Contextual Information and Communication

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Abstract:

We designed a future prototype of a contextually relevant system which also provides meta-context for your contacts. Recent trends in industry and research have been moving towards information and services being presented within the context of which the user is in. Our design chronicles a user from their home to a restaurant, providing valuable information to them when they need it. To inform our design, we created a survey determining what users want to see within certain contexts, what information they need and are willing to share in order to better communicate, and the privacy concerns users have regarding contextual systems.

Introduction:

Our face to face communication is highly dependent on the context of which you are in. For example, the way you interact with a person while in the classroom and outside the classroom can vary quite drastically. Some of the factors that composite this difference include the privacy of the location, the person with whom you are interacting with, the subject matter, your mood, time of day, and the space you're in. How you communicate with others digitally is also mediated by contextual factors.

In today's world, cell phones have transcended from only providing calling and SMS based services. Smartphones allow users to organize their lives with calendars and notebooks, provide access to social networking media like Facebook or Twitter, and improve decision making with utilities like Yelp and One Bus Away. While these services are empowering, users access information in them the same way regardless of the context they are in.

Our group was interested in analyzing mobile contextual communication and information presentation. We researched and designed a future prototype for the Facebook Home lock

screen which contextually presents information and contact meta information while traveling from home to a restaurant. The potential users of our community would have access to smart phones and want a better experience of communicating and accessing information based upon their context.

Literature background:

In order to provide contextually relevant services to a user, one must first understand what is meant by the word "context." Information that characterizes the situation of an entity is context. This entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves. Primary context types for characterizing situations of entities are location, identity, time, and activity (Abowd et. al., 1999). Put in another way, the word 'context' encapsulates two categories; one category for information regarding the user, the social environment, and the task at hand. The other category is the physical environment of location, infrastructure and conditions (Herstand & Audestatd, 1999). The definition of the word context is not officially agreed upon, but can more or less be summed as all the relevant factors that affect choices (Karikoski & Soikkeli, 2013).

From these vague definitions of context, one might argue that user context would change with each second of the day, or as soon as you enter another room of your home. Categorizing and presenting information for each and every context is impossible. Karikoski & Soikkeli (2013) began to break this problem down by analyzing mobile phone usage patterns of location context. They identified five locations with most usage: home, office, other meaningful, elsewhere, and abroad. Other meaningful refers to another place where one spends significant time, such as the home of a friend, parent, or partner. Elsewhere is an on-the-go context where you are moving or traveling. Abroad is when you are traveling outside your normal geographical location.

Other similar work of analyzing context usage patterns has been researched by Roth (2011). He developed a platform named Zonezz which works to identify the most prevalent contexts of use. Zonezz identified similar usage patterns as the research from Karikoski & Soikkeli (2013): voice calls are used least frequently at home, but the length of a call is the longest. SMS is sent most frequently at the office, where call length is the shortest. While one is elsewhere, one is more likely to initiate a call. These usage patterns are to aid in successful anticipation of user intent based on location.

Although there is a high volume of research concerning context usage patterns, sampled participants usage patterns can vary highly (Böhmer et. al, 2011; Karikoski et. al., 2013). To account for varied individual usage patterns within a context, there has to be a user intent prediction algorithm that feasibly anticipates which application the user would most likely open. Researchers have been prototyping and testing these anticipatory algorithms; even designing them to be the least battery intensive (Huang et. al, 2012; Shin et. al, 2012; Sun et. al, 2013; Parate et. al, 2013). Said prediction algorithms are being developed for commercial use today, such as Cover.

While it's important to logically analyze location context and anticipate user intent, one must not overlook what the actual user needs are for this type of technology. Kaasinen (2003), prototyped an early contextual device that provided relevant SMS and GPS contextual information. Users were asked to be autonomous within a set scenario and report their needs. The research found that users were interested in receiving location aware information about traffic, weather, or last-minute ticket deals throughout most scenarios. The GPS services should prompt pre-trip planning and on-route information for points of interest. Most users expressed they would desire this type of technology to prompt phone numbers for relevant friends and services. Many requested that they would like to store and share location-aware data with others. Users indicated that they were likely to use this technology in an unfamiliar location. Although this research is dated, Google Now implements all these findings into their mobile context-aware system for Android.

