Gaze Analysis in Mobile Pedestrian Navigation: Socio-Cultural Aspects and Wayfinding

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1 Introduction

Using augmented reality is recognized as a suitable alternative to map-based interfaces for mobile pedestrian navigation, as it provides route instructions directly into the real visual context of the user [1].

The analysis of the concrete orientation behavior of using the phone, of paying attention to the immediate environment and the navigation landmarks has been of minor interest so far. However, researching the impact of socio-cultural aspects on wayfinding styles requires detailed information about the user's focus of attention, its preference for information types associated with particular affordances and environments, and continuous measurements about the user interaction, across extended periods of time.

An exploratory analysis of gaze behavior was conducted to identify point-of-regards (POR) on predefined areas of interest (AOI) within the smartphone display and towards the environment. To acquire video and eye movement data, SMI Eye Tracking Glasses were used, with 30 Hz sampling rate of gaze information and 1280 x 960 pixels scene camera (Figure 1). A screencast video of the navigation app was recorded and synchronized with the eye tracking data. For the post-processing of the gaze data, the smartphone eye tracking (SMET) system [2] was applied, which was demonstrated to be feasible for large scale studies [4].

2 Mobile eye tracking study

Navigation modes. In an outdoor study, gaze movements were recorded to investigate participants´ gaze during a wayfinding task on a predefined route on the campus at University Hospital Graz, Austria (Figure 1). A mobile navigation tool was used providing two alternative presentation modes on the smartphone (Figure

Published at SAGA Workshop 2015, proceedings archived under DOI: 10.2390/biecoll-saga2015_0.
Individual article archived under DOI: 10.2390/biecoll-saga2015_14

2a) to indicate the recommended route: (1) a two-dimensional map based view (MAP) and (2) an augmented reality-supported view (AR).

Data capture. The SMET system [2] enables fully automated analysis of attention in user studies and showed highly accurate POR mappings on smartphone displays. Figure 2b shows the automated smartphone localization on a sample video frame from the eye tracking scene camera. Synchronization and image analysis provide a correlated data stream of smartphone events, geometric transformations and heat-mapping for further attention analysis. For the analysis of the gaze patterns we investigated content-dependent AOI assignments (Figure 2**Fehler! Verweisquelle konnte nicht gefunden werden.**b) including the two interface elements on the smartphone (MAP, AR) as well as gaze into the physical surrounding (SUR).

Study. In total 20 women participated in the study, including 10 immigrants from Turkey and 10 local citizens from Graz, Austria. Among the Turkish participants the average duration of stay in Graz was 8.55 ±5.43[1] years. The age of the participants was 28.3 ±6.5 (Turkish) and 28.3 ±6.5 years (Austrian). All participants had experience with smartphones and were familiar with the overall area; they all had previously visited the hospital. Turkish participants reported to be less experienced with maps.

The objective of the study was to investigate whether there are principal differences between the viewing behaviors of the two participant groups, in the context of using a mobile interface for navigation, in particular, in the usage of map or augmented reality based services for wayfinding.

3 Results

Figure 3 shows the average count of PORs with respect to the selected AOIs, i.e., AOIs of the augmented reality mode (AR), the map mode (MAP) and the spatial surrounding (SUR).

Analysis revealed that the Austrian participants preferred to look on the MAP than on the AR display region whereas Turkish users looked on average more often on the AR view than on the MAP. Results indicate a tendency in the context of the users' socio-cultural background on the amount of PORs regarding the functional use of the MAP and SUR views, respectively.

Consequently, the findings drawn from eye tracking data as well as from qualitative feedback were capable to reveal that there exist relevant differences in the interface preferences of the Turkish users in the study in contrast to behaviors of the native Austrian participants. Future work will investigate the attention processes in more depth and in the context of the socio-cultural variables, for example, whether the social (immigrants vs. permanent citizen) or the cultural back-

[1] *Note: M ±S with M (=mean) and S (=standard deviation)*

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ground (Turkish vs. Austrian) of the users definitely impacts the wayfinding and the tool use in mobile navigation.

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(a) (b)

Figure 1. Eye tracking glasses used by (a) local and (b) immigrant users.

(a) (b)

Figure 2. Navigation app: (a) AR (left) and MAP (right) presentation modes, (b) view from eye tracking scene camera with automated gaze recovery (green dot) [2].

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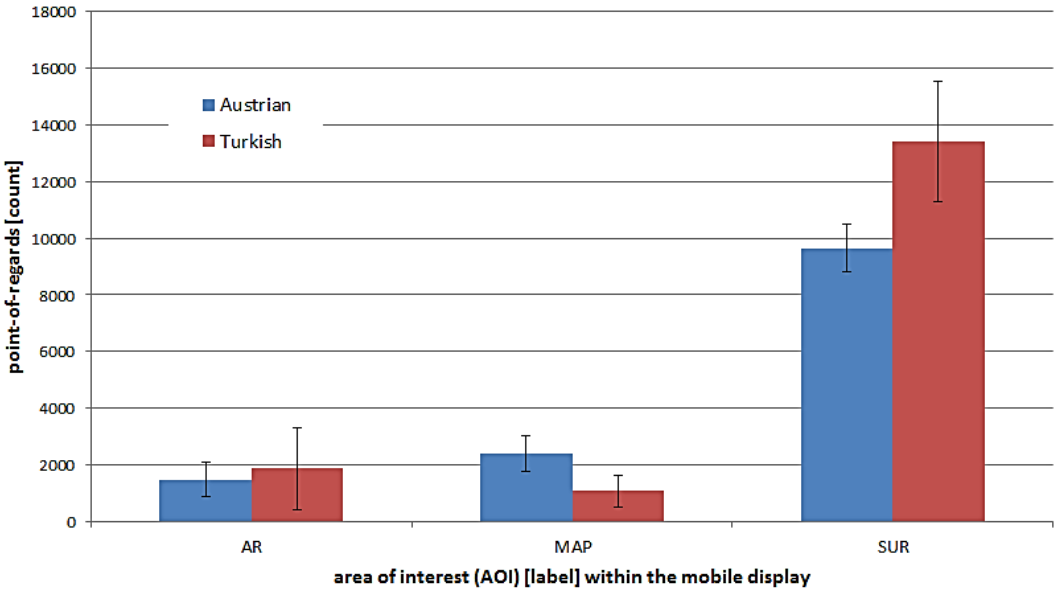

Figure 3. Average gaze count on areas-of-interest (AR-augmented reality, MAP-map, SUR-surrounding) with respect to the mobile display by Austrian (blue) and Turkish immigrant (red) participants. The error bars indicate the 95% confidence intervals. Austrian participants clearly preferred to look at the map based information than on the augmented reality interface component. Turkish participants focused more on the surrounding than Austrian participants and looked on average more on intuitive navigation information (AR) than on the map based information display.

Acknowledgments

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement No. 288587 (MASELTOV) as well as from the Austrian Research Promotion Agency (FFG) under contract No. 832045 (FACTS).

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