

# INNOVATIVE DESIGN APPROACH FOR USER INTERFACES FOR RURAL FARMING COMMUNITIES: THE KENYAN EXPERIENCE

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## ABSTRACT

Existing designs modeled in the developed countries assume a user who is sophisticated, has experience with Graphical User Interfaces and is therefore able to conceptualize and contextualize interactions and is literate. However, the case in Africa is markedly different, especially in the rural areas where literacy levels are low and technology is often seen more of an end than as a means. This paper outlines our experience beginning with pre-study data collection and analysis from two rural communities in Kenya, setting up of ICT resource centers, task analysis to prototype design, development and evaluation. The user (farmer) is at the core of the activities of developing appropriate user interfaces to access vital information like crop diseases and markets as well as getting useful tips on modern farming techniques from the comfort of their mobile phones. We have successfully combined ethnography and socio-technical experiments to come up with a suitable prototype for the farmers. We believe that this approach will provide an insight into how rural communities can benefit from technology.

## Author Keywords

Ethnographic studies, User-Centric Design, Socio-technical experiments, Knowledge Management System

## ACM Classification Keywords

H5.2. User Interfaces: User Centered Design

## INTRODUCTION

The proliferation of mobile phones in the last decade has

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made it possible for many people to gain access to this pervasive piece of technology [3]. Indeed in Kenya, the entry of mobile service providers has seen subscribers in Kenya jump to over ten million from just few hundred a decade ago [3]. However there are still many more people who have been left out of this wave. The rural communities, who make up about 70% of the population in Kenya [6], have meager resources and limited education are not enjoying in this revolution. Part of this reason is due to rampant poverty which makes purchasing a mobile phone a luxury rather than a necessity

Designing user interfaces and associated applications for rural communities is a challenge that has not been adequately addressed. Indeed many users in two of the communities under study expressed concern at the interfaces offered by the phones and the challenges faced by trying to get access to essential services through the phones and other hand held devices [8]. We posit that by putting the user at the center of design, we can bridge the gap between theory and practice to this category of users who are currently technologically marginalized. We seek to approach this design from a participatory perspective to ensure maximum user involvement as much as practically possible. We describe in detail our innovative approach, the data collection and analysis done so far, the setting up of ICT resource centers and subsequent user training and feedback, tasks analysis done to date and the initial prototype designs undertaken to date. Evidently, large investments are being made in ICT for development, education and marketing of produce in rural communities within developing nations. It is important however that these developments are in fact usable, useful, and appropriate and well adapted to the communities in which they are intended to be used [5].

## RELATED WORK

We have reviewed different approaches to find a suitable one fit for rural farming communities where literacy levels are low. User-centered approach seems ideal for such situations as it enables the designers to focus on the user

tasks through collaborative and participatory approach involving community members and incorporating the social and functional dynamics which have not been considered hitherto [2, 11]. However there are challenges in working with rural population such as overcoming rough operating conditions, intermittent power supply, poor or on-existent communications infrastructure, a negative attitude of the populace born from a feeling of being marginalized etc [4]. We looked at these challenges as an opportunity to address a digital divide through an innovative approach. [2, 4, 5, 7, 8]. We seek to use the hope that ICT's have provided [10] to address the needs of the rural communities.

### OUR APPROACH

Through an initial baseline survey (figures 1 and 2), we sought to understand how rural communities interact or would interact with information, communication and technology as a useful tool in resolving some of their key agri-business challenges. In choosing to engage the communities, we realized that factors such as poverty, lack of infrastructure, low literacy levels etc were going to be a challenge. We therefore decided to start off with two groups of rural farming communities (ended up with other groups of users as well); one community is located in Kambu, in the Eastern Province of Kenya, about 250 Kilometers from the capital city of Nairobi along the Nairobi-Mombasa highway. Kambu is dry and receives little rainfall with an annual average of 15 cm compared to the country's average of 1000mm/40 (BBC Weather Centre, 2008). Majority of the inhabitants of Kambu are from the Akamba tribe, speaking English, (the official language), Kiswahili (the national language) and the local language Kikamba. Because of the harsh weather, agricultural produce is low and at subsistence levels. The second community is located about 120 Km from Nairobi in the Central province, in Kiangwachi and is inhabited by the Gikuyu who apart from English and Kiswahili, also speak Kikuyu as the local language. The area receives moderate to high rainfall with an average of 102 cm per year [1] and the predominant crop grown here is French Beans. The farmers in both sites are organized into community self help groups.

