CSE 165:
3D User Interaction

Lecture #11: Wayfinding

Instructor:
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Announcements

- Homework Assignment #3
  - Due February 13th at 1:00pm
- This week's instructor's office hour moved to Thursday after class (3:30-4:30pm)

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

- 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 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

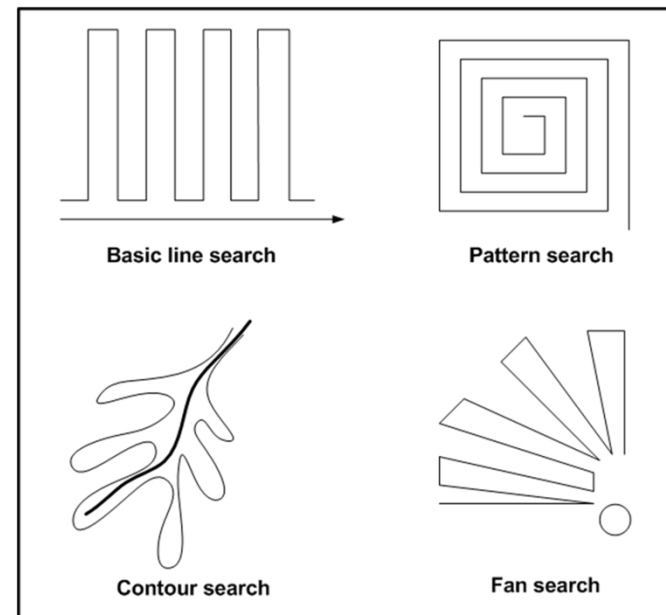# User-Centered Wayfinding Support (1)

- 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 backtracking of user's own movement
  - cue conflicts can hinder cognitive map development
- Multisensory Output
  - audio
  - Tactile maps

Tactile Map

User-Centered Wayfinding Support (2)

- 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 (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
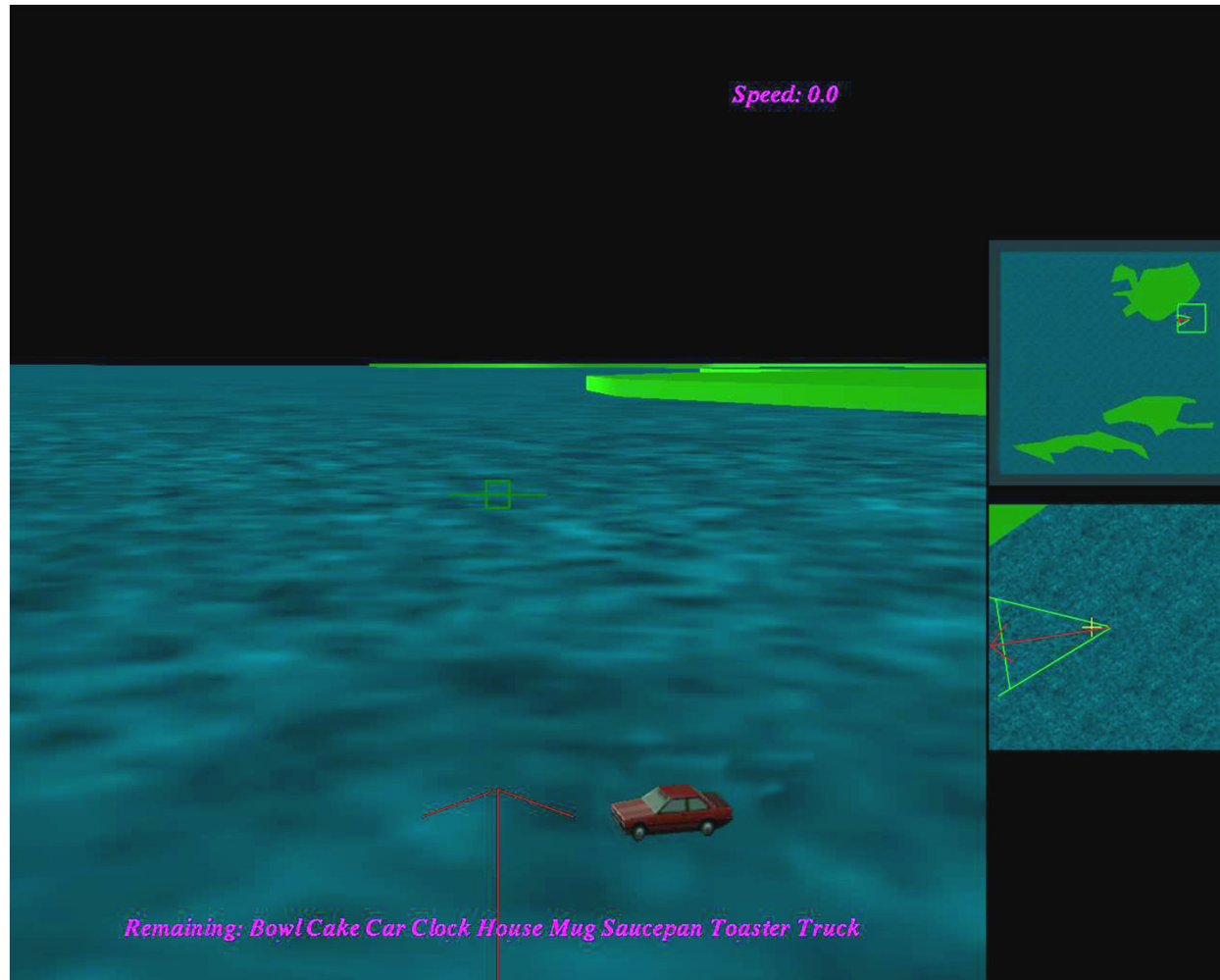 - often repetitive