Moving beyond information and service anticipation, we wanted to provide a more contextual means to communicate with others. The problem we currently face for mobile communication is that there is no way for user A or user B to engage in any meta communication about the intended exchange (Herstad et. al, 1999). Meaning when you are about to contact someone, there is currently no way to understand the contact's context for which they would receive the medium of communication. Our fieldwork focused on exploring how to best present contact meta communication, at a comfortable privacy level.

Fieldwork:

In previous research that attempts to design informative meta context for mobile phones, researchers have surveyed population samples to gather what a person would want to know and be willing to share in order to better communicate (Knittel et. al, 2013). Other research found that users are most comfortable sharing location and information with others when trying to organize a meeting (Seeburger & Schroeter, 2009). If sharing with companies or services, users voiced that they require advanced privacy settings and transparency (Kelley et. al, 2011). We designed our survey similarly as the previous research with the goals of (1) finding what services or information people wish to see in certain contexts, (2) what information people would like to know about their contacts context to better communicate with them, (3) what information people are willing to share about their context, and (4) what privacy concerns people have regarding contextual systems.

Methods:

We utilized Google Surveys to create and distribute our questionnaire to our social networks. There was a total of 23 participants who completed the full survey. The context questions inquired what services one would use within a home, bus, and restaurant context. This is the question for the home context:

"You are at your HOME and made a reservation for dinner using the Open Table application for you and a friend. You are about to leave to catch the bus for your reservation and look at your smartphone, what information / services would you use or want to see?"

Participants were provided a set of services, such as social media or directions, in which they would select how likely they were to use them on a 1(least likely) - 5(most likely) Likert Scale. We decided to use set services instead of self-reported services for simple quantification and to reduce the cognitive load on the participant creating a higher chance for them to finish the full survey.

Our questions on user meta context sharing were structured in a similar manner:

"What information are you willing to share in order for your friends to better communicate with you?"

Participants indicated a 1(least willing) - 5(most willing) for set sharing options, such as abstract location (home, work, downtown) or activity state (walking, in vehicle, at rest). Last, we asked the users to voice their privacy concerns about a contextually anticipatory system in an open ended response. View the survey here!

Results:

To identify the services people would want or not want to use within a given context, we operationalized a service want as majority participants (12 or more participants) indicating a 4 - 5 and service not needed as majority indicating 1 - 2. While at the HOME context, services that participants wanted to use were getting directions (20 / 23), contact the person involved (14 / 23), and view restaurant details (16 / 23). Services that were not needed included reading the news (16 / 23), playing a game (15 / 23), browse the internet (15 / 23), check calendar (12 / 23).

While on the bus traveling to the restaurant, participants wanted to get directions or look at the bus schedule (15 / 23), contact the person involved (16 / 23), listen to music (15 / 23), view social media (12 / 23), and view restaurant details (15 / 23). On the bus participants would want to not explore nearby places (14 / 23), play a game (13 / 23), or check calendar (14 / 23).

At the Restaurant, people had no services that they wanted to use. They indicated that they would not use directions (19 / 23), listen to music (23 / 23), read the news (22 / 23), check email (20 / 23), explore nearby places (13 / 23), play a game (23 / 23), browse the internet (20 / 23), post to social media (13 / 23), browse social media (14 / 23), and check calendar (16 / 23)

Our meta context questions were quantified in a similar manner; information that was needed to better communicate is majority of responses (12 or more participants) that are 4 - 5, information that is not needed is majority of response that are 1 - 2. Participants indicated that they would need this information to better communicate with their contacts: abstract location (15 / 23 - home, work, downtown, ect.), specific location (12 / 23 - current address, map of your location), and calendar (12 / 23 - in a meeting, planned activities). Participants reported they would not need to know contacts mood (14 / 23) to communicate better.

Majority of participants indicated they were only willing to share abstract location (17 / 23) with their contacts. Participants were not willing to share their specific location (13 / 23) and whether they are alone (13 / 23).

