Virtual reality: Effective surroundings, Enormous demonstration and mediator system in the games, industrial design and manufacturing

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ABSTRACT

In this thesis, the concept of virtual reality has been elaborated in the context of games, industrial design and manufacturing. The main purpose of this master's thesis is to create a virtual environment for games that are near to the reality and according to the human nature through aspects like better interface, simulation, lights, shadow effects and their types. The importance of these aspects regarding realistic virtual environment is complemented through the comparison between two environments i.e. desktop and CAVE on a flight simulation program.

Keywords: Virtual reality, simulation, cave, MATLAB/ Simulink, VAPS, MultiGen, Vega

PREFACE

We would like to take this opportunity to thank those people, who have helped me performing the experiment and supported me with writing this thesis, specially my supervisor Dr. Hans Tap for his support and guidance during thesis work.

CONTENTS

1   INTRODUCTION

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"A picture is an intermediate something between a thought and a thing."

- Samuel Taylor Coleridge

1.1   Purpose

The purpose of this study is to practice interactive design in the context of virtual reality and its effectiveness and enormous surroundings, which is used in the designing of games, industrial design and manufacturing.

It will totally focus on the effective environment, enormous demonstration and realism in computer games, industrial design and manufacturing, because this is the requirement for future simulation of any product. It's also helpful for simulate certain aspect of reality in the real time and with accurate precision and perfect simulation e.g. flight simulator, online virtual conference etc.

This paper provides demanding information to evaluate difference the two environments of enormous demonstration field of view according to the user's perspective. The other way to see if the virtual environment surrounds the user peripheral field of view or if the user feels like he is standing in front of it.

1.2   Research Focus

Virtual reality is a new technology for interaction in environment with simulation, design, entertainment, and many other pursuits. The purpose of our paper is to identify weaknesses and how interface simulation and light shadows effective in the virtual reality. We will point out the current solutions to problems in these areas, possible areas of improvement, and those problems that remain completely unsolved at this point.

In real time rendering require the generation of at least 20-30 frame/sec, if we are viewing in perspective views. Its mean user can watch the three sides of an object at same time is called perspective view. So right now we still need more deeply research for creating / developing real objects, and its simulation. Our research is focus on virtual environments and its effectiveness of the surrounding for the user. Which are helpful in designing games, industrial design and manufacturing e.g. interface, simulation and light-shadow?

Today the importance of Virtual Reality has broadened and includes three types of techniques.

1. Immersive

2. Semi-immersive

3. Non- immersive (monitor)

When we talking about the immersive VR system refer to the walls display devices or a type of flat projection devices it refers to CAVE and HMD, both these display systems produce very broad FOV (field of view), but in this paper we only focus CAVE instead of HMD. Although it is very clear HMD has the potential to provide higher immersion than the cave, but the HMD actually FOV is smaller. But my motivation to check or enhanced the environment with the help of experiment. The experiment will perform on the two immersive and non- immersive environments. Immersive environment is called CAVE and the non-immersive environment is called monitor.

1.3   Scope

The field of VR initially focused in immersive viewing via expensive equipment, For example, artifacts for creating car models are expansive so it is better to create virtual artifacts which is near to reality and can be tested for quality with less difficulty and with less cost.

That is why this thesis is helpful for creating new ideas and advancement in realism such as aircraft pilot training, computer games, manufacturing design, tele-operated vehicles, engineering and scientific visualization

1.4   Research question

This thesis wills discuss the following question and problems.

1. What are interface and its current realism of computer games?

2. How can the accuracy of an object be improved by better simulation

3. How can we improve the completeness and complexity of simulation?

4. Why light and shadows quality are not effective.

5. Future technological development in the form of product and VR system.

1.5   Method

In this thesis, my approach is to find the result with the help of collecting data from the literature study, and this research comprises of procedure like data collection, which include observations and the participation contribution, the comparison of two different environments to find the empirical result and some questionnaires from the participants.

After critically observe the surroundings and the participants contribution in the virtual environments, we will give you the result in the form of both environments average results output and the chat table.

2   BACKGROUND
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The first idea of virtual reality was come into the mind of Ivan Sutherland around since 1965; when Ivan Sutherland expressed his ideas of create virtual or imaginary worlds. At MIT, he conducted experiments with three dimensional displays [7]. He developed the first system to surround people in three dimensional displays in 1969 [7]. The concept of virtual reality was mainly used by the United States in between 70 and late 80s [7]. This concept is used for military purpose to train pilot through flight simulator. But the rest of the world did not show attention in this new technology [7].

"A computer generated simulation of 3-dimensional environments, in which the user is able to both view and manipulate the contents of that environment."

Virtual reality is very useful idea to create the environments and provides a deep knowledge for designing games industrial designing and manufacturing field. Due to this, it can be very helpful for practitioners their customers and the research student in a number of innovative ways.

In the beginning, there were a number of terms for the new field: artificial reality (Myron Krueger, 1970s), virtual reality, and cyberspace (William Gibson, 1984), actually VR has been done for over 10 years. [3]

Below is a list of key dates and people who have made their mark on the virtual reality historical timeline.

Year	Person(s) Responsible	Accomplishment	Why it was important
1965	Ivan Sutherland	Ultimate Display	The beginnings of VR
1977	Dan Sandin, Richard Sayre and Thomas Defanti	The first dataglove	Interaction through body movement
1982	Bonnie MacBird (Writer)	Tron	The first computer-generated movie
1983	Myron Krueger	Videospace	First virtual environment
1984	William Gibson (His assistant)	Neuromancer	The term 'Cyberspace'
1987	Michael Piller (Writer)	Star Trek - The Next Generation	The Holodeck, idea of immersive VR
1992	Stephen King (Official Website)	Lawnmower Man	A look at the possible negative side of VR
1995	Silicon Graphics	VRML 1.0	Virtual Reality Modeling Language
1999	Larry and Andy Wachowski	The Matrix	Virtual Reality movie grosses $750M worldwide

http://www.bilawchuk.com/mark/history.html

## 2.1   Virtual worlds are unreal (Truth and fiction)

Virtual reality is not magic but someday it will very near to the reality and it is always facing challenges about the concept of reality. VR is based on computer graphics simulation, and other existing techniques and it will be more powerful depending on the development of new technologies.

Virtual worlds are artificial, imitation, imaginary, insubstantial, and invented. If we put all these condition so far virtual worlds are real, as well. All things synthetic or imaginary do not fall entirely outside the ambit of reality. If they did, we would require to banish from reality all manner of human actions and creations, including buildings, languages, laws and most important for our purposes [4]

Virtual reality is in the process of leaving the area of purely academic research. The industry is evaluating its potential in design, development, and manufacturing processes.

Virtual reality is totally based on trio based idea, immersion, interaction and imagination, Adapted from Burdea [1993], Fig below.
If you can imagine any thing, this is possible to interact with your own imagination and you can immerse with sound, pictures and tactual effects in virtual environment with the help of virtual reality.

Virtual reality triangle
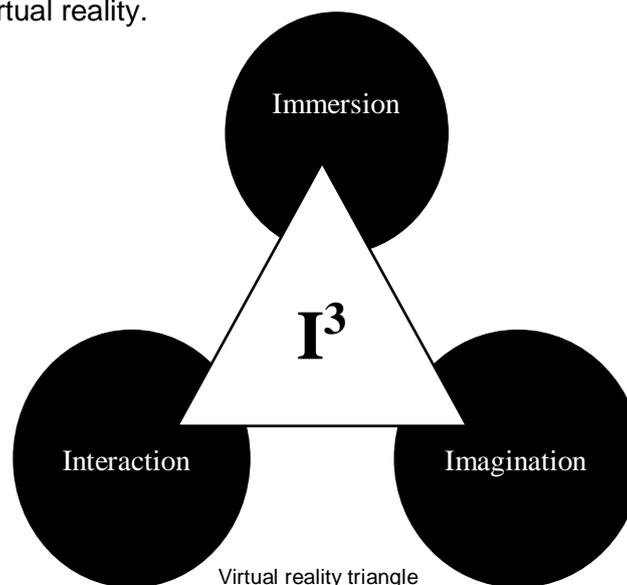
Three-dimensional simulations of reality in cyberspace, where people move, lived, worked, act and socialized. The development of these virtual worlds has been motivated by the game, industrial design and manufacturing that is why we can say that, now that types of world are used for far more than play, and very soon they will be widely adopted as spaces for research, education, politics, Aircraft pilot training, computer games, manufacturing design, tele-operated vehicles, engineering and scientific visualization work. In some aspects coming year our gateway maybe to the Internet and it look more like a video game and less like a book. Nobody assume that exactly where the future of VR is heading but it is clear anyone understand the value/future of the Internet needs to understand virtual worlds.

Millions of people around the world play in these virtual or synthetic worlds. According to the balkin information figure, 20 to 30 million regular participants now spend more time in virtual environments as compared to their real world jobs or engaged with their real-world environments/communities [4].

According to balkin finding the average number of hours played are almost 22 per week. People who do not participate in real breathing space excitedly do so in virtual spaces, because of new adventures, new identities, and the possibility of building new social universes [4].

2.2   Laws of virtual worlds

There are three primary reasons of law of virtual worlds.

First, virtual worlds are attracting an ever-increasing population of participants who believe that the social interactions that occur within these environments are important. [4]	Second reason why virtual worlds are worthy of consideration is that the economic boundaries between the real and the virtual world are not as distinct as they might appear. [4]	Third reason for exploring the laws of virtual worlds is that they provide a parallel alternative to existing legal systems, where new forms of social regulation can be explored. [4]

Previously VR is more convergence disciplines as compare to the new branches of technology that's why it's simply appear in fresh look at human interaction. This is only possible due to the developing of user interface design, simulation and a better visually telepresence technologies. It can be totally dependent on the experiences of the human participant.

3 PROBLEM DEFINATION/GOALS
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Here we are defining the problems and goal according to the thesis topic. The success of any goal is reliant on the definition of problem, identification, root cause, quantification. Before explanation of the question and its purpose, we are going to explain the goal, this paper focus on the visual realism, image resolution, frame rate and the latency and its simulation in the games but the context of the virtual environment.

- To increase the level of realism in a scene considerably, in order to make a believable environment.

- We are trying to find the best application of this technology, which results in the form of viewer not noticing any transition or discrepancies between real footage and computer generated effects.

- Providing high level of detail and sophistication is extremely complex and requires a great deal of rendering time.

