Using split screens to combine maps and images for pedestrian navigation

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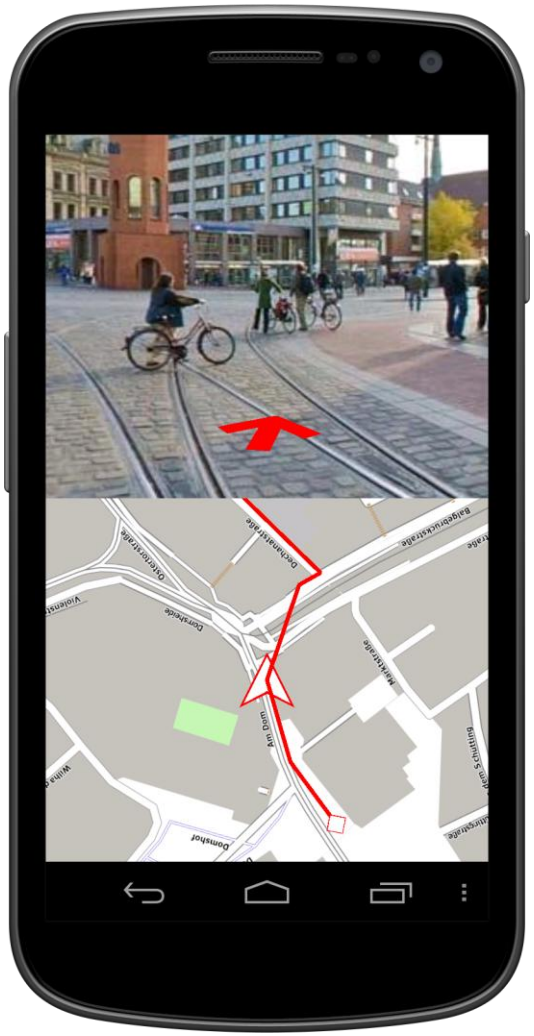
Motivation and Approach

- Studies have shown **advantages of map-image combinations**
  - Map view **automatically replaced** with image view (Chittaro and Burigat 2005)
  - **Manual switching** between views (Beeharee and Steed 2006)
- **Split screen** to display **maps and images at the same time**
  - **No active interaction**, only gaze switching
  - Overstraining amount of information?
- Interaction prototypes
  - **Simple photographs** and **panoramic images**



