SNS COLLEGE OF TECHNOLOGY

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Department of Artificial Intelligence and Machine Learning

Unit-3
Introduction to Virtual reality

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What is virtual reality?

Virtual reality is the use of computer technology to create a 3-dimensional artificial environment and place the user in it. There are three basic types of virtual reality.

Non-immersive VR systems: Users are aware of their surroundings and use a monitor to enter the 3-D world, for example, video games.

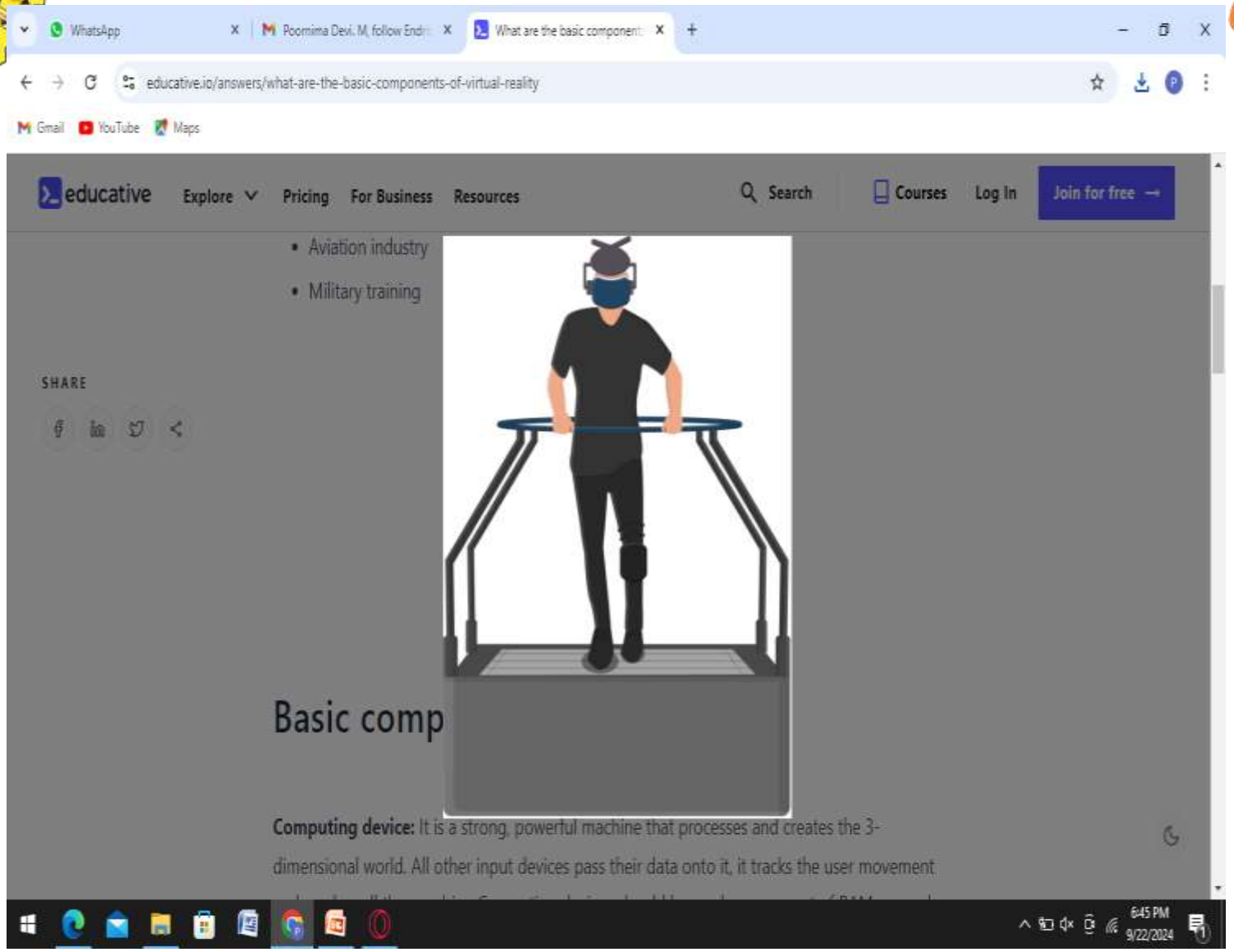
Semi-immersive VR systems: Users usually have a large screen in front of them and input devices that they can use. Semi-immersive VR technology is used in flight simulation.

