

Context-Aware Communication Scenarios

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Abstract

This paper discusses context-aware communication which can be defined as the class of applications that apply knowledge of people's context to reduce communication barriers. The scope is restricted to non-verbal and electronic communication. Based on a literature study of previous research, thirteen different scenarios that arise from this context are recognized. These scenarios are evaluated with 48 users using a questionnaire. The results provide many practical examples of utilizing these scenarios. They also indicate that the more actively people send text and multimedia messages the more interested they tend to be in the features provided by context-awareness. The results should provide a good basis for the creation of a context-aware communication application.

1. Introduction

Context-awareness means knowledge of the user's physical and social surroundings. This allows the development of richer applications that use this information in some meaningful way to better satisfy the user. The most commonly used context information is location, but there are many other possibilities as well.

Communication is a fundamental part of each and every one's life. Especially nowadays, people communicate more and more using mobile devices, which can only convey very little context information. Therefore, an interesting question is how the addition of more context information would improve the communication. This paper focuses on this issue by extracting different

context-aware communication scenarios from previous research and evaluating them with users using a questionnaire.

The scope of this study is restricted to non-verbal and electronic communication. Examples of this kind of communication include e-mail, SMS and MMS messages, electronic chats, electronic message boards, and mailing lists.

In this paper the following definitions for context, context-awareness, and context-aware communication are used.

"Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves." [1]

"A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task." [1]

"Context-aware communication applications apply knowledge of people's context to reduce communication barriers." [6]

The study focuses on the most important context elements as defined by Abowd & Dey [1]. These are location, activity, time, and identities of nearby people. Context may consist of a single element (e.g., at home) or from a combination of multiple elements (e.g., at home having dinner with Matt and Mary).

2. Previous research

In the following, different context-aware communication scenarios are extracted from the previous research on the topic.

When making the decision of whether to approach a possible communication partner one considers e.g., how important is it for me to communicate now, where is the communication partner located, what is he doing, who is he with, and how convenient does it seem for him to be interrupted. *Seeing other person's current context information* is recognized as a means to provide this information. [7]

It is usually best to notify users of context changes in a lightweight manner. This means that the notification does not require user's full attention, but allows other tasks to be executed in parallel. Typical lightweight methods are sounds, small icons, etc. Notifications can be used to *notify the user every time his automatically activated context changes* and to *notify the user every time a certain contact person's context changes*. [2]

Reminders are messages that are sent to inform someone about some future activity that he should engage in. CybreMinder discussed *sending of reminder messages to oneself to certain situations*. [3]

Kontti enabled *leaving of messages to certain places for anyone that arrives at the same place to read* as well as *sending of messages so that they are delivered to the recipient only after the recipient is in a certain context*. It also discussed, but did not implement *sending of messages so that they are delivered to the recipient only after the sender is in a certain context*. Users' need to *automatically activate one's context information instead of having to manually change it every time the context changes* was also recognized. [4]

ContextPhone tackled privacy issues related to the sharing of context information by allowing users to *restrict what context information about them other persons were allowed to see in different situations* and to *see what context information about them had been sent to others and when*. [5]

Finally, two typical scenarios for message based communication are 1) *seeing whether the message has already been delivered to the recipient and whether the recipient has already read the message* and 2) *cancelling or modifying messages before sender and/or recipient have*

been in such contexts that the messages could have been sent.

3. Research methods

The different scenarios of context-aware communication that arose from the literary study were studied by using a web questionnaire. The purpose was to examine how useful the different scenarios are considered by the users and what concerns and advantages users see in them.

The web questionnaire was targeted for people with technical knowledge and/or interest in mobile phones, because that was considered necessary for the respondents to be able to fully understand the scenarios. The questionnaire was advertised in public news groups and web forums that focus on discussion about mobile phones. After the questionnaire was advertised, it was kept available for about a month. The number of users that answered the questionnaire was 48. Their background information is presented in Tables 1-3.

Table 1. The age distribution of the persons that answered the questionnaire.

	Freq.	Percent	Cumulative Percent
Under 18	3	6,3	6,3
18-21 years	5	10,4	16,7
22-25 years	8	16,7	33,3
26-30 years	11	22,9	56,3
Over 30 years	21	43,8	100,0
Total	48	100,0	

Table 2. The gender distribution of the persons that answered the questionnaire.

	<i>Freq.</i>	<i>Percent</i>
Male	35	72,9
Female	13	27,1
Total	48	100,0

Table 3. The distribution of how often the persons that answered the questionnaire send text / multimedia messages.

