CS-525U: 3D User Interaction

Intro to 3D UI

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Why Study 3D UI?

- Relevant to real-world tasks
  - Can use familiarity to ease adaptation
  - Can increase realism of experience
- Mature technology
  - Cheap, robust solutions
  - Need to create interface mappings
- 3D interaction is difficult
  - Many VR/gaming systems lack necessary cues
  - Adapting WIMP techniques is not adequate

Why Study 3D UI? (cont.)

- Current approaches are either too simple or unusable
  - Since users have problems, dumb it down!
  - Need to be able to perform all actions though!
- Ripe area for study
  - Very hot area of HCI
  - We know *a lot* about doing things in 2D
  - And also about doing things in the real world

Sample Applications

- Design and prototyping
  - Assembly
  - Ergonomics (test virtual prototype)
- Psychiatric treatment
  - Phobias
  - Post-traunatic stress disorders
- Scientific visualization
  - Explore 3D data sets
- Collaborative work
  - Tools, gestures, madia control

A Brief History

- Before 1980
  - Mostly keyboard input
  - Display for text
- After first Graphical User Interfaces (GUIs)
  - Added complexity
  - Growth in HCI studies

A Brief History (cont.)

- HCI draws on
  - Perception
  - Cognition
  - Linguistics
  - Human factors
  - Ethnography
  - Graphics design
  - Computer science
  - …

A Brief History (cont.)

- Technology developments also drove growth
  - Flight simulators
  - 3D Graphics
  - Augmented Reality (AR)
  - Virtual Reality (VR)
  - Flight

Birth of Virtual Reality

- *The Ultimate Display* paper by Ivan Sutherland (1965)
- Sutherland's HMD (1968)
- Jaron Lanier VPL DataGlove (1985)
- Jim Foley's *Scientific American* paper (1987)

Basic Interaction Tasks in VR (Bowman *et al.*)

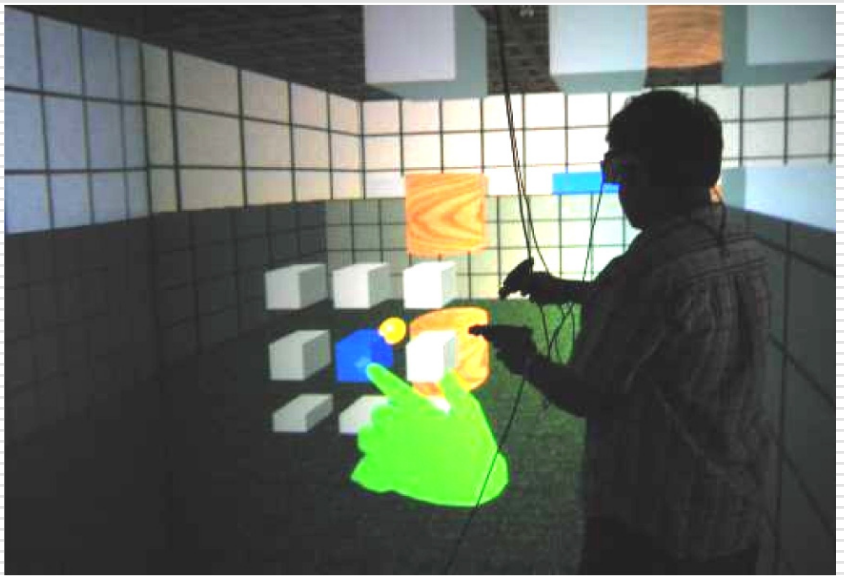
- Object Selection
  - What do I want to manipulate?
- Object Manipulation
  - How can I manipulate it?
- Navigation
  - Wayfinding: How do I know where I am, and how to get where I am going?
  - Travel: How do I get there? (locomotion)
- System Control
  - How do I change system parameters?
- Symbolic Input
  - Inputting text and numbers

Oh, I forgot One (Lindeman)

