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Contextual Mobile Interface Design For Rural Users In Kenya

BY

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January 2009

Submitted in partial fulfilment of the requirements of Master of Science in Computer Science

Declaration

This thesis is my original work and has not been presented for a degree in any other university.

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This thesis has been submitted for examination with my approval as university lecturer.

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Dedication

To my husband Charles and to Shawna my beautiful daughter – Thank you for being there always

Acknowledgements

My heartfelt gratitude goes to Mr. Dan Orwa and Prof. Timothy Waema whose firm guidance has seen me to the end of this project.

I would also like to thank the VeSeL team for the opportunity to work together in such an instructive research work as this.

To my husband Charles and daughter Shawna – your love, patience, support and immense grace has seen me all through. Thank you for being my right hand.

Finally to God – your immense grace and strength has truly been sufficient for me.

To all the friends who asked everyday how far – thank you all.

Abstract

Existing technologies, interaction design methodologies, and usability testing techniques have been developed mainly for and by the developed world (HCI 2007). For this reason, the mobile applications intended for the rural users have been and are being designed using design methods based on past research and implementation on user groups diversely differing from the target user of a developing country's rural context. Successful design of relevant user interfaces will require sensitive use of design practices in the local context, to cater for this category of users whose needs and perceptions are very unique and diverse.

In order to achieve this, this study sought to gain a deep and expansive understanding of the diverse and unique needs and perceptions of the target users in a local rural context through study of the rural users

Based on the results of the study we examined existing usability design methods and identified design methods that could be employed to inform the development of a design framework relevant for development of mobile interfaces for rural users in a developing country such as Kenya

Finally, we designed and developed a mobile user interface - based application using the new framework developed – 'The Translating User Design Model' in order to examine the research findings and test the design framework.

Results of the study demonstrate the vital relevance of this research work. It is critical that not only should mobile applications be designed and developed with the rural user in mind, but also that design tools used should guide the designer in putting the rural user and the local context at the centre of the development.

Future directions for study in this area have also been discussed and the resulting design model that has been developed will be a valuable tool that will provide other researchers with insight into the development of usable mobile application in the local rural context.

'A man should look for what is, and not for what he thinks should be.' - Albert Einstein

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Glossary of terms

3G – 3rd Generation

CD – Contextual Design

GSM – Global System for Mobile Communications

HCI – Human Computer Interface

ICT – Information Communications Technology

ICT4D - Information and communication technologies for development

IDE – Integrated Development Environment

LUCID – Logical User Centred Interaction Design

PC – Personal Computer

PD – Participatory Design

Rural People – Population of people living outside urban and suburban areas

UCD – User Centred Design

UCT4D - User-centred design approaches for development

UDP – User Design Process

UI – User Interface

CHAPTER ONE

1 INTRODUCTION

'An idea not coupled with action will never get any bigger than the brain cell it occupied.' -Arnold Glasgow

1.1 Background

In many of the under-developed and developing countries, people are living in times when there is a great push towards technology adoption and especially so, in rural areas. Much of the pressure arises from the need to close the digital divide between developing nations and the developed ones. The biggest push however for technology adoption comes from the urgent need for poverty eradication. Previous survey and analysis indicates that implementation of technology is one of the key effectors of turnaround of rural economies (Tapan, S.P. et al May 2006). Moreover, according to a World Bank Development report (World Bank 1999), Information and Communications Technologies can be used to remedy information asymmetries and stimulate poor people's entrepreneurship by better connecting them to markets. To this end, large investments are being made in ICT for development, education and marketing of produce in rural communities within developing nations, specifically Kenya.

1.2 Technology/Mobility in Kenya

In the past few years, much has been done in an attempt to find ways in which rural users can be empowered to access, store and use information through various information systems - with varying degrees of success. Providing timely and efficient information services to rural areas is a difficult task. Due to environmental and user constraints, the introduction of computing to automate various processes is not only demanding, but also requires addressing a number of significant challenges.

Most of the rural villages do not have the economy or infrastructure required to support a computer. Therefore, rural people must travel to larger towns or cities to access digital resources, either in a public place or via an intermediary. Given the condition of rural roads, and the inconsistency of public transportation, this requires significant time and motivation. Otherwise they must wait for someone to bring resources to them in a medium that they can access. In either case, the latency is high and the access is limited

(Tapan, S.P et al May 2006). Additionally, low literacy levels, limited disposable income, intermittent power, intermittent connectivity and variable population densities have contributed to low penetration of computer use in these target areas. A new system or technology must fulfill an immediately perceived need to be relevant in this context.

One technology is nearly pervasive — the mobile phone. It is used by most of the population, even in rural areas (Cecchini, S. 2002). Mobile phones have been cited as the most likely modern digital tool to support economic development in underdeveloped regions (Tapan, S.P et al April 2006). If a phone is shared by a group of people, it can be afforded by even the poorest communities. For rural computing applications, a mobile phone has inherent advantages over a computer in terms of relative cost, portability and familiarity to users. Recent advances in mobile phone computing capabilities also make this device a likely candidate to address the client hardware constraints common with computers. Longer battery life, wireless connectivity, solid-state memory, low price and immediate utility all make it better suited to rural conditions than a computer (World Bank 1999). Mobile computing is poised to be the next paradigm with its capabilities of extending the reach to rural areas and unconnected communities and minimal capacity building requirements for end users (World Bank PSD 2007).

Historically, there has been a slow uptake of various ICTs in developing countries, due to equipment costs, lack of infrastructure, logistical problems, and lack of finance or political/commercial commitment. On the other hand, mobile phone growth in the developing world has been staggering, due to ease of network expansion, cheaper relative costs, high demand, and willingness of companies to invest. Rates of mobile phone uptake have differed markedly between and within countries in the developing world (Banks, K. et al 2004).

Due to the introduction of new information and communication technologies in developing countries – and here, mobile technology, there has been a huge social and economic impact in recent years. The rapid expansion of mobile phones has done much to reduce the digital divide in Africa, for example, where the number has grown from just 15 million in 2000 to more than 160 million by the end of 2006, according to the International Telecommunications Union (ITU 2007).

As seen in the figures above, the demand for connectivity in Africa has been phenomenal. The boom in mobile phone usage has largely been facilitated by the availability of cheap pay as- you-go SIM cards and recycled handsets, which has allowed even the poorest members of society to make and receive calls. Some observers highlight that many countries across the African continent are now 'leapfrogging' older technologies. Mobile phones and other wireless technologies are often the preferred options (Paul, B. et al 2008).

In the local context, the mobile phone networks in Kenya have grown tremendously in the last few years to cover the most remote areas. The cost of using mobile phone services has also reduced considerably and with GSM mobile phone operators upgrading their networks to 3G, there will be an increase in the data transfer capabilities of their networks (Paul, B. et al 2008). With this in place, various opportunities to deliver information systems to the poor in remote areas via mobile phones have been availed.

Consequently, there has been a dramatic rise of mobile applications development in Kenya (Nathan, E. September 2007) and especially at the School of Computing and Informatics (SCI) University of Nairobi. For example, since the majority of the populace in rural Kenya rely on agriculture as the key economic activity; applications providing access to market information, good prices as well as superior farming practices to apply are being developed to be accessed via handheld devices, particularly the mobile phone.

Clearly, availability of mobile phones has revolutionised the way people communicate more here than it has in other parts of the world. The proliferation of mobile connections and the wireless broadband technologies is beginning to provide unbridled access to information and opportunities to interact among the communities of citizens and the government. The advent of 3G and 4G technologies is beginning to make mobile computing more sophisticated and doubling up the mobile phones as computing devices than mere email and voice. SMS alone can prove to be a killer application for provisioning of informational services by the government and enhancing the civic participation (ITU 2007).

Yet, application scenarios and user requirements are quite different to established mobile services. For the majority of people from these countries the mobile phone is the only computer device they have. This means for example that they can take photos with their mobile phone, but they cannot download them onto a desktop computer (University of

Sidney 2007). To understand the potential of new technologies for these countries, it is inevitable to first understand the user requirements and expectations. This requires the application of user-centred design approaches for development (UCD4D) to collect data about user requirements and to inform the design of new ICT4D interfaces that can possibly improve the quality of life of people in developing countries. The goal of this study is to evaluate UCD methods regarding their applicability for developing countries as well as how this new methods or frameworks may be used to design new interfaces.

1.3 Problem Statement

There is therefore need for research work to be carried out within the local context to identify unique characteristics and environments of rural users and based on the currently existing design methods; Use the results to inform design and development of a design framework relevant for development of mobile interfaces in the local rural context.

1.4 Justification

Research shows that less than 50% of software developed are actually adopted and used (Neochange 2008). Something clearly is amiss. While there are many plausible reasons for this, the user interface, the part of the application that the user sees and interacts with, contributes highly to the successful or poor adoption of software. Many poorly designed and unusable systems exist which users find difficult to learn and complicated to operate. Such applications are likely to be under used, misused or fall into disuse with frustrated users maintaining their current working methods (Maguire, M. 2001).

For our target users to be able to accept, adopt, effectively use and thereby access information from existing mobile applications or newly developed mobile systems; appropriate, relevant and usable mobile user interfaces must be developed so as to make this information in reality readily accessible to them. It is imperative therefore, rather, critical that these developments are in fact useful and well adapted to the communities in which they are intended to be used (HCI 2007).

There is therefore need for design and development of innovative and relevant user interfaces based on the local context, catering for this category of users whose needs and perceptions are very unique and diverse. Such successful design of relevant user

interfaces will require sensitive use of design practices in the local context. Regrettably, the existing technologies, interaction design methodologies, and usability testing techniques have been developed mainly for and by the developed world (HCI 2007). For this reason, the mobile applications intended for the rural users have been and are being designed using design methods based on past research and implementation on user groups diversely differing from the target user of our local rural context.

Clearly there is need for research work to be done in the local context to identify unique characteristics and environments of the users, analysis of this information in a multi-disciplinary design process[1] and finally development of an innovative design approach that combines existing and new technology with our rural situation. Only then can we be able to develop interfaces that are in fact relevant and usable.

1.5 Objectives of Study

The Objectives of this study are:

- To gain a deep and expansive understanding of the diverse and unique needs and perceptions of the target users in the local rural context.
- Based on the results, to identify usability methods that can be employed to inform a design framework relevant for rural users mobile interface development.
- And finally, in order to examine the research findings, design and develop a mobile user interface to demonstrate the vital relevance of this research work.

1.6 Structure / Layout of this thesis

Chapter one gives the background of this research work, discusses the problem statement and gives a justification to this work, as well as the objectives of the study. Chapter two discusses the literature review of various usability design model that are currently in use and gives rise to the development of the design model that has been adopted for the duration of the study. In chapter three, we look at the methodology of the research, based on the design model that has been adopted.

[1] The design team comprises of Computer Scientists, ICT personnel , as well as Agricultural experts

In chapter four we examine the product analysis and design, while in chapter five we look at the results and discussions. Finally in chapter six, we will look at the research conclusions, achievements of this work as well as future recommendations.

