A Framework for Community-Oriented Mobile Interaction Design in Emerging Regions

Monica Sebillo[1], Genoveffa Tortora[1], Giuliana Vitiello[1], Pasquale Di Giovanni[1,2], and Marco Romano[3]

[1] Department of Management and Information Technology, University of Salerno, Italy
{msebillo,tortora,gvitiello}@unisa.it
[2] School of Computer Science and Informatics, University College Dublin, Ireland
pasquale.di-giovanni@ucdconnect.ie
[3]Universidad Carlos III de Madrid, Spain
mromano@inf.uc3m.es

Abstract. The interaction design of mobile applications for a specific community of users, requires a deep knowledge of that community in order to establish appropriate usability requirements and tune the subsequent development activities. This is especially true when the target community is situated in one of the developing countries. There, mobile devices are increasingly playing the role that personal computers play in 'developed' countries, in spite of quite different cultural, social and technological constraints. In this paper we propose a 'community-centered' design approach, where different aspects of a community are used to formulate usability goals and are taken into account throughout the design, prototyping and testing phases, so as to ensure the actual application deployment by users of that community. The case study of a project carried out with a community of farmers in Sri Lanka is used to illustrate the approach.

Keywords: Analysis and design methods, Human Centered Design and User Centered Design, Human Factors Engineering Approach, Interaction design

1 Introduction

In the last few years several design guidelines and hci patterns have been issued to provide guidance in the design of mobile applications addressing common usability challenges [10-12, 15-18]. For instance, knowledge of cultural norms of reading conventions and how people process information is used to suggest how to design elements for an interface and place items on it so that users will understand. All such guidelines and patterns share the basic assumption that mobile users are everywhere, want to access information quickly and to be able to manipulate it easily. Mobile users are in the design focus and the adoption of common best design practices is recommended to guarantee usability with users who keep moving around with their devices and whose focus on the screen can be frequently distracted by the surrounding environment.

M. Kurosu (Ed.): Human-Computer Interaction, Part III, HCII 2013, LNCS 8006, pp. 342–351, 2013.

However, the design of mobile applications for a specific community of users, requires a deep knowledge of that community, that often goes beyond the single user and introduces cultural and social constraints which may invalidate some of the general guidelines. Knowledge of the community, in that case, helps establishing appropriate usability requirements and tuning the subsequent development activities on the community itself. This is especially true when the target community is situated in one of the developing countries [5-8]. There, mobile devices are increasingly playing the role that personal computers play in the developed countries in spite of personal, social and technological constraints.

In this paper we introduce a 'community-centered' design approach, where the social, cultural, technological and economic aspects of a community are used to formulate adequate usability goals and are taken into account throughout the design, prototyping and testing phases, so as to ensure the actual deployment of the application by users of that community (Fig. 1). The paper is organized as follows. In Section 2 we describe the two-layered ethnographic observation method which characterizes the proposed approach. We provide guidelines for community profiling in the mobile world that can be used to separate the 'once-for-all' community observation activity from the specific problem domain analysis. In Section 3 we illustrate the community-oriented design approach on a concrete case study, i.e., the design of a mobile application for a community of farmers in Sri Lanka.

2 Guidelines for Community Profiling in the Mobile World

The human/sociological/behavioral aspects which characterize a community of people are usually derived from the observation of their Cultural, Social and Technological contexts [9]. In the following, a set of guidelines is defined to be used for profiling a community of people using mobile devices, independently of the specific problem domain.

- *Social Context* (Social Organization, Ethical beliefs etc.)
  - Consider the social organization of the community. It "describes the collection of values, norms, processes and behavior patterns within a community that organize, facilitate and constrain the interactions among community members"[1]
    - Find out the social necessities and limitations.
    - Find out social relationships between individual subjects belonging to the same community.
    - Find out possible participation in governative or voluntary organizations.
- *Cultural Context* (Language, Education)
  - Consider the average cultural level of the target community. The designed interface should be easily understood by any stakeholder.
  - Consider the average education level of community members. Never make a design choice based on incorrect knowledge assumptions about the user.

- Different languages may affect the use of text in the visual design of the interface. This is especially true for communities living in some Eastern countries and where the official spoken language uses an alphabet different from the common Latin alphabet. Consider that:
  - sentences could be hard to represent on small screens,
  - the (virtual) keyboard could be missing some characters of the language alphabet. This would again affect the choice of the mobile device.
- In some countries more than one language is spoken. So, consider the necessity to design a multi-language interface.
- Consider the semiotics of the target community. Signs, colors, symbols, metaphors can have different meanings in different environments.