The open-ended privacy concerns reported that participants have mixed feelings concerning contextually anticipatory systems:

"Not many... For the most part I am OK with it."
"I should be able to choose what information is shared and at what level."
"I have serious privacy concerns about services being able to anticipate my intentions and provide relevant information. If I am not informing an individual that I am meeting with about my intentions and other relevant information then I clearly don't want them to know. I should have a choice when it comes to some of the information that is shared about me."

See the results quantified here!

Discussion:

The services participants would want or not want to see within a given context are essential as to how to present relevant information. In our journey from home to the restaurant, participants wanted route information, restaurant details, and easy access to people involved until they arrive at the restaurant. If there is information placed into an application that plans a meeting, such as a calendar or Open Table, then one should provide quick access to Maps, the planned event information, and the contacts involved.

Other services such as listening to music, reading the news, or playing games varied highly in the responses. These services need to be anticipated based on personal usage patterns within a location context.

When the person arrives at the restaurant, one should be mindful of what exactly that person wants to see. Our participants indicated that there is no service that they would like to use, yet there are several services they would not use. Perhaps presenting no information while at the event would move users stay more focused. Again, a prediction algorithm based upon context usage patterns would be most appropriate to present relevant information for this scenario.

To create a non-intrusive meta context for your contacts, there is a chasm from helpful to invasive that designers should be cautious of. We were able to grasp a few repeating concerns about privacy to remember while designing: uncontrolled access to my private information, giving up location as well as possibly suggesting what you are doing there, and not being aware of the information you are agreeing to share.

Our approach is to propose transparency for the system. This involves alerting the user before sharing information - presented in a clear, concise vernacular so an informed decision can be made. Our design should allow the user to customize their privacy level in terms of what information they'd like to share. These also may be intertwined with Facebook's own settings.

According to the participants, knowing how to better communicate with others would involve an abstract location, a specific location, and an indication of whether they are busy. The same participants indicated that they would only be willing to share their abstract location. Creating a non-invasive meta context would have to involve (1) sharing an abstract location (home, work, traveling elsewhere), (2) knowledge of whether person is busy (sharing calendar status), (3) advanced privacy options with the ability to share more context or restrictions. With our literature review and fieldwork we should have an excellent framework to prototype a contextually relevant system.

Prototype:

The goals of our prototype include presenting context--relevant information, adapting and anticipating to user inputs, and providing non-intrusive meta context for contacts. The system would provide users with only what they need and only when they need it. The scenario we are prototyping for is a person's journey from his or her home to a restaurant, where the person has made a reservation. We prototyped the Facebook Home-based lock screen for when the person is leaving his or her home and for when the person arrives at the restaurant.