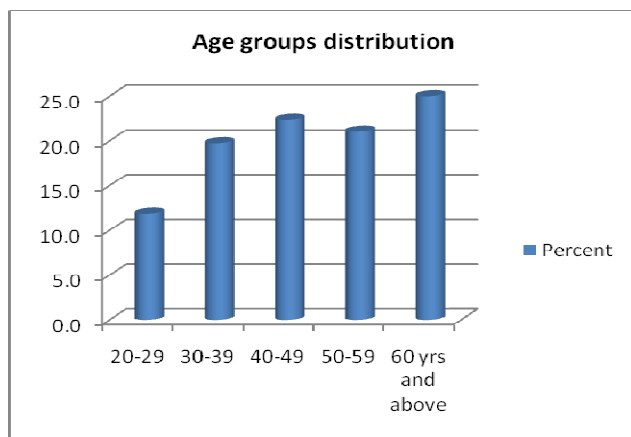


Figure 1: Respondents by age from both sites

We spent four days each at the two different localities, living at a local family's home at each site. This was critical in experiencing and understanding the social and cultural environments of participants. During this time, we visited various farmers explained the reason for our visit, talked over their various challenges, needs, life in the village, and generally participated in various activities like assisting the hosting families in cooking, fetching water, farm work like harvesting among others. The respondents, normally wary of strangers, slowly but surely began to trust us and were able to open up. We believe that by living with them and speaking the same local language, we identified with them and were able to win their trust. Subsequently, they allowed us to be able to observe them in their normal day to day farming/work practices and get a feel of their needs from our dialogues with them.

In addition, using questionnaires we had designed, we were also able to collect critical data such as exposure and use of computers, mobile phones and mobile phone-based applications. Other additional information we collected included educational background, access to farming information and knowledge of modern farming practices, access to competitive markets as well as acquisition of negotiating power for better prices.

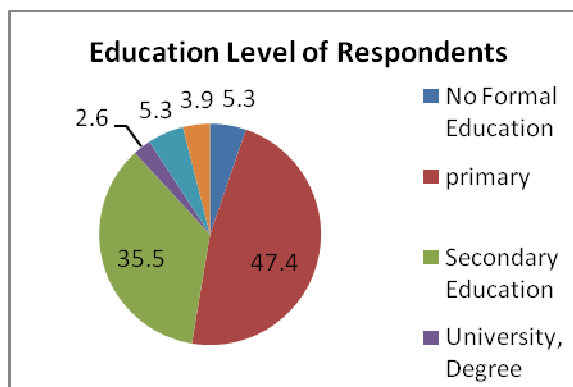


Figure 2: Education Level distribution (figures in percentages)

### Data analysis

The data collected was analyzed using SPSS version 17 to help come up with personas (e.g. farmers, agricultural extension officers, primary school teachers and primary school students) and user requirements based on level of education, exposure to technology, culture and user expectations. The farmers were interested in disease and pest information as well as market information to be presented in English, Swahili or Gikuyu; the extension officers wanted to explore how they can use the technology to enrich their agricultural knowledge as well as techniques of disseminating the knowledge to the famers; the teachers were interested in E-mail and internet as well as learning how to use the internet to get resource materials for their lessons; the students were mostly interested in exploring

technology to learn its capabilities. In this paper, we focus on the farmers.

We then applied Thomas Hansen's [9] model of socio-technical experiments, figure 3. The inspiration came from our earlier interaction with the farmers as well as the need to address their needs. We used paper prototypes to get the farmers to express their needs which we translated into formal requirements. The design of the prototype was participatory through paper models representing the use environment and also through use of a socio-technical matrix [7] the current use-cases and interactions.