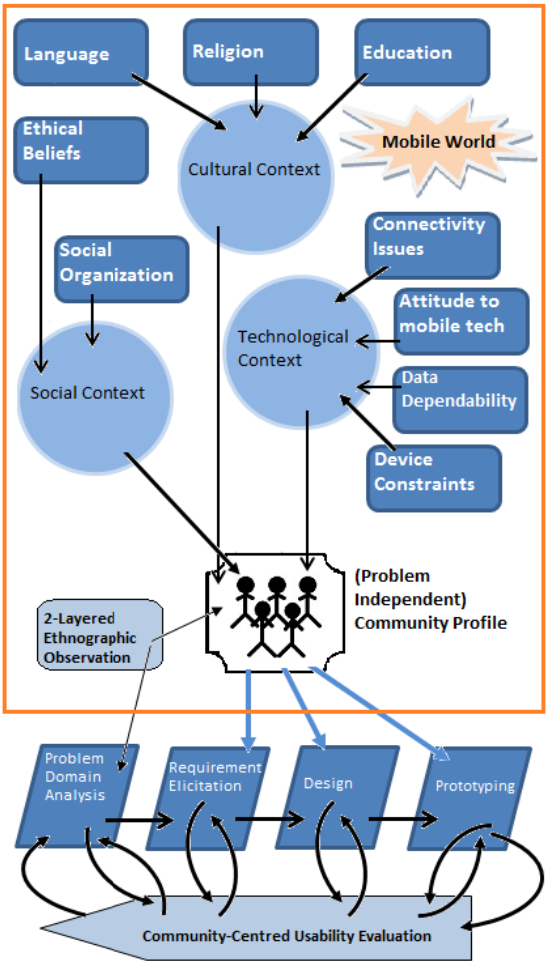

Fig. 1. Community-oriented design and development

- *Technological Context* (Available technology, Familiarity with mobile devices)
  - Consider the technological means available in the geographic area of the community. Also consider the average degree of familiarity with the mobile technology you are planning to use and the attitude to learning new technologies.
  - Mobile devices operations often depend on remote services. Therefore connectivity issues are paramount in this context:
    - consider the data quantity that the system needs to transmit on the wireless networks
    - bad connections can cause loss of reliability and can make the application progressively slower causing usability problems too.
  - The application should run on the majority of the devices available in the community. The world market trends can suggest some devices, however in specific communities particular technological ecosystems could be found.
  - Consider the device models available to that community in the specific country. Advanced devices may be present in rich communities (but this is not a rule), in some countries some models could not be available.

2.1 Problem Domain Analysis

Differently from the traditional approach, the analysis of current practices will aim at observing people from the target community within scenarios related to the specific problem domain [14]. Therefore, being aware of the common characteristics of the community of users and of their general needs with respect to the mobile world will allow designers to focus on the following points:

1. *what* is expected from the target mobile application
   - what tasks are currently performed?
   - what roles?
   - what artifacts?
   - what interactions?

2. *why* users need the application
   - motivations for adopting a mobile application supporting current activities

3. what the *temporal context* of interaction is
   - when is each task accomplished?
   - when should the system be deployed?

4. what the *geographical context* of interaction is
   - where do the observed activities take place?

Requirements elicitation will come out of the answers to the above questions. In the following section we describe the community-oriented design methodology applied on a concrete case study.

3 The Case Study of SLN4MOP

The Social Life Networks for the Middle of the Pyramid (SLN4MoP) is an International Collaborative research program started in 2011 that aims to provide real-time information to support activities related to livelihood delivered by mobile phone applications targeted to meet the needs of people in developing countries [19].The goal of SLN4MOP project is to leverage the enormous reach of mobile phones equipped with myriads of sensors such as GPS and camera, to develop the next generation of social networks that not only connect people to people, but also have the capability of providing real-time, context-sensitive local information by aggregating data from a variety of sources. In order to move towards that goal, Sri Lanka was chosen as the country where a pilot research study could start.

In this section we show how our approach can be adopted for the community of Sri Lankan people who are willing to use mobile phones to improve their daily working activities. In particular, the case study deals with the design of a mobile application meant to support farmers in the initial phases of crop selection and planning.

