Mobile Spatial Interaction and Mediated Social Navigation

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INTRODUCTION

The increasing ubiquity of location and context-aware mobile devices and applications, geographic information systems (GIS) and sophisticated 3D representations of the physical world accessible by lay users is enabling more people to use and manipulate information relevant to their current surroundings (Scharl & Tochtermann, 2007). The relationship between users, their current geographic location and their devices are summarised by the term "mobile spatial interaction" (MSI), and stands for the emerging opportunities and affordances that location sensitive and Internet capable devices provide to its users. The first major academic event which coined the term in its current usage was a workshop on MSI (see http://msi.ftw.at/) at the CHI 2007 (Fröhlich et al., 2007).

Mobile spatial interaction is grounded in a number of technologies that recently started to converge. First, the development of mobile networks and mobile Internet technologies enables people to request and exchange specific information from anywhere at anytime. Using their handheld devices people can, for example, check the latest news, request recent stock exchange values or communicate via mobile instant messaging. The second enabler is global positioning technology. Mobile devices with integrated Global Positioning System (GPS) receivers—soon to be joined by the Russian Global Navigation Satellite System (GLONASS) and the European Galileo system—are aware of their current latitude and longitude coordinates and can use this data as value added information for context-aware services, that is, mobile applications that refer to information relevant to the current location of the user. A possible use scenario for such an information request would be, for example, "find all clubs and pubs in a radius of 500 meters from my current position." The focus of this work is to enrich the opportunities given by such location aware services with selected Web 2.0 design paradigms (Beer & Burrows, 2007; Kolbitsch & Maurer, 2006) toward mobile social networking services that are bound to specific physical places. User participation, folksonomy and geotagging are three design methods that have become popular in Web 2.0 community-platforms and proven to be effective information management tools for various domains (Casey & Savastinuk, 2007; Courtney, 2007; Macgregor & McCulloch, 2006). Applying such a design approach for a mobile information system creates a new experience of collaboration between mobile users, a step toward what Jaokar refers to as the Mobile Web 2.0 (Jaokar & Fish, 2006), that is, a chance for mediated social navigation in physical spaces.

BACKGROUND

Applications based on mobile spatial interaction can be classified into four different categories (Fröhlich et al., 2007): 1) Systems that facilitate navigation and wayfinding in geographic places: This category is, for example, represented by car navigation systems that assist the driver, for example, with interactive maps, arrows or spoken instructions providing directions to the address of destination (Baus, Krüger, & Wahlster, 2002; Kray, Elting, Laakso, & Coors, 2003); 2) Mobile augmented reality applications such as the head-mounted display (HMD) of virtual information added to objects in the physical world, (Bruce, Piekarski, Hepworth, Gunther, & Demczuk, 1998; Piekarski & Bruce, 2002); 3) Applications creating; or 4) providing access to information that is attached to physical places or objects: For such applications, geotagging, a method to attach latitude and longitude identifiers, enables information resources such as text, pictures or videos to be put into a specific geographic context (Torniai, Battle, & Cayzer, 2005).

In categories 3 and 4, which represent the fields relevant to our work, most of the previous studies focus on techniques that allow people to create or access locative information and share their personal stories, thoughts, experiences and knowledge about specific places. Lancaster University's GUIDE project, for example, is an electronic tourist guide that provides users with context-aware information, depending on their profile, interests and location (Cheverst, Davies, Mitchell, Friday, & Efstratiou, 2000). On the other hand, GeoNotes (Espinoza et al., 2001) and Urban Tapestries (West, 2005) allow mobile users to not only read but

also create spatially contextualised content. They can attach virtual sticky notes to particular latitude and longitude coordinates. Equipped with Wi-Fi-enabled personal digital assistants (PDA), users can then see other users' notes that were left behind in their current immediate surroundings. E-graffiti, a context-aware application evaluated on a college campus, detects each participating student's location on the campus and displays notes that were left behind by other students (Burrell & Gay, 2002). Just-for-Us (Kjeldskov & Paay, 2005) helps a group of friends in a city to identify an appropriate place to meet depending on their individual current locations, and the George Square project (Brown et al., 2005) focuses on location, photography and voice sharing functions to let on-site and off-site users collaboratively explore a city sight.