CHAPTER TWO

2 LITERATURE REVIEW

'In an age when technology is everywhere, those who understand how technology works are easy to find. Those who understand how people work are much harder to find.' - Gerry McGovern

2.1 Introduction - Usability

With huge investments being made in technologies for development and education, it is critical that the technologies developments are usable, useful, appropriate and well-adapted to the communities and contexts for which they are intended (Goyal, D. et al 2003). This requires well-designed solutions, which in turn require appropriate design methods.

Usability is a widely recognized critical factor towards the success of any development. Looking back a few years ago, most people in product development had never heard of usability. They were focused on creating application development processes, understanding and serving the customer, quality, time-to-market and a host of other business imperatives (Quesenbery W. 2007). Nowadays however, usability is synonymous to good design and development. But then again, what exactly is understood to be usability? According to a definition by Wikipedia [11.12.2007], usability is a term used to denote the ease with which people can employ a particular tool or other human-made object in order to achieve a particular goal. The International Organization for Standardization (ISO 9241 1998) includes within the standard the definition of usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.

Looking at this definition, it is instructive to observe that it is only within a specified context of use that a product can be used efficiently, effectively and satisfactorily in the process of achieving one's goals. What does this mean for us? According to Karat and Karat (2003) usability is both complex and context-dependent. They continue to state that the acceptability of any software product is not dependent solely on surface interface features, but also on the way a system fits within a use context (Karat J. et al 2003). This sounds deceptively obvious; but as observed by Karat and Karat, many system designers

and usability experts continue to struggle with the difficult question of how to turn this obvious fact into specific approaches for dealing with the context of use in design (Karat J. et al 2003).

It is not that existing approaches disregard context of use in design. Contrarily as seen in Human-Centred design methods "Know the users and their tasks" has always been declared as the first step of any rational design process (Karat J. et al 2003). The challenge with the approaches and what is currently hindering design of appropriate and relevant mobile applications in our rural context; is that the specific approaches developed so far have been much more tuned to well-specified narrow contexts than to our local rural realities. As it stands, to address this challenge means finding new ways of designing and deploying technologies. As Tapan P.S et al (2006) observes, design methods must be revised to fit local cultures, as there is often a massive social divide between designers and end users. As we look at the rural context of use, the user interface remains as the main usability focus since this is the part of the application that the user actually interacts with. Goyal et al defines a user interface (UI) as the part of an application that the user sees and interacts with. He goes on to explain that it is related to the underlying structure, architecture, and code that make the software work. The interface includes the screens, windows, controls, menu, metaphors, online help, documentation and training. Anything the user sees and interacts with is part of the interface (Goyal D. et al 2003).

2.2 User-Centred Design Methodologies

We begin by examining design methods based on the User-Centred design approach. The reason we start with this particular approach in particular is because it is highly instructive in guiding designers towards the goal of achieving usable applications.

The user-centred design (UCD) approach is a Human-centred design philosophy and process in which the needs, wants, and limitations of the end user of an interface or document are given extensive attention at each stage of the design process. Additionally, the user-centred design is characterized as a multi-stage problem solving process that not only requires designers to analyze and foresee how users are likely to use an interface, but to test the validity of their assumptions with regards to user behaviour in real world tests with actual users (Upassoc 2008).

There is an international standard that is the basis for the UCD methodologies that we shall be examining. This standard defines a general process for including Human-centered activities throughout a development life-cycle (see figure 2.1). It is important to note however, that the standard does not specify the exact methods to be used during this process.

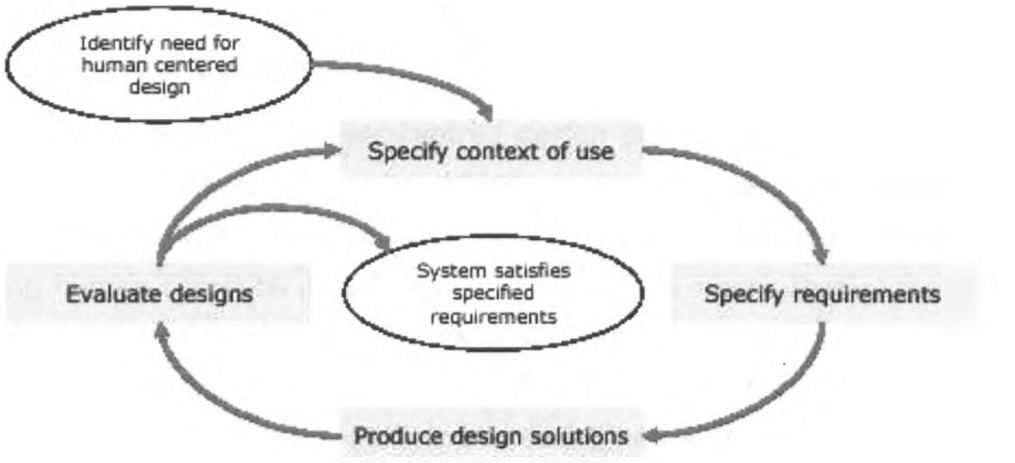


Figure 2.1 ISO 13407: Human-centered design process (Upassoc 2008)

Once the need to use a human centered design process has been identified, four activities form the main cycle of work (Upassoc 2008):

- *Specify the context of use*
  Identify the people who will use the product, what they will use it for, and under what conditions they will use it.
- *Specify requirements*
  Identify any business requirements or user goals that must be met for the product to be successful.
- *Create design solutions*
  This part of the process may be done in stages, building from a rough concept to a complete design.
- *Evaluate designs*
  This is the most important part of this process ideally through usability testing with actual users.

When the requirements are met, the process ends and the products are then availed to the users.

The following UCD methodologies come out strongly as possible candidates to inform designs in the local context. They are Contextual Design and the Logical User Centred Interactive Design (LUCID) methodology or framework. We critically examine each, their strengths and drawbacks, and see how they fit in our local cultures and how appropriate they would be in guiding design models for our local context.

2.2.1 Contextual Design

Contextual Design (CD) is a user-centred design process developed by Hugh Beyer and Karen Holtzblatt (Beyer, H. et al 1998). It incorporates ethnographic methods for gathering data relevant to the product, field studies, rationalizing workflows, system and designing human-computer interfaces. In practice this means that researchers aggregate data from customers in the field, where people are living and applying these findings into a final product (Beyer, H. et al 1998). Contextual Design can be seen as an alternative for engineering and feature driven models of creating new systems.

Contextual inquiry involves collecting detailed information about customer work practice by observing and talking with the user about the work while s/he works, in the normal context of the work. The researcher is expected to stay in the background and let the user lead the situation as much as possible. This means that researcher tries to form a partnership with customer i.e. learning (but not doing) as an apprentice while the customer is the master of the work. This helps the researcher understand the customer's work. The goal is to understand how and why something is done or why something is not done (Beyer, H. et al 1998).

Figure 2.2 illustrates further the five critical activities that define it.

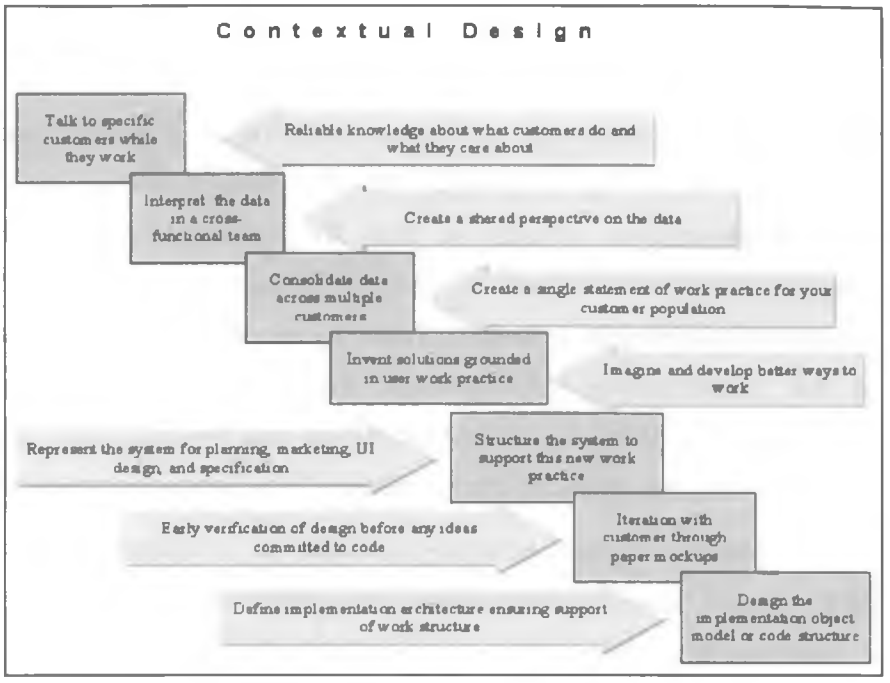


Figure 2.2 Contextual Design Process (Beyer H. et al 1999)

Work practices are analyzed and detailed work models are created in order to understand the workflow. Data from individual customer interviews is then analyzed in to reveal patterns and the structure across distinct interviews. This consolidated data drives conversations about how to improve work by providing a system that better supports the new work practice. A redesigned work practice is captured in a vision which includes the system, its delivery, and support structures to make the new work practice successful (Beyer, H. et al 1998).

A User Environment Design is then normally designed capturing the floor plan of the new system showing each part of the system, how it supports the user's work, what function is available in that part, and how the user gets to and from other parts of the system. Finally testing of the design ideas is done with paper prototypes or even with more sophisticated demos before the implementation phase. Depending on the results of the prototype test, more iterations or alternative designs may be needed (Beyer, H. et al 1998).

Relevance of Contextual Design in the local context

Three important aspects of contextual design come out in its favour as a useful method in user-centred design. Remarkably though, this very strengths of contextual design are the same that make it an inappropriate design approach in our local context and would

require extensive revision to even begin using it.

Firstly, contextual design is primarily used for the design of computer information systems, including hardware and software (Beyer, H. et al 1998). It is extremely well suited for computer applications but just as equally unsuitable for mobile platform applications. It appropriately focuses on work practices within an organization based user environment and has its key focus on work redesign. Conversely a mobile device user environment not only differs with the organizational environment, but is expected to enhance the user activities without being disruptive. In using a mobile device the goal is accessibility as opposed to new work practices that redesign will introduce

Secondly, contextual design is a customer-centred design process which uses thirdly, extensive field data as the foundation for understanding users' needs, task, intents, and processes in order to design products that meet both users' and business' needs (Beyer, H. et al 1998).

Not only is the method too labour-intensive and lengthy, it is actually intended for a business environment. Rural users do not have extensive time to invest in design processes that are lengthy. This is mostly due to the need to see the final product in sufficiently reasonable time to justify the time investments in such a project. Moreover, with challenges like illiteracy, lack of understanding of how the final product will work, any lengthy process runs the risk of the target users loosing interest in the project and moving on to projects that may be seen to be more income generating.

For the success of any methodology or model informing design, it must be able to capture the users within the individual and community setting of mobile devices use, and not as a business organization with standard work processes and practices.

