



# CSE 165: 3D User Interaction

Lecture #8: Manipulation  
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CSE165, Winter 2014

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# Today's Research Papers

- ◉ Diego de Uña Gomez
  - ◉ The God-finger method for Improving 3D interaction with Virtual Objects through Simulation of Contact Area
- ◉ Vincent Nguyen
  - ◉ Mime: Compact, Low-Power 3D Gesture Sensing for Interaction with Head-Mounted Displays

# Upcoming Research Papers

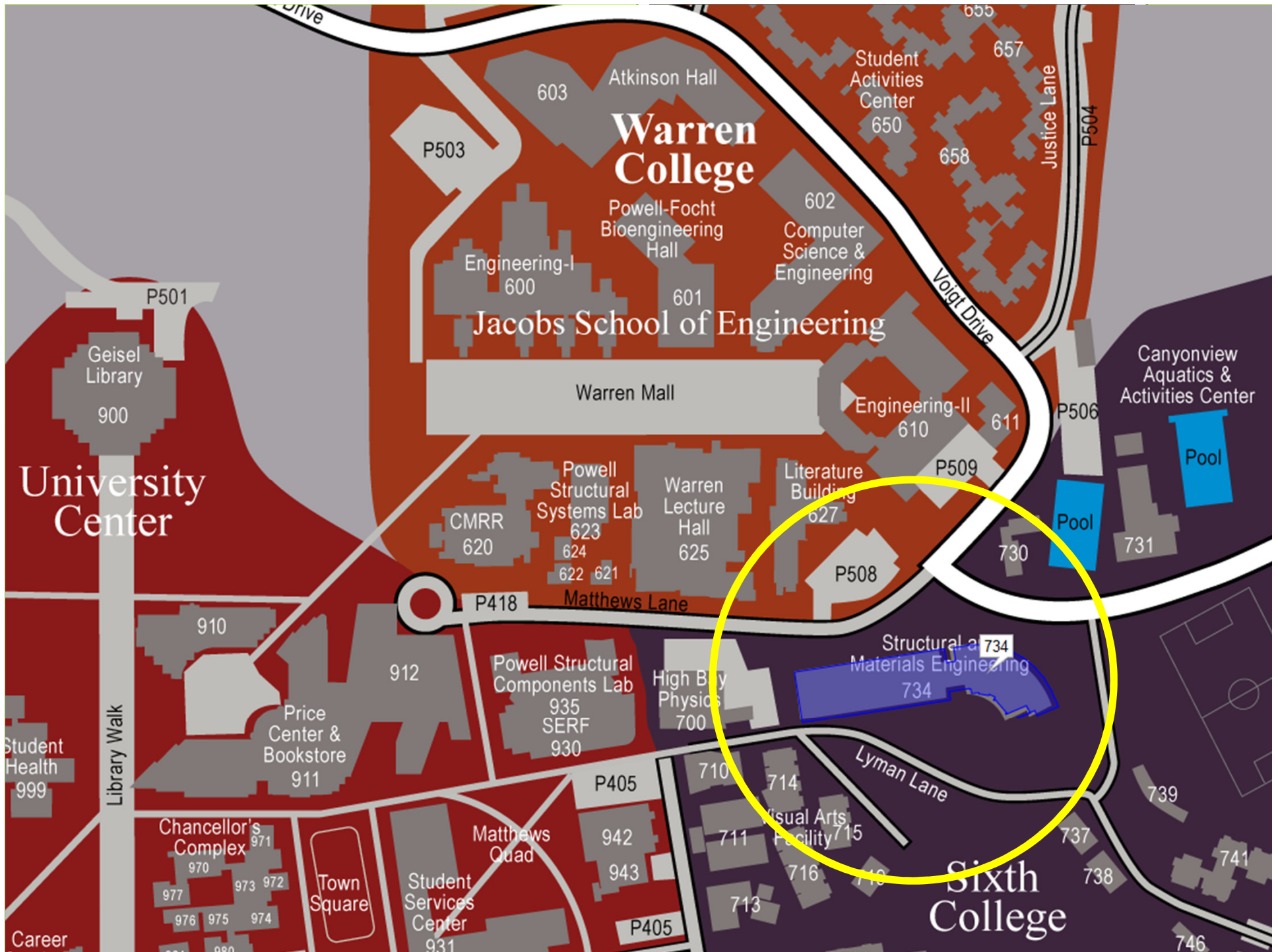
- Thursday Feb 6
  - Zach Johnson
    - Improving digital handoff using the space above the table
  - Andrei Thompson
    - Tapping-In-Place: Increasing the naturalness of immersive walking-in-place locomotion through novel gestural input