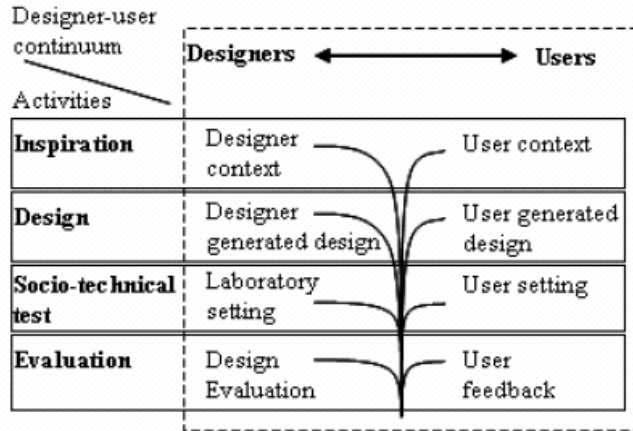


Figure 3: Education Level distribution, adapted from [8]

### Resource Centers

After identifying the personas, we set up resource centers at the two sites. Each resource center has a desktop, Macbook, iPod, digital Camera and a USB modem for internet connectivity. The resource centers were initially used to introduce technology to the farmers so that they could gain confidence using technology. Many of them had never seen a computer or digital camera before so the centers provided opportunities for them to learn and explore technology much more freely. Since they are in-charge of the centers, they feel a sense of ownership and belonging and we were encouraged that even people of advanced age, who had thought they could never encounter such technology, were happy to take part in the exploration and were willing to learn. They felt appreciated and were more than ready to learn. One lady who had never seen a portable computer before commented about the Macbook saying, "it looks so nice and small and very handy, I can carry it everywhere with me". With that, she has managed to learn about mail and typing out letters using the Macbook. Since they can borrow the portable equipment, the learning time has reduced as they engage their school going children, who are more technologically aware, to teach them how to use the devices. The members have consequently brought in more friends to marvel at the technology and we now have increasing members willing to be part of the technological wave. This has had the effect of

increasing membership within the farmers group as they believe the days of the middleman is getting fewer by the day.

The farmers have been (more than six times) trained on operation, use and maintenance of the devices. For maximum effect the trainings were held in English, Swahili and the two local languages. We also carried out training of trainers who in turn have continued to offer basic training to the farmers during their regular once-a-week meetings every Thursday.

### Prototype Design and Development

During the trainings, we continued to carry out data collection on the user's perception of technology through Focus Group Discussion (FGD). During the FGD's we realized that the farmers had new requirements which they wanted to be addressed. For example, it emerged that many of the farmers at Kiangwaci were interested in using the resource center but found it too far from their farms where they were busy with cultivating and tending the French bean crop. They were also interested in learning more about French beans from the internet. We therefore decided to design a system which can be accessed remotely via the internet from the Macbook or through a mobile phone connecting via GPRS. The option of mobile phone appeared attractive to many as the Macbook, being one, could not meet the demand. Our design, figure 4, was informed by the need to provide access to the Knowledge Management System (KMS) which contained information on pests and diseases affecting the French bean as well as intervention measures. The KMS was populated with relevant knowledge from agricultural experts from the school of agriculture of the University of Nairobi.

