Navigation, Travel, and Wayfinding

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Unless otherwise noted, images take from Chapter 8 of 3D UI text

Navigation: Travel + WayFinding

- Travel: the motor component of navigation
  - 3D Travel Tasks (8.2)
  - Classification of 3D travel techniques (8.3)
  - Various metaphors
    - Walking (8.4), Steering (8.5), selection-based travel (8.6), manipulation-based travel (8.7)
  - Other aspects of travel technique design (8.8)
- Wayfinding: the cognitive process of determine and following a route between and origin and destination
  - Design of wayfinding aids (8.9)
- Guidelines (8.10) and case studies (8.11)

Travel Tasks

- Different sorts of activity: exploration, search, and maneuvering

- Classifications:
  - active versus passive
  - physical versus virtual
  - using task decomposition
  - by metaphor

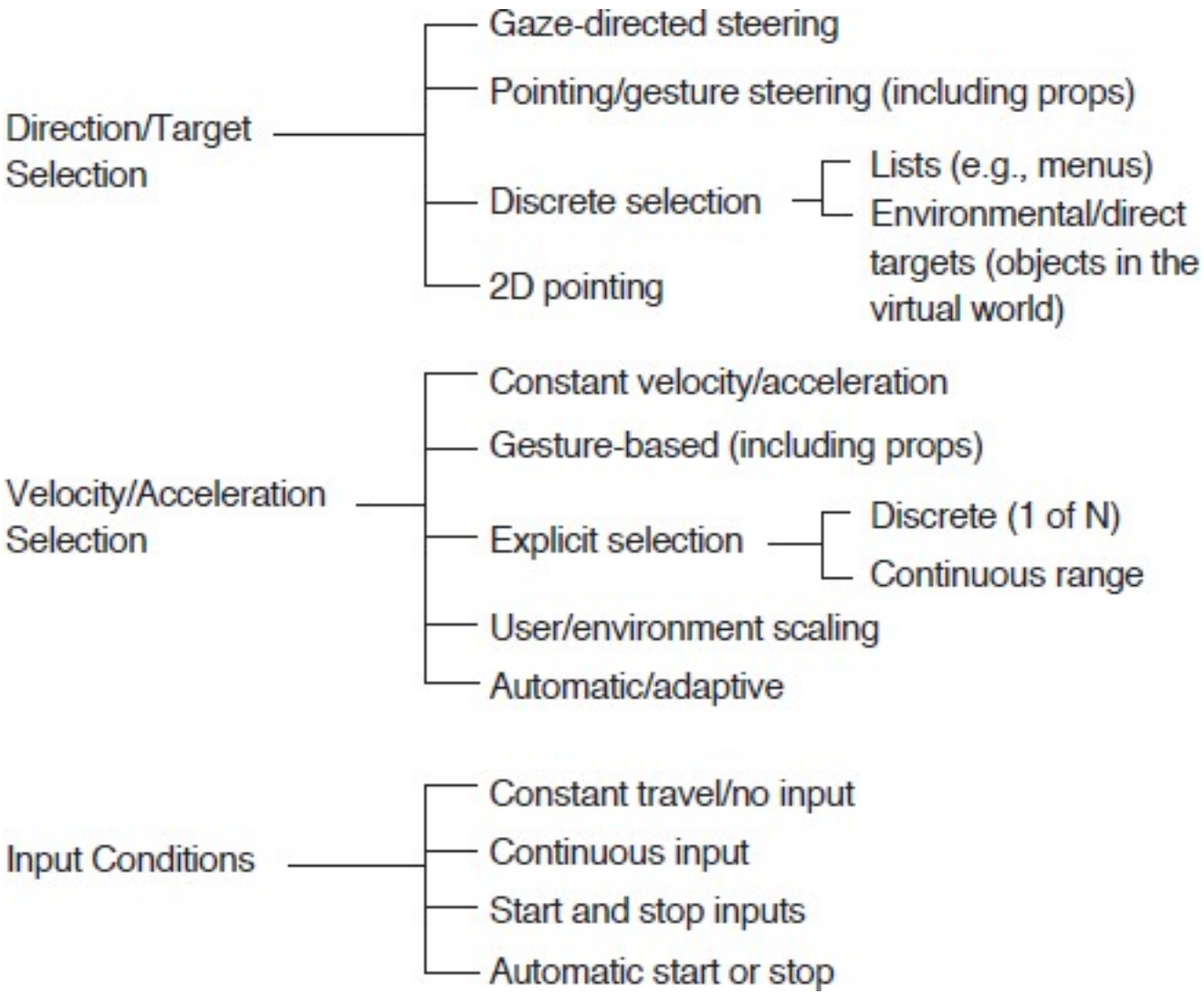


Figure 8.1 Taxonomy of travel techniques focusing on subtasks of travel. (Bowman et al. 1997, © 1997 IEEE)