# Announcements

- Next lecture (Tuesday Feb 4):
  - field trip to WAVE by Dr. Thomas DeFanti



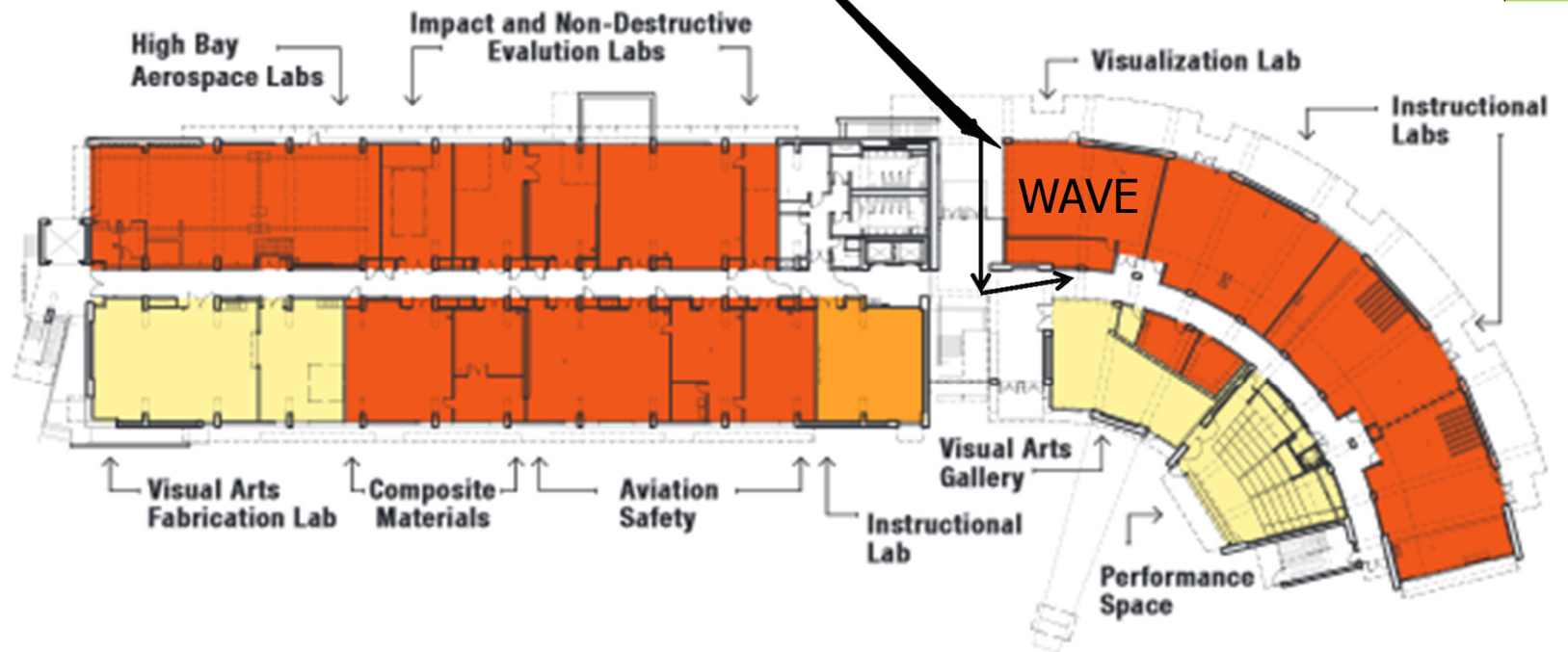
- Homework assignment #2
  - Due Friday, February 7<sup>th</sup> at 1:30pm in CSE lab 260



