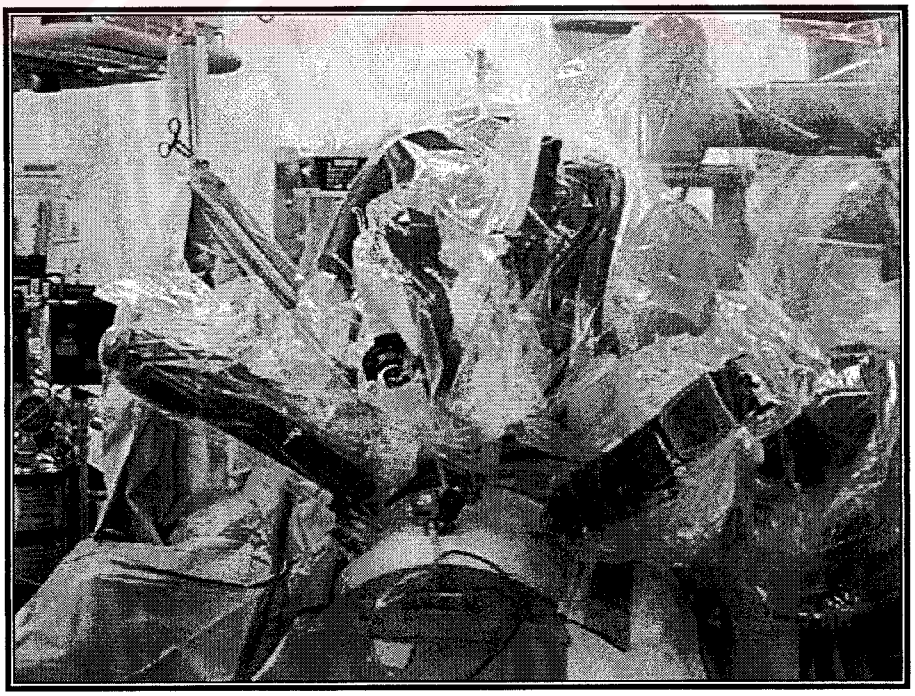


Fig.3.2.5.3d The robot arms going into the patient

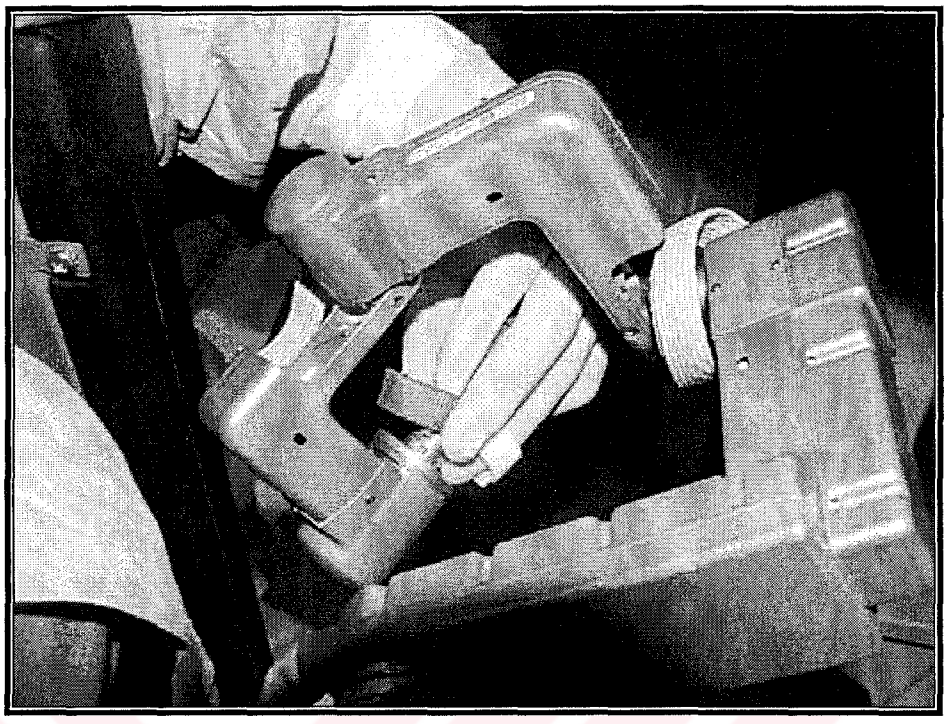


Fig.3.2.5.3e Handles where surgeon controls the robot from

He puts his hands into the handles where he will control the robot from. The robot mimmicks the exact wrist and hand motions of the surgeon.