2.2.2 Logical User Centered Interactive Design (LUCID)

LUCID began as a way of describing the interface design approach at Cognetics Corporation. It has evolved over the years into a framework to manage the process of designing an interface in a way which encourages software usability. It has the following important goals which are its key strengths (Virginia Tech University 2008):

- To provide UI designers with a framework within which to apply best practices

- To allow for seamless integration of design and usability activities with software development methodologies
- To support a user-centred approach to interface design
- To enhance the usability of the finished software

The above four goals are achieved through the following six significant stages. The stages iterate, but at every iteration and in the overall project, the deliverables from one stage are the input for the next. In addition, assumptions about users and usability requirements are continually tested during the entire life-cycle (Cognetics 2008).

Figure 2.3 below illustrates the LUCID stages;

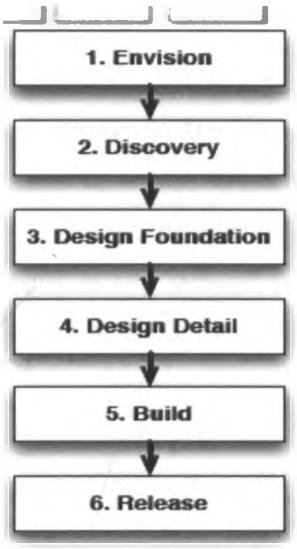


Figure 2.3 LUCID Stages (Congnetics 2008)

The LUCID methodology is a logical design process that builds on a strong conceptual model. It implements an iterative review and refinement that includes user feedback at all critical stages. Successive prototypes and team reviews are then used to allow opportunities for technical review and ensure viability of the design (Virginia Tech University 2008). As a method that is user-centred, its design model fits the user's mental model rather than the technical implementation model. Software is designed within the context of the overall tasks and work flow (including both manual and computerized activities) of target users. Design is then based on user activity and employs the user's language and context. The scope of the design is "everything but code" and includes the

following aspects: the look and feel, language, screen objects & layout navigation as well as user assistance (Virginia Tech University 2008).

Relevance of LUCID in the local Context

The LUCID framework focuses greatly on enhancing software usability. In essence, this becomes a drawback. With too much focus on the usability of the product along the activity contexts of the user; the user environment, behavior and lifestyle which significantly inform in mobile use context are ignored. Under normal circumstances, this would be detrimental to mobile interface designs. In the rural context, it would prove disastrous. This point is discussed in further detail in the paper.

2.3 User-Design Process

User-centred design is a useful and important construct; it is one that suggests that users are taken as centers in the design process, consulting with users heavily. However, it does not allow users to make the decisions, nor does it empower users with the tools that the experts use. By acknowledging the end user's tacit knowledge and thereby actively involving them in the design process the User-Design Process (UDP) seeks to circumvent the weaknesses of UCD method.

At first glance, user-design process sounds like user-centred design, but there are differences. User-design is design by users, while user-centred design is design for users (Wikipedia 10.01.2008). There is a very significant differentiation between user-design and User-centred design in that there is an emancipatory theoretical foundation and a systems theory bedrock on which user-design is founded.

2.3.1 Participatory Design

Participatory design (PD) is an approach to design, that attempts to actively involve the end users in the design process in order to ensure that the product designed meets their needs and is usable (Wikipedia 10.01.2008). It originated in Scandinavia in the 1970s as a way to empower workers by involving them in the design of tools and artefacts. The method drew on the workers' "tacit knowledge" that is, their implicit or unarticulated knowledge learned and transmitted through experience and apprenticeship (Wikipedia 10.01.2008).

In participatory design, end-users (putative, potential or future) are invited to cooperate with researchers and developers during an innovation process. They participate during the initial exploration and problem definition both to help define the problem and to focus ideas for solution, and during development, they help evaluate proposed solutions (Wikipedia 10.01.2008).

Traditionally, Participatory Design occurs in three stages. During the first "discovery" stage, the researcher-designer gains the trust of the participants, explores their working practices, and studies their goals, values, and needs. S/he also gets additional context from examining the visual and textual sources used in practice.
In the second "evaluative" stage, the participants (end–users) explore and evaluate the artifacts for example in our case, a mobile application user interface, focusing on the strengths and weaknesses of that artifact; then they encourage each other to tell about their positive experiences with similar artifacts.
The third "prototyping" stage involves brainstorming with the participants as they suggest ideas, sketch concepts, and envision future use and developments in the field. Finally, the participants evaluate the new design and approve its final version (Nikolova-Houston, T. 2008).

Participatory Design has a critical strength that makes it more appropriate than contextual design and LUCID methodologies that we discussed earlier when it comes to informing design in our rural context. Participatory design creates a more intimate and trusting social atmosphere between the researcher and the participants. The participants are able to effectively share their feelings, values, needs, and knowledge. The researcher can then be confident that s/he has understood and has a tacit knowledge of the users (Nikolova-Houston, T. 2008).

Relevance of Participatory Design in the local context

Despite the fact that various approaches have been developed to enable the users to take active roles in many design activities; it is likely that techniques derived from this experience might need to be modified to fit use contexts that are different. System design is ultimately a partnership between developer and user, and the level of partnership between user and developer is a factor that will vary (Nikolova-Houston, T. 2008).` Additionally, Participatory design does take time and the designer needs to keep in mind the value of time for the participants (Nikolova-Houston, T. 2008).

The above drawbacks are aspects that can easily be overcome with various adjustments to the design process. However, there is one weakness of the Participatory design process that is much harder to circumvent, seeing that it arises from its theoretical foundation. Participatory design focuses solely on design but not on deployment. Yet, the main challenge when designing pervasive systems for the rural context is to break with the dichotomy between designing the technology and implementing that technology.

It is for this reason that as effective as participatory design is, even over and above UCD methodologies, it cannot be used as it is to effectively inform a design process in our rural context.

2.3.2 Socio-Technical experiments

A recent research approach to cultural differences has focused on user acceptance of technology, and draws from a body of research known as the sociology of technology.

The frame socio-technical experiments focuses equally on the technical and the social part of a design, by exploring future use situations and by highlighting how the strengths from different disciplines benefit the overall design (Hansen, T.R 2006). For example, the design of an agricultural knowledge system to be accessed by rural farmers from their mobile phones: Access of market information, good farming practices, pest and disease control are some of the intended uses of the system. Over and above the expected technical requirements the system design will also require a critical understanding of how farmers typically acquire such information and pass it on, existing social and environmental conditions surrounding such farmers, input from experts in the related knowledge fields, to name a few.

The socio-technical perspective acknowledges the participatory design tradition and circumvents the weakness in the approach where new technology is designed separated from the use context and the subsequent social-technical changes that will occur following implementation of a system. Seen in isolation, the technology may work as stated in the requirement specification, but within the socio-technical network may fail to work as

expected since users are expected to change their behaviour and do all kinds of workarounds just to accomplish their normal tasks (Hansen, T.R 2006). A socio-technical network refers to the relationship between the social and the technical, not as separate entities, but as highly interwoven as a form of network. The term socio-technical network dissolves the distinction between the social on one side and the technical on the other (Hansen, T.R 2006).

Whenever a new design is introduced to users the socio-technical network is going to change into some new form. This new form is referred to as the *translating socio-technical network* (Hansen, T.R 2006). The focus of social-technical experiments is not on the existing socio-technical network, but on a network that is changed due to the introduction of a new design.

A socio-technical experiment tries to investigate properties of a translating socio-technical network by experimenting with it. It is not the design as an isolated entity that is tested but it is the combination of the design and its users that is tested. The experiments are used as metaphors to describe and guide the design process.

Figure 2.4 below shows the design activities of the experimental model:

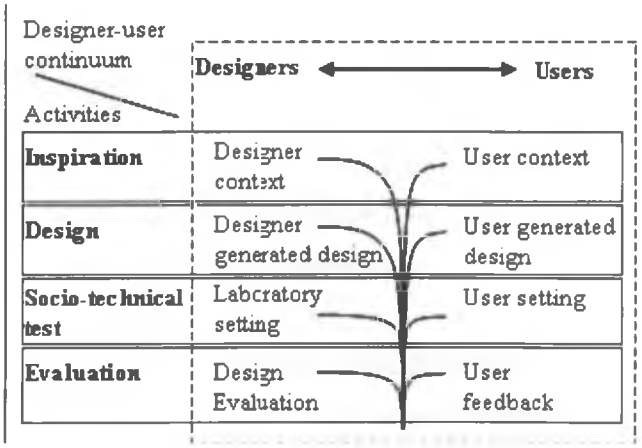


Figure 2.4 Experimental Model (Hansen, T.R 2006)

The motivation behind a socio-technical experiment can be the development of one or more concrete products or it can be to explore a new technology in a socio-technical setting. Moreover a socio-technical experiment can be treated as independent design activity. It is with this separation possible to use the results of the socio-technical

network, in many different settings. The reflected hypotheses can for instance be used in the design of one or more specific product or they can be published in scientific journals. It also makes it possible to have many socio-technical experiments running in parallel investigating different properties of the design. And it is possible to have several multidisciplinary teams working on input to the same design process (Hansen, T.R 2006).

Relevance of Social-technical experiments in the local context

These extensive advantages of this model make it a possible candidate in designing for our rural users, except that its main drawback denies a designer an opportunity to address a critical issue that follows implementation of a system. As noted, a socio-technical experiment addresses the translated and not the existing socio-technical network. The model however does not address the challenge of designing for a continually translating network and how to make flexible designs that supports continuing translations.

2.4 Discussion

The UCD methods we have discussed – contextual design and LUCID methodology effectively address one of the key weaknesses of traditional software design by putting the user at the centre of all the iterative processes of design. We have gone further to examine Participatory design, a user-design approach and have acknowledged they are apt to produce more usable systems in our local context than the UCD methods. This is because by involving the user in the design process, not only is tacit knowledge acquired, but the user environment, behaviour and lifestyle is captured which was priory overlooked by the above mentioned UCD methods.

We go on to note that participatory design fails to capture in its design process the impact of the social-technical changes that occur following the implementation of a system. The social-technical experimental model effectively addresses this challenge. In our rural context however, we find that it may not be sufficient or fully appropriate to adopt the experimental model as it is. The following paragraphs explain why this is so.

Our goal is to be able to get a design model whose methods can be used to design and develop applications that are in fact usable, useful, appropriate and well adapted to the

communities in which they are intended to be used (Goyal, D. et al 2003). How well adapted the applications are to the communities in which they are intended to be used is actually the foundational measure on how usable, useful and appropriate they really are.

An initial pre-design research revealed that the social-technical changes that will occur following mobile application implementation will neither be a single process or transient. Rather, there will continual translation of the social-technical environment at all design stages.
While there is a big digital/technical divide between the rural communities in under-developed and developing countries, we must acknowledge however that we are living in a global world. As such, that digital gap is closing. In some rural area rapidly, in others at erratic paces owing to various environmental, social and infrastructural as user constraints.

We can therefore arrive at the conclusion that an appropriate model/framework to guide the design in our rural context; is one that can be used to design for a continually changing or translating network or community.