- Computer generated images consist of discrete picture elements or pixels.

- The size and number of pixels depend on the display size and resolution.

- At higher resolutions the discrete nature of the display becomes less apparent, however, the number of pixels in the image becomes vastly greater.

- As the color and intensity of each pixel must be generated individually, this puts a heavier load on the graphics system.

- To give the impression of a dynamic picture, the system simply updates the display very frequently with a new image.

- This system relies on the human phenomenon of persistence of vision.

- Normal television broadcasts update at a frequency of 50Hz in the UK - 60 Hz in the US.

- This means that in order for a virtual environment to appear flicker free, the system must update the image greater than 20 times each second >> a heavy load on the graphics system.

- The most important aspects which must be addressed to make the environment not only more realistic, but simply tolerable.

- Latency or lag is the delay induced by the various components of a VR system between a user's inputs and the corresponding response from the system in the form of a change in the display.

- As latency increases, a user's senses become increasingly confused as their actions become more and more delayed.

- Chronic cases can even result in simulator sickness, a recognized medical problem associated with virtual environments.

- Latency must be kept to a minimum in order to create a usable VR system.

3.1 Interface of games

Games are very popular for people at all ages, no difference between male or female. The purpose of gamming is not only for enjoyment or pleasure. It's also use for education and brain training.

There are many types of games like 3D, Action, adventures, arcade, Brain Training, Dancing & Shows, Hot, Learning, Motor sports, Multiplayer, Political, Puzzle, Racing, Shooting, Soccer, Sports and simulation etc.

The attractiveness of games is based on the user friendly interface. The question is arising how can we evaluate, which games attractive for playing or not, what are factors involve to generated the way to positive affect on the user, either its depend on the user entertained or others. If game is not entertaining then you can say easily, that game is neither motivating nor attractive.

More the interface effective, more the value of software games, same as that of designing of function and performance. What is the requirement of attractiveness in games? How can we check the fun and instrumental aspect of games? How can we calculate the usability in the sense of user friendly, natural, look and feel and more perceptive view?

The purpose of these questions are to find the solution of design and advance interface of games and how can we improve the realism of current games, because the communication between player and game is depend on the reality, and we am sure if games will more realistic, more player will playing games with full enjoyment.

3.2 Simulation and its reality

First of all what is simulation and how can we differentiate between simulation and modeling?

Modeling is a computer generated process to explain the imaginary movement of any polygon shaped in a virtual world. But simulation concept is entirely different from the modeling in virtual reality.

A simulation is a process of an imitation of some real thing, state of affairs or apparatus to generate test condition that approximates real or operational condition. It can be representing different characteristics or behaviors of a real thing, e.g. flight simulator, second life and Medal of Honor etc.

Now the point is come, where the simulation is embedded or involve in computer. The answer is, in computer games, industrial product design, manufacturing fields and many more.

How can we say that, simulation is effective in the virtual enviroment? This is totally depending on the comparison of real thing to the simulated object.

So we can say that the only question is able to answerable now a days, what is the reason that our simulation is not provide an effective results, what is the concept of simulation, how they work and tools are helpful for creating the simulation, either simulation is hardware dependent or not.

3.3   Games simulation complexity and completeness

Games does not work its self, its can be control by the help of different components are called infrastructure and the especially simulation is entirely part of many algorithms and data structure. These components and their relationship give a complete architecture of the game. But one thing is very important that each and every concept, and architecture is different to the other games Here we are give you the brief description of problems of simulation and its complexity. What factors are involved to producing the real simulation in games? Here we are discussing the simulation types, physical simulation and games simulation [11].

Physical simulation has different attributes of an object as compared to the game simulation it has more abstract perception. Under this question will describe the terminologies used in simulation.

3.4   Light and shadows

Lightning is one of the most important things in Computer Graphics-art. One big problem was lighting up the scene.

In short three lightning techniques are:

- The three lights scene,
- The sphere of lights and
- Lightning with mental ray.

The three different lights are:
- Key-Light
- Fill-Light and
- Back-Light

Now the question is arise how the light works and come into and out of the eye. We mean what is the technical procedure. When you look at a physical surface, your eye's perception of the color depends on the distribution of photon energies that arrive and trigger your cone cells [9]. Those photons come from a light source or combination of sources, some of which are absorbed and some of which are reflected by the surface. [9]

In addition, different surfaces may have very different properties -
- Some are shiny and preferentially reflect light in certain directions [9].
- Some are scatter incoming light equally in all directions [9].
- Most surfaces are somewhere in between [9].

Shadows are an important way to add realism to a scene [10]. There are a number of trade-offs achievable when rendering a scene with shadows. Shadows are composed of two parts, the umbra and the penumbra. Fig below The umbra is the area of a shadowed object that isn't visible from any part of the light source. The penumbra is the area of a shadowed object that can receive some, but not all of the light [10]. An easy-to-implement type of shadow can be created using projection transforms [8].
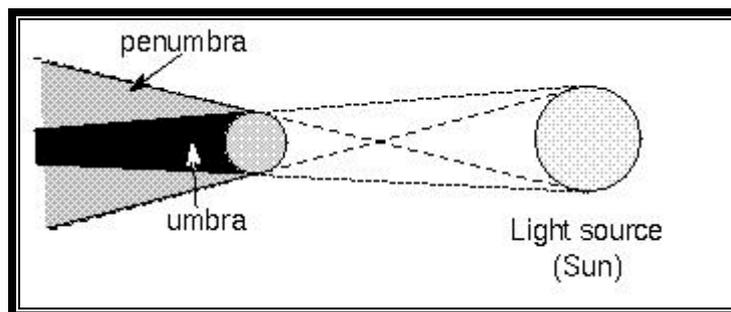
Why light and shadow are not real, we will try to find the valid problem of light and its shadows, its size and limits, through the help of type and its techniques, more over we will discuss the latest technology like OpenGL and RADIANCE

3.5   Future VR system

What is the meaning of technology, and how can we differentiate the term science and technology. The term technology has the multiple meanings, but according to the Microsoft's Encarta 1995 encyclopedia: "Technology, it is a process by which human beings fashion tools and machines to increase their control and performance" [12].

Here we will starts the research on the future technologies in the field of games in the context of virtual reality and its systems. The term technology is not only use for hardware, it also used in the term of, the study or technique for better output. Technology is also conceived for both conditions like creative and destructive process

4   METHODOLOGY
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Research is a systematic way to find the one or more solution of any problems or it can be define like that to find the answer of question in structured way. When anybody withdrawing to prepare research, they always understands the background, questions and the way they are starting, which are comparative helpful for finding that goal.

4.1   Why use Qualitative Research

In order to find out the solution or to gain specific information in attempt to answer the specific questions, qualitative research methodology will be used, but the result of this type of research is based on the experiment and out of two experiments one is done with the help of participants and the other is done by the help of previous research.

The reason to adopt this methodology is that, we have to perform an experiment in the form of CRT environment, but as compared to the cave are need proper environment and it is more expensive in the sense of hardware. That's why my idea to compare the two environment on the basis of previous research and some questionnaires. It is less expensive as compared to the practical quantitative research or an effort to prove some numerical result or data. The more important aspect of this research they give you flexible time and distance, and you don't need many interviews and meeting for gathering data, we just perform an experiment through some participants. Infect my aim in this topic is to find out the quality of the research, or to have some clear ideas about the issues related to reality in games.

So in order to perform research in such type of type, we repair to have consider to gathering data, analyze to data and then come up with some comprehensive result, which depicts information regarding the solution of the proposed research questions.

Qualitative research comprises of procedure like data collection, which include observation, in which the researcher critically observe the surroundings and the participants which are engaged in some natural happenings and the observer it become a participants and fires to have a feel of the whole system itself.

In this way the observer can better extract useful and vital information by expecting itself and also by observing others. The other way of collecting information is through interviews, in which observer tries to read the mind of the peoples whom he is interviewing and also by telephonic calls in another way.

One more ways to collecting data or information regarding research to have an idea about the quality of the topic is that researcher tries to read document, articles, research paper and books

4.2   Finding my goal in qualitative research

In order to perform qualitative research, its mean you want to explore a topic or given a new idea on the behalf old with the help of questionnaires and my

observation. Then you cover the target audience, people motivation culture and its behaviors. Important point why we are going to start, select this topic and what the result comes out. Weather you are doing quantitative or qualitative research it's totally depend on the assumptions and your appropriate method for your research.

## 4.3   Qualitative Techniques for Data Collection

Many researchers prefer the term Empirical data, which are directly belong with qualitative research, because qualitative data is non- numeric. There are different techniques for data collection like interviews, observation, published and unpublished articles and documents, daily or weekly reports, many more

Here is new a concept of sources, primary experiment and secondary source, that experiment which are not had been done before are called primary experiment, and the sources which are published are called secondary data

4.4   My approach

My approach is to find the result with the help of collecting data from the literature study, the comparison of two different environments to find the empirical result and some questionnaires from the participants. We will start my thesis from the very first chapter, the background, then Problem definitions, theoretical work and in the last chapter will the comparison of the two environments. Two out of one environment is my contribution and the other is the previous concepts. The actual purpose of this empirical study to find the environmental interactions of one or more individuals, groups, to observed and analyzed for virtual environments and its effects according to the research questions in relation to internal and external influences.

Qualitative research comprises of procedure like data collection, which include observation and empirical results. In which the researcher critically observe the surroundings and the participants engagements in virtual environments and the observer also a type of a participants feel of the whole system itself.
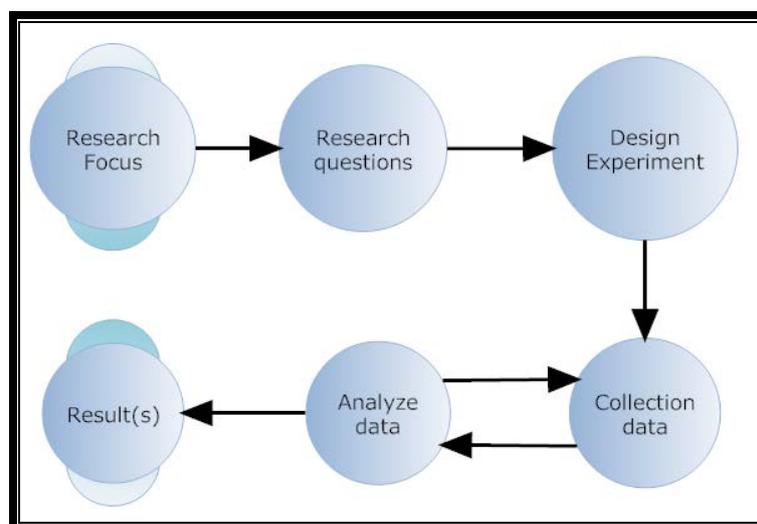
Flowchart of experiment design

According to the above flowchart, it is necessary for research to get the knowledge and know how of that topic, then write the question which is not even solve or need updating. Check how can you start the research procedure, this is called design experiment, the third step is collection of data, there are different ways of data collection like reading books, interviews, observation, published and unpublished articles and documents but there are two main types of methodologies for collecting data, one of them is observation and the other is experiment.