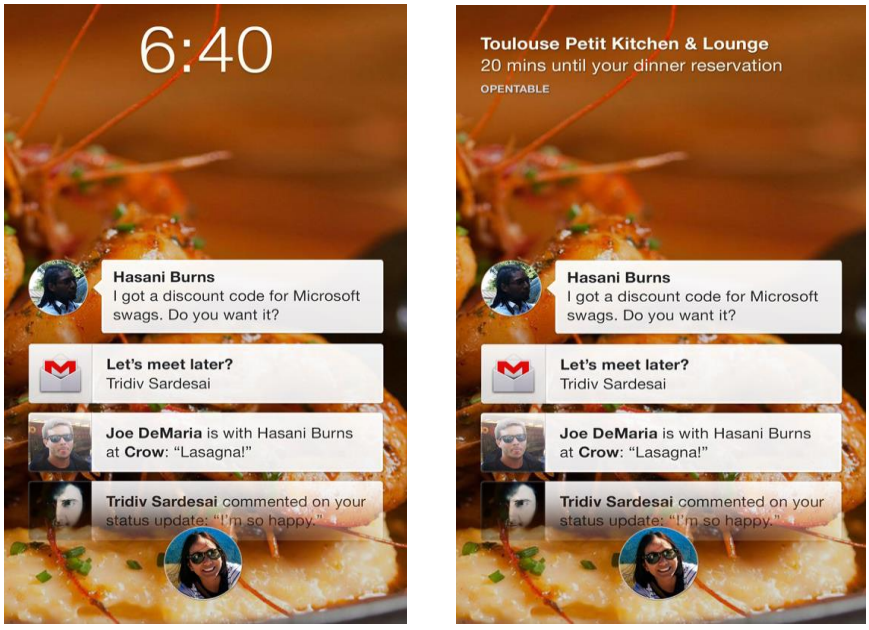


Figure 1: Initial Screens

Our team decided to build the prototype based on Facebook Home for several reasons. First, Facebook has an abundant amount of social data we could use, and it allows users to book and manage Open Table reservations through Facebook Pages. We also thought that the lock screen would be an interesting space to design for, given the immediate access users get once they press the power button. Lastly, we were interested in the idea of silent notification Facebook Home uses to present updates from friends because it is less disruptive to the user's experience.

At Home Context:

For the first part of the scenario, the user is about to leave his or her house to get to the restaurant. Clicking on the power button brings up the lock screen, which shows the time, notifications, and bubble head (Figure 1).

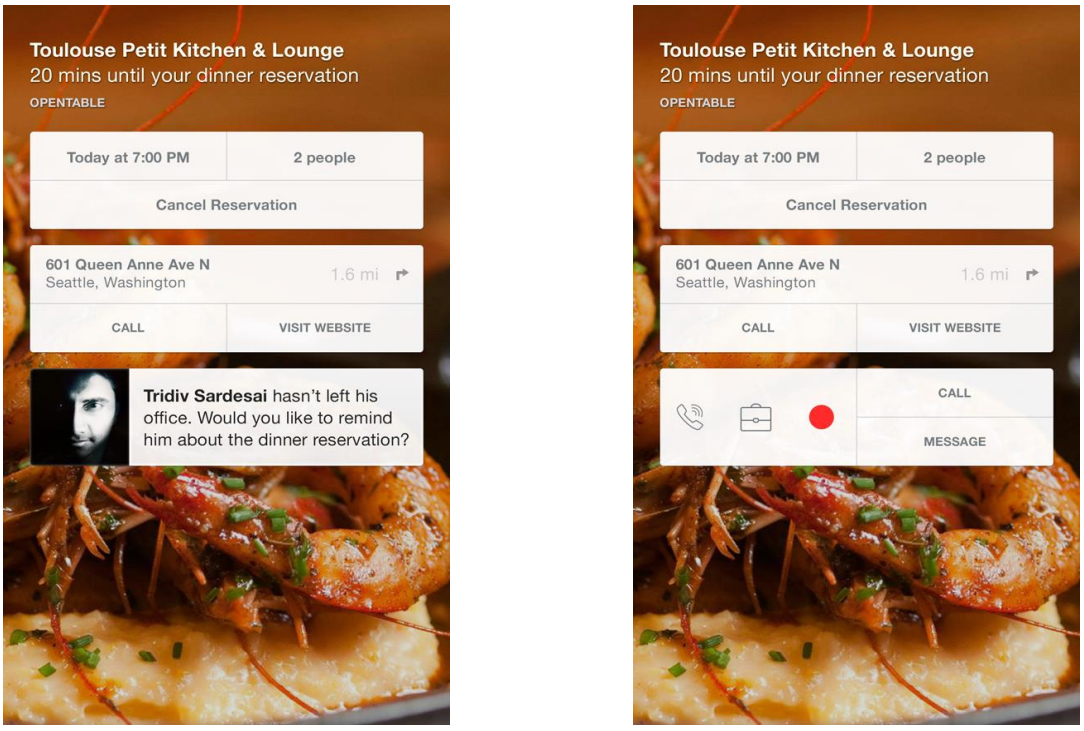


Figure 2: Contact Meta Context

After a couple of seconds, the restaurant reservation notification message appears. The user can tap on the screen to get more context-relevant information. Based on our survey result, our

team found out what information users would like to see when they're about to leave their home to go to a restaurant: reservation information, direction, and ways to contact the person they're having dinner with (Figure 2).