3.1 Profiling the Community of Sri Lankan People

The Sri Lankan society presents opposing aspects: people reflect both some of the typical facets of the modern advanced western societies and some aspects strongly connected to a multiethnic culture, full of ancient traditions. As a result of the initial ethnographic study, we were able to depict a general community profile for people living in Sri Lanka, who may benefit from the use of mobile devices for their daily activities [2, 3]. This represents the common knowledge about the social, cultural and technological contexts, which could be exploited for several application domains.

In the following we present some relevant aspects of the community profile, which directly impacted some of the design choices made for the farming application.

Cultural Context - Sri Lanka is a real multicultural nation. The community is made of two main ethnic groups, namely the Sinhalese and the Tamil. 83% of the members speak Sinhalese and the remaining 17% speak Tamil. However, English is the third official language, mainly spoken in the cities.

*Social Contex*t - Young people have not been extremely influenced by modernity and the effects of westernization. 80% of them have religious beliefs, the majority being Buddhists. Mobile devices are quite widespread but there are still barriers to their adoption, especially among parents who are often concerned with security and reputation issues. Moreover, people's general attitude to ICT is often influenced by the opinion of prestigious members of the community, such as local temple priests.

Technological context - Like in many developing societies, a significant gap in ICT (digital divide) can be observed in Sri Lanka, especially among people living in villages, sometimes even missing electric power supply. In order to encourage the adoption of technology and support the diffusion of culture, the local government has recently created the so called "Nenasala telecenters" supply [4]. Computer desktops and laptops are absent for the majority of individuals, while mobile devices are widespread enough. Statistics say that 86.5% of the population owns at least one SIM

(Subscriber Identity Module). Nevertheless, even if the Sri Lankan mobile network currently covers almost the totality of the urban areas, temporary lacks of connectivity, may affect services which heavily rely on network uptime.

In this context, the use of ICT and especially mobiles, have the potential to reduce the information and knowledge gaps in the affected areas.

3.2 Problem Domain Analysis: The Cultivation in Sri Lanka

Agriculture in this developing economy employs the largest share of the workforce; yet it contributes the least to GDP (Gross Domestic Product) when compared to the Industry and Services sectors. The cultivation pattern of Sri Lanka is bi-modal. This is mainly due to the two monsoons, which bring rainfall to the island in two distinctively different periods resulting in two distinct cultivation seasons [13].

From the survey we conducted with local farmers, it was noticed that due to this distinction there are specific crops to be cultivated in each season. Other factors that contribute to the crop selection are type of soil, weather, water, financial status, pest and diseases. Although several factors may affect the selection of crops for cultivation, farmers are used to choose crops primarily based on the profit. As a result they are biased by the market price of the previous year and they tend to select crops that produce a high yield within a short time period.

None of the interviewed farmers had a specific land extend per crop in mind at the time of cultivation, though they have a better understanding about the different types of crops that can be grown on a particular season. This knowledge is gained mainly based on the practical experience that came via ancestors. Moreover, during the study it was further identified that farmer awareness with respect to what others grow is limited to the neighboring farmers. This is mainly gained by watching what others are growing. They were reluctant to get this information by formal communication due to social phobia and the competition among farmers.

Different selling mechanisms are adopted by farmers in Sri Lanka. Some bring the harvest directly to the market, while around 90% depend on a middle person, namely the transport agent or the shop keeper. However, none of them get help from the government to sell the harvest. Another interesting fact is the behavior with respect to the selling prices. The selling price is a dynamic value which changes very frequently at a particular market. The farmers reported that they were often unable to predict the price as it changed vigorously within few hours. However, it was revealed that, according to their experience, they were unable to gain a good price for their harvest at the market, when all farmers tend to grow the same crop at the same time. As a result, in some cases farmers gave up farming and joined other industries to find their living. If this trend would continue in the future, it might have a huge impact for the economic growth of the country.

In the following, we summarize the most important claims about the domain specific issues observed from the field study:

- users are disposed to use some technological instruments provided that they are not invasive;

- governmental centers aimed at supporting agricultural activities are located all around the farms;
- there is a very low level of trust among the members of the same community, insomuch as not sharing basic information about their crop production.

3.3 The Community-Oriented Design

The user interface and application functionalities have been designed on the basis of the social, cultural and technical contexts characterizing the Community Profile of Sri Lankan people. Based on that, we understood that the adoption of smartphones was paramount in this work, since users are distrustful of technology with the exception of mobile devices, which are widespread. Moreover, farmers may need training that could be provided by experts of governmental centers.