The important point, not every piece of data is useful according to your requirements and your research. So be careful before, when you starts collecting data. Now the second last stage is very significant for data, is called analyzing the data. If you find the right data for your right search then you able to find the answer of the first stage. Otherwise you couldn't find the solution of the problem.

5 THEORATICAL WORK

This chapter gives you a tangible knowledge of the sight and displaying components in the virtual environment. This chapter does not focus on the entire VR systems but it explains only the basic knowledge of the VR component from the reader perspective. After having some understanding of how the VR system and its component works, then we will discuss the proposed research questions and their possible solutions.

5.1 What is…….."VIRTUAL"?

The term virtual is frequently used in the computer industry to pass on to something that is simulated in software, e.g. virtual memory. Now this concept will come into the name of virtual reality for computer-based simulated environment. The question is how the virtual environment will simulated exactly to the real world. The answer is the concept of real environment is embedded into the virtual environment like, gravity, topography, locomotion, real-time actions, and communication [13].

5.2 What is……."REAL"?

Our all perception of the world come through five senses, touch, smell, taste, sight, hearing and further more virtual reality doesn't only these five senses they also need environment effect like wind effect, gravity, pressure, weather effect etc. and the most important thing is that not all the senses is not equally important for example in virtual world we couldn't feel the taste of any thing, because we are in the virtual world.

5.3 Virtual reality its self reality

Virtual reality is a next generation human computer interface. In early days its very costly VR system but now very cheap systems can now be assembled. The reality can be generated with the help of VR systems, visual world, auditory world and tactile world. Now we can describe how system is working [14].

5.4 Sight and displaying components

Out of five senses sight is very important and main emphasis in the VR research at the present time of graphics area. Realistic images are an important part for producing real simulation. This is only possible by the used of display and color resolution and frame rate of simulation. Display resolution is the number of dots called image.

5.4.1 Display resolution

The higher the resolution, the more realistic images appears. Below table give you a brief information related display resolution depending on the video graphic adaptor.

Low VR system	320 columns by 200 rows
Television graphics	640 columns by 480 rows
High resolution PC	1024 columns by 768 rows
High resolution workstation	1280 columns by 1204 rows
Computer generated images for film	4096 columns by 4096 rows
HMD use LCD color	170 columns by 140 rows

5.4.2 Color resolution

Color resolution is the number of different colors the computer can display

4-bit display	16 colors
8-bit display	256 colors
16-bit display	65536 colors
24-bit display	Over 16 million colors

5.4.3 Frame rate

The frame rate is also very important for realism, the number of images per second that the computer can update the entire screen with new image. Television update screen every 30 time per second, film seen updates every 24 time each second and cartoon use 3 to 4 frame per second. So we can say that higher the frame rate lower the resolution and vise versa [13].
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5.4.4 Polygons

A polygon is the object made up of many sides. If you have more sides of polygon its mean your polygons is smoother. Today mostly system used polygon graphics. So if you more polygon side its mean your computer need more time to computes to done to draw an object. When you create any polygon the next point is realism, the techniques is called texture mapping, ray tracing and radiosity [18]. See figure below
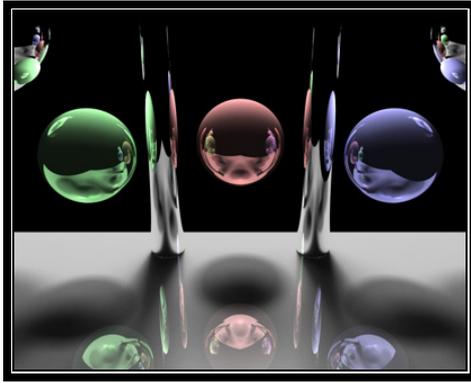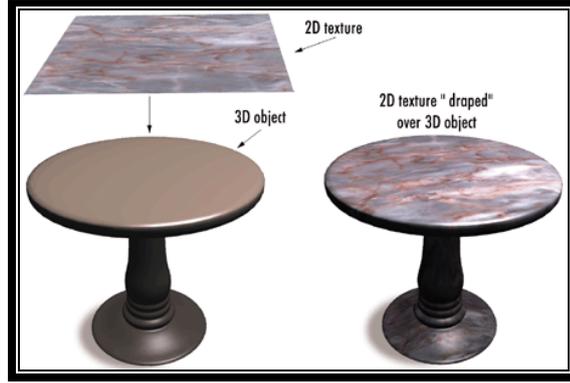
| A ray-traced image | 3D object | texture applied 3D object |

5.5   VR system and its component

A virtual world is work with the modulator workstation and it communicates 3D spherical and presence of operator, but we cannot say that we can always make destination. If we talking about successful reality and its simulation it is neccessary virtual system completely depend on the integration coupling between VR system and the operator by human [14]. (Figure 1)

Figure 1 Basic Virtual Man Machine Interface [14]

The main demanding area is visual channels of the computing requirements. According to the human knowledge this is very complicated work like stability, field of views, left and right eye demonstration, color difference check and its resolution settings [14].

Figure 2 Output effectors
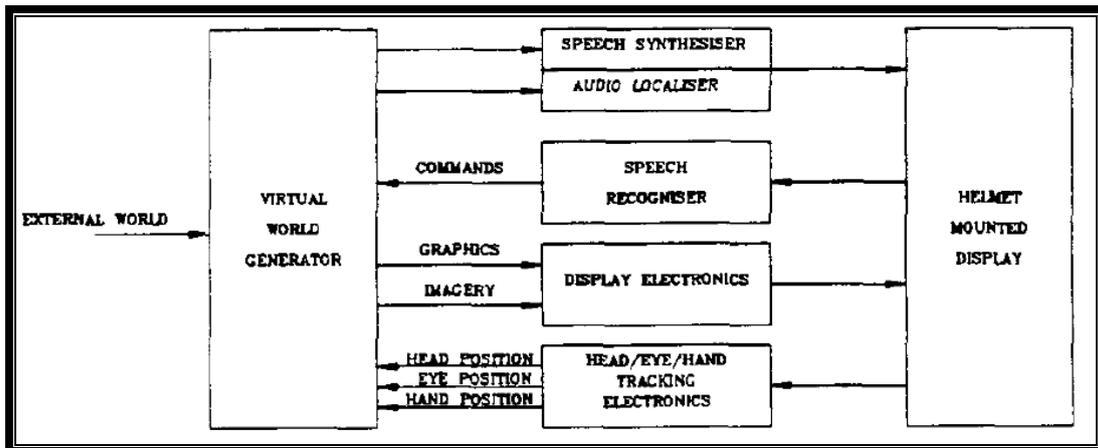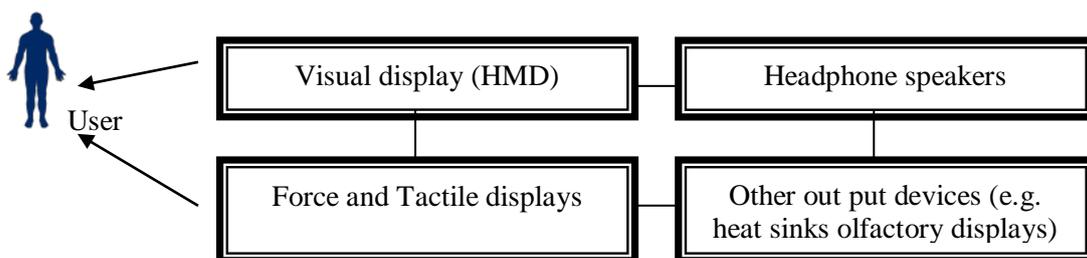
Output technologies for the virtual environments do not have to accurately reproduce the distal stimuli from the real world objects that are to be portrayed in the virtual environment; instead they have to present proximal stimuli that incorporate those features to generate the desired percepts in the user [15]. Show the output effectors shown in figure 2.

5.5.1   Visual Displays

Displaying images to the user of a virtual environment requires as image generator, an image source, and an optical system. There are different types of visual display, if image is viewed by the both eyes is called monoscopic, if different images are presented to the two eyes is called stereoscopic and the images display system have two lenses is called objective lens, and the eyepiece, which is use for magnifies the images [15].

A computer synthesized graphic generated by the visual display system and provide to the user with help of helmet-mounted display. The HMD is fully occupied with visor, eye-glasses or 1 or 2 small displays with lenses or you can say that semi-transparent mirrors embedded in a helmet. This can explain the position in the form of x, y, z changes of angle, movements, rotate or elevation after that it can be transfer into a high performance graphics system. In HMD a visor is present which is used for configure the appropriate view of the world whenever or wherever the user looking. This display device is binocular (it's a mirror-symmetrical telescopes) device give us a wide view, display resolution, colors etc [14].

5.5.2   Acoustic Display

The audio sources comprise a speech synthesis, sound synthesis, audio synthesis and digital sounds. These all are used for input and control the audio sound. The audio synthesizer take into account head line of sight, acoustic masking presented by the user of head and ear shape, it's responsible for the synthesis and the 3D auditory localization [14].

The Speech of the user can come from the three sources.
- Transmitted speech from the other synchronous user of the virtual environment
- Prerecorded speech
- Synthesized speech [14]

5.5.3   Force and Tactile feedback

Force and tactile display for the virtual environments are possible by either attaching display devices to the user or letting the user grab or otherwise make contact with the display devices [15]. It gives you an accurate and ordinary response through tactile stimulation. So the user move hand any position either any angle either move finger all are display on the HMD helmet mounted display. By displaying virtual control panels then it is possible to interact with the virtual controls. When you enter the virtual world you can grasp the object with your own hands and you can feel the object and tactile give a feedback when user feels resistance [14].

Its totally depend on the user task; either he/she need or not feedback from the tactile. Head and hand coupled unit give you the interface between the man virtual world generators. [14]

There are different types of constructional and functional requirements for force and tactile feedbacks. So the hand movements are often used by the following categories.