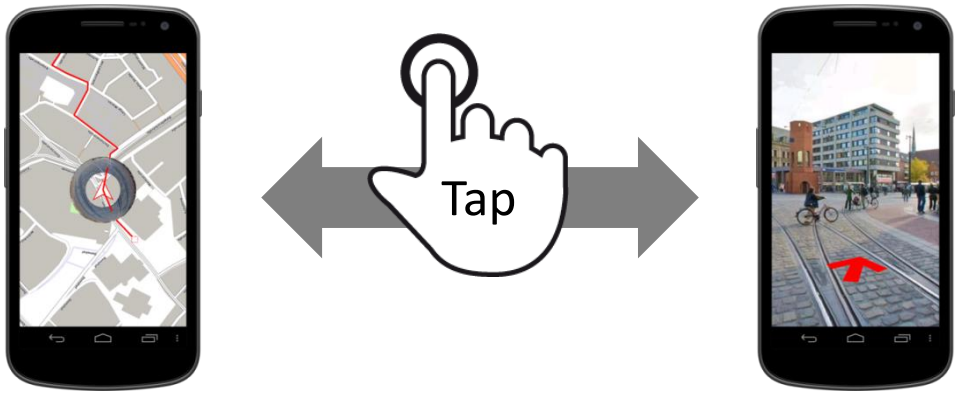
Split Screen: Simple Photographs

Split Screen: Panoramic Images

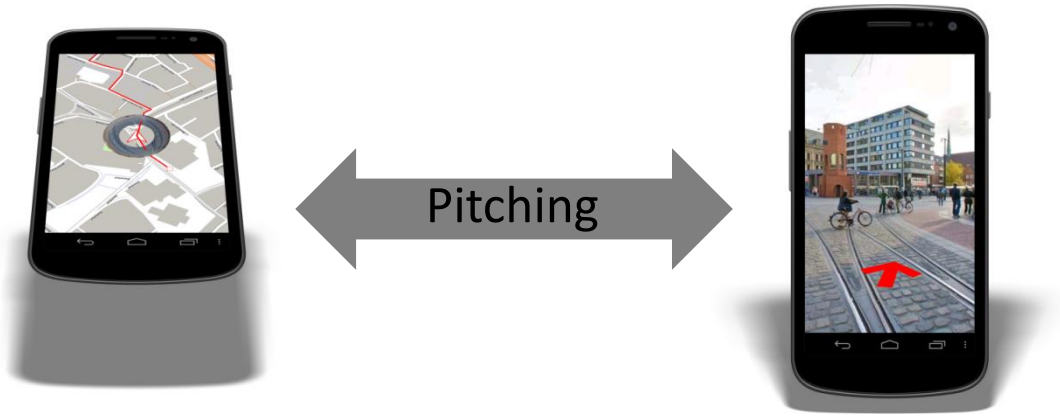
Alternating View: Manual Switching

Pre-study of Manual Switching (Baseline)

Touch interaction



Physical gesture



- Is touch or physical gesture better **suited for switching views**?

Pre-study of Manual Switching

- **Field study**
  - **Within-subjects** design
  - Counterbalanced interfaces and route sections
- Route
  - Inner city of Bremen
  - **550m (section A)** and **570m (section B)**
- Participants
  - **16 volunteers** (10 female, 6 male)
  - Aged between 17 and 54 years

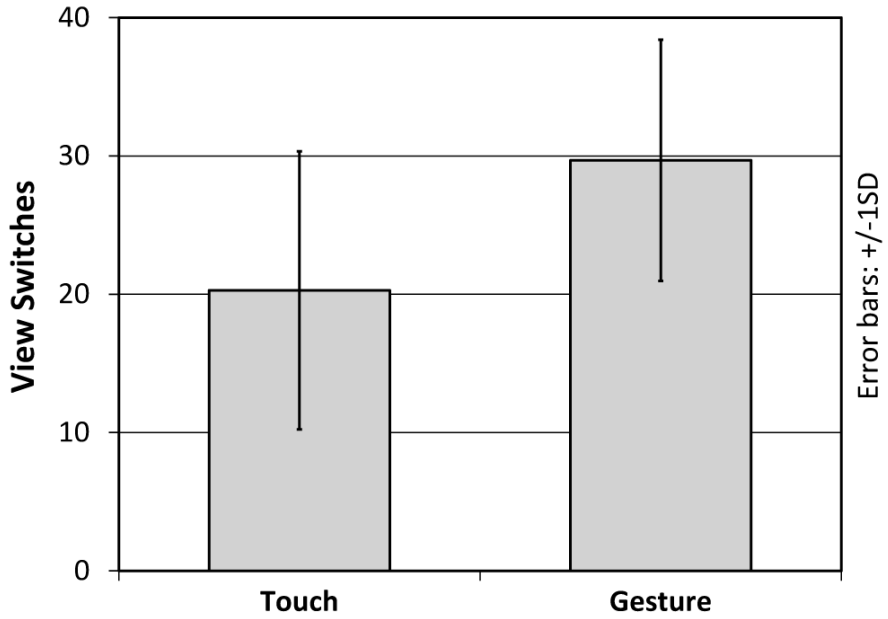
Route Section A

Results

- No differences in time (mean: touch 6:40 min, gesture 6:46 min)
- Less navigation errors with gesture (accumulated: **touch 6**, **gesture 1**)
  - **Difference statistically not significant**
- Higher perceived usability for gesture in questionnaire
  - System Usability Scale, SUS (mean scores: **touch 81.7**, **gesture 91.4**)
  - **Not significant**
- **Physical gesture preferred** by most of the users
  - **11 of 16 participants prefer the gesture**
  - More simple and more intuitive

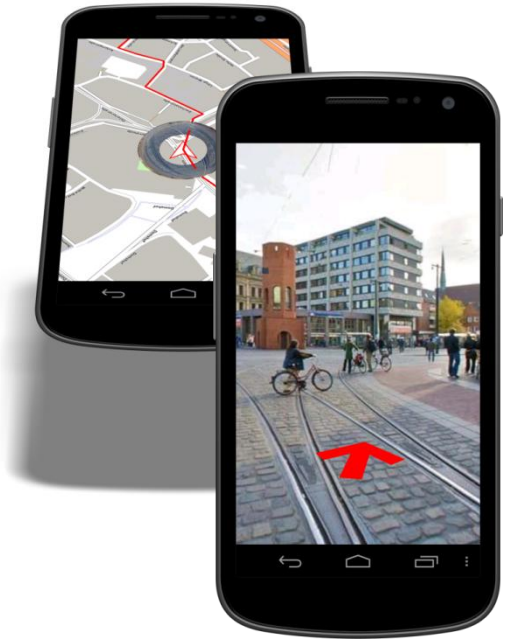
Results

- View usage (map view/image view)
  - **View switches higher for gesture (mean: touch 20.3, gesture 29.7)**
    - Difference significant
  - **Potentially** less navigation errors because of more view switches

