Module 5

Introduction to Virtual Reality

User Monitoring (User Input to the Virtual World)

- Position Tracking
- Body Tracking
- Other Physical Input Devices

World Monitoring (Dynamic Input to the Virtual World)

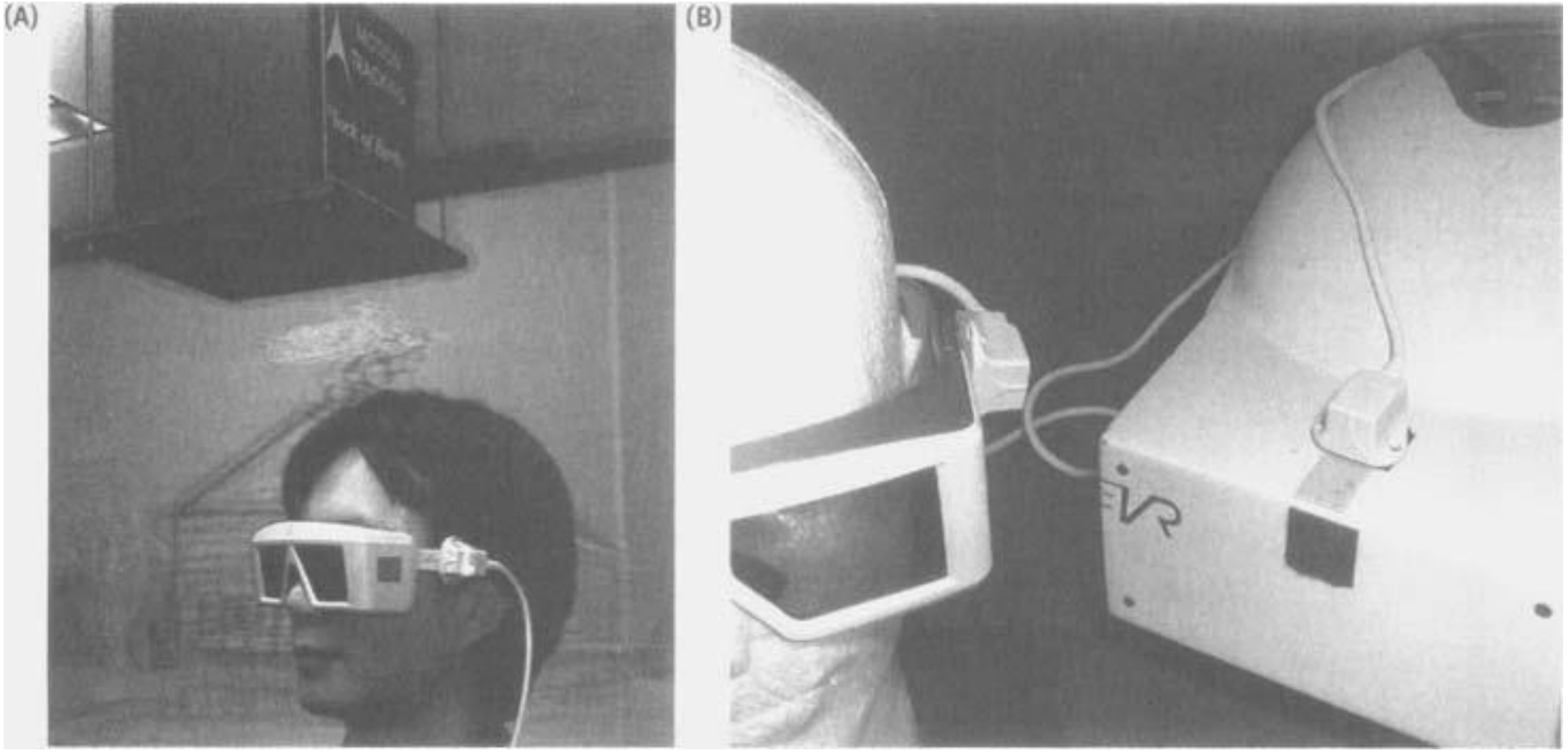
- Persistent Virtual Worlds
- Bringing the Real World Into the Virtual World

Position Tracking

- **Position Tracking**
- A position sensor is a device that reports its location and/or orientation to the computer.
- The position sensor is the most important tracking device of any VR system.
- Position tracking tells the VR system where the users are located within a VR space
- **There are several types of position sensors**

1. Electromagnetic
2. Mechanical
3. Optical
4. Videometric
5. Ultrasonic
6. Inertial
7. Neural

Electromagnetic



Mechanical Tracking

Optical Tracking

- use of a video camera that acts as an electronic eye to "watch" the tracked object or person.
- The video camera is normally in a fixed location. Computer vision techniques are then used to determine the object's position based on what the camera "sees.“

Ultrasonic Tracking

- Ultrasonic tracking uses high-pitch sounds emitted at timed intervals to determine the distance between the transmitter (a speaker) and the receiver (a microphone).

Videometric (Optical) Tracking

- The camera could be mounted on a head-based display to provide input to the VR system, which would be able to determine the locations of the corners of the surrounding room and calculate the user's position from this information.

Body Tracking

- The body parts and techniques of body tracking commonly used in VR applications Include
- Tracking the head
- Tracking the hand and fingers
- Tracking the eyes
- Tracking the torso
- Tracking the feet
- Tracking other body parts

World Monitoring (Dynamic Input to the Virtual World)

World Monitoring (Dynamic Input to the Virtual World)

- Persistent Virtual Worlds
- Bringing the Real World Into the Virtual World

Interface to the Virtual World-Output

- Visual Displays
- Visual Depth Cues
- Properties of Visual Displays
- Monitor-based--or Fishtank--VR
- Projection-based VR
- Head-based VR
- See-through Head-based Displays
- Handheld VR

Visual Displays

- Three display paradigms.