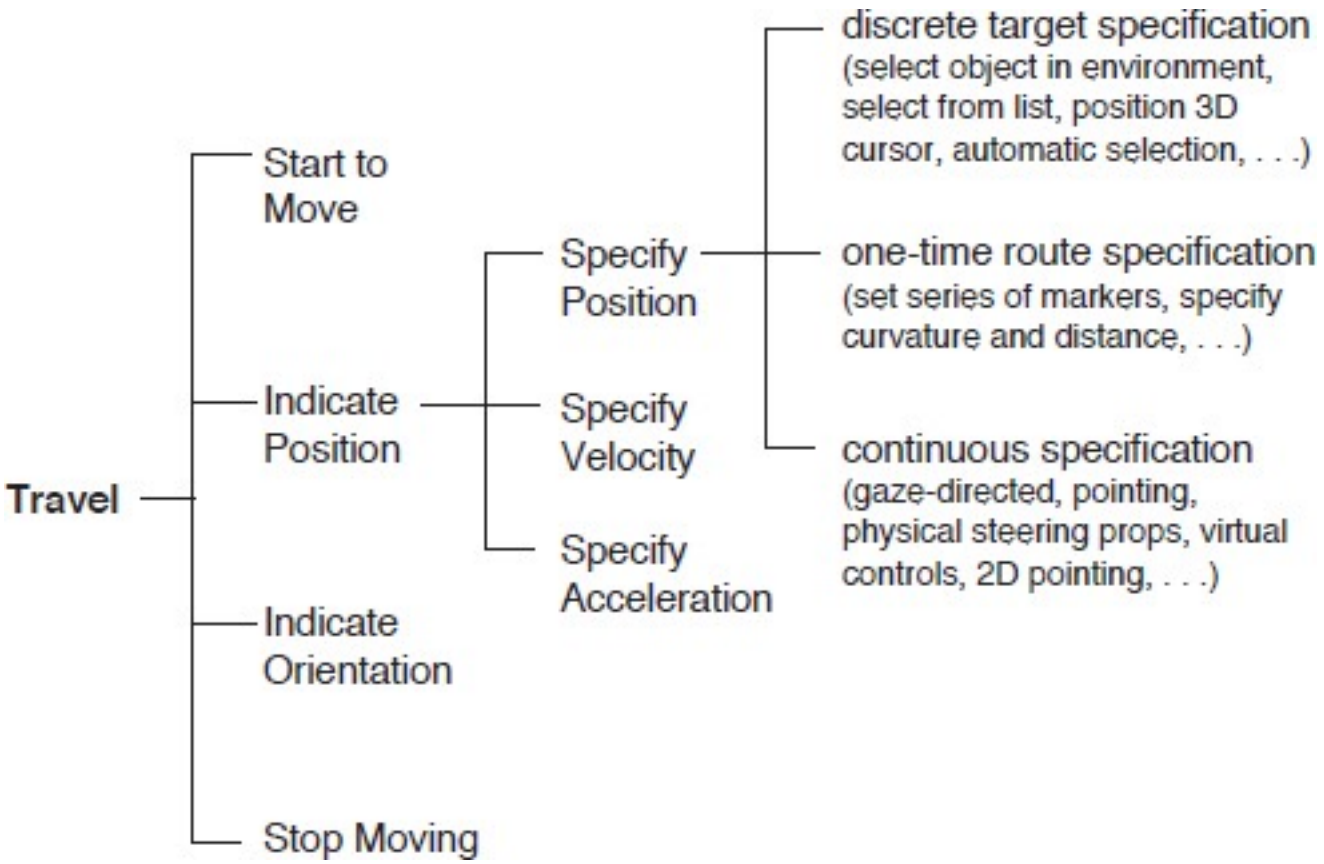


Figure 8.2 Taxonomy of travel techniques focusing on level of user control. (Bowman, Davis et al. 1999; reprinted by permission of MIT Press and *Presence: Teleoperators and Virtual Environments*)

