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SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641035.

B.E / B.Tech – Internal Assessment - I

Academic Year 2023-2024 (ODD)

SEVENTH SEMESTER



19CSE402- VIRTUAL REALITY AND DIGITAL ENTERTAINMENT

Time: 1^{1/2} Hours

Maximum Marks: 50

Answer Key

Answer All Questions

PART A — (5 x 2 = 10 Marks)

1. Write any four Applications of VR.

CO1 Rem

- Healthcare : VR is used for training and making a significant impact in healthcare.
- Entertainment: VR is used in the entertainment industry for gaming and other applications.
- Automotive: VR allows engineers and designers to experiment easily with the look and build of a vehicle before commissioning expensive prototypes.
- Education: VR is used in education for training and simulations.
- Space & Military: VR is used for simulations and training.

2. Define Virtual Reality.

CO1 Rem

Virtual reality (VR) is a computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors. VR applications immerse the user in a computer-generated environment that simulates reality through the use of interactive devices, which send and receive information and are worn as goggles, headsets, gloves, or body suits.

3. Identify the use of Computer Graphics in Virtual Reality. CO2 Und

- To display a picture of any size on a computer screen is a difficult process.
- Computer graphics are used to simplify this process.
- Various algorithms and techniques are used to generate graphics in computers.
- Computer graphics is an art of drawing pictures on computer screens with the help of programming. It involves computations, creation, and manipulation of data.
- computer graphics is a rendering tool for the generation and manipulation of images

4. Differentiate between real-time rendering and offline-rendering.

CO2 Ana

- **Real-time rendering** creates immersive experiences involving 30 to 60 images per second to create a seamless and responsive experience for the user.
- This type of rendering requires PDR maps, aka physically based rendering maps, which is a set of textures that define the physical properties of an object.
- This technology can be used in web viewers, digital showrooms, eCommerce platforms, game engines, AR, VR, and even the Metaverse.
- **Offline rendering** is sometimes called pre-render as well. It's a static image that's high in quality and can be used in various applications like print, web, video, marketing materials.

- Typically, it involves generating an image in one to 60 minutes, depending on the application you're using. Offline rendering also uses additional maps beyond PDR, which can include effects such as glossiness, specular displacement, IOR, subsurface scattering, and other elements that add to the realism of your render. Offline rendering also has higher lighting fidelity, so you have more control over shadows and more complex lighting rigs.

5. Infer the impact of virtual reality in human life in your own words. CO1 Ana

At least once in your life, you've played a game. From a card game to a board game, now in our new technological times ' video games. What would you say if you could experience a new reality and think it's real? That's what Virtual Reality (VR) is bringing to life. VR will soon become our new norm but how does that affect you? Well, it has the potential to change education, businesses, medical advancements, and how you view the world.

PART B — (13+13+14=40 Marks)

(Note: U-Understand R-Remember Ana-Analyze App-Apply)

6a. "VR in sports"-Analyze and Illustrate with real time scenario. (13)CO1 Und

Sports are intrinsically engaging activities that bring out unique emotions and experiences irrespective of whether you are just a fan or an athlete. Virtual Reality technology can address experiences linked to sports. This new way is more sensory, immersive and engaging from both the fan's and athlete's perspective. With multiple industries implementing Virtual Reality in their business, VR has now paved its way into sports as well. It is changing the way we watch sports. With several VR companies specialising in making live sports accessible to its audience. Broadcasters are trying hard to even deliver these live sports experiences on mobile VR.

This is a great way of opening up live sports events to fans. This also makes it easy for the fans who can't travel to the venue or afford the tickets to watch the sports in person. VR in the sports industry is most effective.