Environmental Design (2)
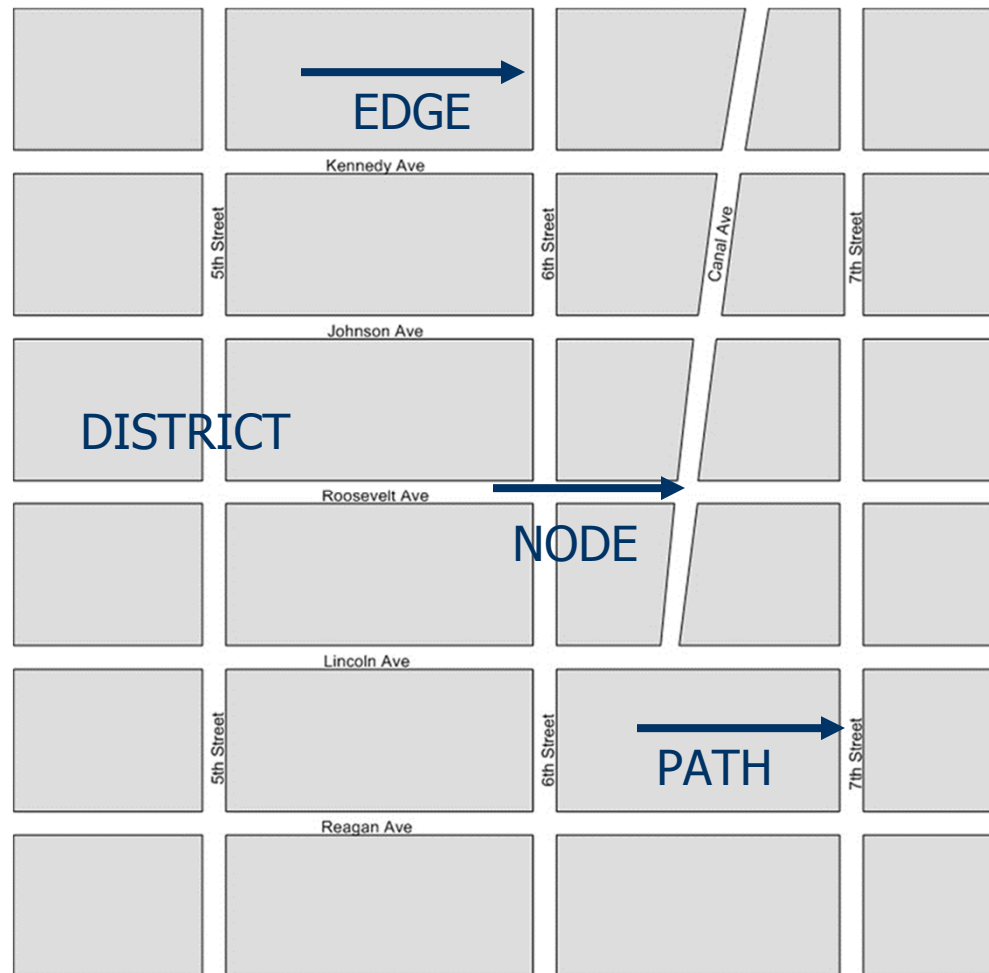
Environmental Design (3)