- Killing

Dealing with Objects

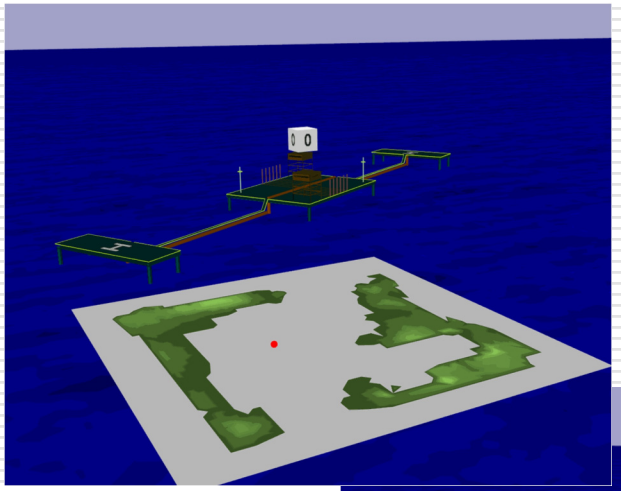
- Problems
  - Ambiguity
  - Distance
- Selection Approaches
  - Direct / enhanced grabbing
  - Ray-casting techniques
  - Image-plane techniques
- Manipulation Approaches
  - Direct position / orientation control
  - Worlds in miniature
  - Skewers
  - Surrogates

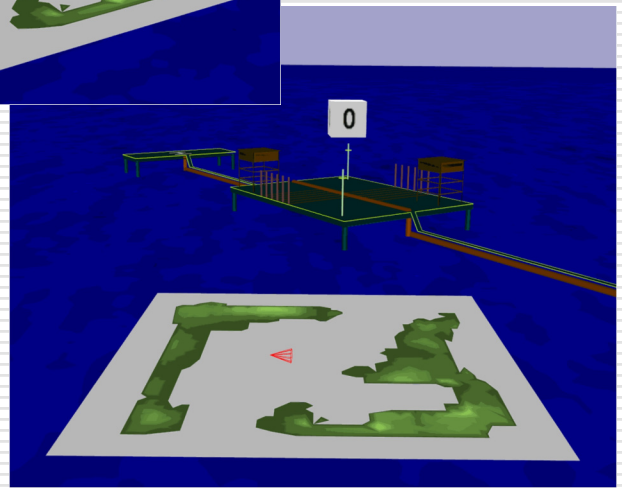


Courtesy: D. Bowman

Navigation: Wayfinding

- People get lost/disoriented easily
- Traditional tools
  - Maps (North-up vs. Forward-up)
  - Landmarks
  - Spoken directions
- Non-traditional
  - Callouts
  - Zooming





Images: http://vehand.engr.ucf.edu/handbook/Chapters/Chapter28/Chapter28.html

Navigation: Travel

- Problems
  - Limited physical space, unlimited virtual space
  - Cables
- Approaches
  - Fly where you point/look
  - Treadmills
  - Walking in place
  - Big track ball

