CSE 165: 3D User Interaction

Lecture #10: Wayfinding

Announcements

- Homework Assignment #2 due tomorrow at 2pm
  - Grading in VR lab B210
    - Even hour teams: grading starts at 2pm
    - Odd hour teams: grading starts at 2:30pm
    - Will be grading until 3pm or later if needed
- Monday 7pm: Homework discussion for assignment #3
- Looking for students for AR project

Navigation

Wayfinding – Cognitive Component

Travel – Motor Component

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 (except when we are lost)

Information for the Wayfinding Task

- Landmarks
- Signs
- Maps
- Directional information

Transferring Spatial Knowledge

- How to transfer spatial knowledge to the real world
  - Training (eg, walk with guide)
  - Planning (eg, map, Streetview)

Wayfinding in Virtual Worlds

- Non-trivial
- Issues with wayfinding in virtual world compared to real world:
    - Less constrained movement
        - 6 DOF possible
    - Absence of physical constraints
        - No fundamental limitations by vehicle or environment
    - Lack of physical motion cues
        - User's motion in physical space does not match motion in virtual space

Wayfinding in Virtual Worlds

- Advantages of wayfinding in virtual worlds:
  - Potential to provide much more information
  - Distractions have less severe consequences

Objectives for Wayfinding

- Exploration
  - browse environment
  - useful to build cognitive map
- Search
  - spatial knowledge acquired and used
  - naïve search – not enough info in cognitive map
  - primed search – use of cognitive map

Useful Spatial Knowledge

- Landmark knowledge
  - visual characteristics of environment
  - shape, size, texture
  - relative positioning
- Procedural knowledge
  - sequence of actions required to follow a path (eg, turn by turn directions)
  - requires only sparse visual information
- Survey knowledge
  - maps
  - topographical knowledge

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
- Use egocentric when exploring for first time
  - creates landmark/procedural knowledge
- Repeated wayfinding builds up exocentric representation of world
  - creates survey knowledge
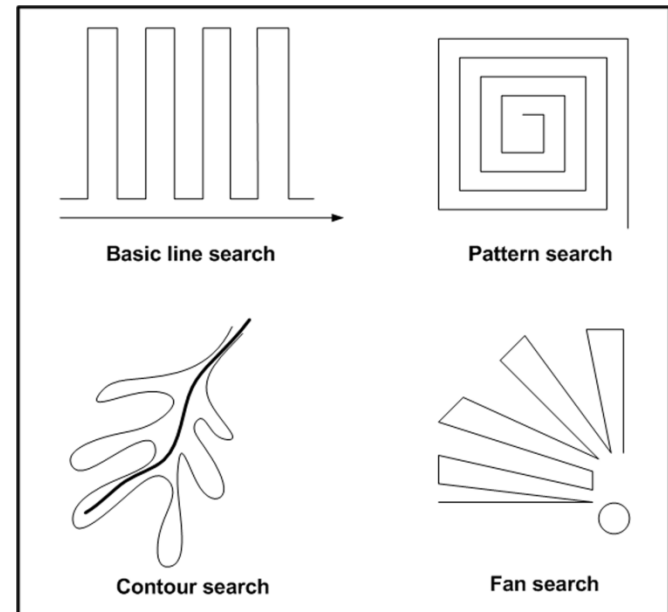
User-Centered Wayfinding Support

- Field of view (eg, HMDs)
  - 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 backtracking of user's own movement
  - cue conflicts can hinder cognitive map development
- Multisensory output for visually impaired
  - audio
  - tactile maps