Walking Metaphors: Full Gait

- Real Walking
  - Wide area tracking, AR

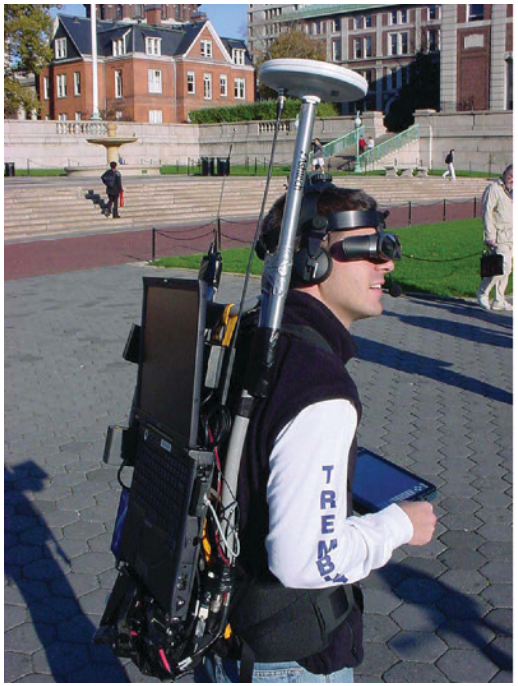


Figure 8.4 Mobile augmented reality: (a) prototype system (© 2002 Computer Graphics and User Interfaces Lab, Columbia University); (b) user's view (© 1999 Tobias Höllerer, Steve Feiner, and John Pavlik, Computer Graphics and User Interfaces Lab, Columbia University)

- Redirected Walking
  -

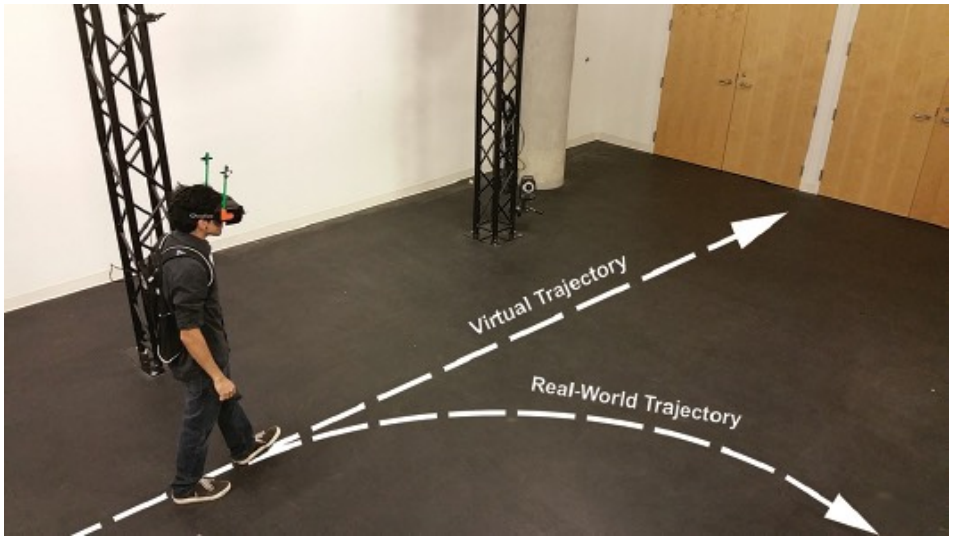


Figure 8.5 With continuous redirected walking, the user is imperceptibly guided away from the boundaries of the tracking area through subtle manipulations of the virtual scene. (Image adapted from Bruder et al. 2015)

Walking Metaphors: Partial Gait

- Walking in Place
  - Sense "steps in place"
- Human Joystick

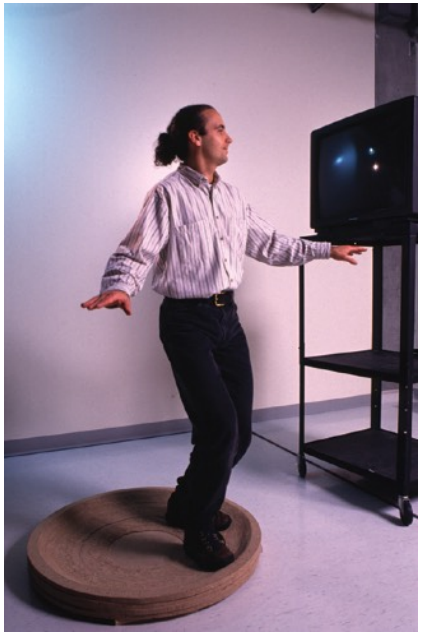


Figure 8.7 Virtual Motion Controller. (Photograph courtesy of HIT Lab, University of Washington)