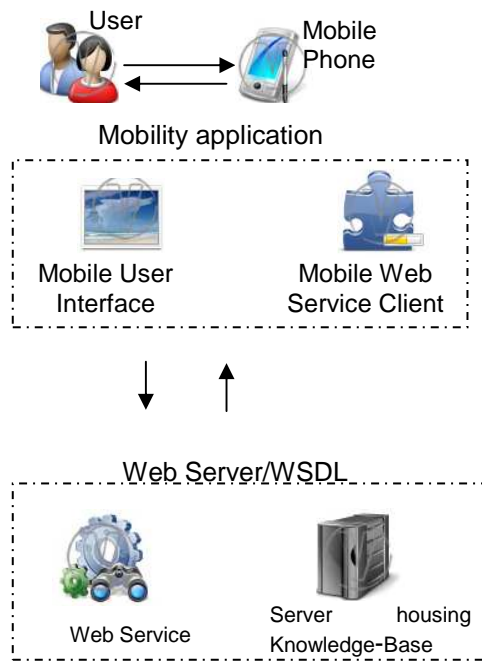


Figure 4: KMS and User interface designs

From the design, we developed a prototype of the mobile interface. The mobile interface is to assist the farmers to interact with the KMS from the comfort of their phones. The interaction will be in both English and Kiswahili as illustrated in figure 5.

The user has the option of choosing the language he or she is comfortable with. The information flow has been modeled around the activities that the farmers perform while tending to the crops. We have therefore designed the prototype to make it possible for the farmers to not only access the KMS for information, but also send important information on say new pests to the KMS. Such additions however will be vetted by the KMS administrator and agricultural experts before they can be added.



Figure 5: Language selection option on the mobile phone interface

### Evaluation

The prototype was evaluated by the farmers who suggested changes in regard to content of information required by the farmers. The farmers indicated a need to have information on potential markets as well as on prevailing market prices. Some farmers also indicated the need to have the local language option added in addition to English and Kiswahili.

### The next steps

We are currently working on having KMS contain information on bananas, cabbages and potatoes which are the other cash crops grown by the farmers alongside French beans. In addition, the farmers over at Kambu are trying out Ja Tropha Caucus, which is a drought resistant crop. We intend to add to the KMS, knowledge on Ja Tropha as well. The KMS will be hosted on a machine with public IP to permit unrestricted access; in addition we are working on an SMS module to cater for farmers who may not be able to have access to the KMS via GPRS. We will create blogs

through which farmers can post their questions and comments via the web client

### CONCLUSION

We have demonstrated the importance of using user-centric approach to design and development for rural farmers whose knowledge and skills on technology was very limited. To address the issue of technophobia; we combined ethnography with socio-technical experiments. The proliferation of mobile phones in Kenya has provided an opportunity to develop applications that can address user needs through mobile phone interface. The incorporation of language component will ensure that more and more users are not discriminated against. We believe that our approach can help reduce resistance to innovations as the users were part and parcel of the inspiration, design, development and evaluation of the prototype.

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### Brief Biographies

**Daniel Orwa Ochieng** is a lecturer and PhD student in the School of Computing and Informatics in the University of Nairobi in Kenya. He lectures and does research in a variety of areas such as mobile phones in education, health, agriculture, ICT4D, M4D, ICT adoption among rural communities in developing countries. Mr Orwa is also a technical committee member of the International Federation of Information Processing (IFIP) representing Kenya, a publication reviewer with ICT4D, a member of Computer Society of Kenya and a member of VeSeL (Village eScience for Life) - a digital divide project collaboration with 5 leading UK universities.

**Timothy M. Waema** is an Associate Professor in the School of Computing and Informatics in the University of Nairobi. He lectures and does research in a variety of areas in Information Systems. His research interests are in information systems strategy, social issues in information systems development and implementation, ICT for national socio-economic development (ICT4D), software engineering and management of change. Prof. Waema is the Lead Researcher in Kenya for the Research ICT Africa (RIA!) network. He is also the Research Director of the Local Governance and ICTs Research Network for Africa (LOG-IN Africa), a pan-African network of researchers and research institutions from nine African countries focusing on local e-governance. Further, he is the University of Nairobi Research Leader in a bridging the global digital divide project in collaboration with 5 leading UK

Universities and sponsored by the British Engineering and Physical Sciences Research Council.

### Expectations from the workshop

To meet, network and share with other researchers in the field of HCI and specifically the use of Ethnography and socio-technical experiments to provide appropriate interfaces for the otherwise technologically marginalized such as the rural communities (e.g. in Africa) where poverty and poor infrastructure have hampered provision of services to people residing in within the countryside.

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