Multiuser Interaction

- Definition: Many people interacting in same VE.
- Hardware: Should have scalable number of input devices
- Common input device
- How to create immersion to user? Different perspective?
    - Common CAVE, wrong perspective
    - HMD for all
    - Retina scanner or all
    - Separate CAVEs (or walls), others represented as avatars
- Audio connection should be available (if separate CAVEs)
- People could play together, interact with one model
- Problems?
    - Avatars, gestures and facial information should be supported
    - Personal interaction
    - Feedback: sound, haptics
- UI, wand, glove, socks!, should be more general
- Gloves, gestures
- Video streams, nice to see faces when discussing
- Different user cases, some in CAVES, others with HMD
- Multiuser VE: acting rehearsal, HydroVR (CAVE-to-CAVE connection)

3-D Widgets

- Classification of widgets
    - Xyz-widget
    - Text
    - Selection
    - Numbers
- Not only positioning, also rotations
- 2D-widgets, but 3D position
- Bendable laser pointer
- Invisible, push and walk/fly/move, also scale/rotate
- Augmented reality widget, virtual PDA with menus etc.
- Gestures in 3D space
- Speech (input and output)
- Dragger, kind of selection object (allows to move objects)
- 2D-widgets are obvious to use, but they can be unnatural in VE
- Gestures can be fast
- Virtual palette (two handed interaction)
- Direct manipulation, do we need 3D-widgets?
- We need 3D-widgets, but they should not be irritating/disturbing
- Optimal widget, does what a user want
- Widgets could also function against physical laws
- 2D-widgets for search, needs text input (speech?)

API for Interaction Devices

- Wish list: transparent, flexible, bug-free, well documented, extensible, OS-independent, language-independent…
- Easy to learn, use, configure
- Plug-and-play could be good one
- Device abstraction
- Ability to record data (for analysis, debugging, etc.)
- Multi-threading needed
- Synchronization of input devices
- Multicasting
- Desired coupling to output devices?
    - Output libraries need information about input?
    - Feedback from input devices?
    - Support for output representations
- Input = output (ask Tommi)
- Real-time processing
    - Multi-threading
    - Independent update rates
    - Input device synchronization
- Handle distributed devices

Out from CAVEs!

- Hardware: easy to carry, light, not disturbing, inexpensive, stylish, safe!
- Easy to learn, like bike riding
- Multimodality, input and output
- Clothing-like devices?
- Inexpensive hardware, but if it is cool the cost can be high!
- Safe, so that people do not hurt each others
- Matrix-style plugin
- Where is the limit for VR?
    - When VR is real(ity), what then?
- Social acceptance, bluetooth headsets have been found irritating and silly
- Professional users, people repairing cars, etc.
- On street, it can be a problem?
- Applications should also be “socially accepted”
- Sun glasses (with AR displays)
- Usable devices?
    - Non-blocking headphones (see Härmä et al., AES 114th convention, preprint 5768)
    - See-through displays