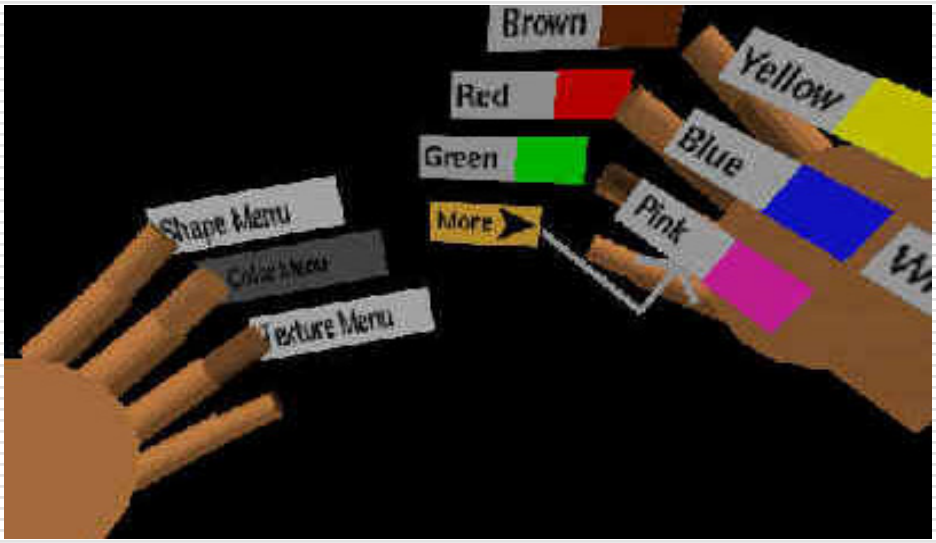
CLIP

Image: www.virtusphere.com

System Control

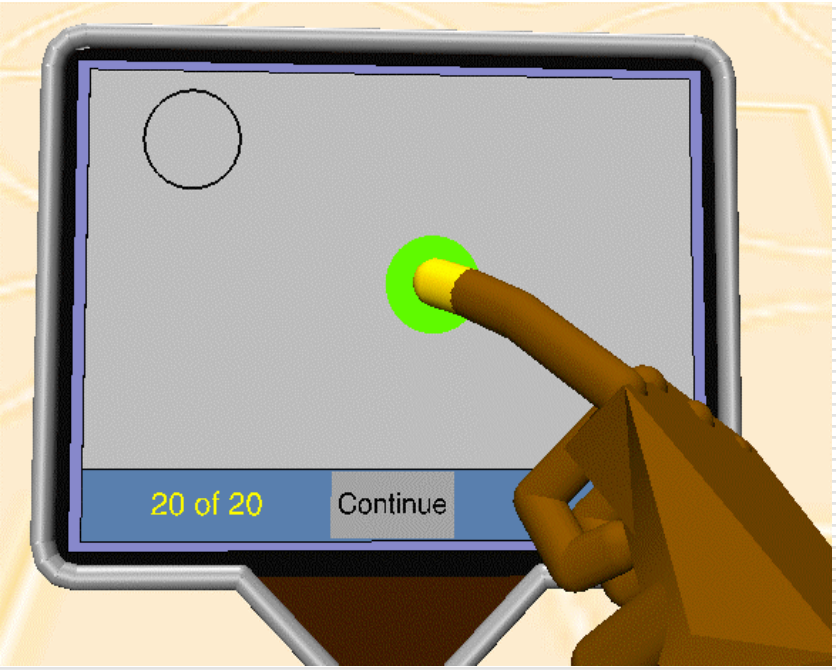
- Need to manipulate widgets
  - Lighting effects
  - Object representation
  - Data filtering
- Approaches
  - Floating windows
  - Hand-held windows
  - Gestures
  - Menus on fingers

