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Concepts & Study of Simulation in Computer Graphics

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Abstract: Computer graphics is the field of computer science that deals with generating images using computers and manipulate them. It is an important area of research with applications in many fields, including medicine, engineering, and entertainment. In recent years, there have been significant advances in the realism and sophistication of graphics, due to the development of new algorithms and the increasing power of computers. Computer graphics and simulation are two important fields that have seen tremendous advances in recent years. Graphics have become increasingly realistic and sophisticated, while simulations have become more accurate and detailed. In this talk, we will review some of the recent advances in these two areas, and discuss how they can be used together to create even more realistic and immersive experiences.

Keywords: Manipulate, Simulation, Graphics, Realism.

I. INTRODUCTION

Computer graphics is the process of using computers to create images. This process can be used to create images for many purposes, including medicine, engineering, and entertainment. A simulation is the imitation of the operation of a real-world process or system over time [1] also it can be said as Simulation is the imitative modelling of the operation of a real-world process or system. It is used in many fields, including engineering, computer science, economics, and military, to study and predict the behaviour of complex systems.

Computer simulations can be used to generate realistic images of objects and phenomena. By combining the strengths of both simulation and graphics, even more realistic and immersive experiences can be created. Simulation is the imitative modelling of the operation of a real-world process or system. It is used in many fields, including engineering, computer science, economics, and military, to study and predict the behaviour of complex systems.

In recent years, there have been significant advances in the accuracy and detail of simulations, due to the development of new techniques and the increasing power of computers.Simulation and graphics are often used together to create more realistic and immersive experiences.For example, computer-generated images can be used to create realistic environments for simulations, or simulations can be used to generate realistic images of objects and phenomena.By combining the strengths of both simulation and graphics, even more realistic and immersive experiences can be created.

II. RELATED APPROACHES AND EVOLUTION TOWARDS GRAPHICAL SIMULATION

Computer simulation was made hand-to-hand with the rapid growth of the computer, following its first large-scale deployment during the Manhattan Projecting World War 2 to model the process of nuclear detonation.

It was a simulation of 12 hard spheres using a **Monte Carlo algorithm** made by Nicolas Metropolis. Computer simulation is often used as substitution for, modelling systems for which simple closed form analytic solutions are not possible.

There are many different variety of computer simulation; the common feature they all share is the aim to generate a sample of representative situation or scenarios for a model in which a complete diverse of all possible states of the model would be restrictive or impossible. Computer models were initially used as a supplement for other arguments, but their use later became rather widespread.

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HISTORY: One of the first simulation was made during the period 1947 as game by Thomas T.goldsmith and Estle Ray Mann.Also during the same Era in the year 1958 the first electronic videogame was made by Willy Higginbotham as a multiplayer simulated game so both the player can play at same time.

A Computer Animated Hand, which was included in Future world in 1976, was the first video to employ computer-generated images to represent items. It was released in 1972. The "targeting computer" that young Skywalker disables in the 1977 film Star Wars came next.The first movie to employ computer-generated images for longer than a few minutes was Tron (1982).

Advancement in technology in the 1980s made computers more affordable and capable than in previous decades, facilitating the introduction of computers such as the Xbox gaming console.

The initial video game consoles developed in the 1970s and early 1980s were destroyed by the 1983 industry meltdown, but Nintendo released the Nintendo Entertainment System (NES) in 1985, which became one of the best-selling platforms in video game history. With the debut of games like The Sims and Command & Conquer in the 1990s, as well as the ever-increasing capability of desktop computers, computer games became extremely popular. Millions of people throughout the world now play computer simulation games like World of Warcraft.

Not only in the field of gaming but also Entertainment was mostly covered by simulated films such at that time were Jurassic Park and Toy story Both these used high tech graphical technology with ease and draw out the max potential in the entertainment area at that era.

By the 2000s or early 2000s new techs were invented so that not only simulation can be used in entertainment purposes by also in helping create a helpful technological era,and thus the technological era began with graphical stuffs with new exploring and open field such as VR(Virtual Reality) creating a much more immersive way to represent Simulation. In previous time only 2-D images and perspective were used but with new era VR,3-D,AR(Augmented reality).

There are many with the concept of VR however it was made possible in early 2000s or 1990 time with not only concept but with the help of proper gears it was implemented.