2.5 Resultant Innovative Theoretical Model

2.5.1 The Translating User Design Model

Having arrived at this conclusion, we came up with the following model that may be used to design for a continually changing or translating network or community which we call *'The Translating User Design Model'.* Based on the methodologies outlined above, the technique combines aspects of the participatory design and the social-technical experimental model and further extends them. This model forms the theoretical basis for the research and has been adopted for the duration of the studies.

The resulting model is presented diagrammatically in figure 2.5:

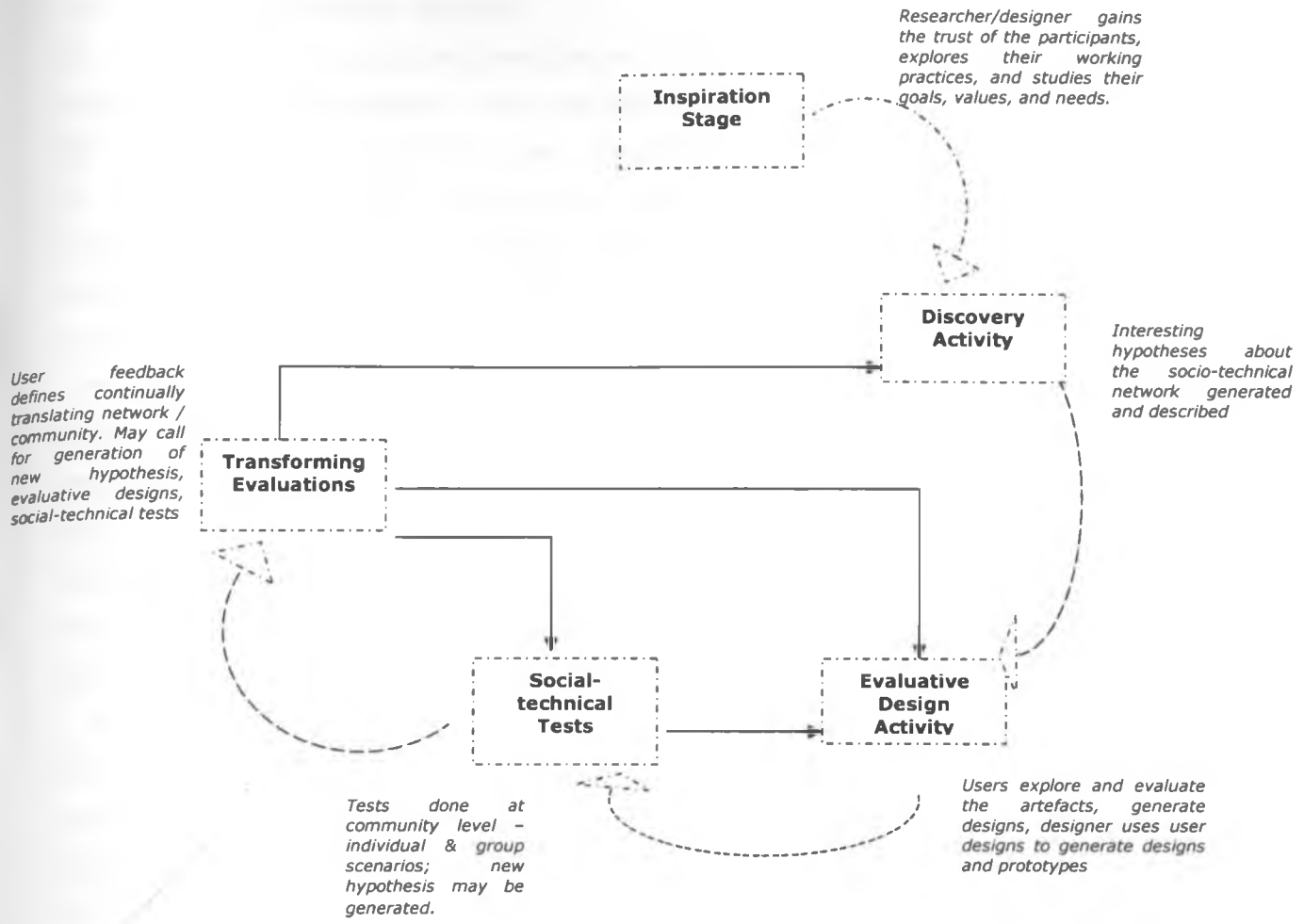


Figure 2.5 The Translating User Design Model

2.5.2 Stages of the Translating User Design Model

I. Inspiration Stage

In this stage, the researcher/designer seeks to gain the trust of the participants, explore their working practices, and study their goals, values, and needs. This is achieved by closely interacting with the participants and through field activities such as contextual inquiries, observation and semi-structured questionnaires.

II. Discovery Activity

During this activity, interesting hypotheses about the socio-technical network are generated and described, based on the information gathered from analysis of data gathered during the inspiration stage and combined with that from literature review.

III. Evaluative Design Activity

At this stage, users explore and evaluate existing artefacts, focusing on the strengths and weaknesses of each artefact. This may be achieved through intensive field work with activities such as contextual inquiries, observation and structured questionnaires. Based on the analysis of the data from this from this activity, procedures or strategies focusing more on social structure are designed and a set of requirements for developing a prototype are included to later guide the prototyping stage. Finally the setting for the user tests is also prepared.

IV. Social technical Tests

In this activity the initial prototype is designed and used for the social technical tests in small workshop settings in various locations where the participants are largely to be found and are comfortable in. The users are then able to contribute to the design activity by suggesting ideas envisioning future use and developments of the product in the research field. Tests are done at community level – with both individual & group scenarios. During this activity, new hypothesis may be generated.

V. Transforming Evaluations

This is the final activity but an ongoing one. In this activity, participants are able to evaluate the product/prototype designed incorporating their ideas and suggestions as collected in the social technical tests activity. This task can be achieved using methods such as assisted evaluation using questionnaires and may be done on as large a sample set as the designer is able to viably manage.

Guided both by the designer's observation during this evaluation and feedback from the user, the results are summarised in a set of reflected hypotheses. User feedback defines a continually translating network / community. This means that this activity may often call for generation of new hypothesis, evaluative designs, social-technical tests as the socio-technical transformations continue to happen.

CHAPTER THREE

3 METHODOLOGY

3.1 System Analysis

'One sometimes finds what one is not looking for.' - Alexander Fleming

Introduction

As discussed earlier, for a model to appropriately guide design in our rural context its steps must be able to cater for design in a continually changing environment or community. With the continual impact of technology implementation on the technology gap in the rural areas; more than ever before, it is critical that the model we use accommodates this growing change. We have therefore adopted our new model – *'The Translating User Design Model'* to guide the research design process, even as we examine how it accommodates a continually changing environment as the backdrop of rural mobile applications interfaces design.

Steps in the activities of the design model are used to: identify unique characteristics and environments of participants/users, analyze this information in a multi-disciplinary design process[2] and finally develop a prototype to evaluate and test the findings arising from this research.

a) Population Sampling

Participants included in the sample are selected from two rural farming communities in rural Kambu[3] and Kiangwaci[4] in Kenya. The two groups consist of mainly of horticultural farmers and those involved in farming Jatropha and other arid land crops for example pigeon peas. The horticultural farmers who come from Kiangwaci will generally be economically better off than the arid land farmers and also, more literate. This is partly due to their proximity to markets for their produce and thus, are able to glean higher incomes than their counterparts in Kambu thereby affording more. The variety will provide for the necessary control and richness in the data collected. Each group comprises of about 40 people who will include farmers and in addition so as to provide breadth of data;

[2] The design team comprise of ICT experts as well as Agricultural experts

[3] Kambu is located in the Eastern part of Kenya

[4] Kiangwaci is located in the Central Eastern part of Kenya

self-help group leaders, local agricultural extension officers, community social workers and administrators. A study with these additional persons in the sample will provide information that will help in understanding how underlying agricultural practices, social factors, cultural issues and legislative issues affect the sample population. The two geographical locations are chosen because of the rich diversity they offer, not just in cultural differences, but also in the environmental and socio-technical variety.

3.1.1 Inspiration Stage

During this activity, the researcher seeks to achieve two goals. Firstly, to gain the trust of the participants through exploration of their working practices and by studying their goals, values, and needs. Secondly, to get additional contexts, by examining the visual and textual sources used in practice (Nikolova-Houston, T. 2008)

a) Overview

In order to attain the two goals, it is critical that ample time is spent in close interaction with the participants. Consequently field studies have been conducted.

During this study period, we visited various farmers explained the reason for our visit, talked over with them about their various challenges and needs as well life in the village as a whole. In addition, we took part in various local activities like assisting the hosting families in cooking, fetching water, farm work like harvesting, packing, among others. We were able to observe them in their normal day to day farming/work practices and also get a feel of their needs from our dialogues with them.

b) Field work

At the Inspiration stage of this research, field work was done where initial data was collected from the 76 respondents from the two rural communities i.e. Kiangwaci and Kambu. This field was done using 3 different methodologies; contextual inquiries, observation as well as semi-structured questionnaires.

- ***Contextual inquiries – Observation***

  Contextual inquiry involves collecting detailed information about customer work practice by observing and interviewing the user while they actually work. The researcher should stay in the background and let the user lead the situation as much

as possible. This means that researcher tries to form a partnership with customer, i.e., learning (but not doing) as an apprentice while the customer is the master of the work. This helps the researcher understand the customer's work. The goal is to understand how and why something is done or why something is not done (Wikipedia 06.03.2008)

- We spent three (3) days each at each locality observing the respondents in their every day like. We found it necessary to live in the village as opposed to boarding in a hotel room so as to ensure that we would capture the social and cultural environments of the respondents through out the day. This immersion is important since it allowed the researcher to be participating in the respondents' every day activity and capture the user context. The researcher also used this period to gain the trust and participation of the respondents ensuring the possibility of working together as a team in all the subsequent stages of this work.

- ***Semi-structured questionnaires***

A structured interview (also known as a standardised interview or a researcher-administered survey) is a quantitative research method commonly employed in survey research. The aim of this approach is to ensure that each interviewee is presented with exactly the same questions in the same order. This ensures that answers can be reliably aggregated and that comparisons can be made with confidence between sample subgroups or between different survey periods.

In this case, the data is collected by an interviewer rather than through a self-administered questionnaire. Interviewers read the questions exactly as they appear on the survey questionnaire. The choice of answers to the questions is often fixed (close-ended) in advance, though open-ended questions can also be included within a structured interview. A structured interview also standardises the order in which questions are asked of survey respondents, so the questions are always answered within the same context (Westburn 2002).

- Having gained the trust of the respondents, we undertook an in-depth interview using semi structured questionnaires. The questionnaires were designed with both open ended and closed questions focussing on the demographics, family life, farming processes and activities, farming challenges, exposure to ICT and finally, exposure, access and use of mobile

phones. Attached is the full questionnaire as was used during this stage [see appendix A].

The results helped us to understand and conceptualize key target user characteristics and ethnographic issues and also provided rich data for the consequent inspiration activity.

