

# 3D User Interface Wayfinding Techniques

Lecture #10: Navigation II – Wayfinding  
Spring 2017  
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## Universal 3D Interaction Tasks

- **Navigation**
  - Travel – motor component
  - **Wayfinding – cognitive component**
- Selection
- Manipulation
- System control
- Symbolic input

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# Wayfinding

- Cognitive process of defining a path through an environment
  - use and acquire spatial knowledge
  - aided by natural and artificial cues
- Common activity in our daily lives
- Often unconscious activity (not when we are lost)

# Information for the Wayfinding Task

- Landmarks
- Signs
- Maps
- Directional information

## Transferring Spatial Knowledge

- Want to transfer knowledge to the real world
  - training
  - planning
- Navigation through complex environments to support other tasks

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## Wayfinding in 3DUIs

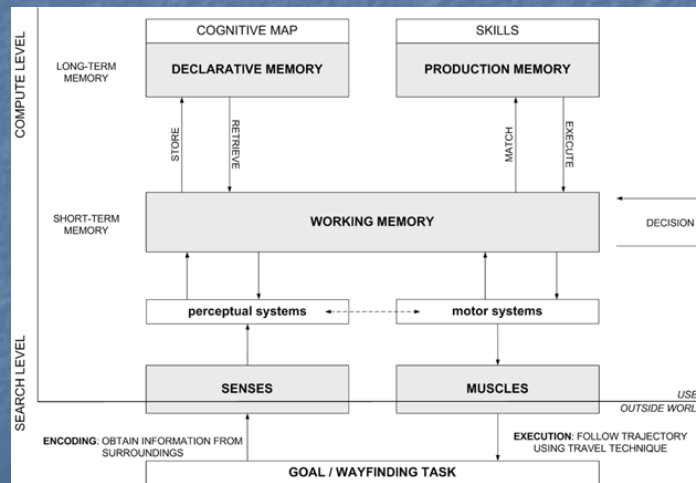
- Difficult problem
- Differences between wayfinding in real world and virtual world
  - unconstrained movement
  - absence of physical constraints
  - lack of realistic motion cues
- 3DUIs can provide a wealth of information

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# Wayfinding as Decision Making Process



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# Wayfinding and Travel

- Exploration
  - browsing environment
  - useful in building cognitive map
- Search
  - spatial knowledge acquired and used
  - naïve search – not enough info in cognitive map
  - primed search – use of cognitive map defines success
- Maneuvering
  - uses very little of cognitive map

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## Wayfinding and Spatial Knowledge

- Landmark knowledge
  - visual characteristics of environment
  - shape, size, and texture
- Procedural knowledge
  - sequence of actions required to follow a path
  - requires sparse visual information
- Survey knowledge
  - topographical knowledge
  - object location/distance/orientation

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## Egocentric and Exocentric Reference Frames

- Egomotion – feeling we are the center of space
- Egocentric – first person
  - relative to human body
- Exocentric – third person
  - relative to world
- Build up exocentric representation of world
  - survey knowledge
- Use egocentric when exploring for first time
  - landmark/procedural knowledge

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## User-Centered Wayfinding Support (1)

- Field of view
  - small FOV can inhibit wayfinding
    - user requires repetitive head movements
    - lack of optical flow in periphery
- Motion cues
  - enable judgment of depth and direction
  - supports dead reckoning (backtracking of user's own movement)
  - cue conflicts can hinder cognitive map development
- Multisensory Output
  - audio
  - Tactile maps

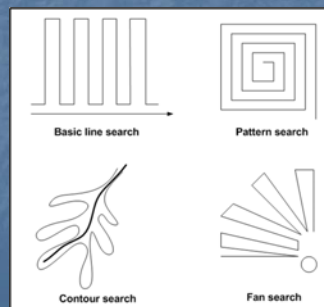
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## User-Centered Wayfinding Support (2)

- Presence (feeling of “being there”)
  - assumed to have impact on spatial knowledge
  - closer to real world
- Search strategies



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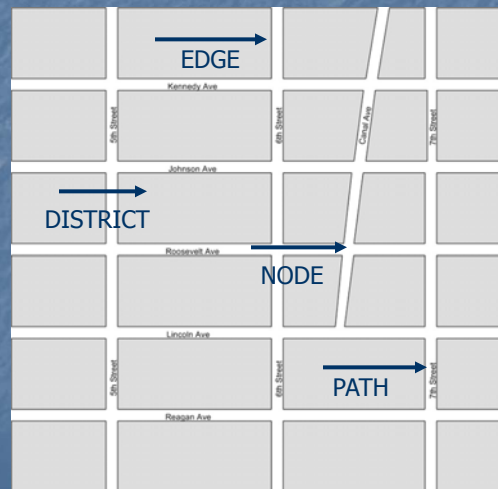
## Environment-Centered Wayfinding Support

- Environmental design
- Artificial aids

## Environmental Design (1)

- World's structure and format can aid in wayfinding
- Legibility techniques
  - divide large scale environment into parts with distinct character
  - create simple spatial organization
  - include directional cues to support egocentric/exocentric reference frames
  - often repetitive

## Environmental Design (2)



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## Environmental Design (3)

- Natural environment
  - horizon, atmospheric color, fog, etc...
- Architectural design
  - lighting
  - closed and open spaces
- Color and texture

