Interaction with Combinations of Maps and Images for Pedestrian Navigation and Virtual Exploration

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Combining Maps and Images

- Maps and images/photographs complement each other
  - **Maps**
    - Brief overview at the cost of mental effort
    - **Context** of route for navigation
  - **Images**
    - Detailed representations of the real world
    - **Focus** on single navigation step
- Studies have shown advantages of **combinations of maps and images** for **pedestrian navigation**
- **Natural and intuitive interaction** supporting the user to utilize the additional value is required
  - **Virtual exploration** of real environments **should benefit**
Pitch Gesture

- Spatially-aware Displays (Fitzmaurice, 1993)
  - **Eye-in-hand** metaphor
  - **Bridge** between the information spaces and physical objects

- **Pitch gesture** to switch between map and images
  - Maps represent space from a bird‘s-eye view
  - Images use a human‘s-eye view
Peephole Interaction

- Peephole displays (Yee, 2003)
  - Extension of spatially-aware displays
  - **Positional mapping** between virtual space and real world
  - **Space around the user is augmented** with information
  - Peepholes enable the use of spatial memory

- **Dynamic peepholes vs. static peepholes** (Mehra et al., 2006)
  - **Dynamic peepholes** are moved to browse a **static information space** behind it
  - Behind a **static peephole** a **dynamic information space** is moved
Combining Pitch and Peephole

- Situating geotagged images on top of a map allows a **combination of the pitch gesture and peephole displays**

- **Before** evaluating **combinations**, the **pitch gesture and peephole interaction** have to be investigated **separately**
Image-based Navigation (for Pedestrians)
Peephole Interaction with Panoramas for Navigation

- **Turn-by-turn navigation** with panoramic images
- **Spherical panoramas**
  - Static peephole realised using touch
  - Dynamic peephole based on digital compass
  - Simple photos are simulated by locking the view
- **Arrows** providing navigation instructions
  - Dynamically rendered
    - Based on the user’s current view
    - Always visible
  - Require **images taken at waypoints**
- Shows images when the user approaches a waypoint
- **Notifies** the user by **sound** and **vibration**
Evaluation together with Tim Nulpa

- **Static and dynamic peepholes** against
  - each other
  - simple photographs
- Results
  - Both *peephole interfaces performed better* than simple photographs
  - *Dynamic Peephole* causes a negative *feeling of being other directed*

Evaluation together with Darya Davydenkova

- Dynamic peephole against **hybrid peepholes**
  - **Double mode**: double tap to switch between peepholes
  - **Discrete compass**: double tap to orient the panorama once
- Results (based on the thesis)
  - None of the interfaces outperformed the others
  - Most of the users prefer the **double mode**, followed by the discrete compass
Results of existing studies on **compass-based map rotation** are mixed
- Different map styles (sketch map vs. street map)
- Different environments/situations (indoor vs. outdoor)

**Custom rendering style** for pedestrian navigation by Norman Wessel
- Entities selected based on existing systems
- German colour scheme

Evaluation together with Norman Wessel
- **Semi-automatic rotation** against
  - North-up/physical rotation
  - Automatic rotation
- Results (based on the thesis)
  - None outperformed the other regarding time and error
  - **Automatic rotation was rated best** in questionnaires
Pitch for Switching between Map and Image View

- Navigation for pedestrians with maps and images
  - Map style used in the previous evaluation
- Prototype almost finished
- Challenges
  - Occlusion of maps and images
  - **Media disruption**
- Evaluation in planning phase
  - **Discrete** and **continuous** pitch gesture against
    - Each other
    - Manual button-based switching
  - **Automatic rotation**/dynamic peephole
Virtual Exploration
(of Real Environments)
Virtual exploration of combinations of maps and geotagged images

Well-known interaction metaphors

Different meaning of touch dependent on the current view

- **Map view**: Touching the screen results in translation
- **Image view**: Touching the screen results in rotation

Evaluation

- **Discrete** and **continuous** pitch gesture against
  - Each other
  - Manual button-based switching
- Done but not analysed in detail
  - Users did understand the different meaning
  - Seemed to like the gesture more than buttons
Extension of the pitch gesture prototype for translation and rotation in both the map and the image view

**Single-touch**
- Target dragging for translation in image view
- Compass needle for rotation in map view

**Multi-touch**
- Two-finger drag gesture for translation in image view
- Two-finger rotate gesture for rotation in map view

Prototype implemented

Evaluation in planning phase
- Discrete, continuous or both pitch gestures?
- Real/existing or abstract/artificial environment?
Pitch gesture to switch between

- Two perspectives
  - Top-down view
  - Third-person view

- Two input modes using touch zones
  - Translation
  - Rotation

Simple **ball-through-labyrinth** game

- Ball moves forward continuously
- **Obstacles** require both views and input modes

- Upcoming thesis including evaluation (Daniel Böhrs)
What am I really working on?

- **Mobile 3D interaction/Spatial input** (Hinckley et al., 1994)
  - In both cases of pedestrian navigation and virtual exploration the **user controls a viewpoint/viewport in a virtual environment**
  - Pedestrian Navigation is a special case!?
    - **Input channel positioning system** (e.g. GPS)
    - User interacts with the system by walking
  - Maps and Images are simplification!?
    - **Two discrete views**
  - Last evaluation in **complex 3D environments**
    - Based on the **results of the evaluations** on
      - Pitch gesture
      - Peephole interfaces
      - Touch interaction
Mobile Interaction for Navigation in Real and Virtual Environments

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Thank You! Questions?