- Strength and durability
- Fit and calibration to the different size hands
- Capability of response at sufficiently high frequency
- Sufficiently low work to rest ratio and force in order to avoid user fatigue
- Adequate sensitivity [15]

5.5.4 Advantages of a virtual world system are:-

1. They provide an extensive field of view and auditory 360* medium.

2. Provide exact real control interface

3. Use 3D spatial capabilities of the human being

4. It can be Software reconfigurable.

5. Have wide application [14].

5.6 Designing interfaces

Interfaces consist of the display information and accept user input. Its components are not part of the games. This includes menus, dialogs, in HMD, buttons and tool bars. Normally games have much more complex interface, because their larger screen resolutions and input combination of keyboard and mouse. Moreover, games windows are special surfaces that use OpenGL, DirectX, or other hardware accelerated drawing [16].

5.7 User Interface Optimizations

The games interfaces concept is same as in non-game applications, but the implementation are quite different, actually mostly games need many loop and redraw concept, each frame redrawn by the UI, its mean when UI feel changes or when user interact in the games then UI redrawn the frame. So we can say that games interfaces is much more complex and tough performance requirements as compare to the other type of UIs. The reason is that in normal UI the user only literally changes can takes but in games need many changes to redraw the frames [16].

There are different types of techniques to solve the complex user interfaces. Now we can tell you the basic properties of User interfaces and its evaluation.

5.7.1 User interface properties

Many professional have a goal of designing a good UI games, but this will only happened if developers follows the UI properties, to understand the people perspectives and behaviors. Here ill give you the important points that are helpful for designing games [17].

Design should be clear mean every menus and its functionality are mentioned and its design should be consistence. Be careful of different perspective of identification of any message and its behavior, interface is effective if they provide a visual feed back [17].

Be careful, while input the audios and sound in the games, you should be consider what type of sound is fit in which environment, what sound create a problem of the user [17].

Before entering the game stage, showing some type of description about stage and how to complete this stage, its only applicable if text is clear and easily to read by the user eyes.

Provide a proper guide line with the help of maps and compass, provide mouse, keyboard and more important joysticks support for better performance. Last but not least property of the interfaces in game, is game model should be the presentable with continuity and control are easy to handle for the user or any player [17].

5.7.2 Evaluate a User Interface Design

Designing a good interface is a challenge for any programmer [19], because the user capabilities and its need depend on the technical requirements of the product. And the only thing is considerable for the user is called interface of the game. There are many types of game like Civilization, racing, simulation and strategic. Nowadays the user is totally focus on the real strategic game, real judgment of information and situations [19].

The meaning of the games is not even the enjoyments and fun, it is flexible and easy to learn. Computer games doesn't mention the design, more than that of it an attractive interface. If the games are visually effective and artistically inspired than user can say that game have an attractive and easy to play [19].

If the game options and its menus are not clear, we don't think so, it is considerable to the user to play that game. Check whether simulation, analyze user procedures required by design or not. Measuring time required for loading environments [21]. In short games are directly proportional to interface, because they are helpful for better play performance in the game. But we couldn't say that, if you can follow this type of interface properties and you can apply these properties each type of games, e.g. Rebellion also fails miserably to provide feedback [19]. For instance, when a mission is sent into enemy territory, there is no visual sign that the mission is underway, in many games the control and interface is according to the standard but still user can not feel comfortable while in the game [19]. The basics problem in these games the designer forget the usability in the favor of other properties of interface like ease of

use, performances and good cognitive mapping. So in some aspect the game is easy to watch but not fun to play [19].

5.7.3   MOHAA vs. BATTLEFIELD 1942

The purpose of this question to find the fact that lack of perceptive interface cues is one of the distinctive features. In this section ill give you the comparison in between two games Medal of Honor (mohaa) and battlefield 1942 interface differences. It is an only way to interact with player- player and player- environment interaction [22].

Now the both games are 3D shooter game, supported with multiplayer environment and the player can play this game by the help of first person and third person view, with diverse soldier sketch and different type's war equipments/ machines [22].

Interaction has been studies in several fields with different names [22]. This concept is gives you the overview of each and every interaction relationship with the model and some evidence of screen shot give you the events and comparisons of the interfaces. The basic purpose of comparison in term of players interest in the games design of interface and we can tell you interfaces is does not mean the menus portion, the main purpose is interaction of user in the games interface, given below the snapshots of the games, left snap of MOHAA and right is BATTLEFIELD 1942.
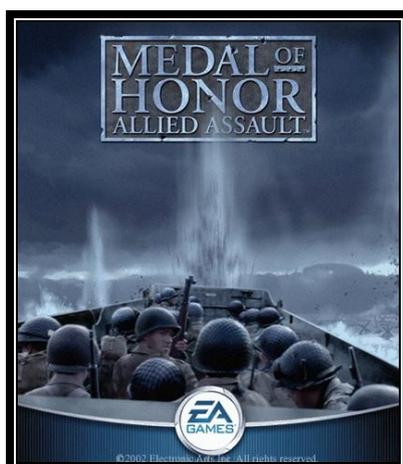
5.7.4   Avatar Appearance

Avatar Appearance has at least two main forms in the game. First, it provides visual team information to other players [22]. Second, the appearance allows the players to identify different roles in the game [22]. So the avatar appearance of battlefield 1942 is better than the mohaa. Because battle field give you the detail presentation of avatar appearance as compare to mohaa this give a carton appearance.

Figure 6 Representations and visual characteristics of players [22].

5.7.5 Facial Expressions

Facial expression of an avatar based on the photo realistic face with slight dynamic changes in expression. There are many changes like blinking of eyes etc are not directly by the players, but some of them is controllable, such as getting injured or killed (e.g., grins) and when initiating certain pre-defined radio messages (e.g., when shouting "Go Go" the mouth is almost lip-synched) [22]. According to my experience in the both games, the facial expression in mohaa game is not proper, as compare to the battlefield mostly expression is good, illustrated in figure 7.

Figure 7 Different facial expressions (neutral, grin, squint, and "lip-synch") [22].

5.7.6 Non-verbal Audio and Language-based Communication

Non-verbal audio, in Battlefield 1942 an in mohaa, includes the sound effects of various actions, such as shooting, running, jumping and reloading. Only in battlefield, different vehicles and weapons make specific and often recognizable sounds. In battlefield, an approaching tank is clearly indicated by the roar of its engine and noise from its tracks. Non-verbal audio would seem to be a very important interaction, especially in fast action games [22].

Spoken or written communication, during the battles of Battlefield 1942 and in mohaa, is mainly handling with predefined voice messages and text-based chat channels, mostly general messages filling the audio space of the game environment. Textual chatting is an additional form of exchanging information in both games, but due to the typing effort, would seem to be used less, we think in order to improve communication in the games, use some hardware like headphone or some voice software for transferring the voice to the other player in the game [22]. There

is no map overview in mohaa as compare to the battlefield; player can observe each and every movement through map and compass.

5.7.7   Overall Environmental Details

Environmental interaction forms include the use, modification and affect of the environment and the objects within. The environment limits the playing area in the form of boundaries, it affects the player performance (e.g., water, visibility), and it offers protection for the players in the form of additional scenery (e.g., colors, textures, and objects) [10]. The environment also contains key locations (i.e., bases that can be invaded or defended) and service areas (e.g., healing, vehicle fixing and ammunition reloading) [10]. In mohaa player couldn't crouch but in battlefield is available, missions are same in both games. The environment detail is more realistic in battlefield as compare to the mohaa. There is a tool tip in battlefield mission to describe the mission statistic, where and which key and action is better, but in mohaa is not included to the update version. There is no option for the player to rebirth in mohaa but in battlefield player as he as area captured, the rebirth places creates.

5.8   Simulation and its concepts

The Latin verb simulare means to imitate [23]. A simulation is a process of an imitation of some real thing, state of affairs or apparatus to generate test condition that approximate real or operational condition. It can be representing different characteristics or behaviors of a real thing, e.g. flight simulator, second life etc.

There are many different simulation techniques, including stochastic modeling, system dynamics, discrete simulation, and role-playing games. Despite the differences among them, all simulation techniques share a common approach to modeling [23].

5.9   Modeling & Simulation

Modeling and Simulation is a discipline for developing a level of understanding of the interaction of the parts of a game or a system. Modeling and Simulation is also very much an art form. One can learn about riding a bicycle from reading a book. To really learn to ride a bicycle one must become actively engaged with a bicycle. Modeling and Simulation follows much the same reality. Skill and talent in developing models and performing simulations is only developed through the building of models and simulating them [25].

5.10 SIMULATION CONVENTIONS

When we talking about the simulation, it is important to identify any parameters of multiples values and trying to integrate system have different underlying

assumptions about who the physical world works is very difficult. It is best approach to identify any ambiguities and solve the before writing any simulation code [16].

In a 2D simulation, the properties of the physical world can vary X and Y axes run, and term is use for rotation, positive turn is clockwise or negative turn is counterclockwise. But in a 3D world, there is an additional Z axis to deal. Here we are talking about the use a standard set of rules for 3D simulations called the Cartesian coordinate system. In this system, the positive X direction is to the right, the positive Y direction is up and Z is backward and positive turn is clockwise and inverse [16].

The simulation code is also use 360-angle, but in some situations to reverse the rotation direction. The utility function Radians has this conversion built in figure below illustrates the conventions [16]
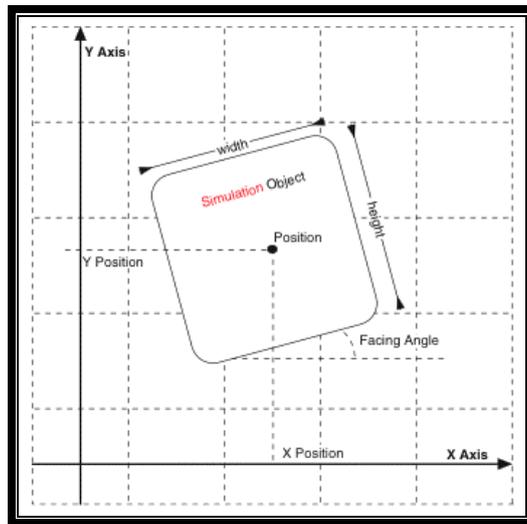
Figure illustrates the 360-angles with radians [4]

5.11 Types of simulations

Generally Simulations come in three styles: live, virtual and constructive

Live simulations	Virtual simulations	Constructive simulations
Typically involve humans and/or equipment and activity in a setting where they would operate for real. Think war games with soldiers out in the field or manning command posts. Time is continuous, as in the real world. Another example of live simulation is testing a car battery using an electrical tester [24].	Typically involve humans and/or equipment in a computer-controlled setting. Time is in discrete steps, allowing users to concentrate on the important stuff, so to speak. A flight simulator falls into this category [24].	Typically do not involve humans or equipment as participants. Rather than by time, they are driven more by the proper sequencing of events. The anticipated path of a hurricane might be "constructed" through application of temperatures, pressures, wind currents and other weather factors [24].