3.1.2 Discovery Activity

During this activity, the focus is to generate and describe interesting hypotheses about the progressively changing rural environment. Inspiration for the hypotheses is drawn from studying the user context data collected during the field studies of the inspiration stage as well as study of related work.

After studying the user context transcribed from the field studies conducted, the results accumulated from the user context were summarized in a design report (see report in Chapter 4) which has been used at subsequent activities to guide design context.

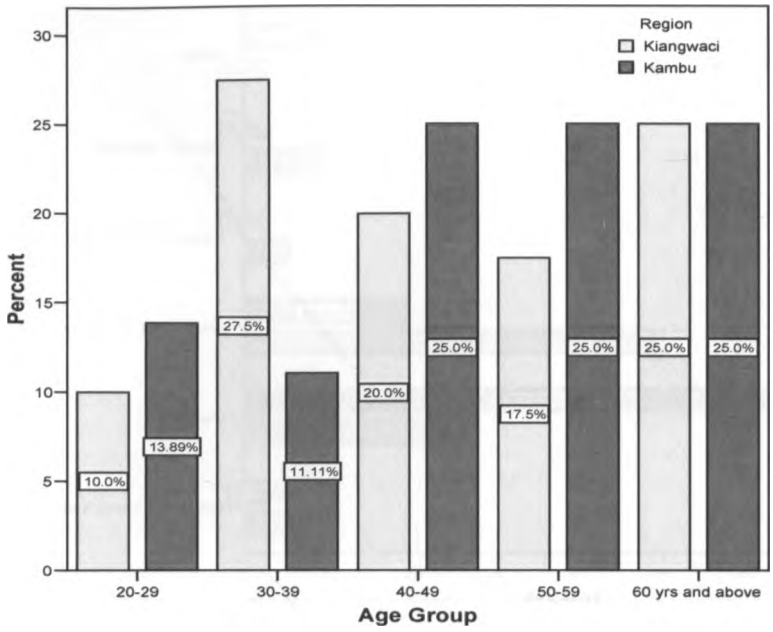
a) Data analysis

Analysis of data was done at two levels - at the individual and self-help group level using the SPSS software over a period of two weeks. The individual level offered data that was the background with which the initial design report was based upon. A further analysis at the group level was then done to aggregate and develop assumptions and generalizations with which the final design report with the design prototype requirements was based on. Related work was also studied and combined with the results arising from this analysis

I. Demographics

The target users/participants were rural farmers from Kiangwaci and Kambu - Ukambani. These are two very distinct towns – the former being in the central and fertile part of the country, the latter being in the eastern semi-arid area. Despite these environmental differences, the users seem to defy these localities in view of the close similarities in the relevant demographics.

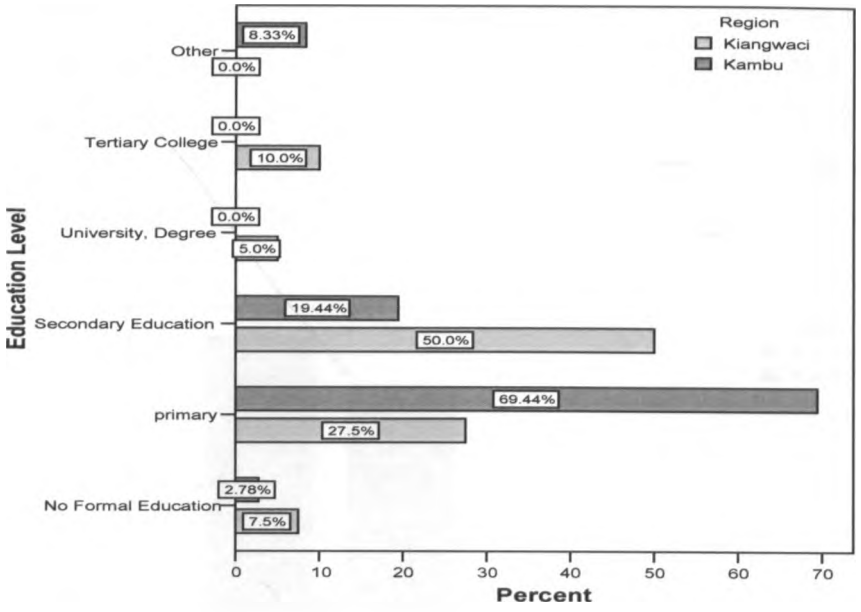
Looking at the analysis of the primary research data, the first notable thing is the age of the respondents. About half of the respondents in Kiangwaci – 42.5% are well above 50 years of age while in Kambu the number grows to 50% [Graph 3.1].



Graph 3.1- Age

This is indicative while trying to gauge the level of exposure to existing technologies as well as the willingness and ability to adapt to or adopt them. The probable reason for such an old population may be the movement of youth to urban areas in search of better opportunities.

It is very encouraging to note that at least 50% of the respondents in both localities have achieved primary school. However, only 20% in Kambu and about 50% in Kiangwaci have some level of secondary education. Only about 7.5% have had no formal education [Graph 3.2].



Graph 3.2 - Education

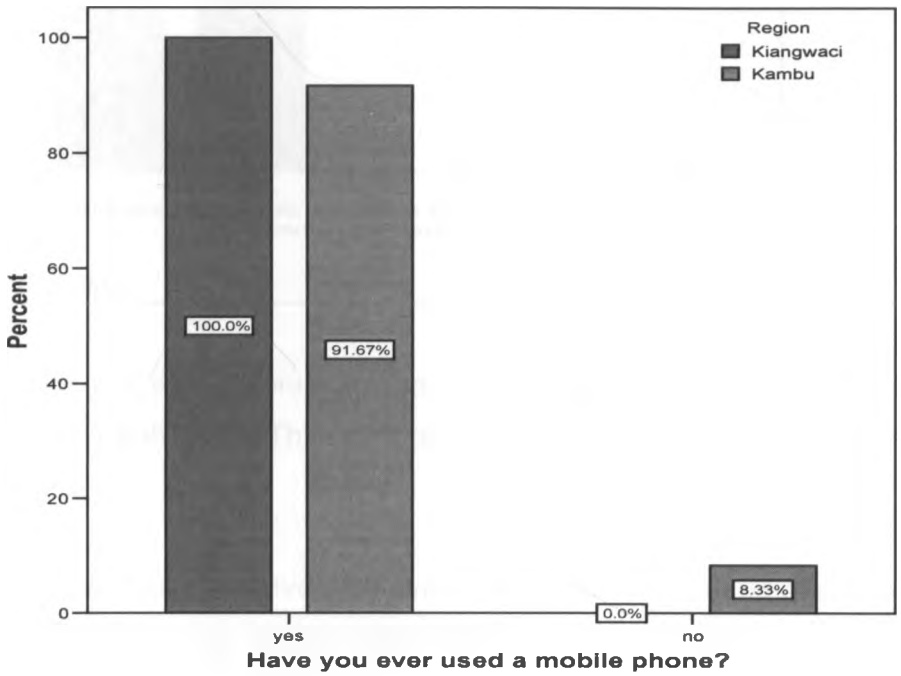
This clearly presents a challenge and opportunity to interface designers and developers. For one, the research reveals that despite these seeming good levels of education; only 8.8% in Kiangwaci and 6.3% in Kambu feel they can comfortably read English. As such, with the interface design, use of other languages other than English must be considered. In view of this, there is need for localization of mobile user interfaces to meet the unique needs of rural users.

II. Exposure to ICT

Even though about half of the respondents could be considered elderly – i.e. above 50 years of age, it is indicative to note that 97.5% of the respondents in Kiangwaci and 100% of those in Kambu indicate a strong interest in learning the use of Computers. Nevertheless, only a meagre 10% have actually used one.

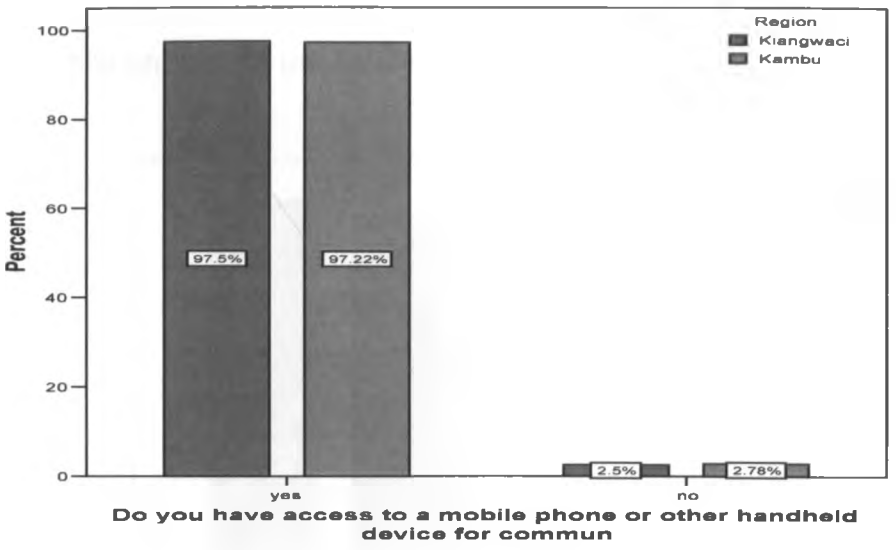
With such low numbers of the respondents having used a computer, it is clear that training in use of computer software must be done before even computer applications be useful and relevant. It also raises the challenge of user participation in the computer interface design. Clearly, without a mental picture of what the end result ought to be, then the user participation could become very limited.

When it comes to mobile user interface, since there is no prior experience with computer use, development of the interface cannot be done with expectation that the user will transfer knowledge from the computer applications priory used, to the mobile applications. Tasks in the mobile application interfaces can therefore not be designed with steps similar to their counterparts designed for PC based access.



Graph 3.3 – Mobile phone usage

Encouragingly, all the respondents in Kiangwaci have used a mobile phone while in Kambu at least 91.6% of the respondents have used one [Graph 3.3]. Further to this, analysis shows that accessibility to mobile phones is equally high, with ease of access in both localities being standing at 97% [Graph 3.4].