VR in sports Industry amplifies the overall sports experience. Read further to find out how VR is revolutionizing the sports industry and changing the way people perceive sports. Here's how VR is revolutionizing sports:

- 1. View Sports through VR**
- 2. View Action from the Player's Perspective**
- 3. Recreating the Action in VR**
- 4. Play Sports through Virtual Reality**
- 5. The Social Shortcomings and how VR Solves it**
- 6. Train Athletes and Teams**
- 7. Sports Manufacture: Equipment Design and Innovation**
- 8. Virtual Reality for Live Sports**
- 9. In-Store VR**

Future of Professional Sports along with Virtual Reality

Virtual reality has not manifested its full potential in sports yet. It can do a lot more than what it is currently doing. For example, the recruitment process can be made easier. The athletes can indulge into this immersive experience of virtual reality completely. They can visit their locker rooms, weighing rooms, stadiums etc very easily. All this without leaving their home and without stepping on any plane.

The mixture of augmented reality, virtual reality and mixed reality can contribute in the emergence of many more new sport technologies. More or less Video games are also a part of sports. Esports have been a part of our lives since a while now. Games such as Pokémon Go and Racket: Nx are a great example of integrating gaming elements into the real physical world.

Until then, watching sports in VR will likely remain as it is. The overall viewing experience will improve and present something truly unique.

Challenges of Virtual Reality in Sports

Currently, Virtual Reality in sports is still in the development phase, and is also facing problems that are far from unsolvable.

Firstly, it is not as practical as compared to other such concepts like augmented reality. Neither is it handy, nor is it that flexible. And surely it is not economical. According to a study by Stanford, it was discovered that people tend to get tired of wearing a VR headset in about eight minutes.

It also isn't much comfortable for professional athletes to use VR along with a big headgear. Another issue in its use-case is that it is not that easy to fix and it can easily cause problems to both athletes during practices and to fans' game watching experience.

The isolation issue is still prevalent. People get isolated when using VR devices and obviously their communication is very limited. Vocal interaction, if added to this, can prove a huge improvement too. Developers from companies like Oculus are working hard to find a way to incorporate vocal interactions and access to social media platforms and networks.

This eliminates the social barrier and allows people to attend social or sport events together. The distance limit would be gone and they can take part irrespective of wherever in the world they are or wherever in the world this event is taking place. Lastly, the video quality of 360 cameras is still not good enough for the modern eye and hence needs improvement.

6b.(i) Compare and Contrast Augmented Reality and Virtual reality(7).

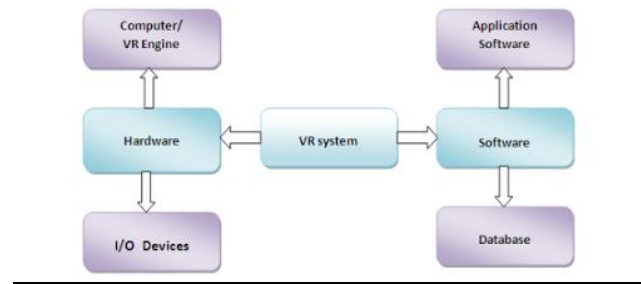
CO2 Rem

Augmented Reality	Virtual reality
Overlying of 3D virtual digital content on real world to augment the latter.	Replacement of real world with 3D virtual world.
AR system detects markers and user locations and system calls on pre-defined content to be overlaid.	VRML creates an interactive sequence of audio, animations, videos, and URLs
AR content overlaid on detected marker or user locations.	No need for markers and user location detection to present 3D content.
Higher bandwidth for top quality experiences – upward of 100 mbps to stream	Lower bandwidth requirement – at least 25 mbps to stream.
Best suitable when the app must capture user's environments.	Best suitable when the app should give full immersion.

6b.(ii) Write down the components of Virtual Reality with a neat diagram and Explain(6).

CO1 Und

The Virtual Reality is basically made up of hardware and software components. Hardware components includes computer or VR engine and I/O devices whereas software components include application software and database.



Virtual Reality System Hardware

The major components of the hardware are the VR engine or computer system, input devices and output devices



I. Input Devices

The input devices are the means by which the user interacts with the virtual world. They send signals to the system about the action of the user, so as to provide appropriate reactions back to the user through the output devices in real time. They can be classified into tracking device, point input device, bio-controllers and voice device.

