Quick Overview of AR/VR Hardware

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Hardware Overview

- Tends to focus on cutting edge hardware
- Very computationally intensive
- Core issues: hardware is not really ready for wide scale deployment

Location

- Tends to be one of the primary problems in AR/VR
- Each sensor technology has limitations
- Currently no high-granularity, high-spread, wide area sensing technologies available
  - Limits deployment
  - Increases number of sensors needed for fidelity
  - Area of study: sensor fusion systems

Position sensors

- Minimum requirement is generally 3 degrees of freedom (DOF): x, y, z
- Higher DOF is simulated with multiple 3DOF sensors + constraints
- 6DOF sensors also available

Position: IR/Visual

- Line of sight tracking, 3DOF by nature
- Can be quite accurate, and can track many points
- Often requires targets
- Minimal on-body equipment
- Can be cheap
- Low marginal cost of added tracked points
- Available in larger full motion capture setups

Position: Ultrasonic

- Now available in wireless
- Accurate, but sensitive to sonic reflection (many things reflect ultrasound)
- Requires more extensive setup for precision
- Small on-body devices needed
- Can track 6DOF with added gyros or accelerometers
- InterSense makes a lot of them in various geometries

Position: Intertial

- Usually used with other tracker systems
- Gives +3DOF (yaw, pitch, tilt), usually in conjunction with 3DOF position sensing
- Often used to track head orientation
- InterSense makes these too to go with ultrasonic tracking

Position: Magnetic

- 3DOF or 6DOF trackers
- Quite precise
- Uses magnetic field for tracking, which may affect other systems
- Sensitive to ferrous substances in range
- Requires on-body receiver, often wired (wireless versions are starting to come out)
- Expensive, high marginal cost of added points
- Ascension and Polhemus are the final word

Position: Others

- GPS
- Differential indoor GPS
- Field sensors of various sorts
    - Electric field sensing
    - Radio field sensing

Displays: HMD

- Fully immersive or See-through HMD
  - Resolution between 800x600 and 1024x768
  - Fairly costly
  - ~2-6 lbs
  - ~90-120 degrees FoV
  - New technology: retinal display from MicroVision (Nomad)
    - Sharp display from light, small device
    - No color…

Cave-type

- Projected on walls of a room
- Generally used with HMD to give higher resolution backplane
- Can be stereoscopic

Other devices

- Finger tracking gloves for gesture detection
- Full body motion capture suits
- Speech recognizers
- Touch sensors for real world objects
- Touch sensitive surfaces (ie, Mitsubishi DiamondTouch)

Techniques

- All the usual aspects of user interface design, except with the viewpoint able to move in 6D
- 3d rendering
- Viewpoint detection
- View-based information filtering
- Adaptive labeling
- Object and scene registration
- Gesture disambiguation/multimodal input
- Multiple view synchronization
- Lag reduction tricks