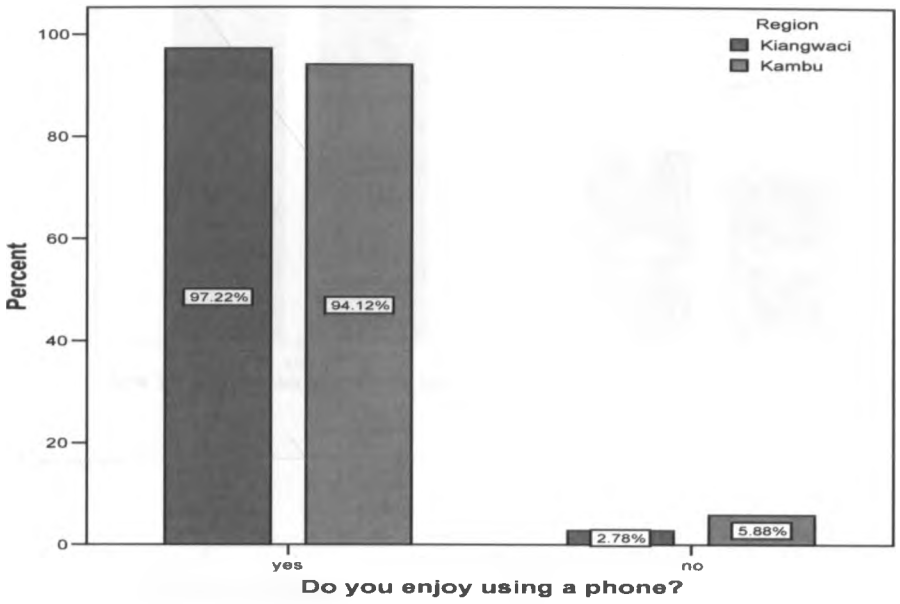


Graph 3.4 – Mobile phone accessibility

Moreover, a majority of the respondents in both areas indicate strong enjoyment while using a mobile phone [Graph 3.5]. This denotes ease of use and familiarity with the device.

Most of the mobile phones in use however are simple low end devices and are only mainly used to make or receive calls. Few of the respondents use them to access any services that have been availed. Nevertheless, most of the users indicate a high interest in the use of color, iconic legends, text interface and representational icons in that order. Numeric key interfaces seem to fare badly with only about 7.5% indicating a preference for them.
An interface that will be appropriate must therefore make use of the afore mentioned preferences. The main challenge that arises is the fact that most of the phones they use would not meet the interface technical requirements. Purchase of new phones that would be appropriate becomes a challenge in the face of disposable income. The respondents have a mean monthly income of ksh.6130 in Kiangwaci, with the amount dipping to ksh.3775 in Kambu. Moreover, the considered reasonable pricing of a phone is at approximately ksh.2000; which means that, purchase of a phone that would effectively launch an elaborately designed interface is beyond the purchasing power of an individual in these rural areas.
This informs that if a mobile application has been designed such that it would not be usable using the current mobile phones owned by rural users, then those proposing to

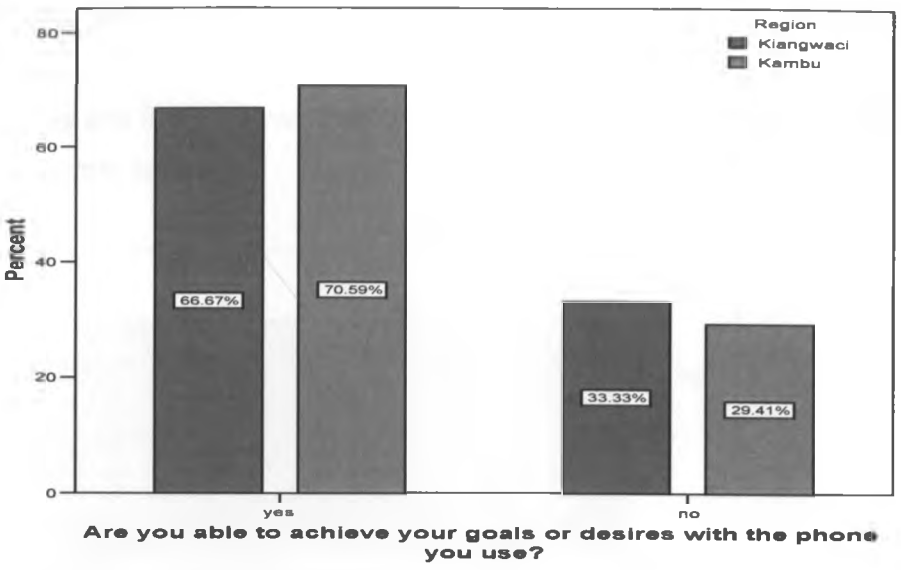
launch such application must prepare and make allocations for access and acquisition of new tools or mobile phones by the rural user.



Graph 3.5 – Enjoyment when using phone

III. Goals, Values and needs

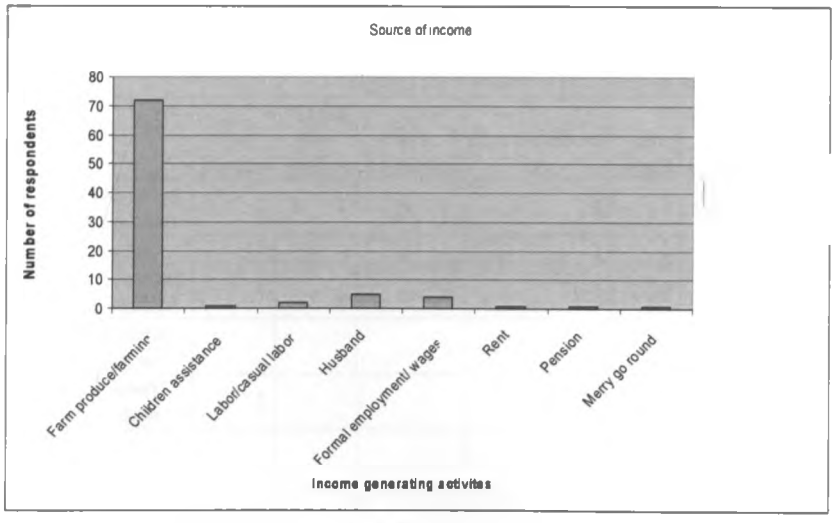
The needs for farmers in rural areas are many and diverse. At the heart of all issues however, is the ever pressing poverty. During the four day interaction time spent at the participants homes and in sharing their activity, it emerged that their goals are largely aimed at getting out of the poverty circle. Goals include accessing farming information and knowledge on modern farming practices, access to competitive markets as well as acquisition of negotiating power for better prices. It is very instructive to note that about 66% of the respondents in Kiangwaci and 70% of those in Kambu [Graph 3.6] feel that they would be able or are able to achieve these goals using a mobile phone.



Graph 3.6 – Goals achievement

b) Design Report – Key findings

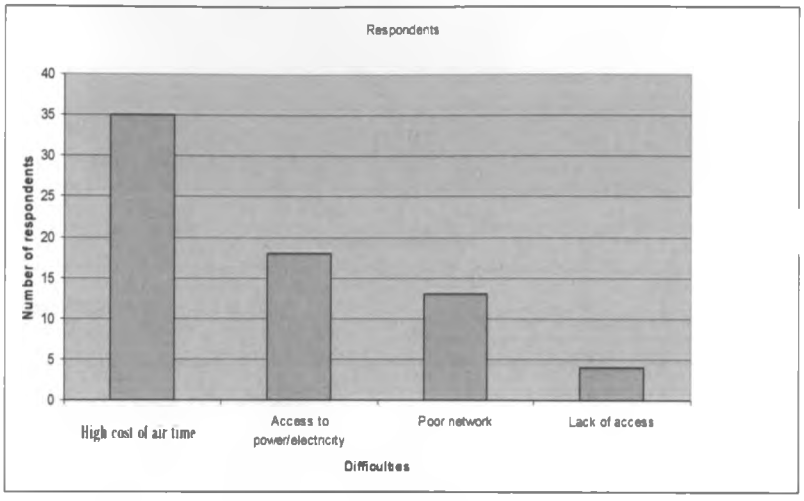
Three areas that address usability needs were identified and critical findings from the study were identified as instructive in guiding design of the prototype as follows:



Graph 3.7 – Main source of Income

a. Relevance (see graph 3.7 and graph 3.8)
   - Rural users value mobile applications that address current and relevant needs – Agriculture

- There is erratic connectivity – mobile applications should reduce/avoid need for this
- Incomes are low and rampant poverty – mobile application should require no or little cost to use



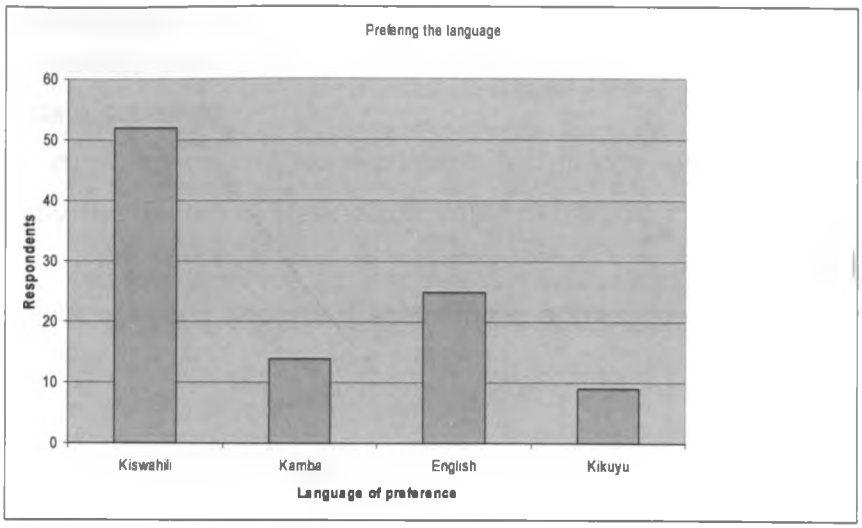
Graph 3.8 – Main difficulties associated with mobile phone usage

b. Usable (see crosstab 1 and graph 3.9)

		What kind of presentation on your phone would you like								Total
		Text interface	Numeric key interface	data organization	Representational icon	Icon legend	Colour	Language	Audio input output	
LEVEL:	No Formal Education		1		1	2	1			3
	primary	4			1	5	14	12	3	23
	Secondary Education	4	2	2	8	9	14	10	6	21
	University, Degree					2				2
	Tertiary College	3				1				3
	Other									
Total		11	3	2	10	19	29	22	9	52

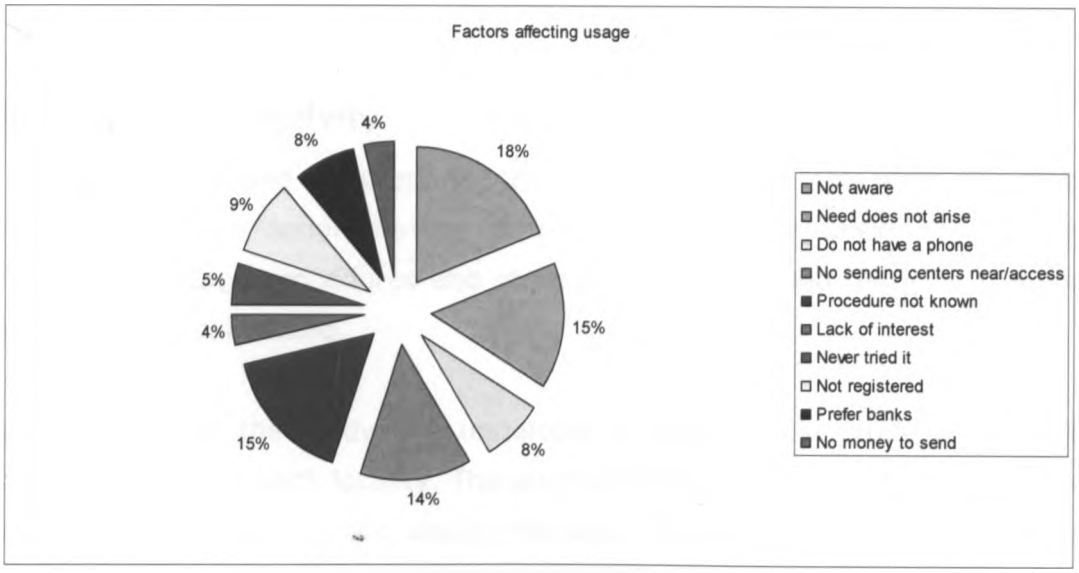
Crosstab 1– Type of interface desired

- Interface should be colored, with iconic legends
- Interface should be localized – use of Swahili or other local language
- Interface should flow with the farmer's way of doing things - i.e. should not alter his work process



Graph3.9– Language Preference

c. Well-adapted (see pie chart 1)
   - Mobile application should have help or information in a form that can be easily accessed and referenced in the future
   - Provide room for translation of the socio-technical network as a result of the implementation of mobile application



Pie Chart 1– Language Preference

c) Generated Hypotheses

Following this activity, the following five hypotheses were generated arising from the analysis of the data collected.