We've also added additional context information on Tridiv (Figure 2). Tapping on the card with he currently in a phone conversation?), his approximate location (he is at work), and his current status (red indicates that he's busy). Users can also call or message Tridiv directly from this interface.

To get direction to the restaurant, the users can tap on the address provided and they will be sent to Google Maps with the restaurant address already entered for them. In usual circumstances, users would have to unlock their phones and navigate to the different apps to get all these information, but we extracted only the information they need and have it displayed right on their lock screen for easy access.

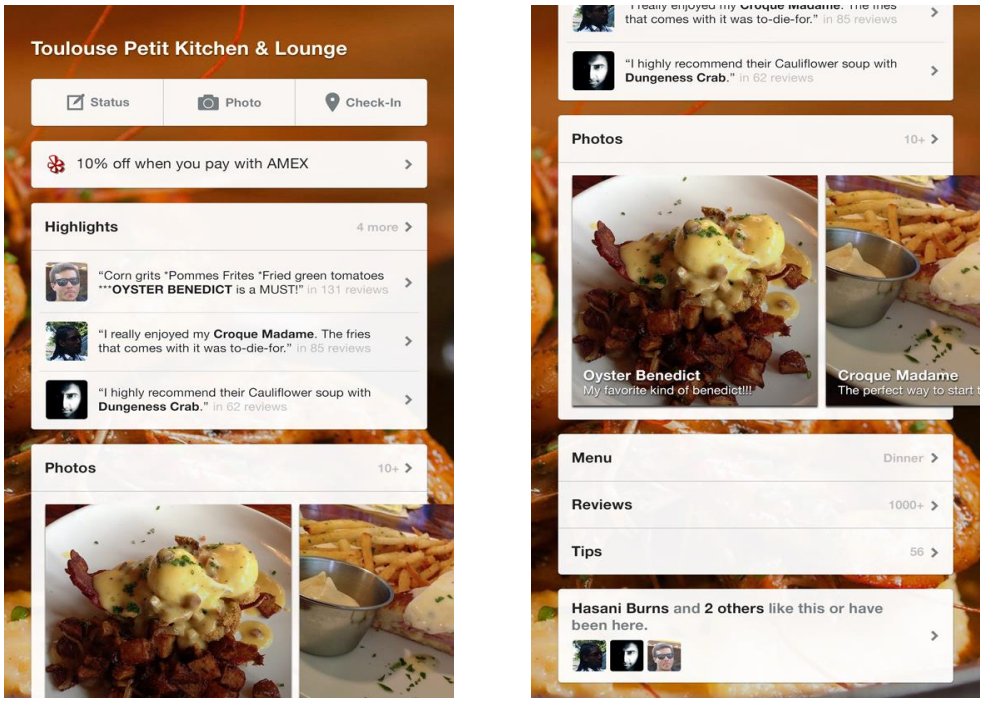
At the Restaurant Context:

When the user arrives at the restaurant, the lock screen displays additional information on the restaurant to help users decide what to order and find deals and tips. There are also shortcut menus for social activities like updating status, posting a picture, and checking in.

Other shortcut menus are for accessing menu, reviews, and tips. Friends who have liked this restaurant on Facebook or have been to the restaurant are also displayed here, so that users can easy message them to ask for tips about the restaurant (Figure 3).

To help users decide what to order, we included "highlights" from Yelp, which is a list of frequently mentioned dishes in the reviews, and photos to help users visualize the dish they might be ordering. Menu, reviews, and tips are also included so that users can quickly access that information, if they feel like the information display on this page is not enough.

Figure 3: At the Restaurant



App Shortcuts:

After reading several papers on predictive algorithms that can determine the apps users are likely to use next, we found a lock screen called Cover. We thought it was really well-implemented and that it would be interesting to incorporate that into our prototype.

If, whenever users feel that the information displayed on the restaurant is not enough or they just need to access other applications, they can do so by swiping up on the lower-left corner of the screen to bring up the app shortcuts for quick access. The list of apps would change depending on user context (location, calendar events, time of the day, etc.) to provide the most accurate predictions. These algorithms would also learn from the user app usage behavior, so this will be a personalized experience (Figure 4).

