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Department of Biomedical Engineering

Course Name: 19BMT401 – Virtual Reality in Medicine

IV Year : VII Semester

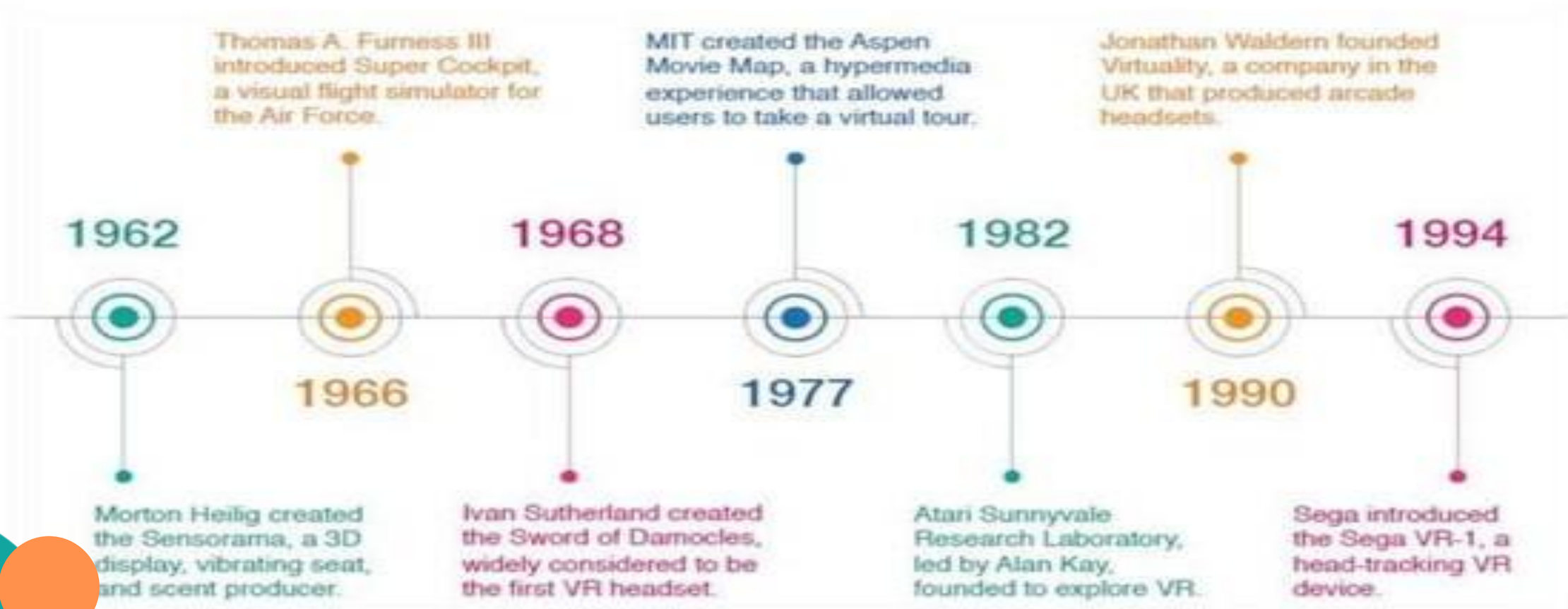
Unit I –INTRODUCTION

Topic : The three I_s of virtual reality

What is virtual reality?

- ***Virtual reality or virtual realities (VR),*** also known as ***immersive multimedia*** or ***computer simulated reality***, it replicates an environment that simulates a physical presence in places in the real world or an imagined world, allowing the user to interact in that world.
- Virtual realities artificially create sensory experiences, which can include sight, touch, hearing, and smell.

History of Virtual Reality



Why Virtual Reality is needed?

- Operations in dangerous environments

  Workers in radioactive, space, or toxic environments could be relocated to the safety of a VR environment where they could handle any hazardous materials without any real danger using ***telepresence***.

- Scientific Visualization

  Scientific Visualization provides the researcher with immediate graphical feedback during the course of the computations and gives him/her the ability to steer the solution process.

Why Virtual Reality is needed?

- Medicine

  Experimenting medical research with virtual patients instead of plastic models with the simulation of the entire physiology of the human body.

- Education and training

  Flight simulator has shown the benefits of simulation environments for training. They have lower operating costs and are safer to use than real aircraft. They also allow the simulation of dangerous scenarios not allowable with real aircraft.

Virtual Reality Systems Types

- VR types can be divided as

Immersive

Non -Immersive

Semi-Immersive

Virtual Reality Systems Types(cont'd)

Immersive Type

- The Immersive Virtual Reality System completely involve the users personal viewpoint in the virtual world.
- In immersive system a large projection displays are used to create a virtual background such as room or cave.
- In fully immersive systems ,the sense of immersion depends on several parameters including the field of view of resolution, the update rate, and contrast and illumination of the display.