- **H1:** The rural community/environment technology gap is not being continually changed by the impact of technology implementation

- **H2:** It is not critically important that mobile applications designed are well adapted to rural users

- **H3:** Mobile user interfaces need not be unique to specific contexts of use

- **H4:** Existing design methodologies do not address the unique needs of the rural user and therefore new models need to be developed or adapted from existing ones to guide mobile user interface design

- **H5**: Proliferation of mobile phones in rural communities does not mean active use or demand

These hypotheses are the guiding questions for the consequent activity.

3.1.3 Evaluative Design Activity

This activity is mainly focused on preparing the setting for the tests that can inspire overall mobile user interface design. Having come up with the initial design report, it was necessary to develop design procedures and strategies that focussed more on the social structure than the technical setting.

To facilitate this stage of the study, we undertook a second field study and spent a maximum of two (2) days at each locality. The purpose of this study was to give the users the opportunity to participate in the design process. Participants were provided with various ICT products, i.e, a laptop, PC, Camera, and IPOD along some mobile phones.

The aim of this exercise was to give the participants the chance to explore and evaluate each artefact, focussing on its user interface strengths and weaknesses. Participants were

encouraged to share about their negative and positive experiences with the artefacts. As we observed them during this activity and drew following key basic generalizations:

- Most rural users are frightened when handling a new / unfamiliar technology tool
- Younger people are more eager to test and explore new technology tools
- Older people describe in better details their experience with technology tools
- Youthful persons would rather not discuss their experience with a new tool than appear un-informed.
- The easier to use a tool, the more it was perceived as good and useful and the more users were willing to learn more about it.

Having made this observations, we then developed an additional set of prototype requirements with was included in the initial report to make the final design report informing the development of the prototype. The evaluative design activity including the field trip took a total of six weeks to complete.

With the hypotheses testing requiring exploration of specific aspects of the progressively changing rural environment, design prototypes were decided upon as the test platform.

3.1.4 Social-Technical Tests

The socio-technical test is where the hypotheses are tested by testing a stage socio-technical environment (Hansen, T.R 2006). Design prototypes which are a common way of representing technology in socio-technical scenarios were used in developing the prototype in this research. The critical thing in the social-technical tests is to incorporate the hypotheses in the test so that the basic assumptions in the hypotheses are challenged (Hansen, T.R 2006).

With the design report ready, we did a rapid prototype of a mobile user interface for a mobile application providing farming information to farmers; to enable us to test the social-technical environment as well as the ability of the new model to handle a continuously translating environment. Additionally, the design prototype was also used to test the above mentioned hypotheses in a social-technical environment so that the basic assumptions in the hypotheses could be challenged.

The design prototype was rapidly developed using Netbeans IDE over a period of two months. The researcher undertook to search and develop localized icons and iconic

legends in addition to using the Kiswahili language as a form of localization. Since respondents indicated a strong preference to coloured screens, a generalized assumption that green screens often found with low entry phones are not appreciated. As such, the prototype design was aesthetically interspersed with various colours often seen in their locality e.g. greens, yellows and browns on simple screens with clear text colours like black.

Picture 1–Researcher demonstrating prototype

The researcher then undertook another field trip in order to carry out the above tests. We spent two days each at each locality and presented the design prototype. Users were allowed to use the prototype and have a feel of it. Many questions were asked by the researcher during an observation period in which the researcher sought to view the impact of the interface on the users' context.

Picture 2– part of Socio-technical test group

As with the Inspirational activity, the researcher undertook a product survey after they had used the prototype, using a semi-structured questionnaire [see Appendix B]. This was done to get same context statistical data on the prototype evaluated.

Picture 3– Researcher demonstrates using a mobile phone emulator

Analysis of the entire social-technical tests over a period of three weeks, with the interview data being analysed using SPSS software.

3.1.5 Transforming Evaluations

With every implementation of some aspect of ICT in our rural areas, the socio-technical environment is affected and thus translates and continues doing so as the users get familiar with technology and consequently encourage others to use that technology. It is for this reason that evaluations done must be able to capture this progressively changing environment.

This activity then is a transforming activity, designed to ebb and flow with the rural environment.

Normally in the evaluation stage, an experiment is evaluated and conclusions summed up. With this activity however, the experiment is evaluated and the results are summarised in a set of reflected hypotheses. This evaluation is guided both by the designer's observation and feedback from the user. There is continuous evaluation of the design techniques and prototyping techniques used during design and for the evaluation of design solutions. This gives us and the target users a broader and better understanding of what an end product should ultimately achieve.

In order to evaluate the design model and test the hypotheses, a third field trip was undertaken. This process was done through the use of assisted evaluations. We observed the users as we led them through the entire use of the product and later undertook questionnaires with 25 respondents with responses weighted on a likert scale moving from strongly agree, agree, disagree, to strongly disagree. Guided both by the researcher's observation and feedback from the user we analysed the results and summarised them as follows.

Table 1 shows the respondents expected performance after use of the mobile application.

Majority of the respondents strongly agree that the system has made their tasks easier and faster whereas 4.2 percent disagree, 4.0 percent did not state their views. Almost all the respondents 91.7 and 8.3 percent agreed that they find the system useful to them only 4.0 percent did not state their opinion.

Table 1: performance expectancy

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
Using the system makes me accomplish tasks more quickly	17(70.8%)	6(25.0%)	1(4.2%)	0	1(4.0%)
I find the system useful to me	22(91.7%)	2(8.3%)		0	1(4.0%)

Table 2 below displays the expected effort of the respondents during the evaluation. While 42.15 percent of the respondents strongly agree that learning how to operate the system was easier for them 21.1 percent of them disagree. According to 52.6 percent of the respondents, their interaction with the system was clear and understandable however, 4.0 percent strongly disagree. Most, 57.9 percent of the respondents strongly disagree that working with the system is complicated and difficult to understand, 10.5 percent of them strongly disagree. Finally, 57.9 percent of the respondents strongly disagree that it takes too long to learn how to use the system to make it worth the effort, 10.5 percent strongly disapprove of that statement.

Table 2: effort expectancy

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
Learning to operate the system was easy for me	8(42.15)	7(36.8%)	4(21.1%)	0	6(24.0%)
My interaction with the system is clear and understandable	10(52.6%)	7(36.8%)	1(4.0%)	1(4.0%)	6(24.0%)
Working with the system is complicated, it is difficult to understand what's going on	2(10.5%)	3(15.8%)	3(15.8%)	11(57.9%)	6(24.0%)
It takes too long to learn to use the system to make it worth the effort	2(10.5%)	5(26.3%)	1(5.3%)	11(57.9%)	6(24.0%)

In table 3 below we see the social and cultural influences on the application usage. Most

of the respondents, 80.0 percent, strongly agree that people who are important to them think they should use the system whereas 4.0 percent disagree. While 72.0 percent of the respondents strongly agree that people who influence their behaviour think that they should use the system, 8.0 percent of the respondents strongly disagree. Eighty four percent of the respondents strongly disagree that cultural practices around them discourages the use of the system, but 4.0 percent strongly agree. Most of the respondents 84.0 percent strongly disagree that their status in society discourages them to use the system, however, 12.0 percent strongly agree. Finally, 72.0 percent of the respondents strongly agree that using the system enhances their image among their peers and society whereas 4.0 percent strongly disagree.

Table 3: social and cultural influence

Category label	Strongly agree	Agree	Disagree	Strongly Disagree
People who are important to me think I should use the system	20(80.0%)	4(16.0%)	1(4.0%)	
People who influence my behavior think I should use the system	18(72.0%)	4(16.0%)	1(4.0%)	2(8.0%)
Cultural practices around me discourages the use of the system	1(4.0%)	2(8.0%)	1(4.0%)	21(84.0%)
My status in society does not encourage me to use the system	3(12.0%)	1(4.0%)	0	21(84.0%)
Using the system enhances my image among my peers and society	18(72.0%)	6(24.0%)	0	1(4.0%)

We now look at the facilitating conditions on the use of the system in table 4. While 43.5 percent of the respondents strongly agreed that they have control over the system, 8.0 percent of them strongly disagreed. A third of the respondents agreed that they have the resources necessary to use the system whereas 4.0 percent strongly disagreed. Most respondents, 31.8 percent strongly agreed that they have the knowledge necessary top use the system but 27.3 percent of the strongly disagreed. Finally, 45.5 percent of the respondents strongly agreed that they get help whenever they need to know more on using the system, 13.6 percent of them strongly disagree.

Table 4: facilitating conditions

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
I have control over using the system	10(43.5%)	8(34.8%)	1(4.3%)	4(17.4%)	2(8.0%)

I have the resources necessary to use the system	7(29.2%)	8(33.3%)	7(29.2%)	2(8.3%)	1(4.0%)
I have the knowledge necessary to use the system	7(31.8%)	6(27.3%)	3(13.6%)	6(27.3%)	3(12.0%)
I get help whenever am in need to know more using the system	10(45.5%)	7(31.8%)	2(9.1%)	3(13.6%)	3(12.0%)

Prevailing personal attitudes have an impact on users' acceptance and table 5 below shows the respondents' attitudes towards using technology. Majority, 91.7 percent of the respondents strongly agreed that using the system is a good idea whereas 4.2 percent of them disagreed. Almost all 96.0 percent of the respondents strongly agreed that they like the idea of using the system, only 4.0 percent of them did not state their opinion. Furthermore, 95.8 percent of the respondents strongly agreed that they enjoy using the system whereas 4.0 percent did not state their opinion. Finally, 95.7 percent of the respondents strongly agreed that they always look forward to using the system but 8.0 percent of the respondents did not state their opinion.