Fully-immersive VR systems: These are VR systems that provide very realistic simulation. Users wear a headset and enter an alternate reality.

Practical applications

Virtual reality is being used all around the world and is benefiting many fields:

- Gaming industry
- Virtual tourism
- Medical training
- Aviation industry
- Military training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Computing device: It is a strong, powerful machine that processes and creates the 3-dimensional world. All other input devices pass their data onto it, it tracks the user movement
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•**Basic components**

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Computing device: It is a strong, powerful machine that processes and creates the 3-dimensional world.

• All other input devices pass their data onto it, it tracks the user movement and renders all the graphics.

•Computing devices should have a large amount of RAM, a good GPU, a powerful CPU, and a sufficient storage device.

•**HMDs:** It is a head-mounted display that consists of two screens that display the virtual world in front of the users.

•They have motion sensors that detect the orientation and position of your head and adjust the picture accordingly. It also usually has built-in headphones or external audio connectors to output sound.

•Moreover, they have a blackout blindfold to ensure the users are fully disconnected from the outside world.

•**Sensors:**

• Sensors are mostly incorporated into the headset of VR. They track users' poses and their head position, detect movement and rotation, and then pass all this data to the VR processor/computing device.

•Because of these sensors, the user can interact with the virtual environment. VR depends upon several sensors, including accelerometers, gyroscopes, magnetometers, and 6DoF.

•**Input devices:** Input devices are used by users in the VR system to interact with the virtual world in front of them.

•These devices might be a tool or a weapon in their artificial world.

• The input devices include mice, controllers, joysticks, gloves with sensors, and body tracking systems.

•**Audio system:**

•Audio systems have a particularly important job in VR, ensuring a great VR experience in which users' brain is forced to think like they are in that artificial world.

•They are mostly integrated inside the HMD. VR provides spatial audio, so the users feel how real the virtual world is.

•**Software:**

•Software is a crucial part of VR systems. The software is an application designed that runs on VR hardware and creates an artificial world.

•There are several different types of software based on what users need. For example, games, simulations, medical ecosystems, etc.

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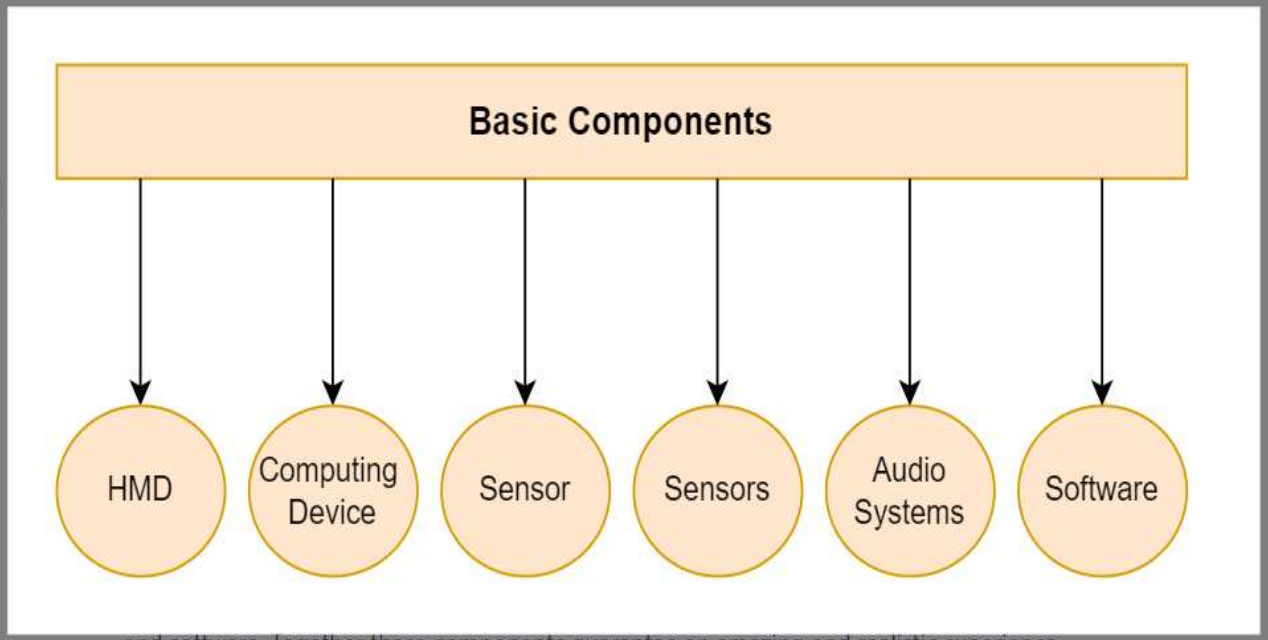