Tracking devices sometimes referred to as position sensors, are used in tracking the position of the user, and they include, electromagnetic, ultrasonic, optical, mechanical and gyroscopic sensors, data gloves, neural and bio or muscular controllers.

Voice communication is a common way of interaction among humans. So it feels natural to incorporate it into a VR system. Voice recognition or processing software can be used in accomplishing this.

II. VR Engine

In VR systems, the VR engine or computer system has to be selected according to the requirement of the application. Graphic display and image generation are some of the most important factors and time consuming task in a VR system. The choice of the VE engine depends on the application field, user, I/O devices, level of immersion and the graphic output required, since it is responsible for calculating and generating graphical models, object rendering, lighting, mapping, texturing, simulation and display in real-time. The computer also handles the interaction with users and serves as an interface with the I/O devices.

III. Output Devices

The output devices get feedback from the VR engine and pass it on to the users through the corresponding output devices to stimulate the senses. The possible classifications of output devices based on the senses are: graphics (visual), audio (aural), haptic (contact or force), smell and taste. Of these, the first 3 are frequently used in VR systems, while smell and taste are still uncommon.

Two possible common options for the graphics are the stereo display monitor, and the HMD which provides a higher level of immersion. In the HMD, the two independent views produced are interpreted by the brain to provide a 3D view of the virtual world.

Audio or sound is an important channel in VR; its importance is only surpassed by that of visual. 3D sound can be used in producing different sounds from different location to make the VR application more realistic.

Haptic is used to allow the user feel virtual objects. This can be achieved through electronic signals or mechanical devices.

Virtual Reality System Software and Tools

Virtual reality system software is a collection of tools and software for designing, developing and maintaining virtual environments and the database where the information is stored. The tools can be classified into modeling tools and development tools.

I. VR Modeling Tools

There are many modeling tools available for VR designing, the most common ones are , 3ds Max, Maya and Creator. Engineering specific applications might use software like CATIA, Pro/E, Solidworks, UG, etc.

II.VR Development Tools

VR is a complex and integrative technology that borrows from many other technologies, such as real time 3D computer graphics, tracking technology, sound processing, and haptic technology, among others, therefore software development flexibility and real time interaction is needed. Starting the development of a VR system from the basic codes in C/C++, Java, OpenGL, etc, requires a large amount of work and such system reliability is usually low, therefore VR development tools are used. Careful consideration is needed in choosing VR development tools due to the difference in flexibility provided by different software packages as related to model input available, interface compatibility, file format, animation ease, collision detection, supported I/O devices and support community available to the users.

VR development tools used in VR content creation include, virtual world authoring tools, VR toolkits/software development kits (SDK) and application program interfaces (APIs). But it is not uncommon to find that some APIs are also toolkits, like OpenGL optimizer.

7a. Articulate how CRT, Raster Scan and Vector Scan used in creating an Virtual Reality Scenario. (13)

CO2 Und

To display a picture of any size on a computer screen is a difficult process. Computer graphics are used to simplify this process. Various algorithms and techniques are used to generate graphics in computers. Computer graphics is an art of drawing pictures on computer screens with the help of programming. It involves computations, creation, and manipulation of data. In other words, computer graphics is a rendering tool for the generation and manipulation of images.

Cathode Ray Tube

The primary output device in a graphical system is the video monitor. The main element of a video monitor is the Cathode Ray Tube CRT, shown in the following illustration.

The operation of CRT is very simple –

- The electron gun emits a beam of electrons cathode rays.
- The electron beam passes through focusing and deflection systems that direct it towards specified positions on the phosphor-coated screen.
- When the beam hits the screen, the phosphor emits a small spot of light at each position contacted by the electron beam.
- It redraws the picture by directing the electron beam back over the same screen points quickly.