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# Artificial Cues

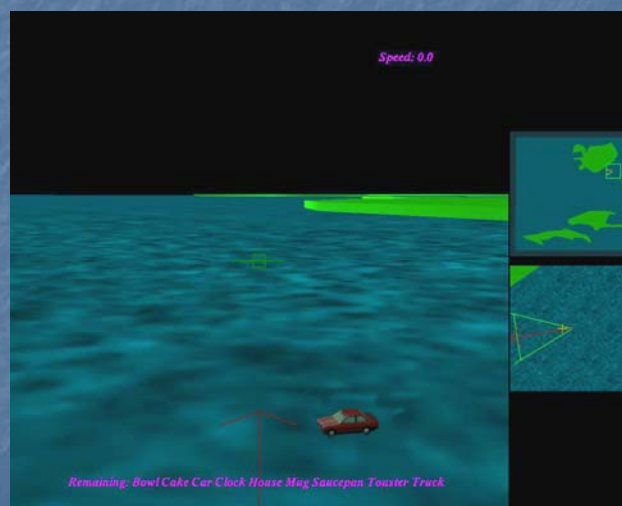
- Maps
- Compasses
- Signs
- Reference objects
- Artificial landmarks
- Trails

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# Maps (1)

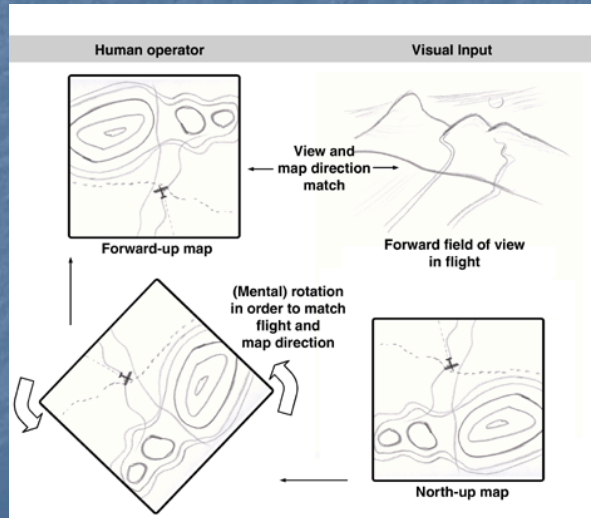


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# Maps (2)



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# Maps (3)

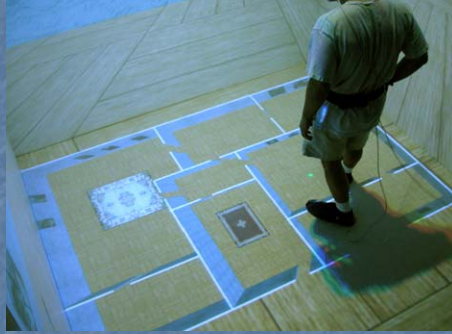


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## Maps (4)

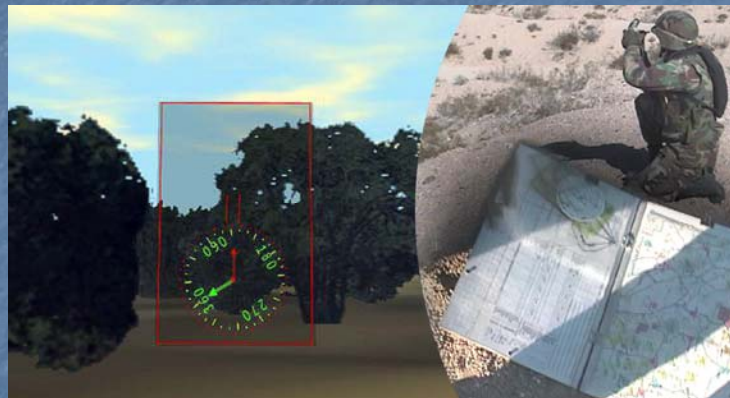


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## Compasses

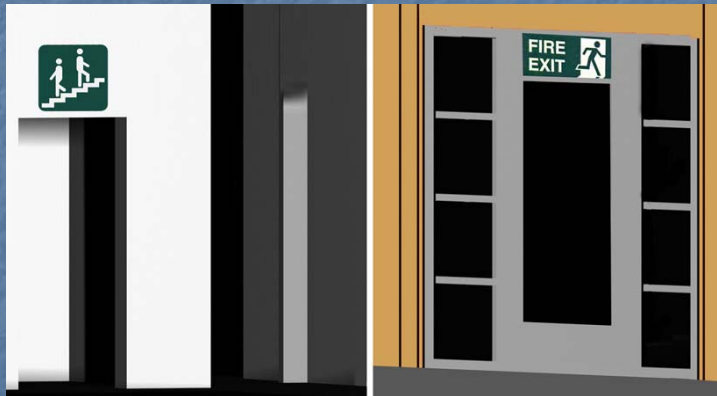


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## Signs



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## Reference Objects

- Objects that have well known size
  - chair, human figure, etc...
- Useful to estimate distances

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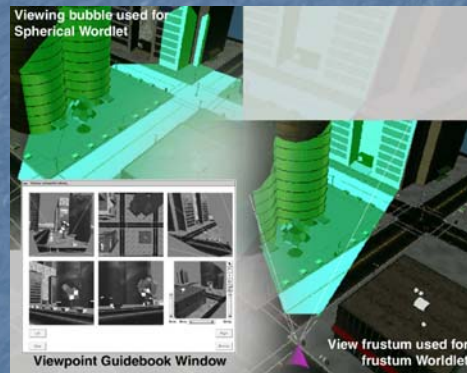
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# Artificial Landmarks

- Local – help users in decision making processes
- Global – seen from any location



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# Trails

- Help user retrace steps
- Show what parts have been visited

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# Next Class

- System Control
- Readings
  - 3DUI Book – Chapter 7