and software. Together these components guarantee an amazing and realistic experience.

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INPUT DEVICES

Here are some common input devices used in Virtual Reality (VR):

Tracking Devices:

1. Controllers: Hand-held devices with sensors and buttons, e.g., Oculus Touch, Vive Wands.

2. Glove-based systems: Track hand movements, e.g., Leap Motion, GloveOne.

3. Head-mounted displays (HMDs): Track head movements, e.g., Oculus Rift, HTC Vive.

Motion Tracking:1. Optical tracking systems: Use cameras to track movement, e.g., OptiTrack, Vicon.2. Inertial Measurement Units (IMUs): Track orientation and acceleration, e.g., Wii Remote.Haptic

Haptic Feedback:

1. Vibration motors: Provide tactile feedback, e.g., in controllers or vests.
2. 2. Force feedback: Simulate resistance or force, e.g., in specialized vests or suits.

Voice and Gesture Recognition:

1. Voice commands: Use microphones to recognize voice inputs.
2. 2. Gesture recognition: Use computer vision or sensors to recognize hand or body gestures.

Biometric Sensors:

1. Eye-tracking: Track gaze and focus, e.g., Tobii Eye Tracking.
2. 2. Brain-Computer Interfaces (BCIs): Detect neural activity, e.g., Neurable.

Specialized Devices:

1. Omnidirectional treadmills: Allow walking in any direction.
2. 2. Exoskeletons: Provide full-body motion tracking and haptic feedback.

3. VR shoes: Track foot movements, e.g., VR First's "VR Shoes".

Emerging Technologies:

1. Hand-tracking using computer vision: No controllers needed.
2. Facial recognition: Track emotions and expressions.
3. Muscle-computer interfaces: Detect muscle activity.

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TRACKERS

Full-Body Trackers:

1. Vive Tracker: Attaches to body parts, tracking movement.

2. Oculus Tracker: Similar to Vive Tracker, for Oculus Rift.

3. 3. OptiTrack: High-end optical tracking system for full-body motion.

Hand Trackers:

1. Leap Motion: Hand and finger tracking using infrared sensors.

2. GloveOne: Haptic feedback and tracking in a glove form factor

3. VRFirst's Hand Tracker: Computer vision-based hand tracking.

Head Trackers:

1. Oculus Constellation: Tracks head movement for Oculus Rift.
2. HTC Vive's Base Stations: Track head and controller movement.
3. PlayStation VR's Camera: Tracks head and controller movement.

4. Eye Trackers:

1.Tobii Eye Tracking: Integrates with VR headsets for gaze tracking.

2. EyeTribe: Tracks eye movement for interactive experiences.

3. Pupil Labs: Open-source eye tracking for VR research

Foot Trackers:

1. VR Shoes: Track foot movement for immersive locomotion
2. Cybershoes: Track foot movement for walking experiences.
3. Virtuix Omni: Omnidirectional treadmill for walking.

Specialized Trackers:

1. Valve Index's Finger Tracking: Tracks individual finger movement.2. Teslasuit's

2. Full-Body Tracking: Includes haptic feedback and biometrics.
3. Neurable's Brain-Computer Interface: Tracks neural activity.

4. Tracking Technologies

- Optical tracking (cameras)
- Inertial Measurement Units (IMUs)
- Computer vision
- Infrared sensing
- Electromyography (EMG) for muscle tracking

Advantages:

1. Enhanced immersion
2. 2. Improved precision
3. 3. Increased interactivity
4. 4. Better motion control
5. 5. More realistic experiences

6. Applications:

1. Gaming
2. Training simulations
3. Healthcare
4. Education
5. Architecture and design
6. Art and entertainment

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