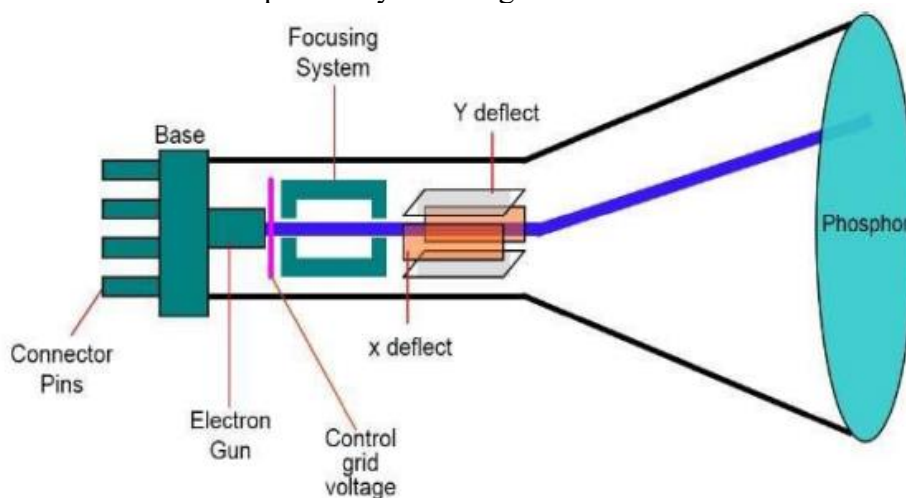


Fig. 3.1 Cathode Ray Tube

Raster Scan

In a raster scan system, the electron beam is swept across the screen, one row at a time from top to bottom. As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots. Picture definition is stored in memory area called the Refresh Buffer or Frame Buffer. This memory area holds the set of intensity values for all the screen points. Stored intensity values are then retrieved from the refresh buffer and “painted” on the screen one row scanline at a time as shown in the following illustration. Each screen point is referred to as a pixel picture element or pel. At the end of each scan line, the electron beam returns to the left side of the screen to begin displaying the next scan line.

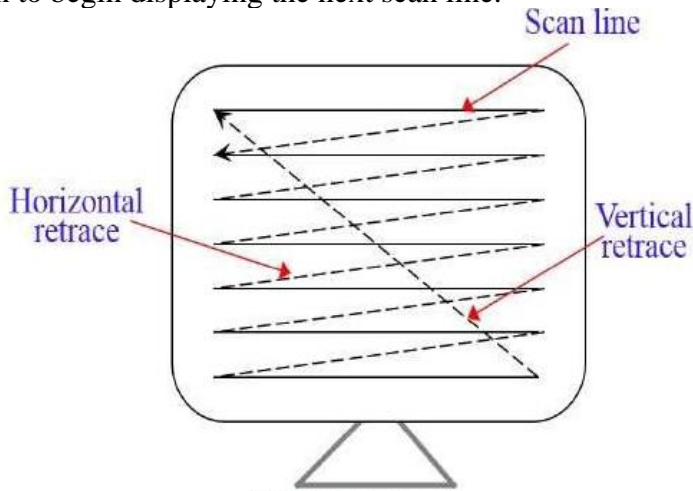


Fig. 3.2 Raster Scan

Vector Scan

In this technique, the electron beam is directed only to the part of the screen where the picture is to be drawn rather than scanning from left to right and top to bottom as in raster scan. It is also called vector display, stroke-writing display, or calligraphic display. Picture definition is stored as a set of line-drawing commands in an area of memory referred to as the refresh display file. To display a specified picture, the system cycles through the set of commands in the display file, drawing each component line in turn. After all the line drawing commands are processed, the system cycles back to the first line command in the list. Random-scan displays are designed to draw all the component lines of a picture 30 to 60 times each second