The application was also expected to provide support to a critical task on the basis of data updated directly by users. Therefore, it was paramount to augment the perception of the data reliability.

The social and cultural contexts characterizing the profile of Sri Lankan community, besides the existing technological constraints, led us to choose the Android operating system for our mobile application, due to the high variety of device models running that system that are sold in that country. The technical and cultural issues, along with the small display size of the devices on which it will be executed also deeply influenced the choices regarding the design of the application user interface.

Major technical limitations are represented by the low resolution of the screen and the aforementioned limited sizes, the low computing power and the limited amount of main memory available. Such limitations, as well as the necessity to preserve as much as possible the battery life, were a determining factor in our decision to limit the amount of data processed directly on the smartphone. However, the need to communicate, via the mobile network, with a remote server has not been a trivial challenge and a lot of efforts have been made to handle with the payload of our application on the network. Even if the Sri Lankan mobile network currently covers almost the totality of the urban areas, we had the necessity to find the right tradeoff with regard to the data exchange modality and the quantity of data transmitted, while limiting as much as possible the impact that a temporary lack of connectivity, typical of a GSM / UMTS network could have on the general usability of our system.

More specifically, in order to decrease the total payload of exchanged network data we adopted two main solutions. First of all, we chose JSON (JavaScript Object Notation) as a lightweight data-interchange format. JSON essentially allowed us to present the data choosing the desired level of detail, with less verbosity than XML.

The second solution we adopted is based on a geographical information filter. Data sent from the remote server are preventively filtered on the basis of the farmers' location. The server collects information about products adequate for the soil type and climatic conditions of the region of interest and about the products which have been selected by neighbors so far. Such information is then aggregated, combined and computed in order to send only relevant data through the network. It is worth to point out that the given solutions addressed a general implementation problem characterizing

the target community and may therefore be adopted in different domains without further efforts. The same consideration applies to the visual interaction paradigm we decided to adopt, based on colors and images with little textual descriptions.

From the social context we knew that even if English is spoken among the members of our target community, users feel more comfortable using their own language so we decided to design our interface by allowing multiple languages. At the very beginning we designed the interface for the English language and then we translated the text in Sinhalese. We noticed that the graphical representation of this language is often significantly longer than the English text representation. This caused a visualization problem and a resulting redesign of some screens of the application that made the interface auto-adapting to the text dimensions.

At a later stage, the knowledge of the social phobia among farmers, who are reluctant to share with others the information on what crops they are growing, led us to design the interface so that the needed information could be provided anonymously and visualized using a 'traffic light' metaphor. Figure 2 shows the crops catalog filtered by the farmer's geographic position. For a better readability, a zoomed portion of the screen is also displayed. The colored background of each crop indicates the approximate quantity already in production. Figure 3 shows the comparison screen. A farmer can use this feature if he wishes to get more information about a specific subset of crops.

Fig. 2. The Crops Catalog

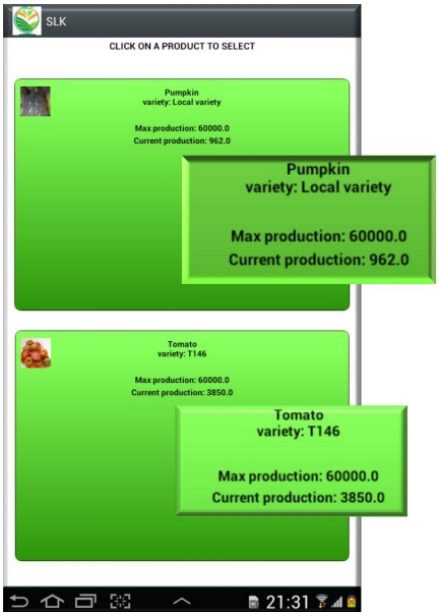

Fig. 3. Crops Comparison

4 Conclusion

The development of mobile applications is paramount to support users living in developing countries to improve their lives. However, a deep understanding of the target community is crucial for the realization of an application that is effectively accepted by those users. In this paper we propose a community-centered mobile design methodology, based on the idea that relevant aspects of the community can constitute a bulk of knowledge upon which mobile interaction designers can build appropriate solutions to a specific problem. The case study of Sri Lankan farmers presented in the paper is part of a wider international project, which is meant to provide ICT support to people from developing countries, with the goal to improve their quality of life. In the near future we plan to validate the proposed methodology designing other mobile applications for users who belong to the same socio/cultural community. This could be the case, for instance, of an application meant to support fishermen of Sri Lanka in their trading activities.