III. OVERVIEW OF GRAPHICS AND SIMULATION

Computer graphics is concerned with the creation of visuals using computers. Computer graphics is now a basic technology in digital photography, movies, video games, mobile phone and computer displays, and a wide range of specialised applications. A vast amount of specialised hardware and software has been developed, with computer graphics hardware driving the displays of the majority of devices.

In the field of Computer Graphics there are way more hierarchy one of them include simulation.Graphics and simulation can be other terms in their own way ,One include manipulating visual data while simulation is said to be creating or imitating a operation.There are many term common such as pixel, Shader,texture,etc requiring a detail study but they mainly depend upon folllowing type study:

Graphics have two different type.

- Graphics can be displayed in raster (e.g. bitmap) or vector (e.g. polygon) form
- Raster graphics are more common on the web, as they can be easily compressed without losing detail
- Vector graphics are more common in print media, as they can be scaled without losing detail

Graphical Object in vector form (polygon) or raster form (bitmap) can be displayed as a 2-D as well as 3-D depending upon the perspective and software used but before time most commonly used were 2-D perspective giving the use of only two axis x and y because less software enhancement, while 3-D the name suggest 3 dimensional uses three axis x,y and z.this is because now a days more realistic and detail oriented object require 3-D use so softwares are being developed and enhanced now a days.

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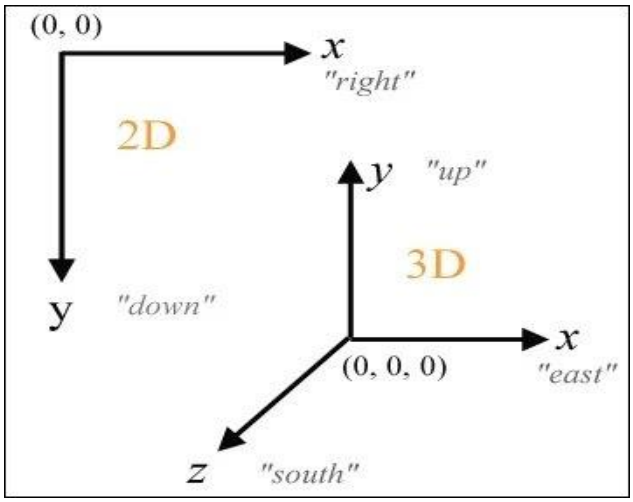

Fig 1. shows the difference in use of axis in 2-D and 3-D

While software are enhancing day to day over update, Hardware are also being enhanced with performance boost for graphical support towards system from CPU as well as GPU separately.OpenGL helps a lot in this process to generate 2D & 3D vector objects using the API interacting with GPU to get the maximum Hardware Acceleration,this a median between Hardware as well as Software.This opens a whole new field towards many sector for eg.Industrial,Health Care,Entertainment,etc.

While the Graphics have such criteria and field open Simulation also have many new field as well uses to itself.Simulation not only helps in creating or imitate operation but also help to explore new undiscovered areas,new possibility with creating new certain situation and possibility so efforts and resources can't be wasted.For this Hardware as well as software enhanced device specialised for this criteria re used they can be said as Simulators A simulator is a device, computer program, or system that performs simulation. Simulation is the replication or a similar of the operation of a real-world process or system over time. The act of simulating something generally entails modeling the key characteristics or behaviors of a specified system or process.

Just as Graphics,Simulators can also be categorized they are:

1. Live: Simulation requires real people operating a real systems

- Involve individuals or majority
- May use real technologies eg- hardware
- Should provide a similar concept of operations
- Should be close enough to produce the actual situation

2. Virtual: Simulation involving real people handling simulated systems.:

- Like use of Motor control skills training (e.g., flying an airplane)
- Decision making skills (e.g., fire control and perform other action)
- Communication working skills (e.g., members of a C4I team)

3. Constructive: Simulation involving simulated people working in simulated systems. Real people can stimulate (give inputs) but are not involved in getting desired outcomes. Constructive simulations offer the ability to:

- Analyse concepts and ideas
- Stress large organizations
- Make measurements beforehand
- Generate statistics of data and models
- Perform analysis based on a certain criteria

Virtual simulator connects towards new branch and sector giving out purposes like training etc,for this specified hardware are used to give maximum simulation.This opens a Gateway and connection towards Virtual Reality- Virtual reality (VR)

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is a simulated or parallel experience that can be near to or completely distinct from the real world. Applications of virtual reality include entertainment (e.g. video games) and education (e.g. medical or military training).