5.12 THE PHYSICAL SIMULATION

In games, there are conceptually two simulations that are closely related. First is the physical simulation of the world. This deals with the physical nature of the world and objects within it with respect to the rules, such as position, size, and velocity. Second is the game simulation, which deals with the specific properties of objects in the world in regard to the actual game, such as hit points, magic, or experience. The proportion of each type of simulation varies enormously between different types of games. Some games are almost entirely physical simulations that deal with cars racing down tracks or tanks firing guns. Some games are almost entirely game simulations that deal with points or virtual cash. Most games fall somewhere in between. Since the game simulation sits on top of the physical simulation, there should be a robust physical simulation in place before implementing the game simulation [16].

5.12.1 COMPONENTS OF THE PHYSICAL SIMULATION

Physical simulations consist of rules, information and object these all components inhabit the games worlds. When we talk about the implementation phase in games, physical simulations also often include a collision system [16].

Rules are the information that describes how the simulation works and how the objects in the simulation interact with each other. Physical simulation is based on existence of the entities of simulation objects. These entities must behave with the rules, but within that limitation, and these rules varying the characteristics of and the behaviors that can be driven by higher-level systems such as artificial intelligence and player input [16].

Simulations can be 3D (e. g., first person shooters and flight simulators), or 2D (e. g., many arcade games and puzzle games), but in each case, many of the underlying concepts are the same [16].

5.13 Reactive simulation

When we talk about reactive simulation, both the simulation and the simulation objects are built in a low-level language. Here we are discussing simulation with the concept of Python, it is used for decision making and behavior as the simulation is running, but no state actually resides on the Python side. It is only used to describe the behavior of objects that already exist in the physical simulation [16].

For example, when a door is opened in the simulation world, this Python code could set other high-level events in motion in the simulation, such as spawning a monster to attack the layer, but the simulation would then run without any other Python code until some other event happens and a decision has to be made, shown in figure reactive simulation figure [16].
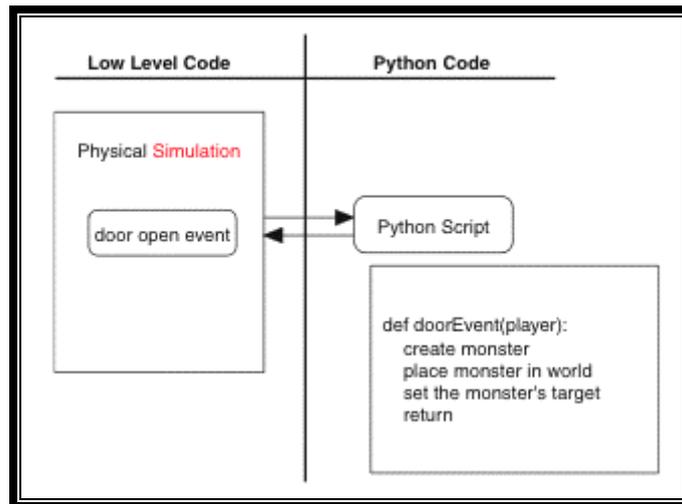
Figure: Reactive simulation [16]

5.14 Controlled simulation

Now here we are talking about a controlled simulation, this simulation is a hybrid of Python code and low-level code that combine to provide a full simulation and the simulation objects are Python objects that might have representations in the lower-level code. In this type of simulation, the Python code does not include all of the information required to actually run the simulation [16]. For example, there is a door which is depending on the python object in a physical simulation. This object has performed a task when operations such as opening and closing are performed. The opening and closing of the door is contain the references to other game or simulation objects and is able to interact with them directly [16]

In addition to the Python door object, there is a door object in the low-level code that tracks more detailed information about the object, such as its exact open angle, its current swinging velocity, and its 3D representation. The main point of these simulations, object interact with each others, but the decision making and control are the responsibility of the python object, because the python simulation will decides, when the door is needed to start and stop the swinging the door. Showing figure in the controlled simulation below, this approach is a higher functionality in this language but they need small interface to the physical simulation. [16]
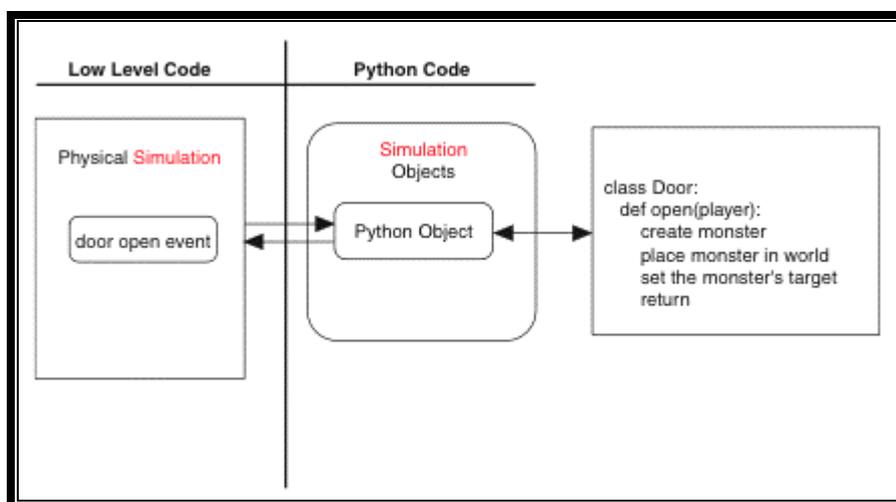

Figure controlled simulation through physical simulation [16]

5.15 Parallel simulation

In a parallel simulation means two simulations run in parallel. One is used for low-level language runs very accurately at a level of granularity, with the help of low level simulation is very accurate, run in a real time and be update accurately every frame, such as rendering and animation. Now in second simulation runs in the python at a course level of granularity, but it's sufficient for making certain decisions required for the simulations. This approach does require interaction between the simulations to ensure that they stay in synchronization, and it also includes the elements of reactive and controlled simulation. In this approach, the python code has run the simulation at the level of requirements for game level decisions; main thing all information doesn't required rendering the world [16].

For example, in this approach, there are door objects in two simulations. Both objects are capable of opening and closing, and the objects communicate with each other to ensure that they keep their states synchronized. But in some cases, such as on a server, the low-level door object might not exist, as the type of simulation it is performing is not needed. In these cases, the higher-level door object is still able to act function because it can act independently. Showing in the below figure of parallel simulation [16].
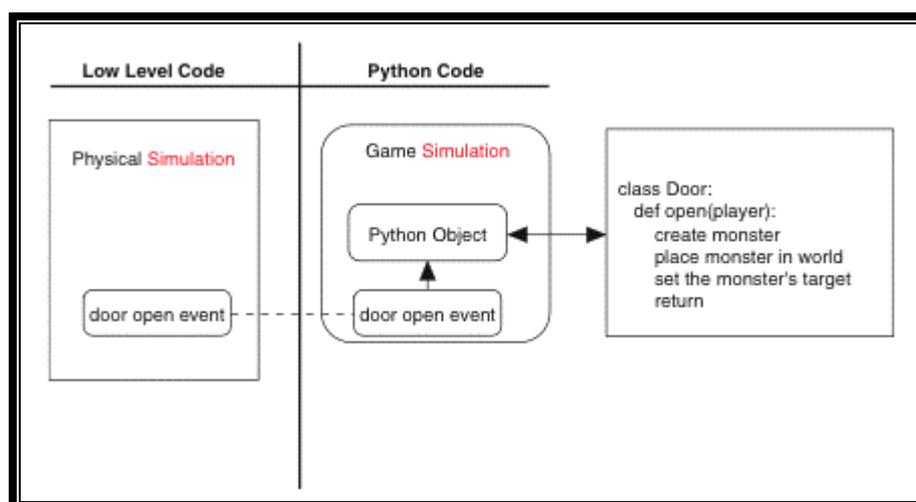
Figure of parallel simulation [16]

This approach has the advantage of simulation; it can be run without the low-level version of the simulation. This means that the Python could be run on a server, or on a low-end client that doesn't have graphical capabilities. It can also mean that development on the Python version of the simulation can be performed independently of the low-level simulation. This separation between the simulations can allow progress to be made on game systems before the low-level simulation is in place [16].

5.16 VARIABLE RATE UPDATING

In computer simulation, object updating is expensive. But the techniques is exist in the game development to minimize the number of object update are performed. One such technique is to vary the frequency at which objects are updated based on the

magnitude of their movement. Fast-moving or spinning objects must be updated every frame, but slower-moving objects and stationary objects can be updated less often without any loss in fidelity of the simulation. But In some conditions, this method is helpful for take decreases amount of processing times required for updating the simulation objects [16].

5.17 Light and shadows

Lightning is one of the most important things in Computer Graphics-art. Ever since CG exists, artists wanted to create perfect copies of real life. One big problem was lighting up the scene [26].
Where to put the different spots to get a half-decent result? Here we are solving the problem of light and shadow. Firstly explain the 3 basic methods of lightning and should help them to choose the right lightning technique for their game, industrial and manufacturing departments [26].

5.17.1 Visual Perception: What We See Is Not Always What We Get

The majority of what we think we see at any moment is actually a virtual world created by our brain. In reality, our eyes can detect details only within a 1.5° arc. The rest of the eye's detectors, which cover about 240°, are equipped only for sensing minimal detail of colorless light. Our brain combines details from continuous scanning with the peripheral image and our expectations to create what we believe we see. When we view a flat-framed image, however, we tend to see exactly what is there. [27].

The other motivation for controlled lighting is for use as a storytelling tool. Different light quality, brightness, direction, and color can change the feel of a scene. This is an important part of the visual story of a film. Let us take a closer look at these elements of lighting [27].