Virtual Reality Systems Types(cont'd)

Immersive Type

- In this type, the user wears an *Head Mounted Displays (*HMD*).*

Virtual Reality Systems Types(cont'd)

Non-Immersive Type(Desktop)

- Non-immersive systems are the least immersive implementation of VR techniques.
- Using the desktop system, the virtual environment (VE) is viewed through a portal or window by utilizing a monitor.

Virtual Reality Systems Types(cont'd)

Non-Immersive Type(Desktop)

- Interaction occurs by using conventional means such as keyboards, and mice or by using 3D interaction devices such as a SpaceBall,or Data Glove .

Virtual Reality Systems Types(cont'd)

Semi-Immersive Type(Projection)

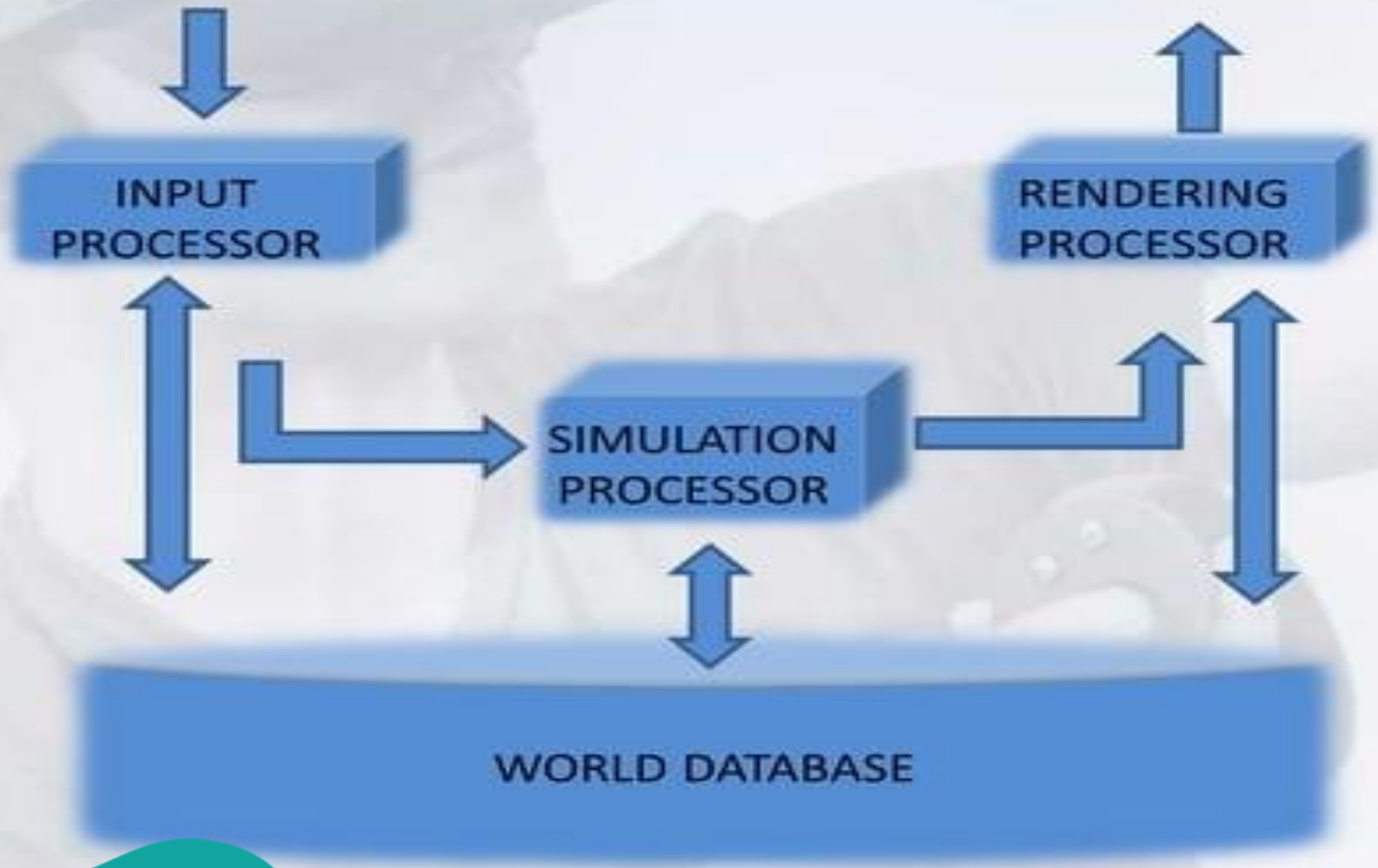
- Semi-immersive systems are a relatively new implementation of VR technology.
- A semi-immersive system will comprise a relatively high performance graphics computing system which can be coupled with either a large screen monitor, a large screen projector system, and multiple television projection systems.