	<i>Freq.</i>	<i>Percent</i>	<i>Cumulative Percent</i>
Never	0 / 16	0 / 33,3	0 / 33,3
Rarely	3 / 20	6,3 / 41,7	6,3 / 75,0
Once a week	3 / 5	6,3 / 10,4	12,5 / 85,4
Several times a week	14 / 5	29,2 / 10,4	41,7 / 95,8
Once a day	7 / 1	14,6 / 2,1	56,3 / 97,9
Several times a day	21 / 1	43,8 / 2,1	100,0 / 100,0
Total	48	100,0	

4. Results

The users evaluated different scenarios on a scale of 1-4, where 1 = no use, 2 = little use, 3 = some use and 4 = much use. The users could also write their comments and thoughts on each scenario. Next, all the scenarios are discussed in the order of how useful they were considered by

the users. The usefulness is indicated by using the notation “(mean \pm standard deviation)” after each scenario name.

1. *Seeing whether the message has already been delivered to the recipient and whether the recipient has already read the message* (3.46 \pm 0.743)

It was pointed out that this functionality is already somewhat available, if the phone supports delivery reports of SMS and MMS messages. Many people found this kind of functionality very useful, if the matter is important or urgent. Knowing that the recipient has received and read the message removes the need to call afterwards or send a new message just to be certain. On the other hand, few people found it unpleasant that the sender would know the exact time when the message was read, because it could make the sender wonder why the recipient hasn't responded yet. Some also pointed out that reading the message does not necessarily mean understanding the message and perhaps there should be a manual confirmation of that.

2. *Restricting what context information about you other persons are allowed to see in different situations* (3.46 \pm 0.824)

Many people emphasized the need for protecting their privacy to prevent the “Big Brother is watching” society from taking place. Many found it obvious that they could reveal more information to some people than others and sometimes they would just want to be in their own privacy. Location information was explicitly mentioned as something that should be carefully restricted to whom it is revealed. It was suggested that there could be different accuracy levels in the location information for different people. For example, circle of acquaintances could see the exact location, buddies a more inaccurate location, and the employer nothing at all. Children were explicitly mentioned as a group whose context information should be continuously available for the parents and should only be allowed to be revealed to a specific group (e.g., family and close friends) to prevent pedophiles and such to track their movements. It was also mentioned that it should be easy to enable and disable the visibility of context

information, so that it could for example be briefly enabled when one is waiting for someone to pick him/her up from an unknown area. By default, no information should be revealed in order to prevent one from revealing information by accident.

3. *Seeing what context information about you has been sent to others and when* (3.44 ± 0.712)

Many people mentioned that it would be interesting and fair for the person who has been pried to see who has pried him/her for example during vacation or lunch. An interesting viewpoint was that it could in a way enable reverse monitoring (the monitored person would also be monitoring the monitors). It was also mentioned that the fact that one knows that a certain person is aware of one's context could be useful in many situations and have an effect on one's doings.

4. *Automatic activation of your own context information instead of having to manually change them every time your context changes* (3.27 ± 0.736)

This functionality was found a necessity by a lot of people, but some questioned whether some amount of manual control is necessary. The automatic activation was seen as a key component in making the application easy to use and in keeping the context information updated. It was mentioned that not many people would remember and have the energy to manually change their context information all the time. Some pointed out that there are already today mobile phones that have the ability to change their profile automatically based on clock and calendar. So, basically only the use of location information is missing. Some questioned whether fully automatic activation would lead to unwanted behavior, when for example one's timetables change. Therefore, it was suggested that some amount of confirming and control should be present. Also, the need to see the history log of how one's context has changed was mentioned.

5. *Cancelling or modifying messages before sender and/or recipient have been in such contexts that the messages could have been sent* (3.02 ± 0.956)

Many people thought that the possibility to cancel or modify messages would be very useful in cases where one's own situation changes and the message turns obsolete. For example, a message "come meet me in town" would become meaningless if the person had already gone home. This way the recipient wouldn't have to react to the message unnecessarily. Another suggested application was the possibility to cancel stupid messages that one had sent while drunk. However, a few people questioned whether the functionality would complicate the sending of messages, because one couldn't be sure whether the message is sent instantly or not.