References

1. Mancini, J.A., Martin, J.A., Bowen, G.L.: Community capacity. In: Gullotta, T.P., Bloom, M. (eds.) Encyclopedia of Primary Prevention and Health Promotion, pp. 319–330. Kluwer Academic, Plenum, New York (2003)

2. Di Giovanni, P., Romano, M., Sebillo, M., Tortora, G., Vitiello, G., Ginige, T., De Silva, L., Goonethilaka, J., Wikramanayake, G., Ginige, A.: User Centered Scenario Based Approach for Developing Mobile Interfaces for Social Life Networks. In: Proceedings of the 2012 First International Workshop on Usability and Accessibility Focused Requirements Engineering (UsARE 2012), Zurich, Switzerland, June 4, pp. 18–24 (2012) ISBN 978-1-4673-1846-4 © 2012 IEEE
3. Di Giovanni, P., Romano, M., Sebillo, M., Tortora, G., Vitiello, G., De Silva, L., Goonethilaka, J., Wikramanayake, G., Ginige, T., Ginige, A.: Building Social Life Networks through Mobile Interfaces–the Case Study of Sri Lanka Farmers. In: Proceedings of the IX Conference of the Italian Chapter of AIS, Rome, September 28-29 (2012)
4. Telecenters in Sri Lanka: The Nenasala project. Technical Report. Skill International Private Limited, Lakshman Building, Colombo
5. Medhi, I., Patnaik, S., Brunskill, E., Gautama, S.N.N., Thies, W., Toyama, K.: Designing mobile interfaces for novice and low-literacy users. ACM Trans. Comput. Hum. Interaction 18(1), Article 2 (2011)
6. Danis, C., Ellis, J., Kellog, W., Hoefman, B., van Beijima, H., Daniels, S., Loggers, J.: Mobile phones for health education in the developing world: SMS as a user interface. ACM DEV, London (2010)
7. Putnam, C., Rose, E., Walton, R., Kolko, B.: Mobile phone users in Kyrgyzstan: a case study of identifying user requirements for diverse users. In: Professional Communication Conference (IPCC). IEEE (2009)
8. Jayaweera, P., Senaratne, R.: Mobile service portal for rural fisher community development. In: Proceedings of the International Conference on Advances in ICT for Emerging Regions (ICTer), pp. 66–70. IEEE, Colombo (2011)
9. Dey, A.K.: Understanding and Using Context. Personal and Ubiquitous Computing 5(1), 4–7 (2001)
10. Preece, J., Rogers, Y., Sharp, H.: Interaction Design, 3rd edn. John Wiley and Sons (2011)
11. Mayhew, D.J.: The usability engineering lifecycle. Morgan Kaufmann Publishers (1999)
12. Longoria, R.: Designing Software for the Mobile Context, 1st edn., vol. XVII, 152 p. 72. Springer, Longoria (2004)
13. Central Bank of Sri Lanka Annual Report (2010)
14. Rosson, M.B., Carrol, J.M.: Scenario-based design, The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications. Lawrence Erlbaum Associates Inc., Mahwah (2002)
15. Hoober, S., Berkman, E.: Designing Mobile Interfaces. O'Reilly Media (2011)
16. Neil, T.: Mobile Design Pattern Gallery. O'Reilly Media (2011)
17. Di Chiara, G., Paolino, L., Romano, M., Sebillo, M., Tortora, G., Vitiello, G., Ginige, A.: The Framy User Interface for Visually-Impaired Users. In: Proc.s of Int. Conf. on Digital Information Management, ICDIM 2011, pp. 36–41. IEEE Press, Melbourne (2011)
18. Ginige, A., Romano, M., Sebillo, M., Vitiello, G., Di Giovanni, P.: Spatial data and mobile applications - general solutions for interface design. In: Tortora, G., Levialdi, S., Tucci, M. (eds.) Proceedings of the International Working Conference on Advanced Visual Interfaces, Capri Island, Naples, Maggio 21-25, pp. 189–196 (2012)
19. Social Life Networks for the Middle of the Pyramid, International project, `http://www.sln4mop.org/sln/home/index/home`