System Control Examples



Courtesy: D. Bowman

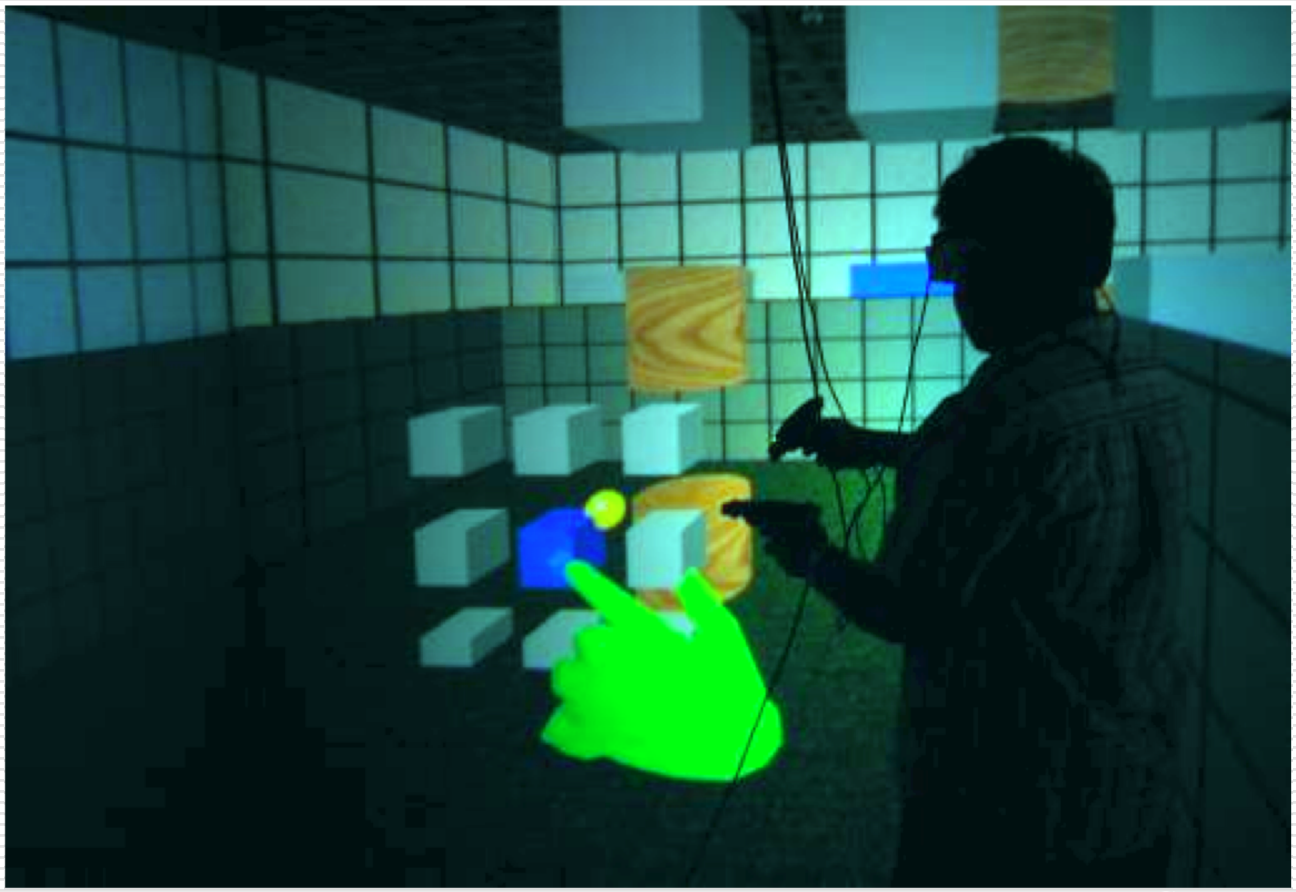
Courtesy: R. Lindeman



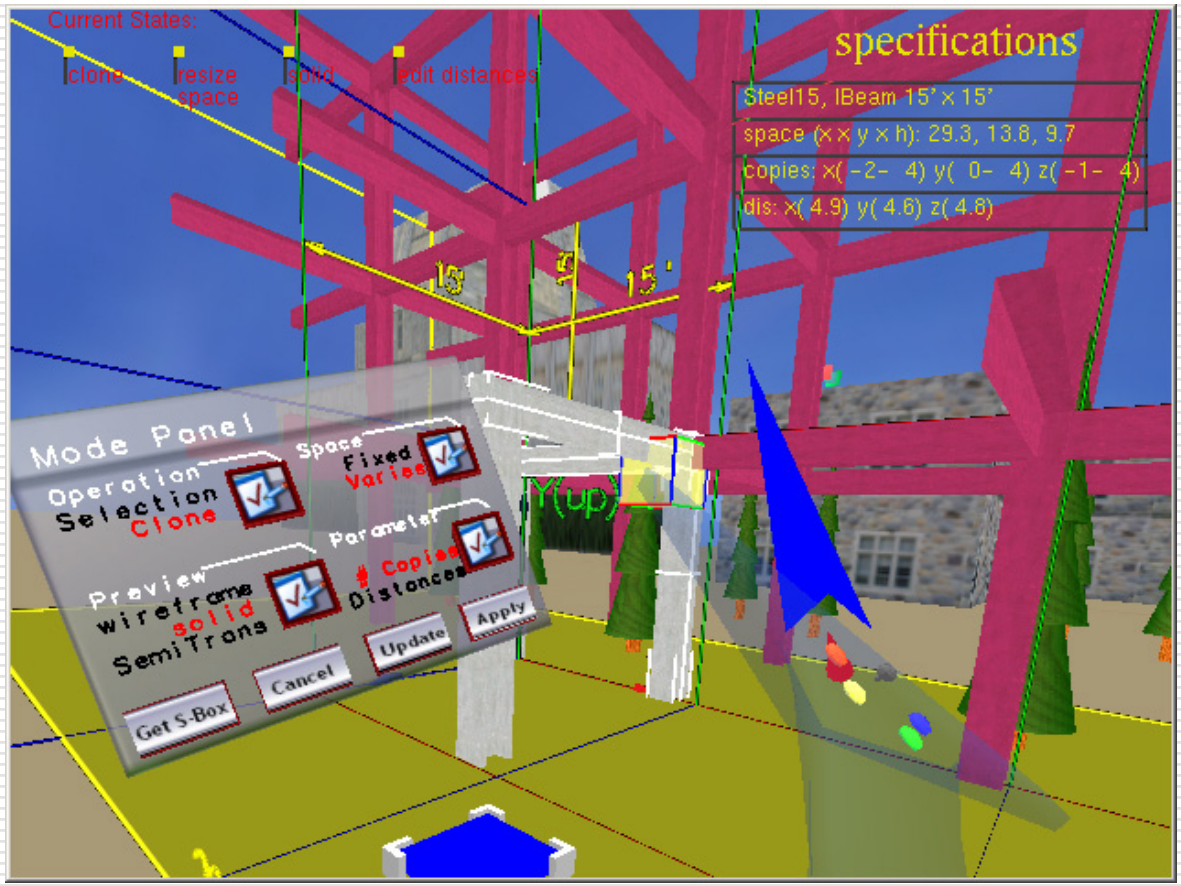
User, Task & Environment

- The "optimal" interface will depend on the capabilities of the *user*, the nature of the *task* being performed, and the constraints of the *environment*.
- User
  - Dexterity, level of expertise
- Task
  - Granularity and complexity of task
- Environment
  - Stationary, moving, noisy, *etc.*

Direct Manipulation



Can We Do WIMP in VR?