5.17.2 Clock layout

The clock layout is very helpful for providing the location according to the lit object. Subject is always present in the centre of the clock. The camera moving around the subject but its location is either V or a H. Its movement is 3H, 6H, 9H and 12H to account the three dimensions. Below figure give you the detail of the clock layout. In 3H and 9H is produces the maximum texture out put are called edge lightening. This is good for the better result of the objects detail. If we are stand in the back of the object 12H, its mean light is in our back the output result is black object appears. [27]. Let figure the clock layout and right one is the example of 12H.
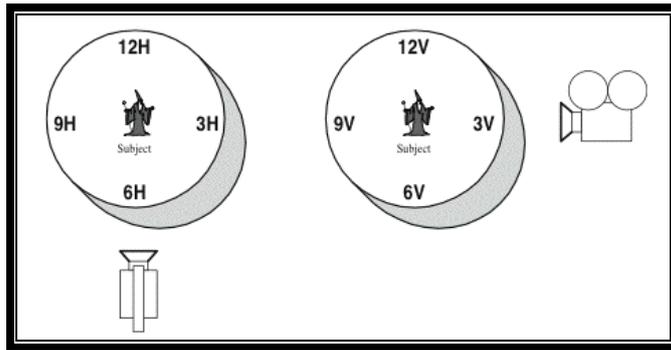
Clock layout	12H position output

5.18 Light quality

Light is a single- point source in different situation, the creation of light is depend on the source or power of light, so according to the my research there is mainly two types of light creating ways, first is hard light, and it is different origin and direction. This type of light has harder shadow with hard edges. The main reason of hard light will give out the small textured on the surface, figure below left. Now the second type is soft light, its fills the space and its directionless and it can be created with the help of multiple reflections of various surfaces in the environment. This type of light produces an equal amount of light hit on the every surface is called light casts. Due to the lack of contrast, it creates the flat image [27]. Figure below center

Hard light	soft light	combinational light

Now this is not a type of original light, actually it is a combination of soft and hard light. The main benefit of this light it will achieves a higher quality of effect, and its will automatically increases the illumination in the dark shadow of a dark light without adding additional shadows, Above figure right [27].

The previous light types describe opposite ends of a continuous spectrum. The image that is in middle position is a light that throws out shadows and it has definite direction with soft edge. The effect of the middle light is same like a as sunlight [27]. While deciding the use of light, there are two important types of aspects such as texture and shadow. The small shadows are also a result of texture and texture is dependent on the direction than the shadow [27].

5.19 Light Direction

When we talking about the light, it is necessary to follow some direction, lighting is relative to the direction the camera is facing. Lighting produce the flat look if produces from the front panel. The reason when the light landing on the surface, no shadow will produce because light is directly to the surface. But this is good for the digital lighting to showing 3D object [27].

Light produces the flat look

In gamming and virtual world, or you can say that in digital world there is no physical camera nor light is present. Usually, however, full frontal lighting is not desirable. As the light moves away from the camera, and around the subject, the modeling or three-dimensional texturing of the subject becomes more evident [27]. The edge, or side, light reveals even small three-dimensional differences by casting shadows from anything that is not facing the camera. In this way, the viewer can see details that would otherwise be impossible to notice without examining the item in person. To reveal these small details in digital rendering, we must perform either high level-of detail self-shadowing or an approximation such as bump mapping [27].

Casting shadow [28]

This is possible to improve the quality of texturing through light, if side light combine with bump map then texture automatically improved. The only problem for machine, its takes time for rendering, otherwise the ray-tracing will produce an accurate image [27].

In virtual environment backlight is better approach as compare to the physical world; the reason is that polygon light doesn't allow for the refractive effect needed for backlighting. This is reality that we do not need to render the back light in the virtual world; the reason is that in virtual world camera has it self light [27]. Below figure give you the result of the polygon when light put on the back side.
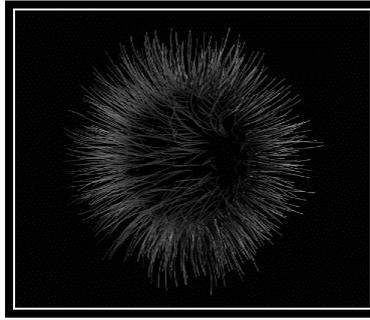
Light put on the polygon from the back side

5.20 Light techniques

There are typically three types of techniques of light in the scene. Three light scenes, Sphere of light, mental rays

Roles of three lights [17]

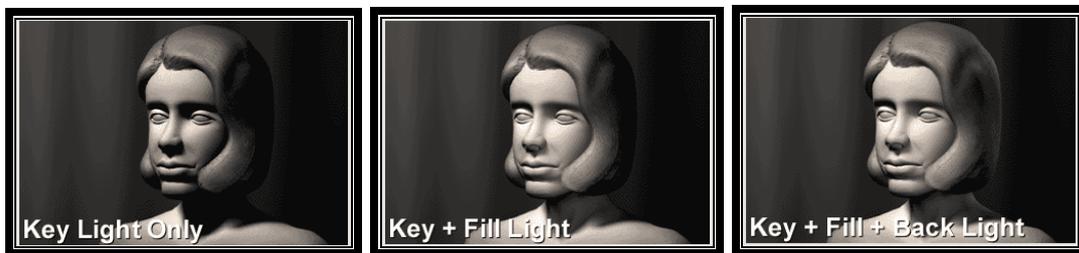This is the fact that light has no rules according to the standards', but every scene has its own lightening positions with the help of these three light scenes. The key light is the man responsible for the main illusion of the scene and it's create the strong shadow with hard light, you can also observe in the left side of the picture that give the example of the key light on her face. The normal amount of multiplier is 1 with a bright white color at the angle of 45 with some height. In virtual world shadow doesn't create automatically, you have to activate them. If we talking about in real life, key light is come from sun and in room from lamp [29].

The fill light is also called the supplement of the key light, because its give the smoothness of the scene and detail of the object. In real life every object omits and emits parts of the light. The emitted light lights up other objects and gets omitted and emitted again. This effect is called "radiosity" [29].

In virtual world these type of effect is more complicated while in simulation, that's why fill light is helpful for create the fake reflection, fill light not strong if we compare with the key light, actually the multiplier ratio is 0.5 or lower and color depend on the scene. This type of light has no specific place for direction, the only purpose to clarify the object. And you can use the fill light through omni or spot light [29].

The back light define the object in a scene and it helpful to light up the boarder of an image, it is place in the opposite side to the key light and its height little bit above. Due to the same setting of a fill light, that why the shadow of this light is also same. The only purpose of this light for opposing the fill light, so the realism will produce in the scene [29].

Now we am talking about the sphere of light, actually this type of light give you the originality of the object shadow, when it is put down on the uneven surface. Here

we am give you the tree example, as shown below, the left picture give you the good output result, except the tree shadow is not present, here we need a shadow which is generating a depth.
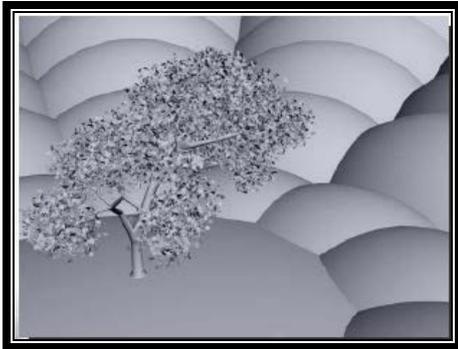
The two different output results left has no shadow and right generates the depth

Every thing in the virtual reality is not an easy task, actually creating real in 3D is very complex, complex in a sense of settings, here we am talking about the E light is use for the produce the real shadow according to the surface. E lightning bring you the geosphere shadow of any object like tree [29].

Mental ray is another type of light which generate the physical correct simulation of the light effects, including reflection, refraction and the whole scene illumination. As we already mention that 3D virtual reality is very complex. So the mental ray is very complex rendered, you can see below the picture left is rendered with the standard scan line rendered using the 3 light technique. And the other one is rendered with the mental rays with global illumination. Caustics effect is only possible and the background is clearer as compare to the other one, these effects only possible with the help of the mental rays. The only problem, mental ray take more time than the other sanline rendered but you can generate the photorealistic picture with physical correct lighting effects [29].

Scan line rendered light technique   mental rays light technique

5.21 Types of shadows

Light is the main part of the scene but without shadow nobody find the mood of any scene in virtual reality. There are four types of shadows.

The primary shadow is created with the help of light but every object has a shadow. Now the question arise what is the deference between shade and shadow. Actually the lack of illumination is called shade but primary shadows is obstructs the light and the illuminates the surfaces that receives the shadow. The secondary shadows that can be generate with the cast on the object and put background of the scene [27].

The tertiary shadows cast on the subject by the objects and background of a scene, making them essentially the reverse of secondary shadows. The false shadow is same as that of shadow , this shadow is generate in the sense of frame, we mean some portion of a scene put in a frame, some in darkness and some in light these limit are called the false shadow [27].

But in virtual reality user can generate multiple shadow, but it's only feasible by the certain amount of light setups. The primary shadow doesn't take time in real time games environments. Secondary shadow gives you the support in the place of subject in the scene. Shadow have a its own density but shadow have light or heavy density and illumination is totally depend on the shadow density, strong shadow always generates the hard edges and little illumination whereas the soft shadow have fades edges and little closer to the reality [27].

5.22 OpenGL and radiance

OpenGL (open graphics library) is a software interface to graphics hardware and it's used for writing the 2D and 3D interfaces. It have many functional and procedures for generating the high quality graphics. They are used in virtual reality CAD and different types of visualizations. It better performance than the Directx. It is only rendered with the frame buffer technology because hardware is also follows the same pattern [30].

The functionality consists of evaluators (used to model curves and surfaces), selection (used to establish rendered primitives on the screen), feedback (which returns GL results before asterization), display lists (used to designate a group of GL commands for later execution by the GL), flushing and finishing (used to synchronize the GL command stream), and hints [30].

The main purpose of the openGL is to hide the complexities of interface and conflicting capabilities of hardware with the help of different programming procedures. According to the experience of games, openGL is better generates the output result, because openGL is work on the frame buffering but direct work on the vertex shaders [30].

Radiance is basically computer software which is used for generating the realistic image with the help of physical environment through proper calculation and

predicting the visible radiation in the space. It is free software for lighting the rendered and its simulation [31].

By using accurate input into the program will give you the positive output, such as manufacturing, industrial design and gaming technology. It also helps out specific lightening fixtures and experimental lightning design and also enhanced the both seculars and diffuses inter-reflection [31].