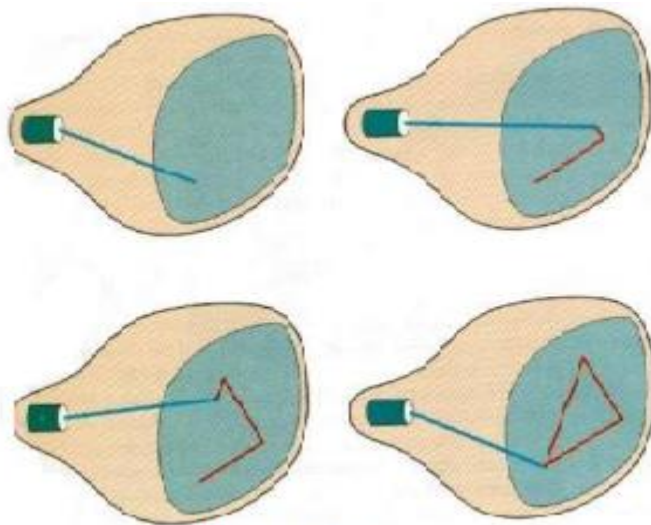


Fig. 3.3 Vector Scan

7b. Categorize the different stereoscopic technologies along with the different software used for it.(13)

CO2

Und

STEREOSCOPIC TECHNOLOGY

Stereoscopic technology is a technology that aims to give you the illusion of depth by mimicking the real world. In other words, viewer's eyes are made to perceive two different CG, or even captured; footage likes what our eyes do to perceive real objects in our lives.

1. Parallax
2. Freeviewing
3. Shutter system
4. Polarization systems
5. Interference filter systems
6. Color anaglyph systems
7. Holography
8. Volumetric displays
9. Integral imaging
10. Wiggle stereoscopy

SOFTWARE FOR STEREOSCOPY

Bino Bino plays stereoscopic videos, also known as 3D videos.

1. KMovisto (Version 0.6.1)
2. Mplaye
3. SIV (Stereoscopic Image Viewer)
4. Split MPO
5. Fuji W3 3D QuickLook Plugin (Version 1.0.0)
6. StereoPress (Version 1.4.0-E)
7. 3D Slide Projector (Version 1.05)
8. Anaglyph Maker (Version 1.08)
9. Stereo Movie Builder (Version 0.3)

8a.Design the steps involved in Real Time Rendering for Large-Scale Forest Scenes.(14) CO2 Rem

Realistic Real-Time Rendering for Large-Scale Forest Scenes

Rendering a realistic large forest scene in real-time plays an important role in virtual reality applications, such as, virtual forestry, virtual tour and computer games. Since a forest consists of an extensive number of highly complex geometric models, real-time forest rendering is still a challenge. Several techniques are there to render highly realistic forests with realtime shadows. Since a forest with thousands of plants contains a vast amount of geometry, an efficient level of details (LOD) algorithm can be used to generate multiresolution (MR) models according to forest features. Leaf modeling method is used to have leaf models match leaf textures well. Parallel-split shadow mapping (PSSM) generation scheme can be used in rendering system. The data of tree models are organized into vertex buffer objects to enhance the rendering performance. A tree clipping operation is designed both in the view frustum and in the light frustum to avoid rendering models outside the current frustum and to remove the popping up and off effects. The combination of these techniques allows to realistically render a large forest with a large number of highly detailed plant models in real-time.

TREE MODELING AND MODEL PROCESSING

Modeling of tree foliage and processing of tree model are two key aspects of this work. Special techniques are used to construct LOD tree foliage models.

- Tree modeling and simplification
- Branch model processing
- Leaf model processing
- Construction of Plant LOD models

REAL-TIME FOREST RENDERING

- Forest Scene Layout
- Forest Rendering

8b.Illustrate with example industrial application of Virtual reality.(14) CO1 App

Virtual reality (VR) is no longer just science fiction. It's part of your present-day reality. In fact, some industries have already had a taste of the new technology and are enjoying the benefits that it provides.

VR offers a controlled environment for mimicking real-life scenarios with little to no risk for the person in it. To learn more about the main uses of virtual realities, stay tuned. Here at Trio, we have the best developers in the market and provide only the finest insights from the world of technology.

1. Healthcare
2. Entertainment
3. Automotive
4. Education
5. Space & Military
6. Architecture
7. Digital Marketing
8. Occupational Safety
9. Social Science and Psychology
10. Tourism