Figure 8.6 Three types of walking-in-place gestures: (a) marching by raising the thighs to lift each foot; (b) wiping by bending the knees to move each foot backward; (c) tapping by lifting the heels while keeping the toes on the ground. (Image adapted from Nilsson et al. 2013)

Walking Metaphors: Gait Negation

- Wide variety have been build
  - treadmills
  - passive omnidirectional treadmills
  - active omnidirectional treadmills
  - low-friction surfaces
  - step-based devices

Figure 8.8 The Virtusphere, a human-sized "hamster ball," is an example of a passive omnidirectional treadmill. (Image courtesy of Mahdi Nabiyouni)

Figure 8.9 A low-friction surface for virtual locomotion in HWD-based VR. (Image courtesy of Virtuix)

Steering Metaphors

- Spatial Steering
  - gaze-directed steering
  - hand-directed steering (pointing)
  - torso-directed steering
  - lean-directed steering
- Gaze-Directed Steering, Hand-Directed Steering (Pointing), Torso-Directed Steering, Lean-Directed Steering
- Steering with props
  - Bikes, cockpits, etc

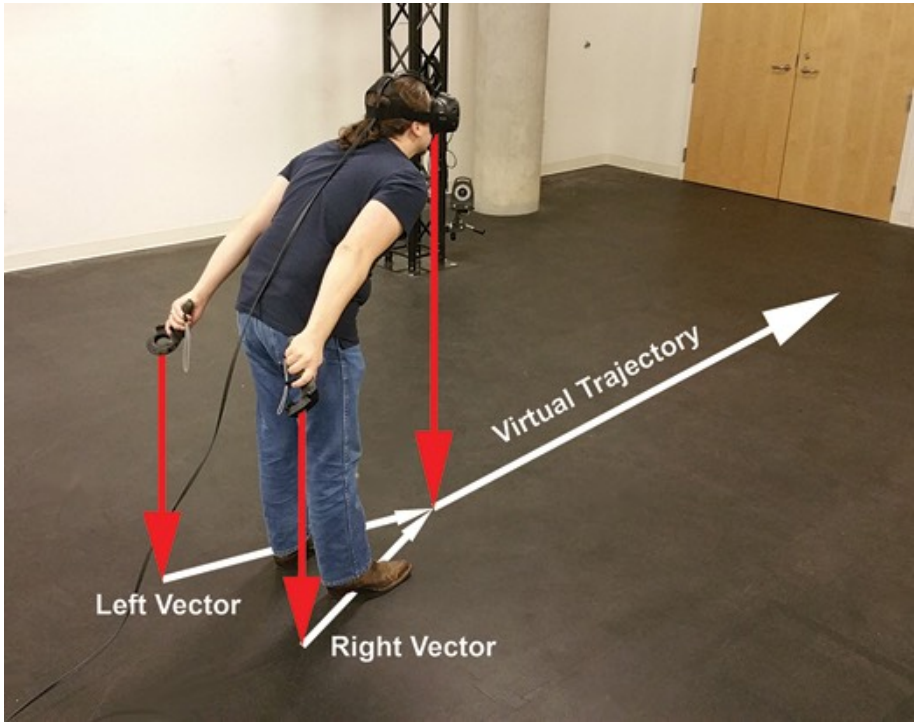


Figure 8.11 PenguFly is a lean-directed steering technique that defines travel direction as the vector created by adding the two vectors created from the hands to the head. The length of this vector also defines the velocity of travel. (Image adapted from von Kapri et al. 2011)

Selection-Based Travel Metaphors

- Various approaches to selecting where to move, and how to traverse the path
  - Maps, etc
  - Routes via paths