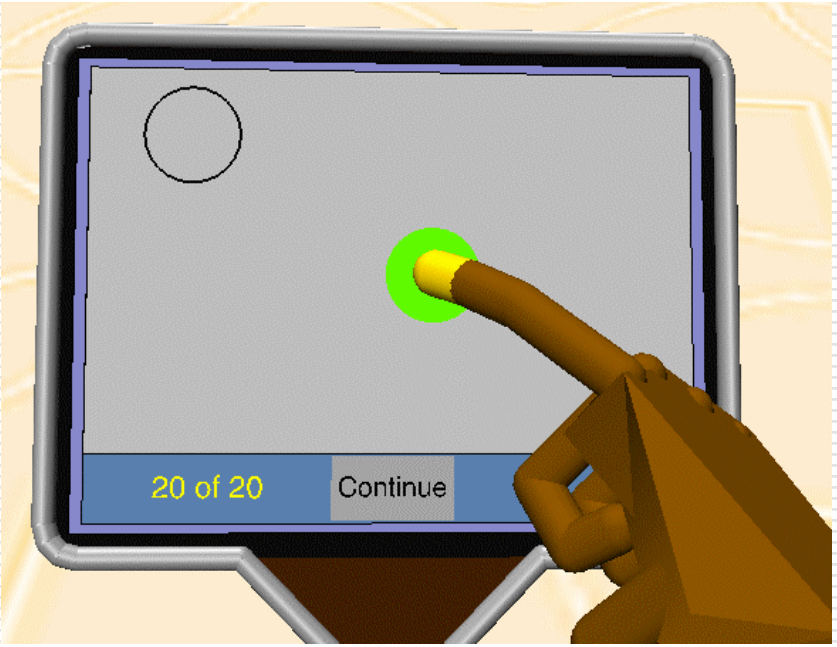


Desktop Interaction: SensAble *PHANToM*

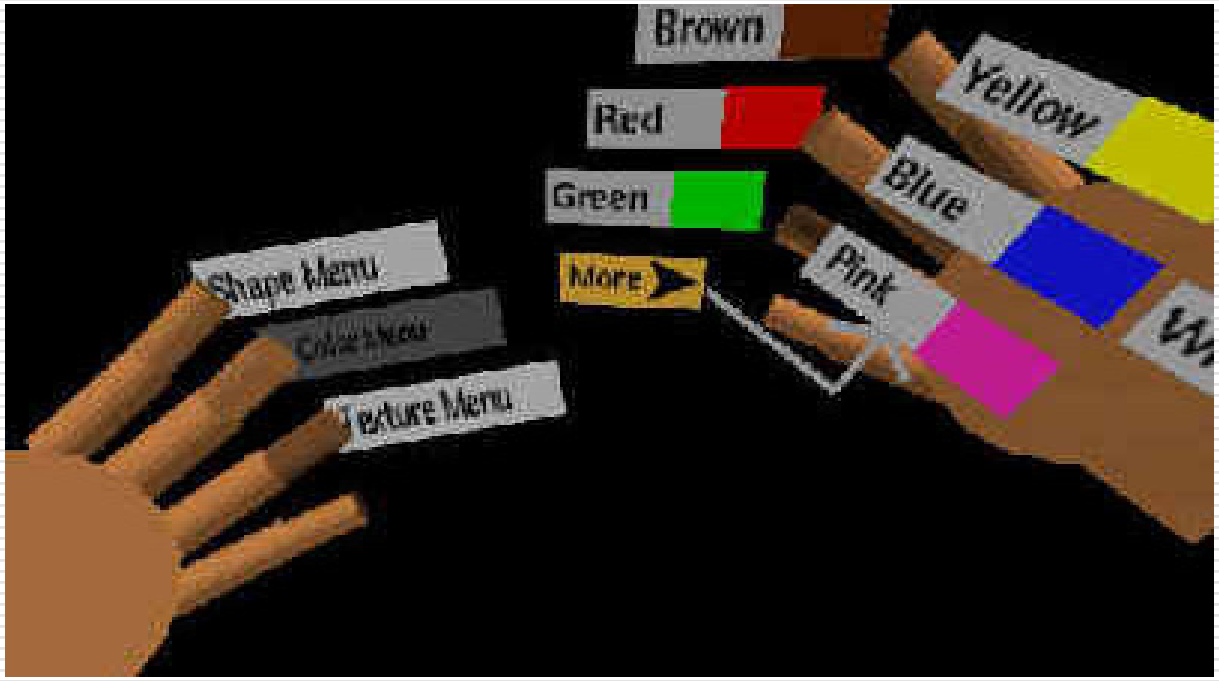
Wearable Interaction with Haptics: Immersion *CyberGrasp*