Virtual Reality Systems Types(cont'd)

Semi-Immersive Type(Projection)

- Semi-immersive systems therefore provide a greater sense of presence than non-immersive systems and also a greater appreciation of scale.

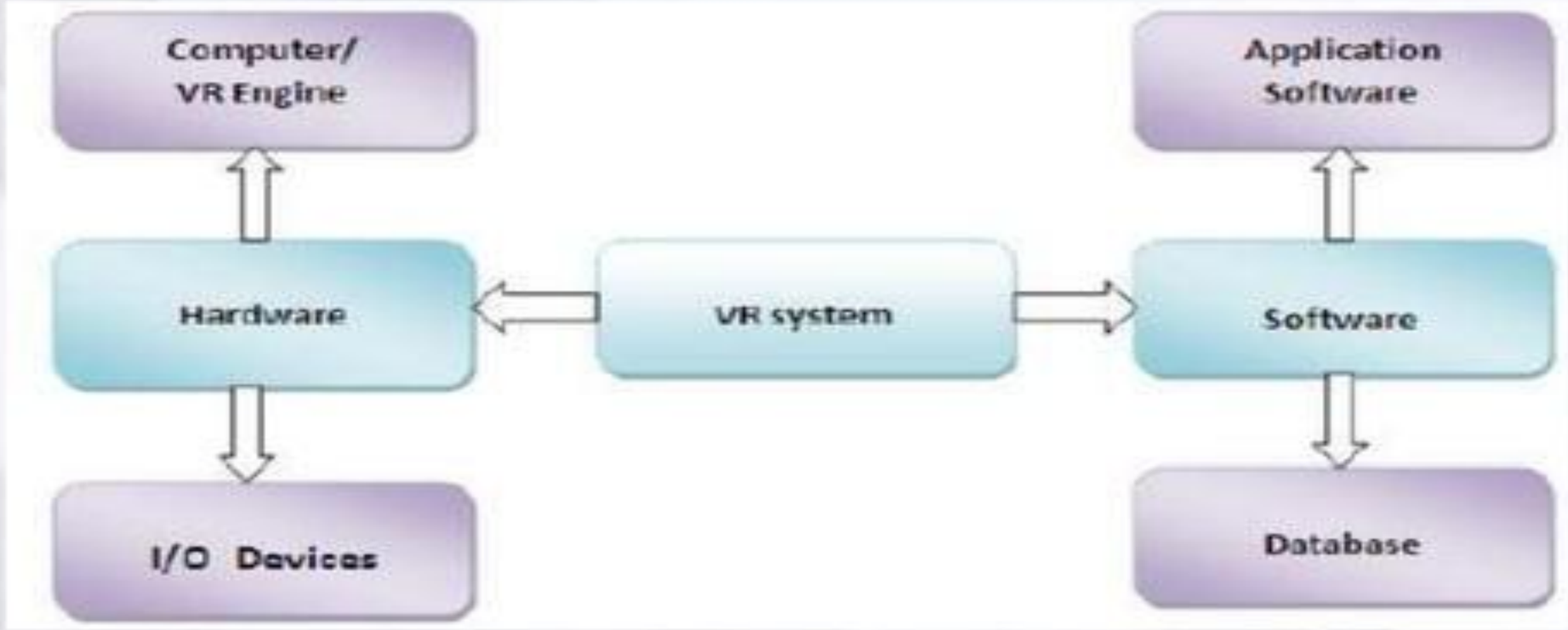
Virtual Reality Systems Archite



Virtual Reality Systems Architecture (cont'd)

- **Input Processor:** Control the devices used to input information to the computer. The object is to get the coordinate data to the rest of the system with minimal lag time. Keyboards, mouse, 3D position trackers, a recognition system, etc.
- **Simulation Processor:** Core of a VR system. It takes the user inputs along with any tasks programmed into the world and determine the actions that will take place in the virtual world.
- **Rendering Processor:** Create the sensations that are output to the user. Separate rendering processes are used for visual, auditory, haptic and other sensory systems
- **World database:** Store the objects that inhabit the world, scripts that describe actions of those objects.