1. **Stationary displays**

- Fishtank VR
- Projection VR

2. **Head-based displays**

- Occlusive HMDs
- Nonocclusive HMDs

3. **Hand-based displays**

- Palm VR

Visual Depth Cues

- four varieties of visual depth cues

1.Monoscopic image depth cues

2.Stereoscopic image depth cue (stereopsis)

3. Motion depth cues

4. Physiological depth cues

Properties of Visual Displays

- **Visual Presentation Properties**
- Color
- Spatial resolution
- Contrast
- Brightness
- Number of display channels
- Focal distance
- Opacity
- Masking

- **Logistic Properties**

- User mobility
- Interface with tracking methods
- Environment requirements
- Associability with other sense displays
- Portability
- Throughput
- Encumbrance
- Safety
- Cost

Five major visual display types.

- I. Fishtank
- 2. Projection
- 3. Head-based (Occlusive)
- 4. See-through Head-based Displays(AR)
- 5. Handheld

Aural Displays

- Like visual displays, aural display systems typically fall into one of the two categories stationary displays and head based displays
- Headphones are analogous to head-mounted visual displays.
- Headphones may be constructed to isolate the participant from sounds in the natural world or to

allow real-world sounds to overlap with virtual sounds

Properties of Aural Displays

- **Aural Presentation Properties**
- Number of display channels
- Sound stage
- Localization
- Masking
- Amplification

- **Number of display channels**
- it is possible to present the same information (monophonic) or different information (stereophonic) to each ear.
- stereophonic sound source that is not produced based on the user's position within the environment can be misleading, because those stereophonic signals will provide spatial cues that will not correlate with the virtual world visuals.

- **Sound Stage.**
- The sound stage is the source from which a sound appears to emanate relative to the listener.
- **Example:**
- if you are in your living room listening music sounds spread out in the stereo field

- **Localization.**
- The feat of perception, of being able to figure out where sound is coming from, is called localization.
- The process of making a sound seem to come from a particular location in space is called **spatialization**.
- Example :for a market scene in the Aladdin experience
- Headphones present sound directly to the ear, whereas speakers present a combination of direct and reflected sound.

- **Masking**
- Masking of sound occurs in two ways. A loud sound can mask a soft sound. This kind of masking can occur with both headphones and speakers
- The other type of masking occurs when a physical entity like a pillow or a projection screen blocks the path of sound from the speaker to the ear.
- For example, placing a pillow in front of a speaker muffles the sound coming from that speaker in a certain, characteristic way. In this example, higher frequency (pitch) sounds will be muffled more than lower frequency sounds.
- Real-world sounds within the environment cannot always be fully masked by speaker systems.

- **Amplification**
- Amplifier is required to boost the audio signals to appropriate levels.
- The amplifier need not be as powerful for headphones as for speakers.
- Systems using a greater number of speakers may require multiple amplifiers. Additionally, room size and volume requirements may demand more amplifier power

Logistic Qualities

- Noise pollution
- User mobility
- Interface with tracking methods
- Environment requirements
- Associability with other sense displays
- Portability
- Throughput
- Encumbrance
- Safety
- Cost

Logistic Qualities

- **Noise Pollution**
- In a VR experience, noises from the real world can pollute the VR experience.
- For experiences that alter participant voices before presenting them to the other participants, the real voices of the participants are unwanted sounds and hence a source of noise pollution.
- Systems using speakers require an environment that is reasonably quiet and echo free.

- **User Mobility.**
- Headphones typically have a cable connecting them to the amplifier.
- This can restrict the participant's movements. Wireless versions are available that use radio or infrared transmission of the audio signal.
- Speakers do not inhibit the movements of the participant, but the sound does appear fainter when farther from the speakers,

- **Interface with Tracking Methods**
- Headphones and speakers both utilize **magnets** that can interfere with electromagnetic tracking sensors.
- Usually, the same tracking technology is used to provide position information for creating both the audio and visual display. That is, there is no need for an additional tracking unit for audio.

- **Environment Requirements**
- The room itself can bounce sound waves and generate cues that may not be intended for the VR experience.
- One problem is echoes created by sound reflections within the *CAVE*

- **Associability with Other Sense Displays.**
- headphones are associated with head-based visual displays and speakers with projection displays
- Headphones are easily combined with head-based visual displays.
- projection displays and speakers work well for group presentations

- **Portability**
- **Throughput**
- **Encumbrance**
- **Safety**
- **Cost**

- **Head-based Aural Displays- Headphones**
- **Stationary Aural Displays-Speakers**

Haptic Displays

- **Properties of Haptic Displays**
  - Haptic Presentation Properties
  - Logistic Properties
- **Features of Tactile Displays**

- **Haptic Presentation Properties**
- Kinesthetic cues
- Tactile cues
- Grounding
- Number of display channels
- Degrees of freedom
- Form
- Fidelity
- Spatial resolution
- Temporal resolution
- Latency tolerance
- Size

- **Logistic Properties**
- User mobility
- Interface with tracking methods
- Environment requirements
- In Associability with other sense displays
- Portability
- Throughput
- Encumbrance
- Safety
- Cost

- **Application of VR**

- Visual Representation in VR
- Aural Representation in VR
- Haptic Representation in VR