Understanding Spatial Mobile Service Discovery using Pointing and Touching

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Abstract
The increasing availability of mobile services makes mobile service discovery difficult. New mobile interaction techniques like point and touch have the potential to simplify this task. Regarding these spatial interaction methods we conducted a study to examine where users expect mobile services and what service they anticipate.

Keywords
Point, touch, mobile service, discovery, interaction techniques, spatial.

ACM Classification Keywords
H.5.2. [Information Systems]: User Interfaces – *Interaction styles;*

Introduction
Recent years showed a continuing growth in mobile services. However, according to Garzonis and O'Neill [4] current limitations of mobile devices hinder the process of service discovery. Their study showed that mobile services remain unused by the majority of mobile phone users due to difficulties with mobile service discovery. They suggest context aware systems to improve service discovery.

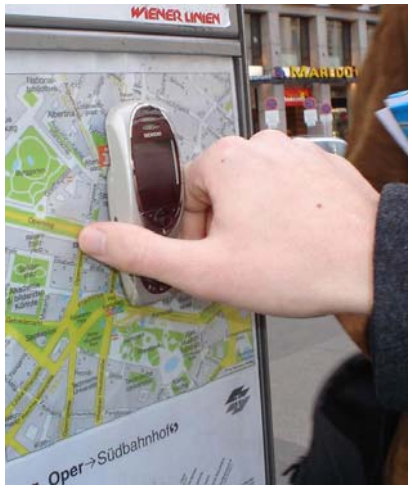

Figure 1. Touching a map

Figure 2. Pointing at subway sign

Egenhofer [2] states that geographic information systems (GISs) will be superseded by spatial information appliances (SIAs). SIAs will be portable and tailored to specific tasks. Considering the direction of the development of mobile phones a mergence of these two technologies seems likely.

As the most important conceptual possibility of SIA usage, Fröhlich et al. [3] define accessing information or services attached to physical objects (points of interest - POI). They identified four perspectives a user can take when accessing SIAs and conducted a study on how to best deliver information to the user. They concluded that users really appreciate the ability to access geo-spatial information using mobile devices and that pointing to objects was attractive to the users.

Välkkynen [7] identified three physical mobile interaction techniques, pointing, touching, and scanning. An experimental comparison [6] showed that users prefer pointing to the other interaction techniques. Only if the POI is close enough they would use touch.

As these interaction techniques are new, an adequate iconography does not exist yet. Arnall [1] proposed a graphic language for touch-based interaction, where a circle surrounded by a dashed line communicates the near-field nature of technology. Additionally, Välkkynen [8] provided suggestions for the visualization of physical hyperlinks.

Motivation and Goal

In the near future many objects in our environment will be intelligent. In order to communicate with them, pointing and touching are the preferred interaction techniques. This way, users can easily discover mobile services. For designers of services that utilize pointing and touching for discovery it is important to know where users expect which service. Hence, our first goal is to gather data on POIs and expected mobile services. Because current design concepts like the graphic language for touch interaction [1] are not based on empirical data our second goal is to evaluate current design practice.

User Study

According to our first goal we designed an experiment with two urban scenarios. One was close to a tram and subway station and participants had to imagine that they were on their way to work. The other was a sightseeing scenario in the city center. We selected 10 participants (4 female), aged between 20 and 26 years. For each scenario participants had to walk through the area and suggest potential services and POI by spatial pointing or touching respectively. Afterwards we presented them a list of common classes of actions (derived from [8]). According to this list again they had to suggest additional services and map already found services to a common class of action. Scenarios were counterbalanced and each session lasted about one and a half hour.

In total we received 208 services and POIs. After omitting duplicates and services that concerned scan or location-based interaction we had 69 potentially interesting services for spatial point and touch interaction left. For pictures taken during the study see Figure 1-4.

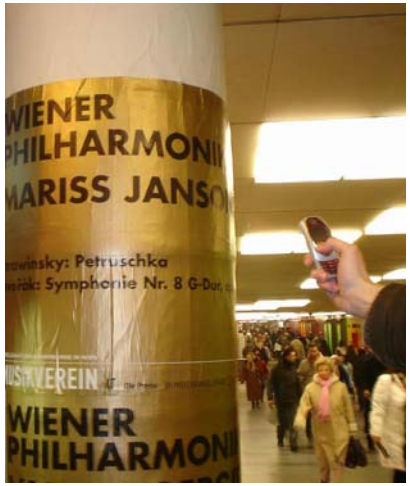

Figure 3. Pointing at a concert poster

Figure 4. Pointing at a star on the „walk of fame“

Where do users expect services?
Results in the user study clearly show that users expect services at existing POIs. They want existing information to be augmented with digital services and accessing them by pointing or touching. For example, if they wanted to know more detailed information about a certain shop, they pointed to the shop entry, because usually opening hours and contact information are located on the front door. We concluded that the knowledge of existing information is important for service discovery.

Further examples for POIs that already provide analog information are poster advertisements, bus schedules, menus in front of restaurants, etc. Participants also expected services behind logos or signs (shop signs, hotel signs, subway signs, bus stop pillars etc.). Certain services included pointing at a building, the floor or an external device like a vending machine or public displays. Pointing on people was also raised by one participant.

Which services do users want?
Analysis of our data showed that we received services for all but one common classes of action. The most prominent category was downloading content, which included information retrieval. Users were very interested in receiving additional information of various spots (e.g. sights) or places (e.g. bars and restaurants). They further wanted to store information for future use (e.g. wish lists for products). Some services used previously saved content to supply the user with contextual information (e.g. displaying previously downloaded information about a sight when pointing at it). Users also expressed the desire for leaving messages or other content at spatial places for others or later use.

Ticketing and payment (e.g. purchasing a ticket for an event presented on an advertisement), making a phone call (e.g. calling a hotline to receive detailed information about an event presented on an advertisement) and setting the phone state (e.g. putting the phone into silent mode by pointing at a specific sign) were other services that users repeatedly mentioned.

Some services were location independent. Participants expected e.g. a translation service of any text placed in the environment or getting Wikipedia information on any objects they pointed on.

Do users prefer point or touch interaction?
In an informal interview after the tests, participants stated that they preferred point interaction. They said that pointing was faster since the interaction could be invoked from far away. Furthermore, participants expressed their worries about placing their mobile phone onto surfaces that might be dirty or unhygienic. Results also indicated that subjects felt more secure using touch interaction. This complies with the results from other studies [3, 6].

User expectations on icon design
During the tests we asked participants what a possible icon for each service might look like. Overall, we received mainly suggestions for concrete and either direct or inferential icons [5]. Results further show that users expect to have similar icons for all services, in most cases consisting of an “i” for information. For some services participants assumed that the specific

meaning would be clear from the spatial position and context of the icon. For others they expressed the desire to have additional information attached to the icons.

Current Work

These results call for an additional experiment evaluating point and touch interaction in more detail. As suspected in the beginning a more detailed analysis of icons (or a sign language) placed in the environment is necessary. Furthermore, the question of accessibility and affordance addresses both point and touch interaction. Maybe users can identify services in a given context easily without additional cues.

We are currently building concrete scenarios and low-fi prototypes of point and touch services selected from our results. We have scheduled an evaluation to better understand mobile service discovery with pointing and touching.

Conclusion

This paper contributes results of a user study about expectations for service discovery using point and touch interaction. In general it is essential to provide cues in the environment, as users expect services to be related to them. These cues could be either places which already contain information, specific signs or symbols. Expected services include information retrieval, annotation, purchasing, ticketing, and location independent services.

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