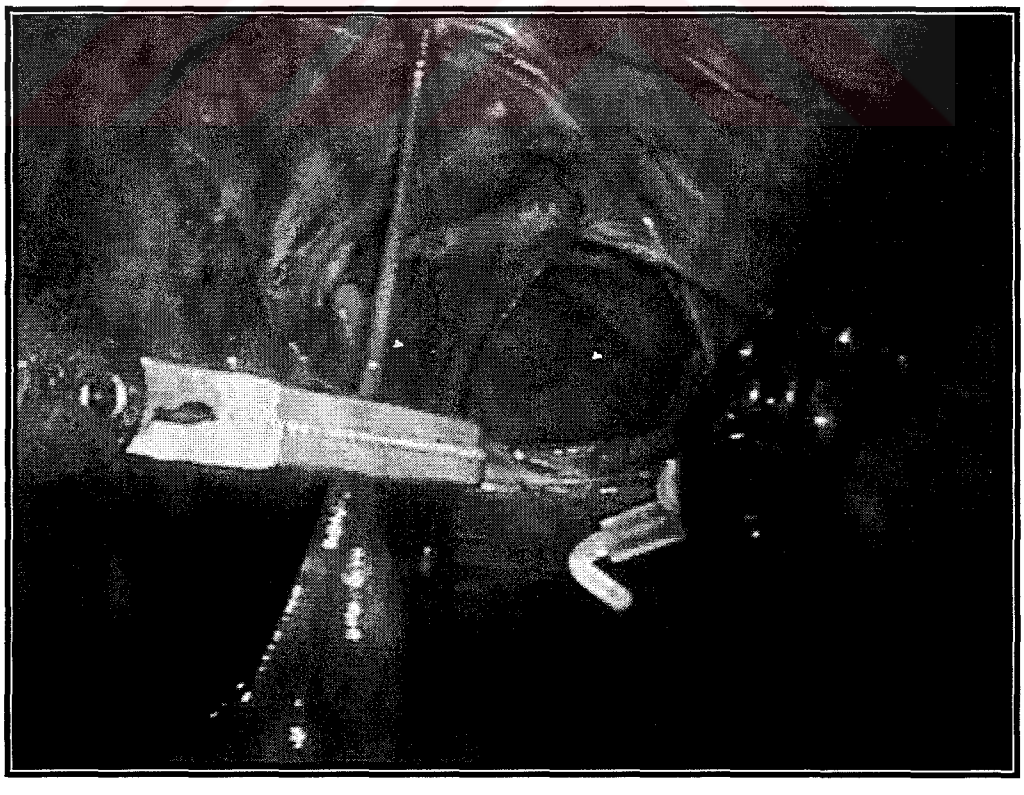


Fig.3.2.5.2f What the surgeon sees.

The surgeon gets instant visual and tactile feedback like the force of the incision.

S.A.M.M.M (Surgeon Asissted Mechanical Miracle Maker) is a very recent robot made for Da Vinci systems intended for ;aparoscopy. S.A.M.M.M is a multiarmed robot that uses scopes, catheters, and video monitors for remote manipulation of surgical instruments. Robots can beat some anatomical barriers experienced by surgeons and perform a wider range of minimally invasive techniques with more ease A robot can be programmed to turn more than 360 degrees for precision incisions, something a human wrist is uncapable of doing.

Telepresence is a very promising practice that will be increasingly integrated into the commercial market as the cost of the technology decreases and the ability to share information over wide area computer networks enhances. The growing public interest and the enthusiastic research devoted in telemedicine will ultimately come up with ways for a more number of feasible projects.

4.CONCLUSION

The 21st century has witnessed a revolution of the ways we communicate, due to the platforms of cyberspace, which is in the midsts of altering the paradigms of social formations, education and work ; and redefining established values like identity, time and space.

The removal of bodily human presence and physical transportation in cyberspace has created new forms of spatial relationships, and a whole new sense of a "place". With the technological improvements like realistic image displays, immersive interfaces, fast network connections, computer generated worlds can be so realistic that they can create a sense of presence in this space.