Tactile Map

User-Centered Wayfinding Support

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

Basic line search

Pattern search

Contour search

Fan search

Environment-Centered Wayfinding Support

- Environmental design
- Artificial aids

Environmental Design

- 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
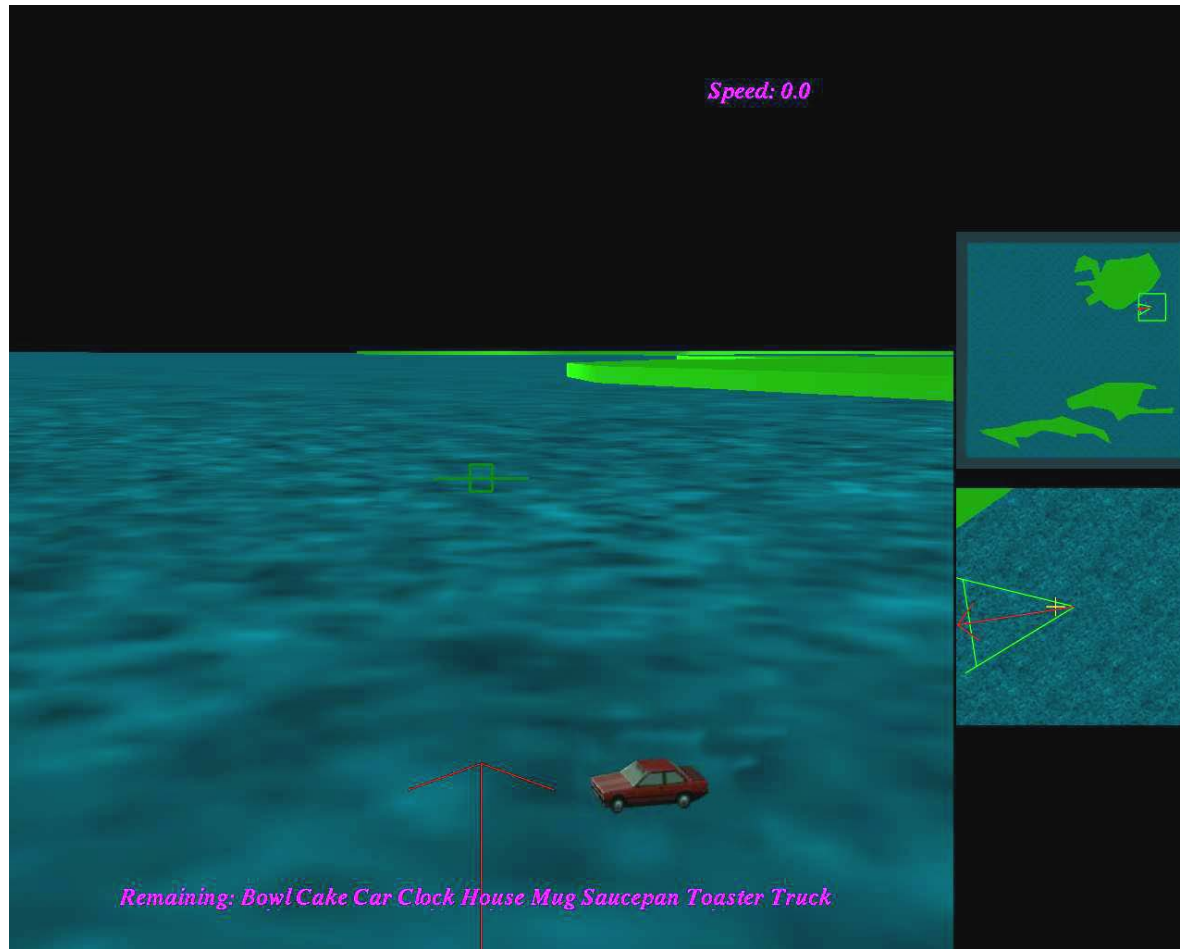 - often repetitive

Environmental Design

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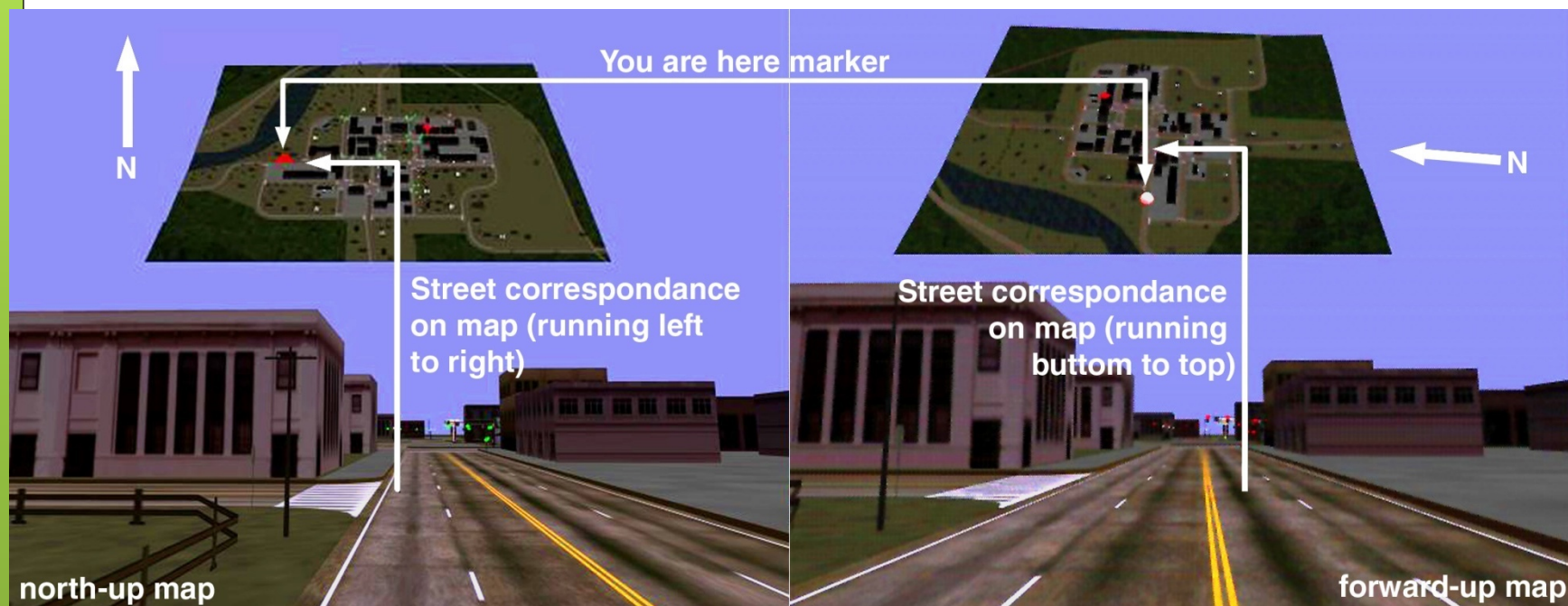 - closed and open spaces
- Color and texture