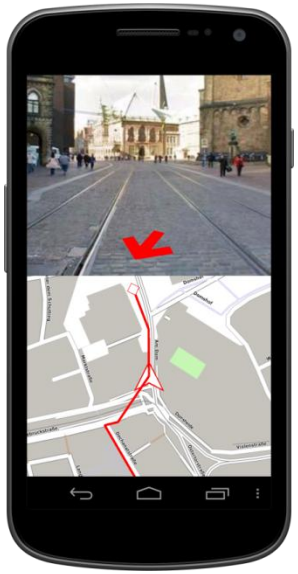


Main Study

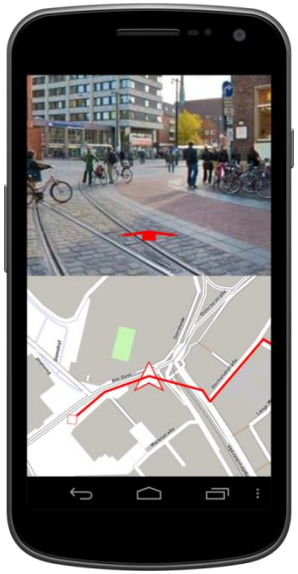
- Is manual switching or a split screen **better suited**?
- Do **panoramic photos** offer any benefits over **simple photographs**?



Manual switching
(pitch gesture)



Split screen
(panoramas)



Split screen
(simple photos)

Main Study

- **Field study**
  - **Within-subjects** design
  - Counterbalanced interfaces and route sections
- Route
  - Both sections used in pre-study
  - Additional section: **550m (section C)**
- Participants
  - **18 volunteers** (13 female, 5 male)
  - Aged between 17 and 61 years
  - Each gained 10€ expense allowance

Route Section C

Results

- Marginally differences in time
- **Few errors in all conditions** (accumulated)
  - Manual switching: 6
  - Panorama-based split screen: 4
  - Split screen with simple photos: 7
- Higher perceived usability for panorama systems (mean SUS scores)
  - Manual switching: 80.4
  - Panorama-based split screen: 81.5
  - Split screen with simple photos: 68.6
  - **Not significant**

Results

- **Attitude** towards the systems **better for panorama-based prototypes**
  - 4 questions from Unified Theory of Acceptance and Use of Technology
  - Significant between manual switching and simple photos
- **16 of 18 participants prefer panorama-based system**
  - 11 prefer manual switching
  - 5 prefer the panorama-based split screen
- General observations
  - All participants were looking at the device again and again
  - **Distracted from the environment**
  - One participant **overlooked a tram** (stopped by the supervisor)

Conclusion

- Pre-study: Manual switching
  - **Physical gesture preferred** by most of the users
- Main study: Split screens
  - None of the interfaces clearly outperformed the others
  - Results indicate **advantages of panorama-based navigation**

- Future work
  - Improve **safety** (e.g. notify the users of trams)
  - Investigate **spatial knowledge** acquisition

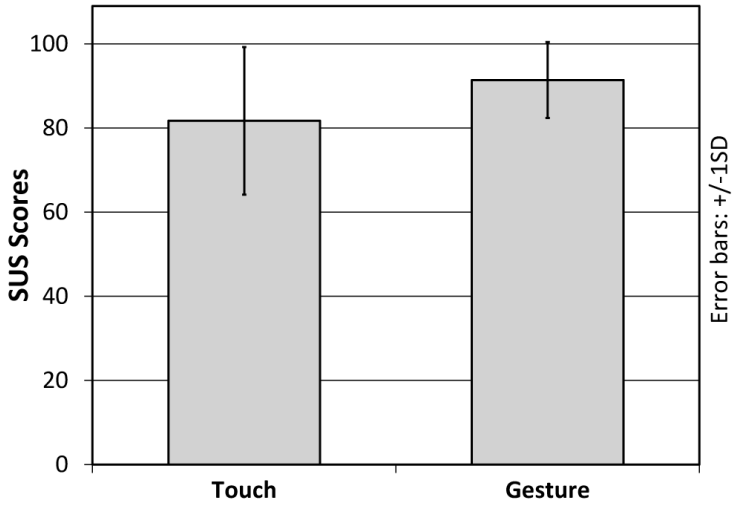
Thank You! Questions?