From WLH

Level

1





# Selection/Manipulation

Part II

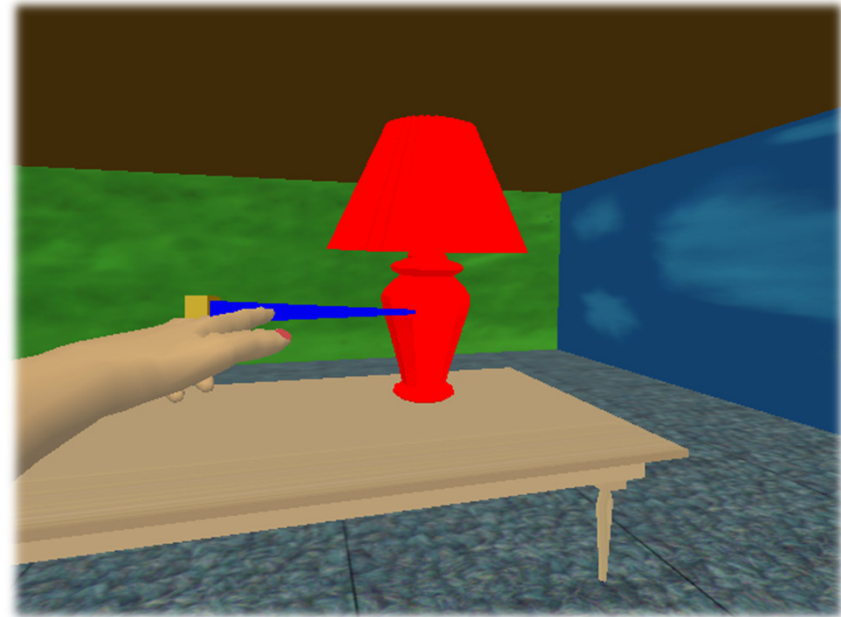
# Isomorphic vs. Non-Isomorphic View

- Isomorphic
  - Geometrical on-to-one correspondence between hand motions in physical and virtual worlds
  - Natural interactions
- Non-Isomorphic
  - “Magic” virtual tools (laser beams, rubber arms, etc.)



# Ray-Casting

- User points at objects with virtual ray
- Ray defines and visualizes pointing direction
- First intersected object is selected



$$\mathbf{p}(\alpha) = \mathbf{h} + \alpha \cdot \vec{\mathbf{p}}$$

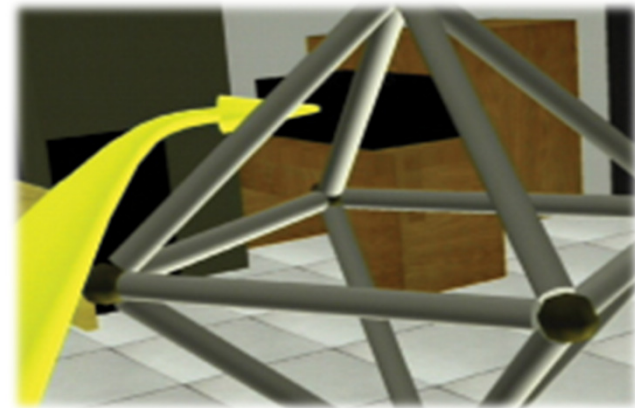
where  $0 < \alpha < \infty$ , determined by first object intersection

$\mathbf{h}$  = 3D position of virtual hand

$\vec{\mathbf{p}}$  = ray attached to  $\mathbf{h}$

# Two-Handed Pointing

- Ray casting with 2 hands
- More control
  - Distance between hands controls length
  - Allows pointing at things behind other things



$$\mathbf{p}(\alpha) = \mathbf{h}_l + \alpha \cdot (\mathbf{h}_r - \mathbf{h}_l)$$

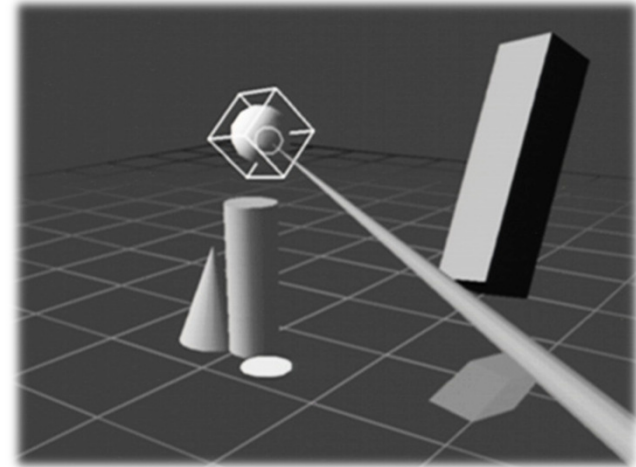
where  $0 < \alpha < \infty$ , fixed parameter

