# 3D User Interface Wayfinding Techniques

Lecture #10: Navigation II – Wayfinding
Spring 2010
Joseph J. LaViola Jr.



## Universal 3D Interaction Tasks

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

# 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

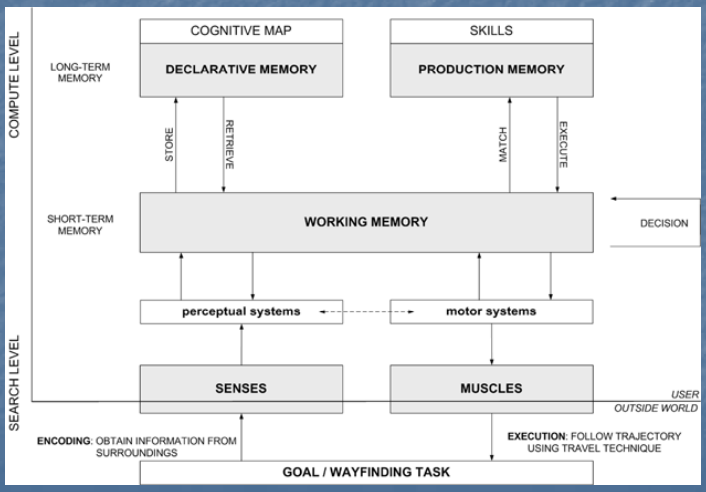
- Want to transfer knowledge to the real world
  - training
  - planning
- Navigation through complex environments to support other tasks



## 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

# Wayfinding as Decision Making Process






# 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

## 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



## 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

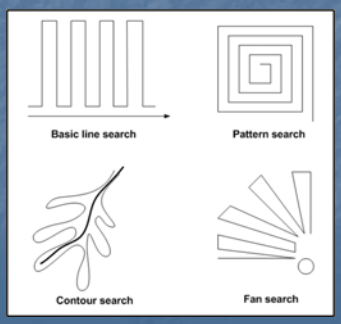
# User-Centered Wayfinding Support (1)

- 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



# User-Centered Wayfinding Support (2)

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



## Environment-Centered Wayfinding Support

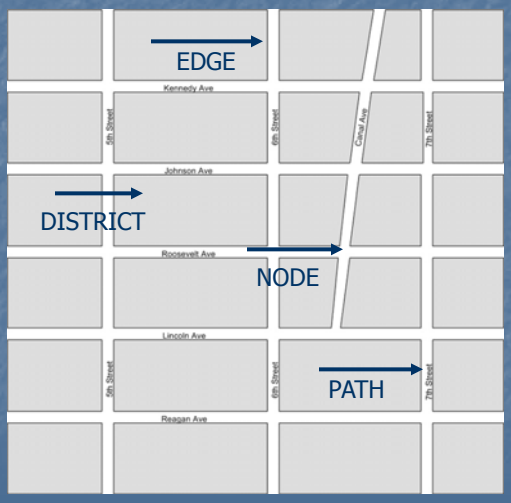
- Environmental design
- Artificial aids



## 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)






# Environmental Design (3)

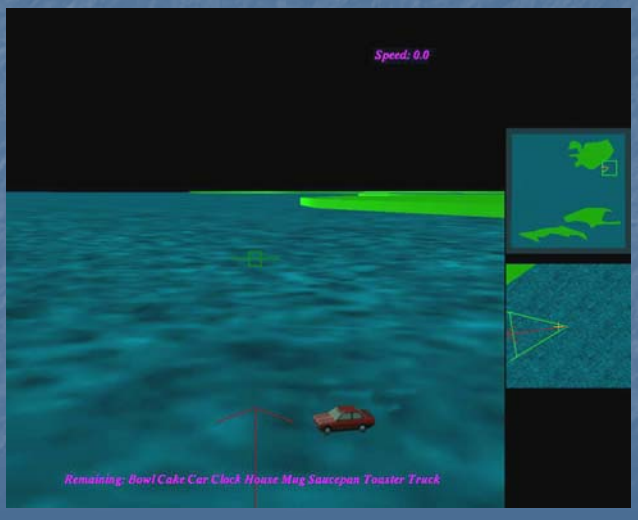
- Natural environment
  - horizon, atmospheric color, fog, etc…
- Architectural design
  - lighting
  - closed and open spaces
- Color and texture

# Artificial Cues

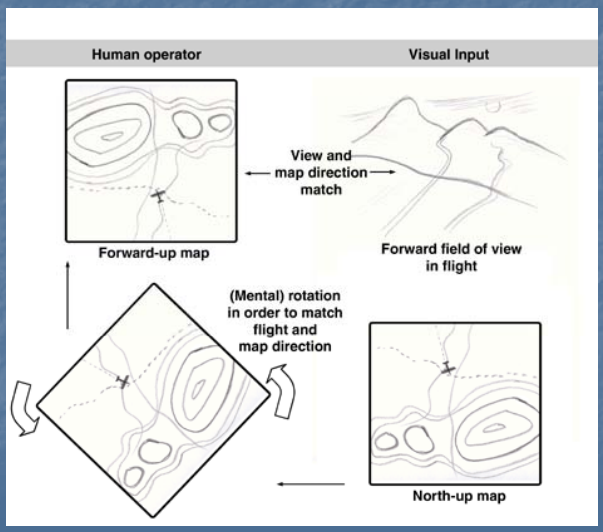
- Maps
- Compasses
- Signs
- Reference objects
- Artificial landmarks
- Trails



# Maps (1)



# Maps (2)

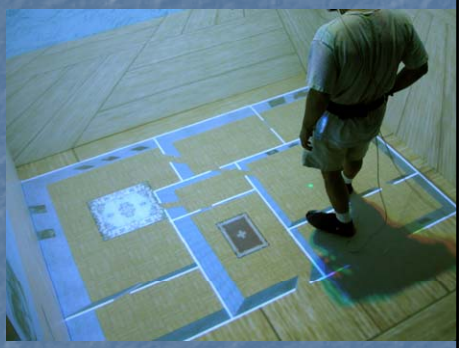

Human operator
Visual Input
View and map direction match
Forward-up map
Forward field of view in flight
(Mental) rotation in order to match flight and map direction
North-up map



# Maps (3)


You are here marker
N
Street correspondance on map (running left to right)
north-up map
N
Street correspondance on map (running buttom to top)
forward-up map

# Maps (4)



# Compasses

# Signs

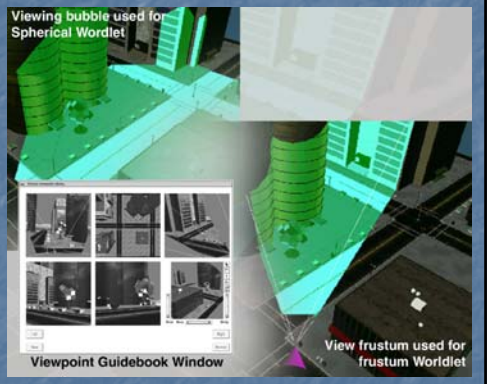



# Reference Objects

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

# Artificial Landmarks

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






# Trails

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

# Next Class

- Symbolic Input
- Readings
  - 3DUI Book – Chapter 7