Play with our interactive prototype here, make sure to zoom your browser to 25%!

Figure 4: Application Prediction

Next Steps:

Moving forward we would want to do extensive usability testing to determine if our designs are easy to use, valuable, and non-intrusive. We would also do more research and prototyping for different scenarios and personas. The recent rise in wearable computing also sparked our interest to develop more contextual systems for these devices.

Conclusion:

Building a valuable contextually-relevant system requires presenting appropriate information when you would want to see it. This means creating an anticipatory system which can, for the most part, accurately predict a user's intent. Creating a useful meta context for your contacts includes cautiously designing to enable comfortable privacy levels when sharing information. Our future prototype is a fusion of these concepts based upon previous research and our own.

The future of computing is this ubiquitous computing - relevant information available when you need it. The implications of a world of systems which predict what you want will create a much richer, personalized experience for a user, consumer, or customer. Balancing users privacy with the personalization he or she would receive will be a main challenge in the years to come. Overall, contextually relevant systems should assist humans better than traditional computing can; our future prototype is an attempt to design this possibility.

References:

Abowd, G. D., Dey, A. K., Brown, P. J., Davies, N., Smith, M., & Steggles, P. (1999). Towards a better understanding of context and context-awareness. Handheld and ubiquitous computing. Springer Berlin Heidelberg.

Böhmer, M., Hecht, B., Schöning, J., Krüger, A., & Bauer, G. (2011). Falling asleep with Angry Birds, Facebook and Kindle: a large scale study on mobile application usage. Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services. ACM.

Herstad, J., van Thanh, D., & Audestad, J. A. (1999). Human centred mobile communication using contextual information. In Parallel Processing, 1999. Proceedings. 1999 International Workshops on (pp. 120-125). IEEE.

Huang, K., Zhang, C., Ma, X., & Chen, G. (2012). Predicting mobile application usage using contextual information. Proceedings of the 2012 ACM Conference on Ubiquitous Computing. ACM.

Kaasinen, E. (2003). User needs for location aware mobile services. Personal and ubiquitous computing, 7(1), 7079.

Karikoski, J., & Soikkeli, T. (2013). Contextual usage patterns in smartphone communication services. Personal and Ubiquitous Computing, 17(3), 491-502.

Kelley, P. G., Benisch, M., Cranor, L. F., & Sadeh, N. (2011, May). When are users comfortable sharing locations with advertisers?. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2449-2452). ACM.

Knittel, J., Sahami Shirazi, A., Henze, N., & Schmidt, A. (2013, April). Utilizing contextual information for mobile communication. In CHI'13 Extended Abstracts on Human Factors in Computing Systems (pp. 13711376). ACM.

Parate, A., Böhmer, M., Chu, D., Ganesan, D., & Marlin, B. M. (2013). Practical prediction and prefetch for faster access to applications on mobile phones. Proceedings of the 2013 ACM international joint conference on Pervasive and ubiquitous computing. ACM.

Roth, J. (2011, October). Context-aware apps with the Zonezz platform. In*Proceedings of the 3rd ACM SOSP Workshop on Networking, Systems, and Applications on Mobile Handhelds* (p. 10). ACM.

Seeburger, J., & Schroeter, R. (2009, November). Disposable maps: ad hoc location sharing. In *Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7* (pp. 377-380). ACM.

Shin, C., Hong, J., & Dey, A. K. (2012). Understanding and prediction of mobile application usage for smart phones. Proceedings of the 2012 ACM Conference on Ubiquitous Computing. ACM.

Soikkeli, T., Karikoski, J., & Hämmäinen, H. (2013). Characterizing Smartphone Usage: Diversity and End User Context. International Journal of Handheld Computing Research (IJHCR), 4(1), 1536.

Sun, C., Zheng, J., Yao, H., Wang, Y., & Hsu, D. F. (2013). AppRush: Using Dynamic Shortcuts to Facilitate Application Launching on Mobile Devices. Procedia Computer Science, 19, 445452.