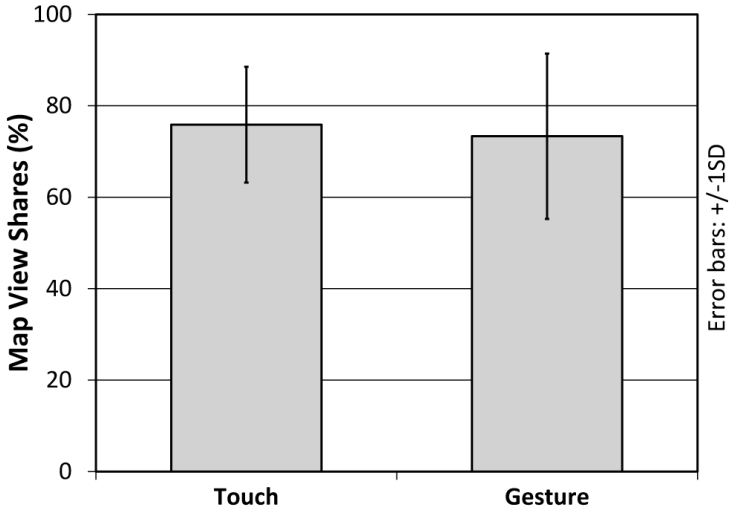
References

- Beeharee, A. K., and A. Steed. 2006. “A Natural Wayfinding: Exploiting Photos in Pedestrian Navigation Systems.” In Proceedings of the MobileHCI ’06, 81–88. New York: ACM.
- Brooke, J. 1996. “SUS: A Quick and Dirty Usability Scale.” In Usability Evaluation in Industry, edited by P. W. Jordan, B. Thomas, B. A. Weerdmeester, and A. L. McClelland. London: Taylor & Francis.
- Chittaro, L., and S. Burigat. 2005. “Augmenting Audio Messages with Visual Directions in Mobile Guides: an Evaluation of Three Approaches.” In Proceedings of the MobileHCI ’05, 107–114. New York: ACM.
- Venkatesh, V., M. G. Morris, G. B. Davis, and F. D. Davis. 2003. “User Acceptance of Information Technology: Toward a Unified View.” MIS Quarterly 27 (3): 425–478.

Results

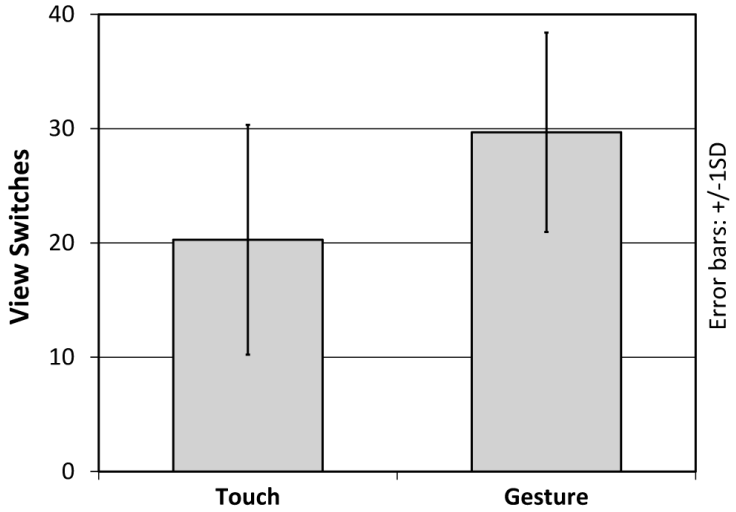
- Time (mean) & errors (accumulated)
  - Touch: 6:40 min (5 errors)
  - Gesture: 6:46 min (1 error)
  - **Differences statistically not significant**
- System Usability Scale (SUS)
  - Touch: 81.7
  - Gesture: 91.4
  - **Difference not significant**
- **Map view shares**
  - Touch: 75.8 %
  - Gesture: 73.4 %





Results

- View switches
  - **Touch: 20.3**
  - **Gesture: 29.7**
  - Difference statistically significant



- Interview and ranking
  - **11 of 16 participants preferred the gesture**
  - More simple and more intuitive

- Conclusion
  - **Physical gesture preferred** by most of the users
  - **Potentially** less errors because of more view switches

Results

- Time
  - All runs between 5:13 min and 9:12 min
  - **No statistically significant differences**
- Errors (accumulated)
  - Manual switching: 6
  - Panorama-based split screen: 4
  - Split screen with simple photos: 7
- System Usability Scale (SUS)
  - Manual switching: 80.4
  - Panorama-based split screen: 81.5
  - **Split screen with simple photos: 68.6**