

Interactional Context for Mobile Applications

Kristijan Mihalic and Manfred Tscheligi

HCI & Usability Unit, ICT&S Center, University of Salzburg

kristijan.mihalic@sbg.ac.at, manfred.tscheligi@sbg.ac.at

Abstract

Mobility and ubiquity bring about an increasing engagement in the concept of context. Environmental context such as location or light have been studied for a while, however little research has been done on interactional context – context that evolves in the course of interaction. This paper presents results of an empirical study conducted in order to assess the interactional context. The empirical study is a major part of an ongoing research project, which is concerned with developing a context-of-use model for users' interaction with mobile devices. The paper discusses the findings, reports the results, and summarises the implications for future development. It argues that the interactional context plays a major role in mobile communication settings. It underpins the necessity for a socially grounded research approach as well as empirical evaluations in order to develop applications, which are unobtrusive and better support users in accomplishing their everyday tasks.

Keywords: Interaction, context, focus groups.

1. Introduction

The emergence of pervasive and ubiquitous computing introduces new forms of devices and novel ways of interaction. The goal is to create systems that are pervasively and unobtrusively embedded in the environment, completely connected, intuitive, effortlessly portable, and constantly available. Context of usage plays a major role in such environments. By improving the contextuality of computational devices the richness of communication in human-computer interaction is increased, thus providing added value services and reducing usability problems (Zetie 2003). In human communication, context is one of the essential components for describing communication processes. It plays an important role in interpersonal communication, both face-to-face as well as mediated (by e.g. mobile phones).

The overall goal of the context assessment is to develop a context-of-use model for user's interaction with mobile devices. Based on the model a prototypical application will be implemented. Evaluation of the application in everyday tasks is also essential. This article presents the results of the initial phase, which comprises the definition of potential users and the first iteration of scenario building in collaboration with potential users. The results of the study on people's expectations on interaction with and by means of mobile devices (cell phones, smart-phones, PDA's) are presented.

2. Related work

Several different approaches have been undertaken to define the notion of context in order to be able to encode and represent it. Context has been defined in terms of location and proximity of objects (Shilit and Theimer 1994), by providing synonyms (Rodden et.al 1998), or by identifying factors that constitute user's current context (Day and Abowd 1999).

The current research in context systems is concerned either with specific components of the context, or context under certain circumstances. A wide range of studies deals with location-aware systems (for example Dix et.al 2000). Further studies concentrate on particular environments and tasks – museums, libraries, event scheduling (for example Aittola et.al 2003). These approaches take into account what can be defined as environmental context. The environmental context is characterised by the information originating from the environment of the user. This is usually acquired using sensors – location, temperature, light etc.

Such environmental context has been studied for a while, however little research has been done on interactional context – context that evolves in the course of interaction. Interactional context is defined by the interaction of the user with information and communication devices or other users by the means of such devices. It is associated with actions and events concerning the user and the interaction, e.g. communication and interaction history, user preferences, user perceptions of actions, etc. The interactional problem of context arises when one wished to represent it in a system: such context is not static information, but rather constituted through the interaction, defined and sustained by the activity itself (Dourish 2003). It is very dynamic in nature, comprising a variety of social factors, like formality, privacy, familiarity with the environment, constraints of the situation, perceived warmth, etc. Given the fact that a major part of the context is generated through the social interaction, there exists only little empirically founded research on this topic. For example, Tamminen et al. (2003) describe characteristics of mobile context by observing people in their urban environments engaged in everyday activities. The emphasis lies on the correlation between the environmental context and the usage of mobile devices. In contrast, the primary focus of the research presented in this article, is the empirical foundation of a model for context, which is constituted by the interaction using a mobile device. Empirical assessment of various context factors, in particular user situations, is of paramount importance in order to gain valuable data on real usage.

3. Research Method

The overall development process of the context-of-use comprises:

- Requirements analysis in which the scenarios are built in collaboration with potential users,
- Development of a context-of-use model based on the above scenarios,
- Implementation of the prototypical application on a mobile device,
- Evaluation of the application – and thus of the context-of-use model – in everyday tasks.

Scenarios were chosen because they provide a method which can be used at different stages during the entire development process: envisioning future technologies, defining user requirements, describing how people will be using new systems, analyzing user tasks, prototyping and evaluating systems or prototypes. (Go and Carroll 2004) In addition, a participatory approach ensures the creation of scenarios with good coverage (Carroll 2000).

Scenario-based system design is suitable for gaining insights into how users will accept and work with future technologies. Scenarios are flexible because they can be expressed in various media and can be used in different phases of the development cycle. Thus, they represent the most suitable method for capturing interactional context, which cannot be easily measured otherwise. The evaluation of the system is conducted by carrying out the defined scenarios in an everyday situation, thus gaining results on interactional context in real-life usage.