A great phenomenon of cyberspace is that it has produced communities through its interactive qualities, something that no other medium has ever achieved to do. With the platforms of the cyberspace, communication has become more interactive, realistic with a higher sense of mutual presence. Virtual communities have proved to be a civilisational revolution that come as a tempting alternative to engage more with the world, strengthen social relations, meet new people, make business, serve and get more service, learn from worldwide professionals and experts, in an age where people have no luxury of free time to travel due to heavy work load and little time.

One other emphasis of this paper is that, cyberspace is capable of growing love and empathy and provide psychological well being. An online community consisting of people with similar concerns provide a person with the social support that he may not find in real life, thus improves the quality of life. Plus, if it wasn't for the instantaneous text-based chatting programs, many social relations would diminish because of the busy times where most people hardly ever have time to visit loved ones.

Cybercommunication offers more open communication than face to face relations. Released of bodily prejudices like gender, race, physical look and so, cyberidentity is like an inner existence, that people sometimes tend to hide in real life but project in cyberspace. Contrary to some critics saying that virtual societies endanger real human relations, cyberspace seems to impove social skills for many people. The anonymity of

the internet gives people a chance to be open about very intimate topics that they normally would be hesitate to discuss. Be it with a friend, a doctor, or a complete stranger, people are emotionally much open online than in real life due to the disinhibiting nature of the cyberspace.

The resources of cyberspace also promote self growth. Computer mediated learning shifts the instructor dominated instruction to a student centered one, thus, provides the student with an education designed particular to him, as a self oriented tutoring at his own pace. The multimedia material of educational sites -like the Digital Anatomist and the Anatomic Visualizer for medical education-made possible to have access to the far, the tiny; the complex and the hidden by providing with many times larger scales of visual material where they can actively construct learning materials and get feedback on their achievement.

Exceptional knowledge is no longer limited to the elite society of scientists, experts and professors, but available to everyone around the world with an internet connection. There is a big amount of superior knowledge on the internet as in the case of the network of professional doctors in telemedicine societies sharing their wisdom with many surgeons to be. Educational communities that enable professional networking can be a better learning environment than a geographical institute.

Another point to state is that the immersive capabilities of cyberspace platforms is attracting a wide range of psychologists and philosophists , who collaborate to redefine reality and how it is perceived through studies on cybernetic issues. The ability to immerse not only mentally but also bodily,to another environment as in the case of Virtual Reality, and interact with this environment, brings the redefinition of the established notions of presence and reality. It is already found that the sense of presence comes from the state of the human mind. Even a simple interface on the internet with limited sensory feedback is enough for the mind to immerse to another reality. If our mind is immersed elsewhere, than what is reality, the place we physically sit or the place our mind feels to be at? If a person is able to send his *mind* somewhere else is he there or here? Or at both places at the same time? Does he divide into two identities ? Isn't this like sending your soul somewhere when your body sits in the same place? These are some questions they try to find answers for.

New technologies bring new perceptions, new perceptions makes us realize new capabilities of the human mind which were not activated before. The mind's exercise of forming new realities through new spatial and temporal perceptions may enhance the brain and foster intelligence.

When technology reaches to the point that it imitates the real so good that it becomes very hard to tell the difference, we may even come to question why should we even bother going to actual places when we have the luxury of bringing it – and maybe a better version- to us and interact with the environment in ways that we would be impossible with the real one, such as customizing the environment to the person to facilitate experiencing the environment. Some artificial experiences are already made better than the real ones and preferred over the real ones, such as those used in the phobia treatments. Collaborative VR environments would let us share the experience with our family and friends.

Also, since the immersion into a virtual environment has proven to alter the perception and the brain activity to a point that it cancels out physical pain, such a way of living – immersed into another reality- may become the preferable way of life over the real life for suffering people like those disabled from the neck down , have a chronic painful disease, or from psychological pain as chronic grief and depression.

This reminds the concept of the movie Vanilla Sky, where the main character suffering from his burned face chooses to continue his life in a human manufactured dream program; or the movie Matrix where people bodily and mentally immerse to a virtual environment through a chip in their heads and participate in various activities in cyberspace while unconscious in real life. These kind of narratives show that there is already a concieving of such concepts as living in artificial reality may be better than the actual life!

There is one curious question in dark and that is if the artificial experiences will ever replace the real ones to an extent that they become the norm of living.

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