This software is mostly used in controlling and enhanced the environmental lightning, actually there is three steps is involved during to create the whole environment, first step to creating and converting a three dimensional description of a physical environment or a scene, for example house interior, rooms, furniture, light etc into simple geometric element that can be interpreted by the radiance packages. In second step, setting up the lightning sources and its strength, and the last and final step to rendered the original image with proper light and environmental effects [31].

5.23   Future technological developments

There is lot of effort has been given in the field of virtual reality, it is still overvalued terminology brings people to closer. Everybody talk, move, playing games, interact with the peoples and touch thing with the help of virtual technology. As the time passes, many real applications coming into people life, many applications is develop for many purposes e.g. architecture, visualization, entertainment, manufacturing, augmented reality, art, education and training, medical, virtual communities and distributed VR. Further ill describe the terms and its benefit in VR [32].

As you know that, in virtual tool every body can create 3D object and demonstrate them. So it is very useful for user to explore a 3D scene in real time, user can see the architectural design or easily manipulate them. Communication is the most important part of the any successful application with the user before design any product. In virtual reality illustration is the main part for demonstration any scene or environment in front of the user, because of computer 3D graphics performance. And this increasing better output, user will see the more visual detail of polygons and environmental effects. With the interaction of VR systems user can move around any restriction and beyond the limits of physics [32].

Visualization is also a very important part of present days; user can resemble the architectural walk through on many aspects. With the help of VR system, visualization gives you the power for visualizing complex equipment and fixed it [32].

The major resources are used for the gamming and entertainment world. And this is also a most profit able area in the field of virtual reality. Many companies are producing game and its hardware related and according to the principles of VR, e.g. VR gloves and HMD. Virtual reality is also helpful for creating the manufacturing objects, and user can interact in 3D environment with VR hardware's, nowadays the uses of VR system is testing, various controlled and its components, simulating airflow and aerodynamic performance of car [32].

 In art, virtual reality is present, in future user will interacts virtual pointing devices in a cave systems, this is not sure these application give the better output or not. And it is also use in the fields of training and education e.g. in flight simulator this is one of

the oldest application in the field of VR. Pilots are trained in virtual environments and fly airplane virtually [32].

People can interact through networks communication, since the start of p2P networks. On behave of virtual reality system evolvement is fully integrated and work cooperatively through a virtual world, patient will be operated from the distance, NASA communicates and interact with the people in space and explore different investigation. But all these application need more reality because it can be work with some limits, actually the reality is limit less. We are sure near future virtual reality will bring something new and its worth is more [32].

6   EMPIRICAL STUDY

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Here we am comparing the two environments one is CRT display and the other is CAVE in the standpoint of games, manufacturing and industrial design, but the main concept is still present are called virtual reality.

Virtual reality systems are used for a variety of application like games, industrial design and manufacturing department. The purpose of research is the interaction of virtual reality appearance and performance in cave and normal desktop display with the help of flight simulator. In this environment, we only consider the visibility of an virtual environment like interface, light and shadows effects and simulation of an object either polygons and physical appearance [33].

According to my observation, the user involvement in the game is depending on the reality and the effectiveness of the game. The cave environment is so called immersive as compare to the desktop display [33].

If we compare the desktop and cave environment, one or two users may sit comfortably and view the virtual environment at same time in a normal PC with 17 inch screen size. But involvement is only possible for one person. But in cave many user can interact in the same virtual environment, if an environment is created with three or four sided projection. [33].

Before an experiment, it is seem very difficult to say that which one is more closely to the user, where user feel environment problem in which scenarios. The development of the flight simulator is very challenging work, the only reason of complexity of the simulation and environmental effects.

6.1   Generic model

A flight simulator normally work on the seven sub systems, simulation models, cockpit instruments, visual cueing system, motion cueing system, audio cueing system, instructor station and cockpit controls & force feedback system. The relationship of these components is shown in fig.1. [34].
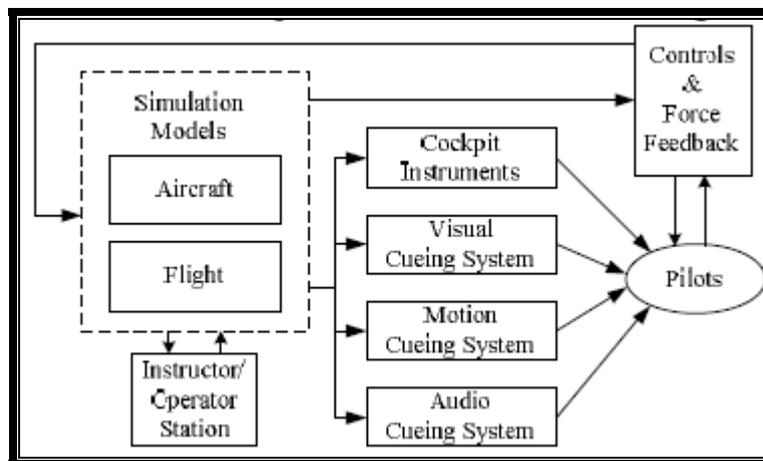

Fig 1: flight simulation functional model [34].

These facilities in the flight simulator are very helpful for the users, visual cue, audio cue, and force feedback signal and motion indication. The instructor is in charge of the educational aspects of flight simulation. It is the person who decides what mission will be run, and under what conditions. [34].

6.2   Software and hardware

There are many software and hardware used for flight operation, simulation and its environmental effects. We chose MATLAB/ Simulink to build simulation models, VAPS for drawing cockpit instruments, MultiGen Creator for modeling virtual visual environment which was driven by MultiGen Vega. Not only visual, the audio files were called by Vega too. The whole system consists of 11 PCs as a cluster shown in picture 1, hydraulic driven force-feedback system, digital geometry and soft edge correction machine (Equipe 3ch-ProMap), 3 projectors (Equipe Contour 300), 2 speakers, a virtual prototype of motion system and ANOVA for analysis the participants results [34].

Cock pit picture   11 computer cluster

Now here ill give you the explanation, why is it necessary and tell you how the overall virtual environment will give you the better output. When we talk about desktop computer with 17" screen monitor, the user can not feel him or her present in the virtual environment. Instead of cave, a virtual environment made up of multiple screens. And user can interact in the interface and environment with the help of head tracking device. More over user can move within the physical cave from 0* to 180* or in some cases 360*.

When a user can interact in the virtual environment, we must manage the tradeoff of physical and virtual navigation in the below table.

	Physical navigation	Virtual navigation
Spatial understanding	Higher	Lower
Directness	More direct	Less direct
Navigation interface	No explicit UI, body provide input	Requires a dedicated navigation UI (button, etc)
Generality	Not always sufficient	Can always be used
Fatigue	Higher	Lower
Input devices	Must be mobile	Any device can be used

Tradeoff of physical and virtual navigation [35]

6.3   Experiment design

The purpose of this experiment was to conclude where the user can feel comfortable in the virtual environment along with all properties; either desktop screen size or the large screen cave. Cave environment should be the faster and accurate as compared to the desktop environment.

We take some participants 4 male and 4 female, 6 participants are the graduate student and 2 of them is master. Each person has to assign a task for two types of display. These participants will check the environmental effects, simulation and the interaction with the cockpit. This experiment took 4 days for full and final evaluation.

6.4   System overview

Before starting experiment, ill give you some properties in CRT and cave environment. In CRT have 17" screen with 3D CAD and in cave three sided screens with 4" x 120" x 120". The cave is compiling with four computers with dual Intel CPU 2.0GHz and 1 GB RAM, instead of this normal desktop computer has 512 RAM with 1.7 GHz CPU. The software is totally controlled all types of rendering and input devices.

Participants start experiment form the desktop and each task, take 25 min for checking and 10 min for filling the form before and after the task. And the total time for all tasks will take 70 min.

6.5   User interface

In CRT, the entire cockpit environment is display in one computer, and if the users need to watch the left or right side of the environment, they need to be change the view. And all type of instrumental detail of the cockpit is display in the monitor, showing in the lower portion and the above portion is used for outer environment.

But in CAVE, the middle screen is used for the cockpit panel and the window of the cockpit, left and right side screen showing the left and right side of the cockpit and environment view.

6.6   Training

Before start experiment, participants were given three to five min to become familiar with the display configuration and navigation systems in the CRT case and in the CAVE environment. The participants give a try to check the working and dynamically changing viewpoint through head position

6.7   Experiments

Before starting experiments, we clearly point out the experiment in the CRT environment which all the empirical result is taken by my self but in case of cave the data is acquire from the previous research papers and experiments.

6.7.1   CRT- Experiment

Before starting experiment, each participant check the eyes vision ability, mean corrected-to-normal vision, and all participants prescreened to have binocular depth acuity of at least 200 arc second. Each participant have to fill the form, previous knowledge and experience and a short question e.g. age, sex, gender etc. In this study the whole environment is totally immersive by the help of SGI Onyx 3200 infinite reality [37], because this will give you the 141 million polygons per/s and unbelievable 3.8 billion pixel per/s of sustained performance [36].

During the desktop condition, monitor is used and situated in the centre of the immersive room. The user will sitting in the middle of the immersive room, because observing the similar visual angle all viewing condition. The resolution for all the displays equipment is 1024* 768 pixels and all the time the stable refresh rate of 96Hz all the time. And the frame rate will be same in 10 frame/ sec and illumination will be very near to darkness [37].

Participant used joystick to move forward and backward and to rotate clockwise and anti clockwise. The model aircraft Boeing 747 for is used for interact the environment and its simulation. This data set is written in the C++ using OpenGL performer and CAVElib. These all software is used for the displacement of the aircraft and helpful for the recording the user performance. To find the accuracy, all rendering distances and the virtual distances from the user, Boeing data set is fixed at the level of 90% [37].

Figure: runway, high altitude view and user interact with flight simulator

6.7.2   Cave- Experiment

In CAVE, the room is fully immersive display with four sided display, but in the case of flight simulator the only front, left and right side of the screen working. Electro home 9500 CRT projectors are used for project images on the screens. Even in cave user can move in the wall configuration but for the accurate output. That's why; user can sit in the immersive environment, same as desktop computer.

Figure: Cave environment in the cockpit

The resolution for all the displays equipment is 1024* 768 pixels and all the time the stable refresh rate of 96Hz all the time. And the frame rate will be same in 10 frame/ sec and illumination will be very near to darkness. For the input user used 360 degree-of-freedom intersense IS9000 ultra sonic tracker and mouse for takeoff, landing and movement of left and right direction [37].