4. Focus Groups

As the first iteration towards a context-of-use model, two groups of potential users were defined, namely students and field workers.

- Students were chosen based on the fact that they have different time-schedules, have to coordinate with their colleagues, and are mobile between the lectures.
- Field workers are involved in meetings with clients, are often en route, and have idle periods during the day.

The prerequisite for the participants was a daily usage of mobile communication devices (e.g. cell phones, smart-phones, etc). They were brought together in two focus groups consisting of 5 participants each, respectively. Each of the two focus group discussions was held separately. Students' focus group consisted of 4 female and 1 male subjects aged 20 to 23 ($M=21.8$, $SD=1.04$). Besides studying, most of them were also part-time or fully employed. Field workers' focus group comprised 1 female and 4 male participants aged 28 to 37 ($M=32.4$, $SD=2.88$). All subjects used mobile phones on a daily basis, of which two participants used up-to-date smart-phones, while the others used 2.5G cell phones.

The discussion involved topics such as describing how the usage of the mobile device looks like during a typical day, how they react when using the mobile in different situations (e.g. getting a call during a lecture), when they perceive something as obtrusive, etc. The results give insights into the importance of social roles and norms, impact of social relationships on the communication, preference of communication channels, impact on the call frequency, as well as situations with different communication potential.

Social roles and norms

In a given situation, we have a fairly clear idea of how others would expect us to behave. If we obey the norms, we are more likely to be accepted by others and the behaviour will be seen as appropriate. However, if we break the norms, we are risking of being rejected and our behaviour may be seen as odd or even hostile. These norms can be either general social norms, or cultural norms that apply to all members of a given culture (e.g. Japanese). They can also be group norms, which only apply to members of a specific group (e.g. teenagers). (Hartley 1993)

In addition to norms, social roles influence how and what we communicate. These roles can be vague and loose, in which case they will be negotiated during the communication process. For example, if you talk to someone you don't know well, the roles will not be defined a priori, but will rather emerge during the conversation. On the other hand, the roles can be very strong and determine how individuals behave (see, for example, Zimbardo's prison

experiment described in Hartley 1993). For example, roles between a boss and an employee strongly determine how and what is communicated.

The study has shown that norms and roles have an impact on how people use mobile phones in particular situations. For example, students would leave the lecture in some cases, in order to immediately call back their boss. They would not do this in case of a friend or a family member calling. Also they would not use SMS to communicate with the boss (see below). The social norms state that, being employees, students are expected to call their boss back as soon as possible. Thus, callers with stronger social role are perceived as more important and people behave according to the norms. While this holds in general, the social roles and norms are not the only factor: if the situation is perceived as less important (e.g. boring topic of the seminar), a higher importance is ascribed to the caller. Thus, the importance of the caller is dependant on both the situation as well as the caller.

Social relationships

Social relationship is the implication our behaviour has for our continued connection with other person or group of people. The relationship can be of different type, ranging from intimate to public. It can also be of distinct quality, e.g. close and informal as opposed to distant and formal. The relationship can be affected by a number of factors, including cultural differences, gender, social class, etc. (Hartley 1993)

Also, social relationships can be understood according to the dimensions of power and affiliation. Power refers to the status relationship of people involved and the ability of one side to influence the other. It may be connected to roles as mentioned before (e.g. boss-employee), but while roles remain static in the course of interaction, power is always shifting. We may use intelligence and persuasive influence in order to shift the power in our favour, although the role of an employee would ascribe more formal power to our boss. Affiliation refers to the emotional dimensions of relation, i.e. the degree of which you like and are drawn towards a person, or dislike and try to avoid the person. (Morreale et.al 2001)

The study confirmed that social relationships have direct implications on how people use mobile phones. Callers to whom the persons have close contacts are perceived as less important when it comes to availability. The participants stated two main reasons for this. First, family and close friends are expected to have a higher degree of understanding compared to others. And second, existing frequent direct contact does not require permanent mobile phone availability. As opposed to that, callers with a higher social status (e.g. boss) and thus more ascribed power are perceived as more important.

In addition, there are some special situations where social relationships play a role when it comes to the importance of calls. The participants stated that, if they receive numerous calls within a short time period, they would perceive the importance of the call as very high, for example because of some emergency. The exception to this is, if the calling person is known to be annoying.

Communication channels

A channel is the means by which a message is carried from one communication participant to another. There is a wide range of communication channels. Any of our five senses can

function as channels. In face-to-face communication we usually think of sound and sight as the most common channels. However, there are situations when we send and receive messages through channels of touch, smell, and taste. In many interactions, we use a combination of these channels, which give us a broader spectrum of stimuli, thus providing more understanding of the particular communication event. Communication channels also occur in forms other than our physiological senses, for example mass-mediated channels like television, radio, etc. Electronic channels allow communication via telephone, e-mail, instant messaging, etc. (McCroskey and Richmond 1996) However, electronic communication often does not allow rich combination of channels. For example, mobile phones only allow voice and text message communication, with emerging new services also enabling video-communication. Still, such communication is limited compared to face-to-face communication.