$\mathbf{h}_l$  = 3D position of left hand

$\mathbf{h}_r$  = 3D position of right hand

# Flashlight

- Soft selection technique
  - Does not need precision
  - Conic selection volume
    - Tip of cone in wand
    - Cone direction determined by wand direction
    - Fixed cone size
- If multiple objects in cone
  - Object closer to center line of cone is selected
  - If multiple objects are equally close to center line: select object closer to device

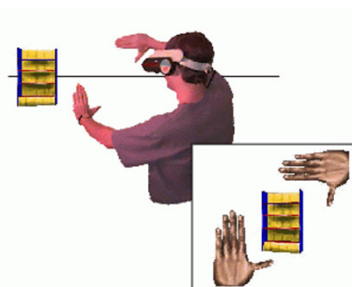


# Image Plane Techniques

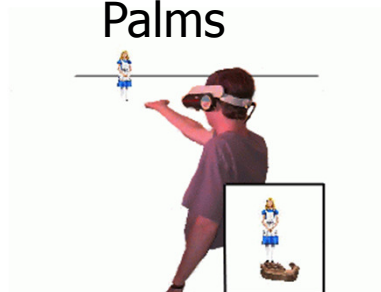
- Require only 2 DOF
  - Selection based on 2D projections
  - Use virtual image plane in front of user
    - Dependent on head/eye position



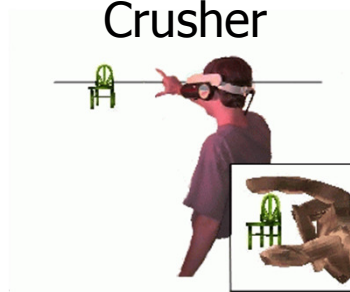
Framing



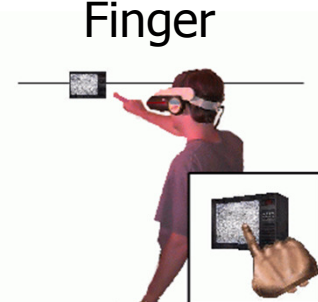
Lifting  
Palms



Head-  
Crusher

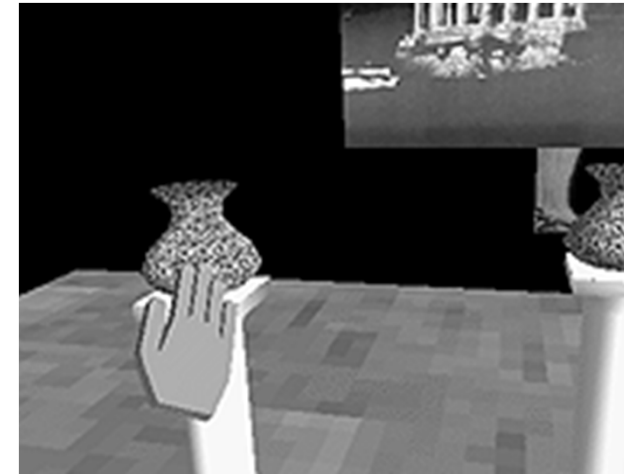


Sticky  
Finger



# Virtual Hand

- Select and manipulate directly with hand
- Hand represented as 3D cursor
- Intersection between cursor and object indicates selection