Virtual Reality Systems Components



Virtual Reality Systems Components (cont'd) *Overview*

- **Input Devices:** the means by which the user interacts with the virtual world.
- **VR Engine**: the choice of the VE engine depends on the application field, user, I/O devices, level of immersion and the graphic output required.
- **Output Devices:** The output devices get feedback from the VR engine and pass it on to the users. The possible classifications of output devices based on the senses are: graphics ,audio ,haptic.
- **System Software**: a collection of tools for designing, developing and maintaining VE and the **database** where the information is stored.

Virtual Reality Systems Components *VR Hardware* (cont'd)

- Primary user input interfaces
- Tracking interfaces
- Visual interfaces
- Auditory interfaces
- Haptic interfaces
- Olfactory interfaces

Virtual Reality Systems Components *VR Hardware* (cont'd)

Primary user input interfaces

- Keyboard, Mouse, Joystick
- 3D Pointing Devices
  - Spaceball
  - CyberWand
  - Ring Mouse
  - EGG
- Whole-hand and body input
  - Glove
  - Hand Master
  - Arm Master





Virtual Reality Systems Components *VR Hardware* (cont'd)

Tracking interfaces

- Measure head, body, hand or eye motion
- Major Characteristics
  - Resolution
  - Accuracy
  - System Responsiveness (Sample rate, data rate, update rate and latency)
- Major Technologies
  - Magnetic
  - Acoustics
  - Optical
- Head & Body Tracking
  - Flock of Bird
  - VideoDesk
- Eye Tracking
  - BioMuse

Virtual Reality Systems Components *VR Hardware* (cont'd)

Visual interfaces

- Field of View
- Resolution
- Refresh rate
- Brightness
- Color

Virtual Reality Systems Components *VR Hardware* (cont'd)

Auditory interfaces

- Auralization
  - 3D simulation of a complex acoustic field
- Sonification
  - Audible display of data
- Speech Recognition

Virtual Reality Systems Components *VR Hardware* (cont'd)

Haptic interfaces

- Tactile (touch)
  - CyberTouch
- Kinesthetic (force)
  - HapticMaster

Virtual Reality Systems Components *VR Hardware* (cont'd)

Olfactory interfaces

- Electronic Nose
- Storage Technologies
  - Liquid
  - Gel
  - Microencapsulation

Virtual Reality Systems Components
VR Software (cont'd)

- standard language for interactive simulation within the World Wide Web allows to create "virtual worlds" networked via the Internet and hyperlinked with the World Wide Web.
- Aspects of virtual world display, interaction and internetworking can be specified using Virtual Reality Modeling Language (VRML) without being dependent on special gear like HMD.
- VR models can be viewed by Netscape or IE with a browser plug-in.

Applications

Virtual reality in :

Military

Education

Sports

Medical

Business

Media

Advantages & Disadvantages

Advantages

- Training.
- Risk-free experience.
- Experiencing things you wouldn't normally be able to experience.
- Entertainment; fun, artistic expression.
- Telepresence applications.

Disadvantages

- Cost
- Disengagement with real world.
- VR replacing reality.
- People preferring VR to reality.
- Addiction.
- Difficulty of distinguishing between virtual and real, 'false realities represented in VR.
- Psychological damage, identity problems.
- Possible impacts on real body.

Modern Era of Virtual Reality

Important Issues

- Interaction Techniques
  - the precise manipulation of objects in the virtual environment is difficult.
  - the equipment used to capture data about the user for the VE is often prohibitively expensive.
  - VR input devices is limited precision.
- Navigation Techniques
  - direction and velocity(hand-directed, gaze-directed, physical devices).
  - point at object, list of coordinates.

Important Issues(cont'd)

- Collision Detection
  - Very computationally intensive, but very important for presence and realism.
  - Bounding Volume (Sphere, Box, Convex Hull).
- Level of Detail (LOD)
  - When looking objects from a far, details not important.
  - Do not show details if they can't be seen.
  - Reduces number of polygons significantly.
  - LOD management (Automatic, pre-define).

The Future of Virtual Reality

- Virtual Reality is a growing industry.
- PC and specialized hardware are getting better, faster and cheaper because of development in VR.
- Huge demand for VR modeling languages programmers in near future.
- Revolution in gaming industries.
- 3D interfaces will replace the windows based ones.
- Low price.
- Phone manufacturers will give free VR headset.

Conclusion

- Though the disadvantages of Virtual reality can disturb the human's perception ability, it's advantages in different fields makes it user friendly.
- The sole objective of virtual reality is to give the user an environment as realistic as possible and a thrilling sensory experience.
- The technology of virtual reality is advancing rapidly and it won't be long before it becomes a most exciting source of entertainment in our homes.
- Virtual Reality is synthetic sensory experience which may one day be indistinguishable from the real physical world.

Thank You