6. *Sending of messages so that they are delivered to the recipient only after the recipient is in a certain context* (2.88 ± 0.959)

This scenario raised contradictory opinions. Some found it useful while others suggested that the recipients themselves could control when they wanted to receive messages by activating relevant profiles on their phones, and then read the messages when they are in suitable situations. The mostly suggested application was to prevent a message from waking up a person if he had forgotten to turn off or mute his phone for the night. However, it was emphasized that messages concerning important matters should be allowed to go through regardless of the situation. Also, it was suggested that this functionality would enable work related messages to be received only when at work. On the other hand, it was mentioned that some nasty applications would also become possible, e.g., sending bad news to a person only after he is far enough.

7. *Notification as a sound, small icon etc. every time your automatically activated context changes* (2.83 ± 0.907)

Most people agreed that this could be a helpful functionality. However, the notification should be barely noticeable (e.g., a soft peep) and should not require any actions from the user in order to not irritate the user in the long run. There should also be an option to switch the notification on and off. Some found this functionality unnecessary. They would trust that the system works without these kinds of notifications.

8. *Seeing other person's current context information* (2.75 ± 0.887)

This functionality was seen to have value both for the sender (or caller) and the recipient (or called). The sender can try to deduce why and for how long the recipient is not responding and the recipient may be saved from unnecessary disturbances, since the sender can choose an appropriate time and means for communication. For example, if a person is in a situation where he cannot answer phone calls, it would be useful to know if the person can be reached via text messages and if the person doesn't respond to text messages, it would be useful to know why (e.g., the person is in a meeting). In some situations a need for communication may arise solely based on the knowledge of the other person's context. The knowledge of other person's context can also affect one's own doings without actual communication. Location information was explicitly mentioned as the most important context information. People would like to see their workmates', buddies', friends', spouse's, children's etc. location and possibly with whom they are. It would also be useful to see if there is anyone at home. In addition to that an agreed meeting in some place was mentioned a couple of times as a situation, where it would be especially useful to see the other person's location, since that would remove the unsure feeling of when and whether the other person will arrive. Yet another example is a situation where one sees that a certain person is shopping and could send supplements for the shopping list. Seeing the context information would also remove doubts of whether to believe where the other person says he is.

9. *Leaving messages to certain places for anyone that arrives at the same place to read* (2.56 ± 0.897)

This functionality was compared to a traditional bulletin board. It was said that it should be as easy to use, which means that one should be able to see if there are messages in a certain place without much effort with the mobile phone. Leaving messages should also be very cheap or free to do. Some also compared this functionality to blogging and geocaching.

Possible applications include comments while traveling, comments about restaurants, and e.g., leaving a message that a copy machine is broken.

10. *Sending of messages so that they are delivered to the recipient only after the sender is in a certain context* (2.52 ± 0.989)

Some commented that it is natural to write messages only when there is need for them and therefore this functionality is not necessary. On the other hand, many people found this functionality useful and suggested different applications for it. Examples include a timed text message, sending a message informing that one is coming while driving to an agreed meeting place, and sending a message about the estimated time of arrival at some place when one makes it to some public service vehicle.

11. *Notification as a sound, small icon etc. every time a certain person's context changes* (2.48 ± 0.772)

Some people thought this functionality would be useful. However, it was emphasized that it should be possible to turn the functionality on and off and the notification shouldn't be too strong, which could irritate the user. Most use for this functionality was found in a situation, where one wants to reach a certain person or when one expects a certain person to arrive at some area. Also, one could use it to track one's children. For the tracked person it could be a bit annoying, if several phone calls would come instantly after the person leaves a meeting.

12. *Sending messages to oneself to certain situations e.g., as reminders* (2.48 ± 0.945)

Reminder functionality in itself was found very useful, but many pointed out that mobile phones already have calendars that provide this functionality and they would prefer using that instead of sending messages to themselves especially if that would cost any money.

13. *Automatic sending of messages repeatedly every time the sender and/or recipient arrive at certain situations* (2.17 ± 0.808)

Most people didn't find much use for this functionality. It was also wondered, whether there would be too much unnecessary messages. Reminder messages were the mostly suggested

application. For example, reminding workmates what there is still to be done.

The results were also examined based on the users' background information. Age and gender did not seem to have significant effects on the results. However, those that send a lot of messages seemed to find almost all scenarios more useful than those that did not send messages so actively. This is not that surprising, since people that send messages actively, probably have more perspective to see the potential benefits of these scenarios. However, this indicates, that it is probably a good idea to target the first context-aware communication applications to these kinds of users.

5. Conclusions

In this paper thirteen different context-aware communication scenarios were recognized based on a literature study of previous research and evaluated with users using a questionnaire. It should be noted, that the results are in no sense conclusive, since the number of users that participated was quite small. Nonetheless, the results should provide a good basis for the creation of a context-aware communication application.

10. References

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