$$\mathbf{p}_v = \alpha \cdot \mathbf{p}_r, \mathbf{R}_v = \mathbf{R}_r$$

$\mathbf{p}_r, \mathbf{R}_r$  = position and orientation of real hand

$\mathbf{p}_v, \mathbf{R}_v$  = position and orientation of hand in VE

$\alpha$  = fixed scaling factor

# Go-Go

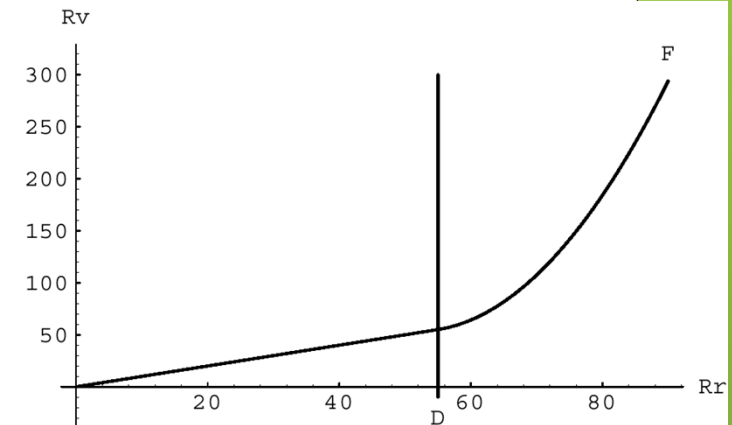
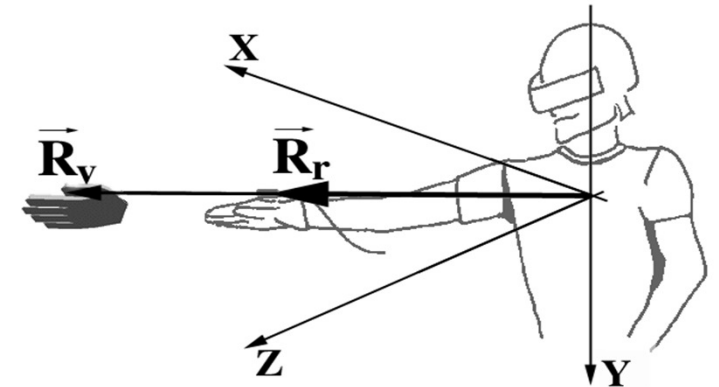
- By Poupyrev, 1996
- Arm-extension technique
- Touch objects to select, like simple virtual hand
- Non-linear mapping between physical and virtual hand position
- Requires torso position
- Local and distant regions

$$r_v = F(r_r) = \begin{cases} r_r & \text{if } r_r \leq D \\ r_r + \alpha(r_r - D)^2 & \text{otherwise} \end{cases}$$

where  $r_r$  = length of  $\vec{\mathbf{R}}_r$

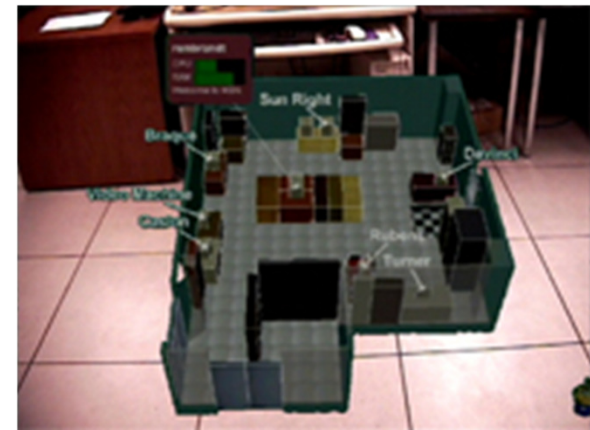
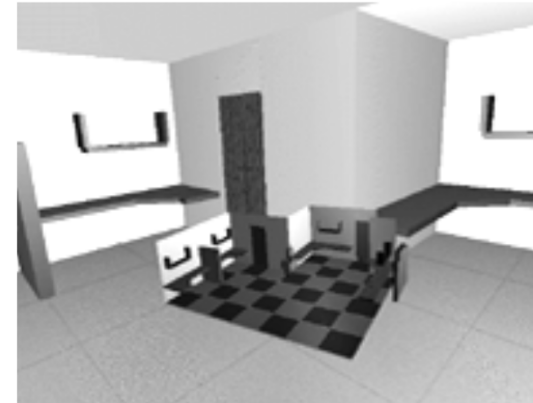
$r_v$  = length of  $\vec{\mathbf{R}}_v$

$D, \alpha$  are constants



# World-in-Miniature (WIM)

- By Stoakley, 1995
- “Dollhouse” world held in user’s hand
- Miniature objects can be manipulated directly
- Moving miniature objects affects full-scale objects
- Can also be used for navigation



# HOMER

**H**and-Centered  
**O**bject  
**M**anipulation  
**E**xtending  
**R**ay-Casting

- By Bowman/Hodges, 1997
- Select: ray-casting
- Manipulate: hand-centered