The study has shown that the selection of communication channels depends on several factors. For example, for business related issues, voice communication is preferred over SMS, whereas for private communication short messages are preferred. Thus, the choice of the channel is dependant on the content that is communicated. Also, the communication partners have an impact on the channels. For formal communication partners, for example clients or bosses, participants preferred voice channel. SMS was preferred for personal and intimate communication partners. The selection of channels is also dependent on the situation and often introduces what can be called 'channel switching': Communication that is initiated using one channel is continued using another channel because of the situation implications. For example, when getting a message during car driving, participants would switch the channel and call back the person, rather than replying using SMS.

Communication potentials and constraints

Part of our total reaction to a particular setting is based on our perception of confinement or constraint. The intensity with which we perceive an environment as constraining is also closely related to the space available to us, as well as the privacy of that space. Some situations are only temporarily constraining, for example a train ride. There are however extreme cases of constraints, like for example prisons. (Knapp 1996) In face-to-face communication settings, the constraints of communication participants are similar, differentiated only by the individual perception. In mobile phone communication, the communication partners may have completely different settings, since they are usually not co-located in the same environment.

The study has confirmed that different situations provide different potential for communication using a mobile phone. Field workers stated that they explicitly instructed their clients to call them during times they know they would be in a car or on a train ride. They perceived such time slots as idle. This side-stepping (Tamminen et.al 2003) is also constrained by the perceived privacy: car driving is far more private compared to a train ride. Students reported that they use messaging during boring lectures in order to fill in the time, since the situation does not allow them to leave easily. However, it is interesting that they preferred communicating via SMS over playing games: all of the student participants stated that they do not play mobile games in such situations. They also reported that they usually switch off the ringing during the lectures, while they do not do this if they meet with colleagues in a workgroup. The perceived level of constraint differs in private and public settings. They stated that they do not phone during lectures, in the cinemas, on the train,

during personal face-to-face conversation, and in public spaces where other people can hear them. Thus, situations with high communication potential include car driving and other times perceived as idle. Situations with low communication potential include formal meetings, or a train ride. Generally, public situations have a lower communication potential in contrast to private situations.

6. Implications for System Design

From the discussed findings several recommendations can be presented for the design of future systems.

- One can envision a device or a service that takes social norms and roles into account and adapts to this for the specific user. A cell phone could automatically choose an appropriate profile based on the caller: during a lecture, the profile for friends and family members would be “silent”, whereas for the boss, the profile would be “vibration”. This way, the phone would reflect particular social roles and norms.
- A mobile device could also reflect social relationships, thus providing a higher user experience to the user. For example, a cell phone could adapt the ring tone to the level of affiliation the user has towards the caller – it would play cheery and joyful tunes for friends, or a dull tune for parents-in-law.
- Respecting preferred communication channels of the user in the particular situation can further increase user’s experience. Thus, services should allow easy switching of channels, while preserving the communication chain, i.e. providing continuous communication history. This is particularly important for future applications, which use additional channels like video, instant messaging, e-mail, etc. It is imaginable that services may be able to transform a voice call to a text message for a particular user in a given situation. Technologies that support such application are already in place, e.g. VoiceXML (McGlashan et.al 2004).
- Taking into account potentials and constraints of the communication setting is also important. A service could detect idle times, and provide the user with messages or calls, which have been buffered or recorded previously during busy times. Calendar information has already been proposed to infer users’ activity (Khalil and Connelly 2005). Also, the device could detect large groups of nearby people (e.g. scanning the Bluetooth neighbourhood) and adapt the profile accordingly, e.g. switch to “silent” mode.

5. Conclusion and Future Work

The results of the empirical study show that interaction plays a major role when describing context in mobile communication settings. It underpins the social aspect of technology use and thus the social and interactional nature of context. Social roles and norms, social relationships, communication channels, call frequency, as well as constraining situations all have an impact on how we use mobile phones in everyday situations.

The next steps in the project involve the definition of the context-of-use model based on the scenarios and the implementation of a prototypical application. Finally, the evaluation of the application in a common, everyday situation will provide insights in the value of interactional context in mobile settings. Although focus groups provided valuable insights into the role and importance of the social context in the domain of mobile devices and service, further

empirical studies are necessary in order to understand the users and their usage in the everyday environments.

Eventually, the combination of the interactional and environmental context can yield applications that are unobtrusive and better support users in accomplishing their everyday tasks. A system using contextual information can provide a less obtrusive and a more natural way of interaction, resulting in a better user experience and higher user satisfaction.

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