Artificial Cues

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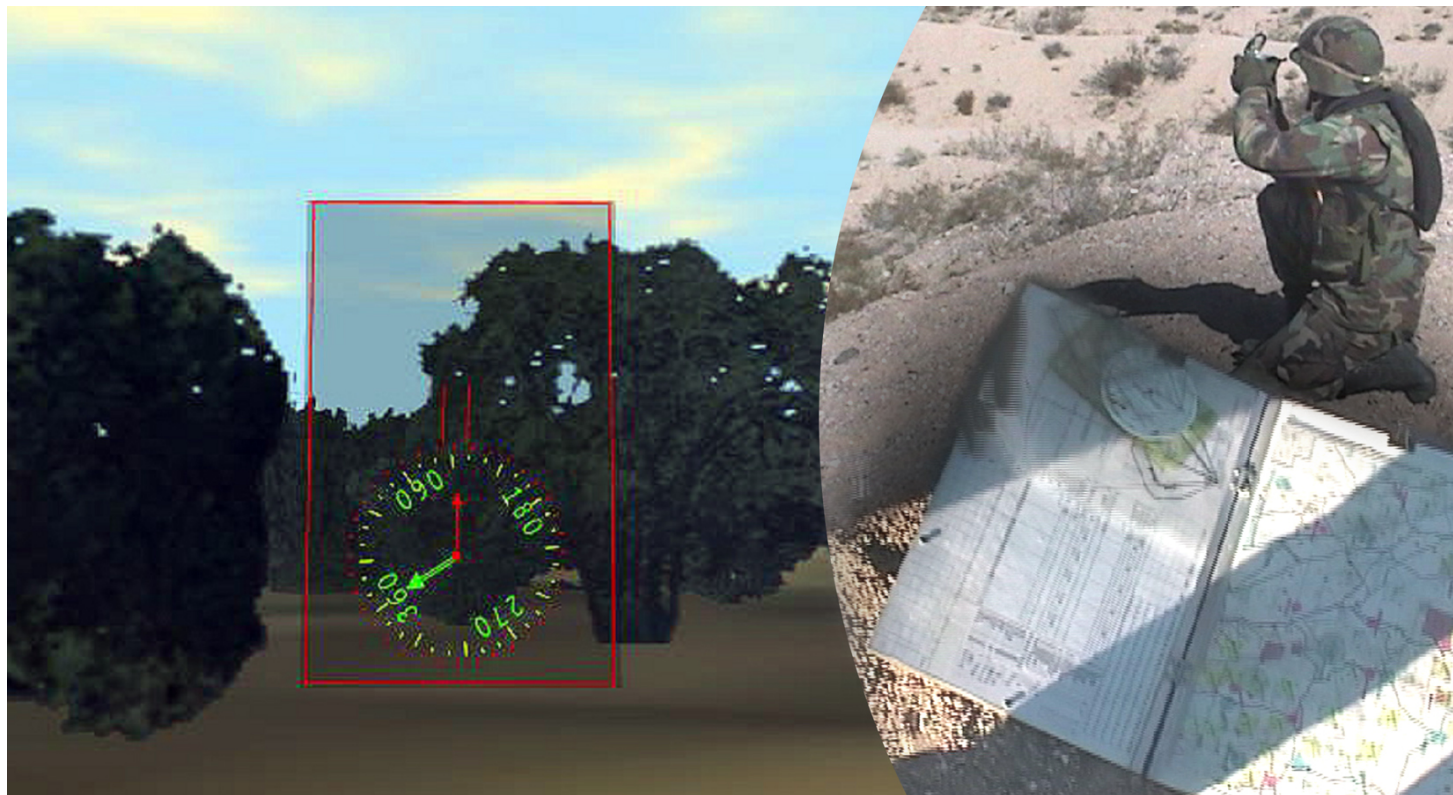- Artificial landmarks
- Trails

Maps

North Up vs. Forward Up

Compass

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

- Aka. Hansel and Gretel's bread crumbs
- Help user retrace steps
- Show what parts have been visited