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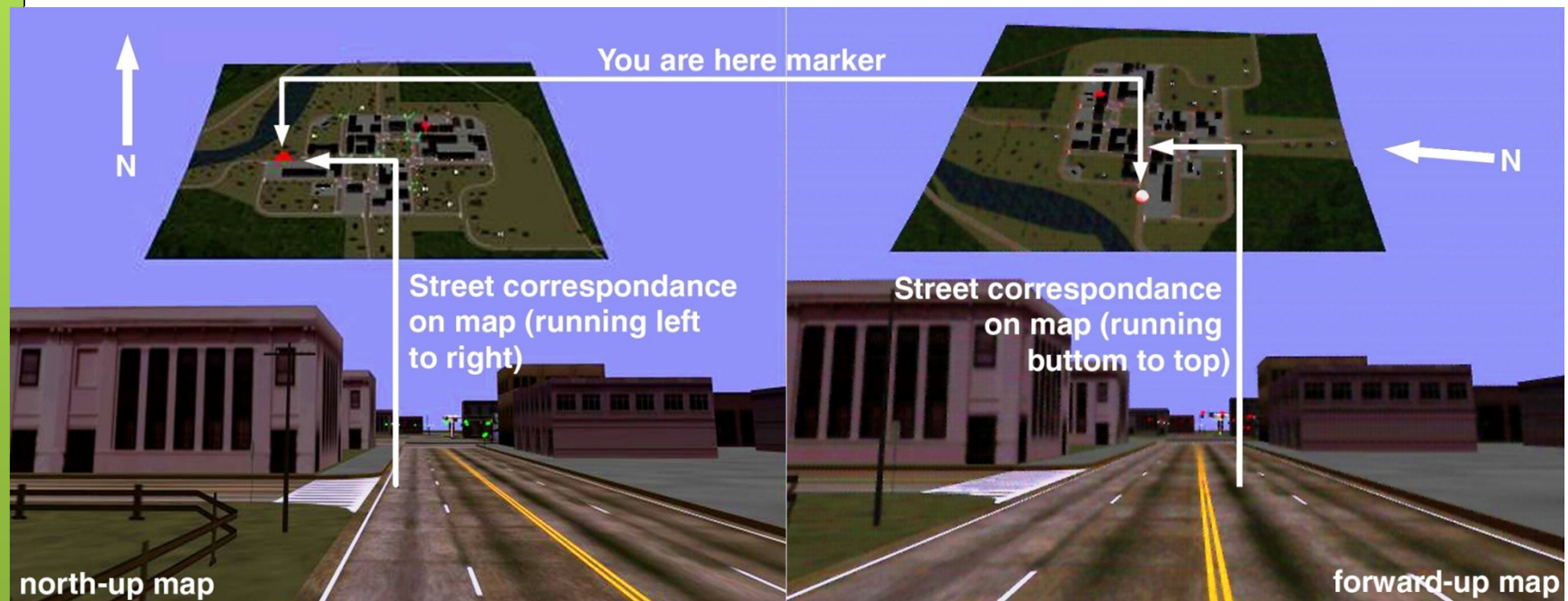
Artificial Cues