7 RESULTS
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So now the time is for output of the result, these two experiments give me a three output results, first part of the result give me the performance of the flight simulator, which is directly related to the simulation of the plane, and it's all the environmental effect. The second result type gets from the questionnaire. And in the last one is my observation during the running task [38].

7.1 Task Presentation

Below chart shows the average user performance in Cave and CRT environment. Out off eight users was place the more quality appearance in the cave as compared to the CRT display. Only one user was not completes the experiment in time, because they got shaky in the cave, that's why we couldn't include in the chart [38].

Average Performance

User	1	2	3	4	5	6	7
CAVE	148	123	117	88	180	82	78
CRT	98	87	91	50	90	88	85
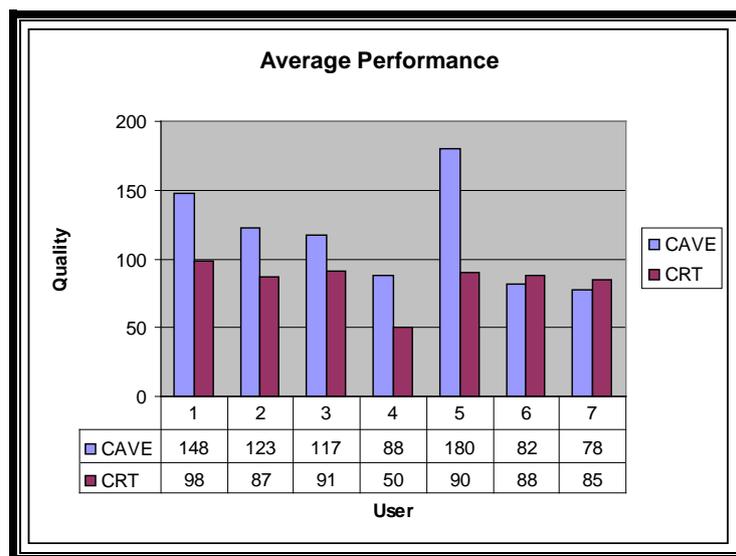
Average performance of the user in flight simulator [38]

7.2 Questionnaire

This is my second result output on the bases of the questionnaire; here ill give you the brief explanation with the help of user form before and after the experiment. This is very clear all the student were student of computer science department, I also asked the entire student, who many student have 3D program experience, five student have no experience and the other have little bit. But not of all have a virtual reality experience especially in the cave environment [38].

In the pre-questionnaire, users just fill the information about self and interests, instead of post-questionnaire, here we asked the student to categories the ten

questions according to the both environment experience, given above the question detail and calculation in the range in between the 1.0 to 10.0 [38].

No.	Questions	Cave
1	How was the effectiveness of the user interface	6.1
2	System help out to perform the task	5.5
3	Which system is easy to use (once you had learned)	6.9
4	In which system the simulation is near to real	5.7
5	How the quality of front panel appears (light and object shadows)	5.5
6	Which environment you experience efficiency to perform the task	7.8
7	Where you feel comfortable	7.0
8	In which environment your confidence was boost up	6.9
9	In which environment you feel real enjoy	7.5
10	Your preference of future use	6.5

Cave average result from the post-questionnaire

No.	Questions	CRT
1	How was the effectiveness of the user interface	3.9
2	System help out to perform the task	4.1
3	Which system is easy to use (once you had learned)	4.0
4	In which system the simulation is near to real	4.5
5	How the quality of front panel appears (light and object shadows)	4.7
6	Which environment you experience efficiency to perform the task	4.4
7	Where you feel comfortable	3.5
8	In which environment your confidence was boost up	4.0
9	In which environment you feel real enjoy	3.5
10	Your preference of future use	3.2

CRT average result from the post-questionnaire

After the above result, cave take a higher scored as compared to the CRT. But in some case the user ranked CRT, especially in the 4, 5 questions. But overall Cave provides a best simulation and environmental effects.

7.3 Participants Proposal

During experiment many participants give suggestion, likeness and dislike about the both environment for improvement. Two students liked cave environment, because it give you the full immersive environment and user can interact with the virtual objects. Mostly student was not satisfied with the CRT environment. Some students give a suggestion to counterbalance the screen, or to add at least two more screens for creating the virtual environment (flight simulator). And the interaction in the CRT monitor is not leading. At the end of this discussion, mostly student was very impress the visualization of cave environment [38].

7.4   Observation

We am very astonished, that mostly user was easily learned and interact the both environment specially the Cave. During experiments we evaluate that, the clearness of the display was not good in the cave as compared to the CRT. The reason is the brightness and contrast in dull through the projectors, that's why mostly users request the higher the resolution in cave [38].
In CRT the display and rendering quality is good but the problem is only with the frame rate. As we already mention above, frame rate is same in both the environment, but during the experiment user feel problem in the CRT. It is very impressive; user can feel very comfortable while controlling the aircraft in the cave environment. This result give me that cave interface is more natural as compared to the CRT, but few drawback of both environment. we could not expect that user was feel difficulty selecting the functionalities while in the cockpit panel, according to my observation cockpit panel is not look at complete at same time [38].

At the end we finally say that, cave got the maximum score as compared to the CRT. But we also say that, we were found the difference is just because of the interacting equipments. This statement is doesn't mean, CRT give you a natural interface.

8   OVERALL DISCUSSION
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This master thesis revolves around the phenomenon of virtual reality. During this virtual reality oriented documentation, the introduction emphasizes on the basic information regarding the context of virtual reality and the purpose that why this field interested me for research. This research mainly focuses on the specific questions related to the virtual environment. The answers to the question mentioned in this research provide the solution and the techniques for simulation, lights and shadow which is helpful for the development of better environment, enhancement and interaction with the user.

Our lives are becoming dependent upon the advancements of Information technology; because of this the purpose of the thesis is to create a relationship between the human and the virtual environment and how they interact with these types of virtual environment.

As an analysis from the theoretical and empirical study (comparison of software within the two different environments has been carried out i.e. one is CRT and the other is CAVE), It was recognized that reality is the most important part of interaction of the user. It was not the case before the experiment but the comparison give me an idea about, how simulation and other environmental effect play an important role for the user interaction.

When we talking about result, I have done one experiment out of two, these two experiments give me a three output results, first part of the result give me the performance of the flight simulator, which is directly related to the simulation of the plane, and it's all the environmental effect.

The second result type gets from the questionnaire; these are ten questionnaires for two different environments and the purpose is to find the answer of the proposed questions. Especially these questions related with the simulation, interface and its light and shadow effectiveness. One thing is very important in these two experiment reader particularly find the light and shadow in the form of results and these result give me the numerical values. And in the last one is my observation during the running task.

Finally it is experienced that virtual reality is very supportive for the development of the industrial design and manufacturing departments. This is only applicable if the interfaces and interaction of the user has been under operation depending upon the specific virtual environment. Many virtual environments failed just because of the less quality of the interface and its environments.

Conclusion

After analysis of theoretical and empirical study, we conclude that

- Environment effects and simulation is more important.

- Reality is more dependent on the environment.

- The clearness of the display was not good in the cave.

- The frame rate problem in CRT

- This is very impressive; user easily controlled the aircraft in the cave. virtual reality is very supportive for the development of the real games, industrial design and manufacturing departments

SUMMARY

After empirical study and answering the questions of this thesis, we fully believe that it is very important for virtual reality is to first create an environment of a game, industrial design and manufacturing for realistic out put for the user point of view. The most essential is how the system works near to realism. How the critical success factor of virtual reality influences these benefits

We believe that it is very necessary to have good approach to compare or to find the effective and enormous environments that does can be used and helpful for producing the real environments. According to the game scenarios, one should start from the interfaces and environmental effect. And compare them into to different situations, and then you can find the effectiveness of the environment.

So that's why we are compared the two virtual environments, which one is more near to the user in the sense of reality. After some analysis of these environments and their out come form the questionnaires and observation,

After empirical study we discovered that, not every thing is easy to measure, only human contribution will demonstrate the actual quality of the product and the involvement of the user.

We hope this thesis will helpful for improving the quality of an environment, either in the case of manufacturing or in any field of designing

My research will give you all the intangible benefit for the future work in the sense of new technology either in game or in manufacturing.

Future work
- TD vision has been trying to develop the 3D view near to the reality
- Future can be done to implement this approach in the field of augmented reality.

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Virtual Worlds Comparison Chart

The following is a comparison table of virtual worlds, as of August 2007. In this table you can find the detail overview of virtual world under difference headings and its comparison related to the other virtual world.

Virtual World	OS	Cost per month	Target user & style	Edit avatars	Build or design content	Script content	Own land or sell items	Education ready	Comm. Events
Active Worlds	PC & Linux	Free / $6.95	General; Exploration	✓	✓	✓	✓ No selling	Can code	✓
Barbie Girls	PC	Free	Young girls Fashion, social	✓	✓	No	Neither	No	✓
Club Penguin	PC & Mac	Free / $5.95	Kids, Games and Activities	✓	No	No	Neither	No	✓
Forterra Systems	PC	Contract	Training, E-Learning, Serious Games	✓	Can code	✓	✓	Can code	Can code
Gaia Online	PC & Mac	Free	Social; Top-down overview, sprites	✓	No	No	Sorta	No	✓
Habbo Hotel	PC & Mac	Free	Teens; Social	✓	✓	No	Neither	No	✓
Kaneva	PC & Mac	Free	Teens; Social	✓	✓	No	Sorta	No	✓
Neopets	PC & Mac	Free / $7.95	Kids and teens; Mini-games, social	✓	No	No	✓	No	✓
Teen Second Life	PC & Mac	Free / $9.95	Teens only; 3D, Creation, social	✓	✓	✓	✓	Can code	✓
Second Life	PC & Mac	Free / $9.95	18+ only; 3D, Creation	✓	✓	✓	✓	Can code	✓
The Sims Online	PC	$9.95/mo.	General; Social; 3D	✓	✓	No	✓ No selling	No	✓
There	PC	Free / $9.95	General; Social	✓	✓	Limited	✓	No	✓
Webkins	PC	Free	Social	✓	No	No	Neither	No	✓
Whyville	PC & Mac	Free	Kids and teens; 2D	✓	✓	No	Neither	✓	✓

			sprites; Educational					
Zwinktopia	PC & Mac	Free	Teens; Social	✓	No	No	Neither No	✓

http://www.virtualenvironments.info/