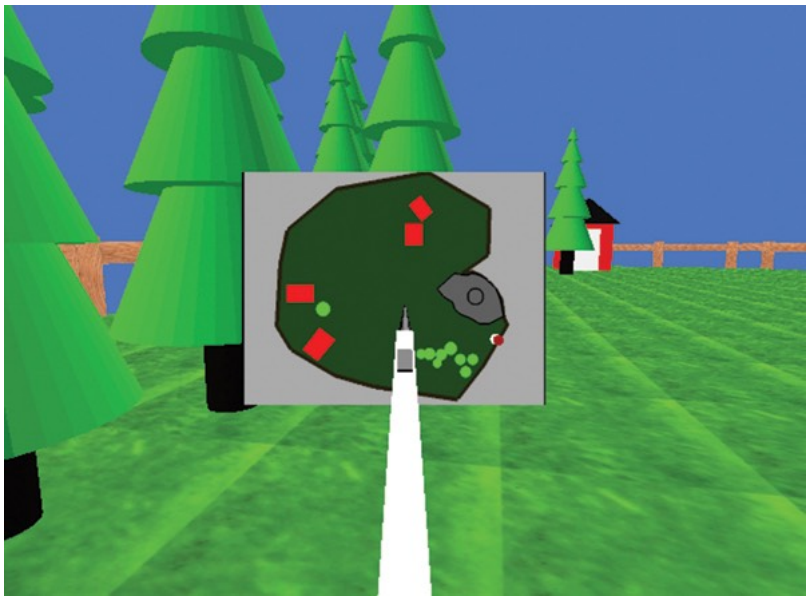
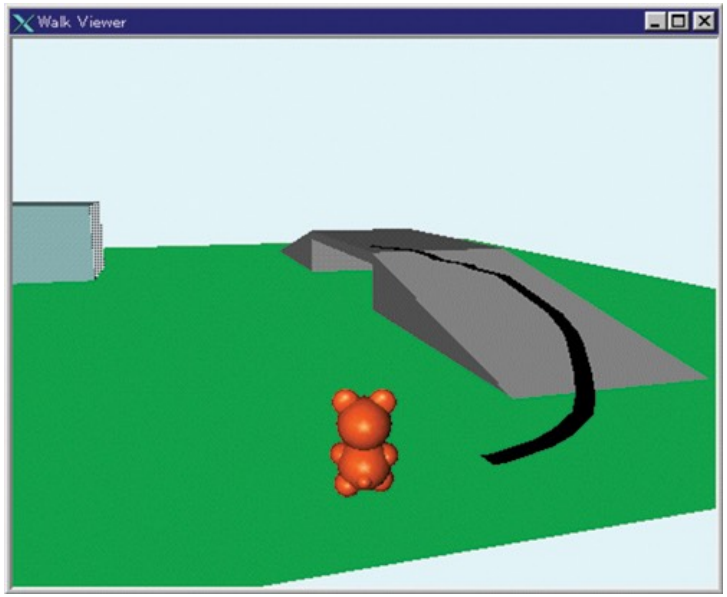


Figure 8.13 Map-based target specification. The darker dot on the lower right of the map indicates the user's current position and can be dragged to a new location on the map to specify a travel target in the full-scale environment. (Bowman, Johnson et al. 1999; reprinted by permission of MIT Press and *Presence: Teleoperators and Virtual Environments*)



8.14 Path-drawing system. (Igarashi et al. 1998, © 1998 ACM; reprinted by permission)

Manipulation-Based Travel Metaphors

- Many ways to indirectly control travel by manipulating elements of the world
  - Talked about Gleicher's "Through the Lens Camera Control" previously
- Many more variations
  - Camera control
  - Indirect Avatar Manipulation
  - Manipulate view via acting on objects

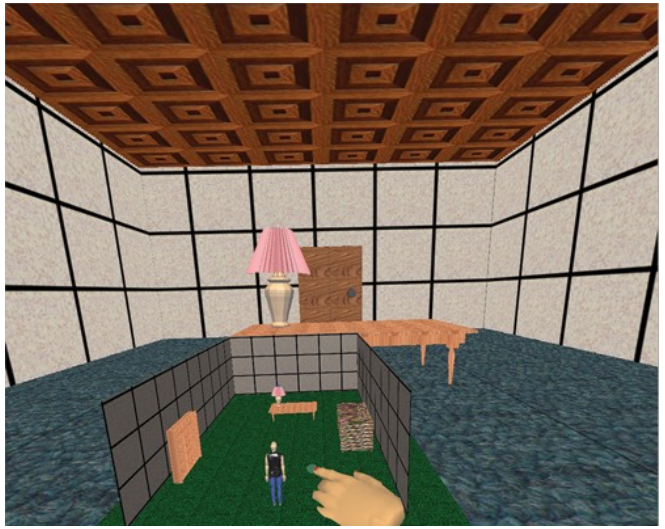


Figure 8.17 WIM (in foreground) held in front of the corresponding full-scale environment. The user icon is at the bottom of the image. (Image courtesy of Doug A. Bowman)

- Book goes into a whole range of variations and then discussion other aspects of travel techniques you should think about
  - Lots of good stuff here. Read it!

Wayfinding in 3D Environments

- Wayfinding cues from human perception (User-Centered)
  - field of view, motion cues, multisensory output
  - presence
  - search strategies
- Environment-Centered Cues
  - environment legibility
  - maps, compasses, signs, trails, reference objects
  - landmarks