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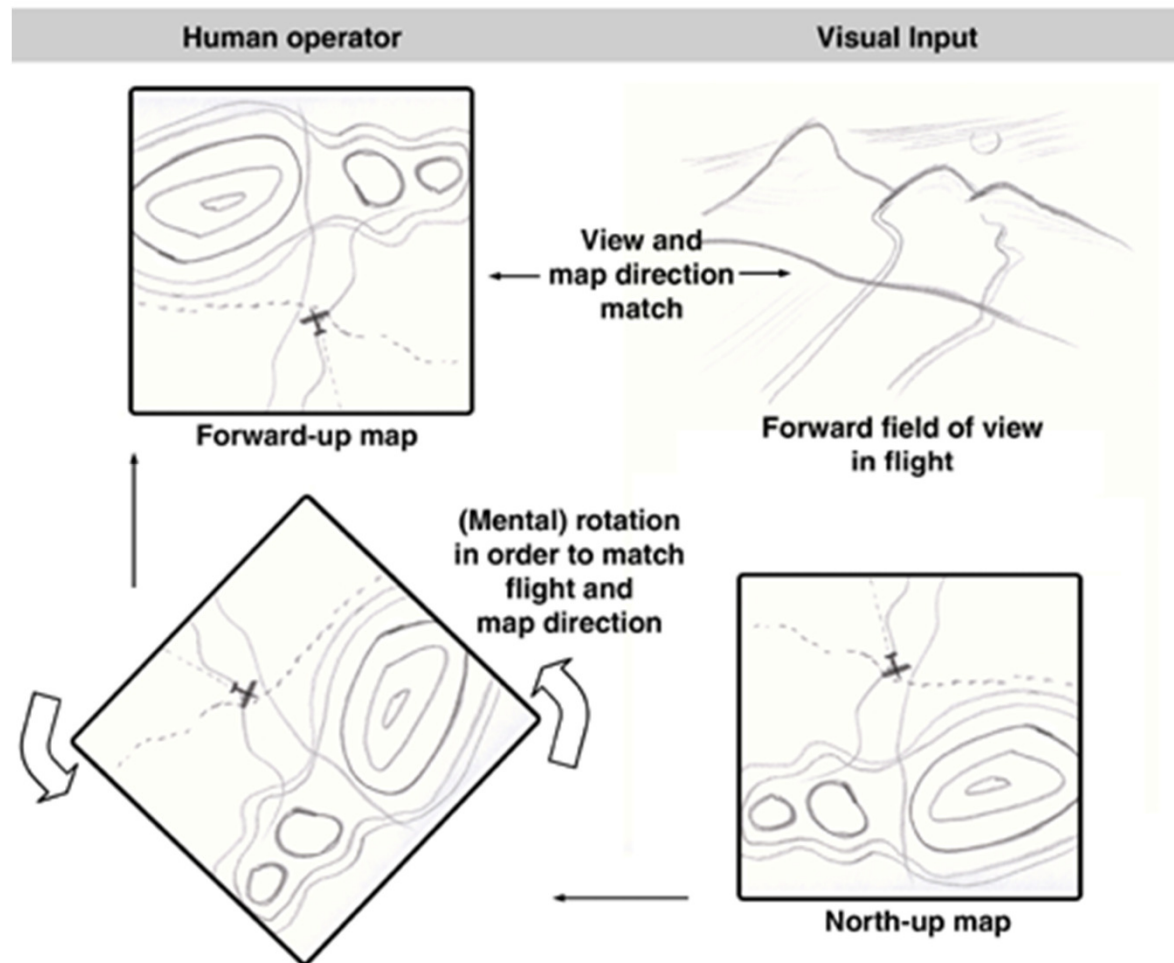- Signs
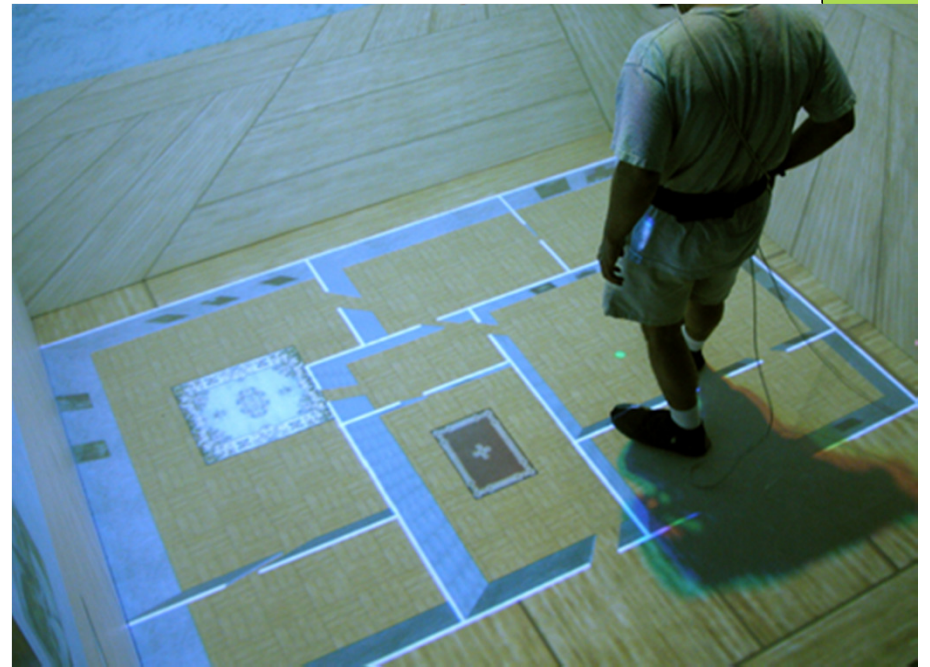- Reference objects
- Artificial landmarks
- Trails