Besides the various use scenarios, the applications primarily differ in the interaction design of specific features (Tungare, Burbey, & Perez-Quinones, 2006), for example, access virtual post-its from remote places (Espinoza et al., 2001; West, 2005) vs. in-situ access (Burrell & Gay, 2002; Rohs, 2005), push (Espinoza et al., 2001; Kjeldskov & Paay, 2005) vs. pull services, expiration dates of the messages or private vs. public messaging (Burrell & Gay, 2002; Espinoza et al., 2001). However, not much work has yet been carried out on studying different interaction techniques between the information provider and information consumer of geographically contextualised content. The focus of our work is on evaluating direct and indirect interaction methods, such as phone calls, text messages and whiteboard messages that can be described and retrieved via folksonomy tags.

MOBILE SPATIAL INTERACTION AS AN ENABLER FOR MEDIATED SOCIAL NAVIGATION IN PHYSICAL SPACES

Our physical world holds certain characteristics that enable us to interpret what other people have done, how they behaved and where they have travelled. Sometimes, we can see traces on physical objects that provide hints about people's actions in the past. Footprints on the ground left by previous walkers can show us the right way through a forest, or in a library, for example, dog-eared books with well-thumbed pages might be worthwhile reading, as they indicate the popularity of the text. The phenomenon of people making decisions about their actions based on what other people have done in the past or what other people have recommended doing, forms part of our everyday social navigation. The concept of social navigation describes the "moving towards a cluster of other people, or selecting objects because others have been examining them" (Dourish & Chalmers, 1994).

Social navigation in its classic sense is often restricted to visible traces that were intentionally or unintentionally left behind by earlier navigators, and indicate a former interaction between them and an object in the physical world. While some previous work use social navigation as a design concept to enhance navigation and wayfinding in virtual spaces such as Web browsing or online shopping (Dieberger, 1995, 1997; Dieberger, Dourish, Höök, Resnick, & Wexelblat, 2000; Dourish & Chalmers, 1994; Erickson & Kellogg, 2000; Forsberg, Höök, & Svensson, 1998; Höök, Benyon, & Munro, 2003; Svensson, 2002; Svensson, Höök, & Cöster, 2005), a different approach is to leverage multimedia and virtual information spaces to enhance social navigation in the physical world, which we refer to as "mediated social navigation." The technical infrastructure comprising mobile Internet and global positioning systems paves the way for mediated social navigation using mobile phones. They enable users to add multimedia content to physical places or objects and overlay the real world with a virtual information space that can then be requested by mobile users (Burrell & Gay, 2002; Jaokar & Fish, 2006), and more specifically, create a mediated social environment. Such applications not only provide hints about what somebody has done at a specific place, but he or she can document this with text, photos, audio and video recordings. Such an infrastructure based on user generated content makes use of mediated social navigation to enable mobile users to effectively exchange local knowledge (Foth, Odendaal, & Hearn, 2007).

In our study, we explored the appropriateness of principles that guide the design of a mobile phone application to support social navigation in physical environments (Bilandzic & Foth, 2007a). Targeting the specific domain of public inner-city places, we have designed "CityFlocks," a mobile system enabling urban residents to leave digital annotations with ratings, recommendations or comments on any place or physical object in the city. Thus, CityFlocks turns residents into in-situ amateur journalists for the benefit of visitors or other residents who have questions or need navigational aid related to any place in the city. Furthermore, it provides two interaction alternatives to let people collectively share information about places in their city or neighbourhoods, one following a direct and the other an indirect social navigation approach (Dieberger, 2003; Svensson, 2002). The direct social navigation feature enables information seekers to set up a direct voice link with a local resident who has agreed to voluntarily provide local information to visitors and other residents. The indirect approach produces a dynamic list of virtual, location-based messages, authored and rated by local residents that provide information about the respective place. In order to retrieve a virtual message or an appropriate voice-link partner, CityFlocks provides a built-in search function based on the folksonomy concept. Folksonomy is a user-generated taxonomy, initially applied to categorise and retrieve Web content such as Web pages or photographs, using open-ended labels called tags (Vander Wal, 2007). For every entry users submit, they can attach a number of