http://www.immersion.com/

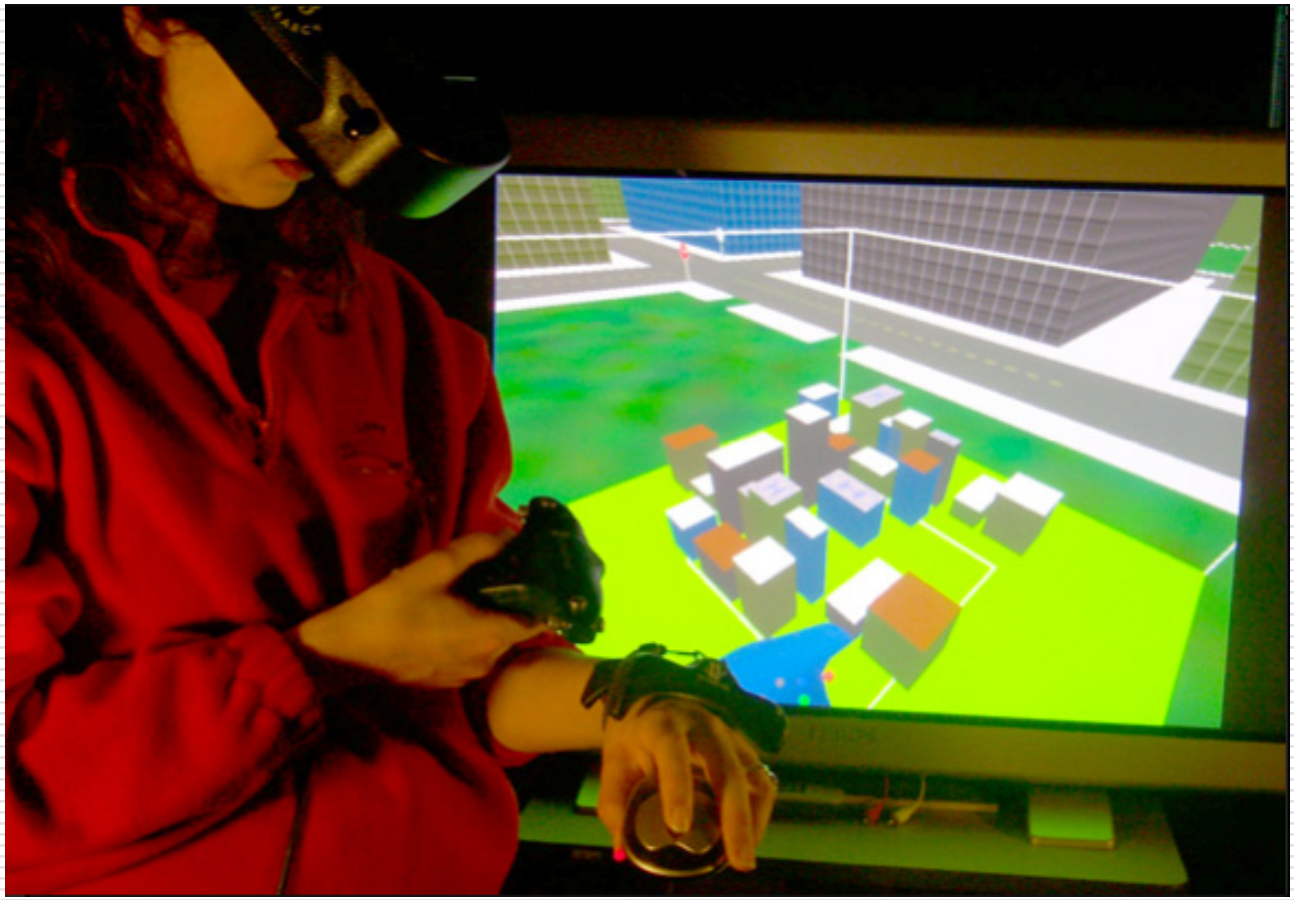
Wearable Interaction: Rob's *Hand-Held Windows*



How Do We Do Menus?



Interface Devices



Augmented Reality (AR)

Applications

- Data perceptualization
  - Map variables to tactors
- Spatial awareness
  - Driver warning system (vibrotactile Bott's dots)
- Navigational aid
  - Firefighter guidance
- Non-verbal communication
  - Map hand signals to vibrotactile patterns