Maps (1)

Speed: 0.0

Remaining: Bowl Cake Car Clock House Mug Saucepan Toaster Truck

Maps (3)

You are here marker

Street correspondance on map (running left to right)

Street correspondance on map (running buttom to top)

north-up map

forward-up map

Maps (2)

Human operator

Visual Input

Forward-up map

View and map direction match

Forward field of view in flight

(Mental) rotation in order to match flight and map direction
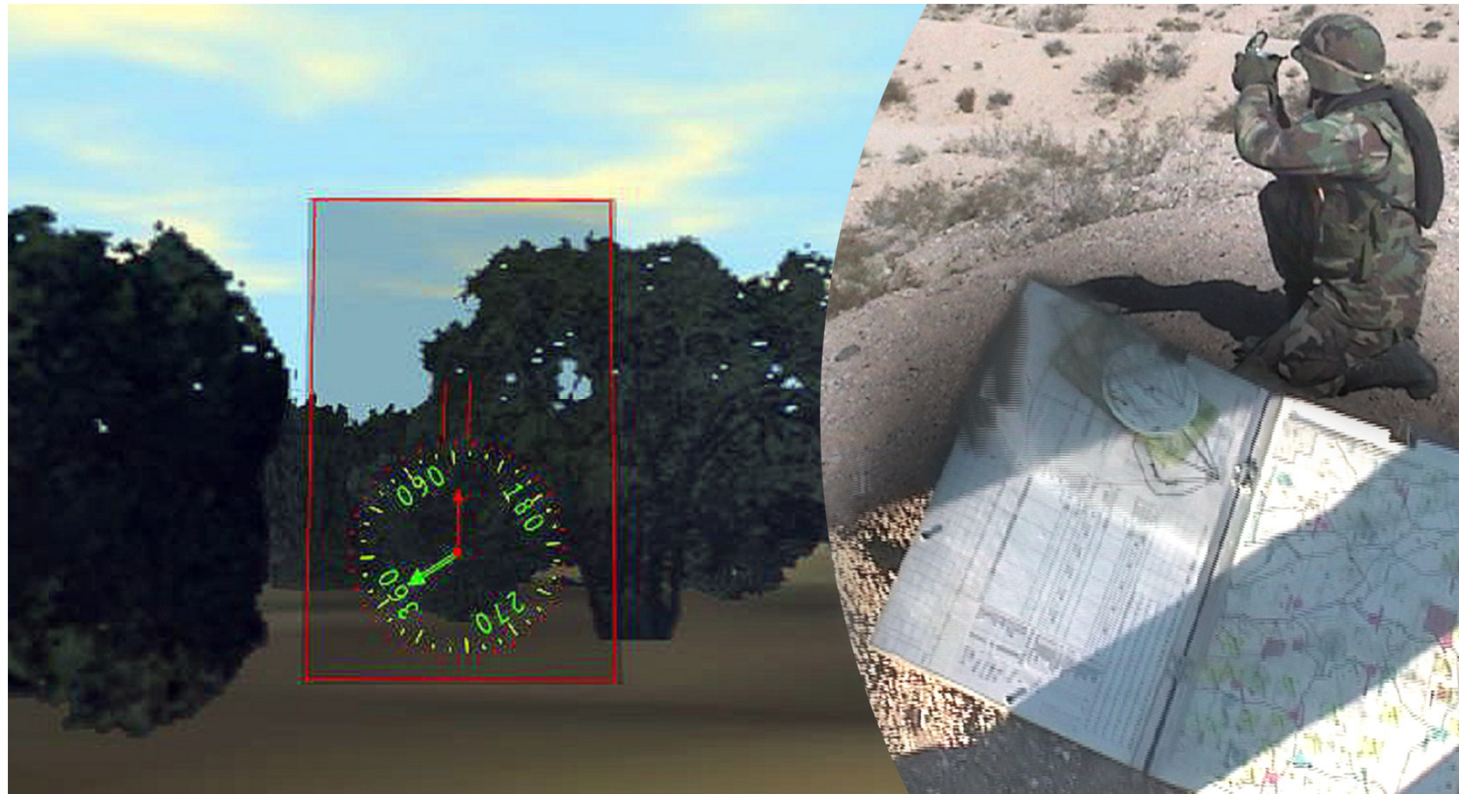
North-up map

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