VR is a rapidly growing industry with immense potential. VR technology is expected to have a significant impact across a wide range of industries, including entertainment, gaming, healthcare, education, manufacturing, architecture, and engineering.

Same connections are made towards AR (Augmented Reality) Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are "augmented" by computer-generated perceptual information. It is related to a more common or established concept called mediated reality, in which a view of reality is redesigned (possibly even diminished rather than augmented) by a computer.

As a result, the technology functions by enhancing one's current perception towards reality. AR systems combining real-time imaging with positional tracking can offer augmented reality in which computer-generated images are registered and tracked relative to real-world objects. AR technology is enhanced by advances in computer vision, graphics, display and sensing technologies.

AR/VR displays can be rendered either on head-mounted displays such as Oculus Rift, or as projection systems and tablets.

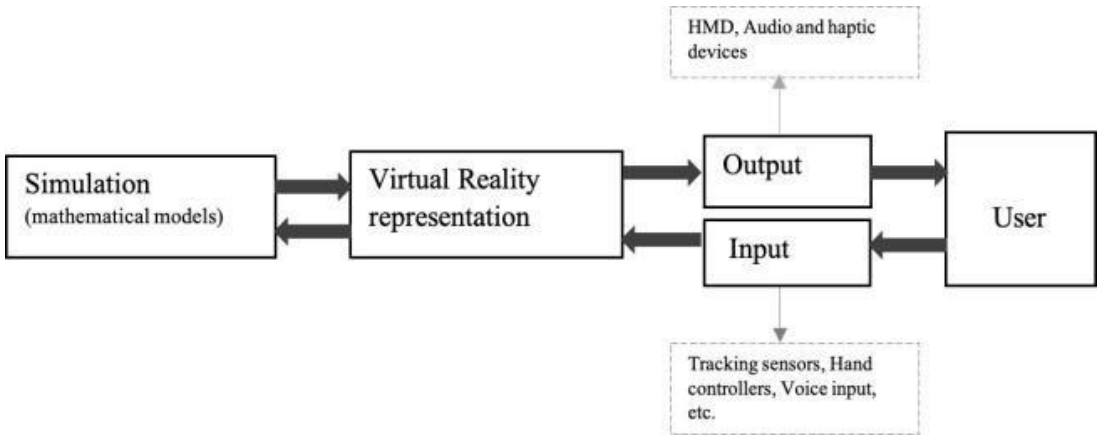

Fig 1.2 Working of VR

Generic model of virtual Reality simulation Fig 1.2 shows how VR based simulation works. The VR system consists of Input and output devices which are connected to mathematical models of the simulation.

User interacts with the VR system through the Input and output devices and the virtual environment in the simulation is refreshed and caught to the system almost in real time according to the given inputs either normal or specialised hardware.

IV. ADVANTAGES

- Used in Training purposes such as plane simulation for pilots and studying multiple real time as well as long term system with ease.
- Helps in experimenting with new concepts with any disruptive or interference in real time world
- Consumes less time when in simulating or studying behavior of a system
- Opens new sectors in world like entertainment,study etc and help people connect(if online simulation)

V. LIMITATION

- The cost of simulation or models can be expensive,so facilities are limited like training etc
- Simulations heavily depends upon hardware requirement so hardware are limited and sensitive with high cost.
- Not every simulation is precise and making one can consume time.
- Can be Addictive as well as overtime use can lead to health issue such as – vision problem,seizure etc

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VI. CONCLUSION

So basically with study of computer graphics and Graphical concept and with various field that opens with it.The evolution itself tells about the upcoming areas that are to be unfolded.with the upcoming era of networking and cloud as well as Ai with hardware Acceleration – motion tracing and sensors VR/AR opens a new world not only for entertainment,gaming and study purpose but many more one can be now said as meta verse for upcoming era.With the upcoming time maybe the limitation will be lifted out and new hardware as well new software will be developed to make things easier making leap and a step toward the future.

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