Table 5: attitudes towards using technology

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
Using the system is a good idea	22(91.7%)	1(4.2%)	1(4.2%)		1(4.0%)
I like the idea of using the system	24(96.0%)				1(4.0%)
I enjoy using the system, it's fun	23(95.8%)	1(4.2%)			1(4.0%)
I always look forward to going to use the system	22(95.7%)	1(4.3%)			2(8.0%)

We analyse further the respondents' behavioural intention to use the system in table 6 below. Ninety two percent of the respondents strongly agree that they intend to use the system. Furthermore, 76.0 percent of the respondents strongly agree that they will always use the system to do their tasks whereas 4.0 percent of the respondents disagree. Thirty six percent of the respondents strongly agree that they feel anxious using the system, but 28.0 percent of the respondents strongly disagree with that statement. Sixty four percent of the respondents strongly disagree that they are not scared losing information while using the system whereas 4.0 percent of the respondents strongly agree. Finally, more than half 58.3 percent of the respondents strongly agree that they have hesitations to use the system for fear of making mistakes whereas 4.2 percent of

them strongly disagree.

Table 6: behavioural intention to use the system

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
I intend to use the system	23(92.0%)	2(8.0%)			
I will always use the system to do my tasks	19(76.0%)	5(20.0%)	1(4.0%)		
I feel anxious using the system	9(36.0%)	6(24.0%)	3(12.0%)	7(28.0%)	
I am scared to lose data and information using the system	1(4.0%)	4(16.0%)	4(16.0%)	16(64.0%)	
I have hesitations to use the system for fear of making mistakes	1(4.2%)	7(29.2%)	2(8.3%)	14(58.3%)	1(4.0%)

In table 7 below, we look at the impact of political institution on the use of the system - a measure often overlooked. Eighty percent of the respondents strongly disagree that people in authority within their community discourages them from using the system, whereas 8.0 percent of them strongly disagree. Most of the respondents, 40.0 percent strongly disagree that there is support from the government to use the system but 36.0 percent of them strongly disagree. Finally, 37.5 percent of the respondents strongly agree that there is easy access to use the computers and internet, only a quarter, 25.0 percent strongly disagree.

Table 7: impact of political institution/infrastructure

Category label	Strongly agree	Agree	Disagree	Strongly Disagree	Not Stated
People in authority within my community discourage me from using the system	2(8.0%)		3(12.)	20(80.0%)	
There is support from the government to use technology	9(36.0%)	5(20.0%)	1(4.0%)	10(40.0%)	
There is easy access to me to use computers and internet	9(37.5%)	8(33.3%)	1(4.2%)	6(25.0%)	1(4.0%)

Finally we look at the influence of the finance on the respondent's use of the system. As shown in table 8 below, sixty percent of the respondents strongly disagreed that using the system is a financial burden to them due to transport and access fees, whereas 12.0 percent strongly agree. Finally, 52.0 percent of the respondents strongly disagree that using the system is a burden to them as they need further training which is costly

however, 20.0 percent of them strongly disagreed.

Table 8: financial factors

Category label	Strongly agree	Agree	Disagree	Strongly Disagree
Using the system is a financial burden to me due to transport and access fees	3(12.0%)	3(12.0%)	4(16.0%)	15(60.0%)
Using the system is a burden to me as I need further training which is costly	5(20.0%)	5(8.0%)	5(20.0%)	13(52.0%)

3.2 SYSTEM DESIGN

'It's far more important to know what person the disease has than what disease the person has.' – Hippocrates

Introduction

As mentioned in systems analysis, design prototypes are a common way of representing technology in socio-technical scenarios and were used in developing the prototype for this research.

In order to inform the design of this test prototype, the user context transcribed from the field studies conducted and the results accumulated from the user context were studied and summarized in a design report. The design report also includes a set of prototype requirements that will facilitate the process of prototyping. The design report guides the design of procedures or strategies that focus more on the social structure than the technical setting. They are as follows:

3.2.1 Design requirements

Often with mobile interface design, designers and developers assume prior experience with computers. Development is therefore done with expectation that the user will transfer knowledge from the computer applications priory used, to the mobile applications. As such, many tasks in mobile application interfaces are designed with steps similar to their counterparts designed for PC based access. It is very instructive however to note that there is very little exposure to computers observed in all the respondents [see figures in 3.1 Systems analysis].
With most rural users in Kenya as demonstrated from this research, such misconceptions can cost severely the adoption of a mobile application, though it may be meeting the analysed needs of the users.

The design prototype after acknowledging the realities on the ground, must therefore address relevance, usability and adaptation to the rural user context.

a) Relevance

In a mobile environment, users have limited time and cognitive resources to spare for performing tasks. Seeing that mobile applications for rural users target a user

group that must find time value and use value for the application, the interface must not only take this point into consideration, but enhance it for this use context. Menu progression needs to be mapped to the social environment of a user for example the fact that mobile phones are commonly shared in rural areas in the processing of the same single task. When relevance is seen, it enhances acceptance of an application and thereby adoption

- Rural users value mobile applications that address current and relevant needs – Agriculture
- There is erratic connectivity – mobile applications should reduce/avoid need for this
- Incomes are low and rampant poverty – mobile application should require no or little cost to use

b) Usability

Usability of the mobile application through its interface is critical in bringing about ease of acceptance and willingness to use of an application.

The most critical factor towards usability in this local rural context is the need for localization of various facets of the user interface. Use the computer WIMP icons and iconic legends that are unfamiliar to rural users who have no prior computer experience may hinder the usability of the application. Additionally, some icons may be interpreted differently as influenced by the local culture. Localization therefore will cover; icons used, to develop icons that rural users will identify and interpret properly, colour of the designed product i.e. the various colours on the interface, to address any cultural inhibitions or interpretations of certain colours as well as use language that they can flow with for example Kiswahili [see next chapter for discussion on language of preference]. How usable the interface is will encourage exploration of a mobile application and thereby encourage use and critically, ease the learning curve.

- Interface should be colored, with iconic legends
- Interface should be localized – use of Swahili or other local language
- Interface should flow with the farmer's way of doing things - i.e. should not alter his work process

c) Adapted to Context

How easily and quickly users adapt to a mobile application is greatly impacted by their confidence in using it. Simple menu structures ease navigation and enhance use confidence. Moreover, beyond just ensuring that the structures are simple, it is important that menus are also straightforward to use i.e. the next step or the flow of steps should follow the anticipated process of the users. Not only will this enhance application literacy, but it also ensures ease of use and negates fear of the application leading to increase use confidence.

- Mobile application should have help or information in a form that can be easily accessed and referenced in the future
- Provide room for translation of the socio-technical network as a result of the implementation of mobile application

d) Implementation

As with all software developments, it is critical with the rural users that there is a seamless system to interface implementation. The underlying application needs to be totally transparent to the user interface so that the rural user does not feel that they have to deal with complicated technology. Technology thus is viewed as a friend and not a frightening adversary. Beyond this challenges like limited bandwidth in some rural areas must be put into consideration.

e) Testing

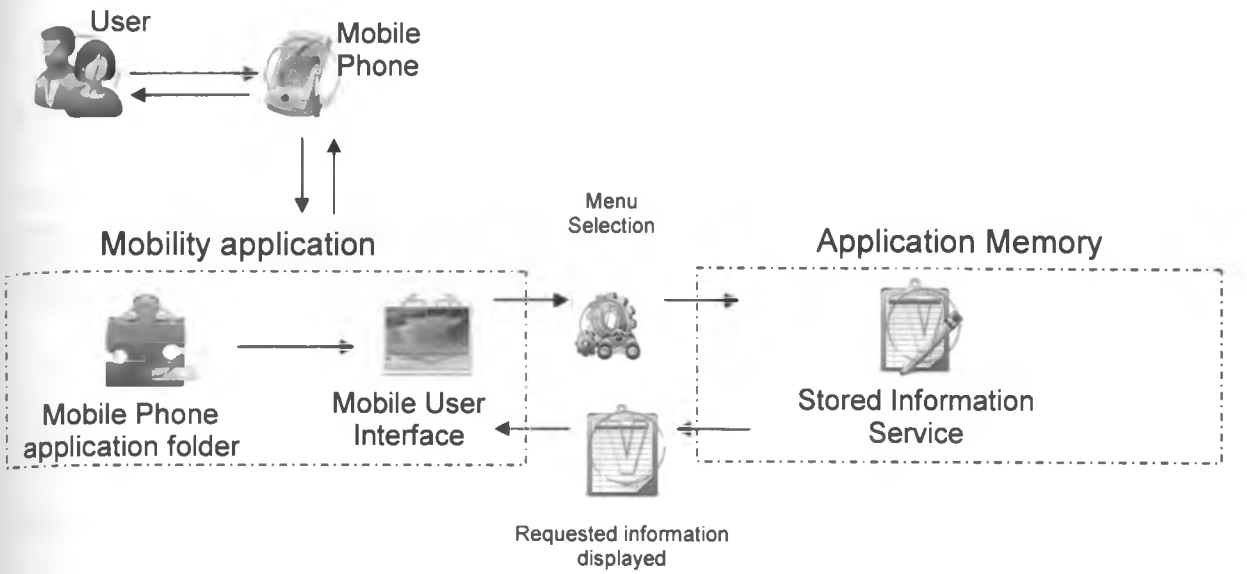
It is important to this research to consider two key issues during testing of the design prototype. At the testing stage of this prototype, it is the social-technical network that will be tested and not the technology itself. Additionally, the translated social-network after implementation requires assessment as well as how the research design is supporting the continually translating social technical network, with each implementation.

Product Design

A mobile application to provide farming information is designed for this project purposes. The application is expected to store various intervention strategies for use by farmers as follows: diseases affecting the crops, how to avoid bad weather conditions that destroy crops, crop pests and marketing information. For the prototype design, information has been restricted to intervention strategies for crop pests and diseases. This prototype is

also form the basis for testing the Translating User Design Model, as well as the hypotheses generated through designing an interface to the application attempting to meet the above usability requirements.

Figure 3– Product design



3.2.2 Development platform

The Netbeans IDE (Integrated Development Environment) was selected for the design of the prototype for its ability to quickly aid rapid prototyping. In addition, Netbeans IDE and Netbeans platform are based on software from netbeans.org which has be dual licensed under the common development and distribution license (CDDL) and the GNU general public license (Netbeans 2008).

Some of the key features of Netbeans IDE that lend to its suitability for the project are:

- Neatbeans Java ME (Java Micro-Edition platform, which was developed for small devises like mobile phones) supports Connected Limited Device Configuration (CLDC) which is for devices with less memory and processing power than CDC-based devices (Connected Device Configuration which is for devices with much greater memory, processing power and network connectivity like smart phones) (Netbeans 2008). As discussed earlier, the mobile phones in use in the rural areas are low entry level phones and this platform is relevant in addressing this development challenge.
- Netbeans IDE also includes Visual Mobile Designer Custom components – a feature that is critical in aiding rapid prototyping (Netbeans 2008).

- Netbeans IDE also supports designing applications for multiple devices (Netbeans 2008).

Netbeans has other interesting features like the ability to create rich content applications as well as web connected applications (Netbeans 06.03.2008), but they are not relevant to this project at this stage.

3.2.3 Product

Source

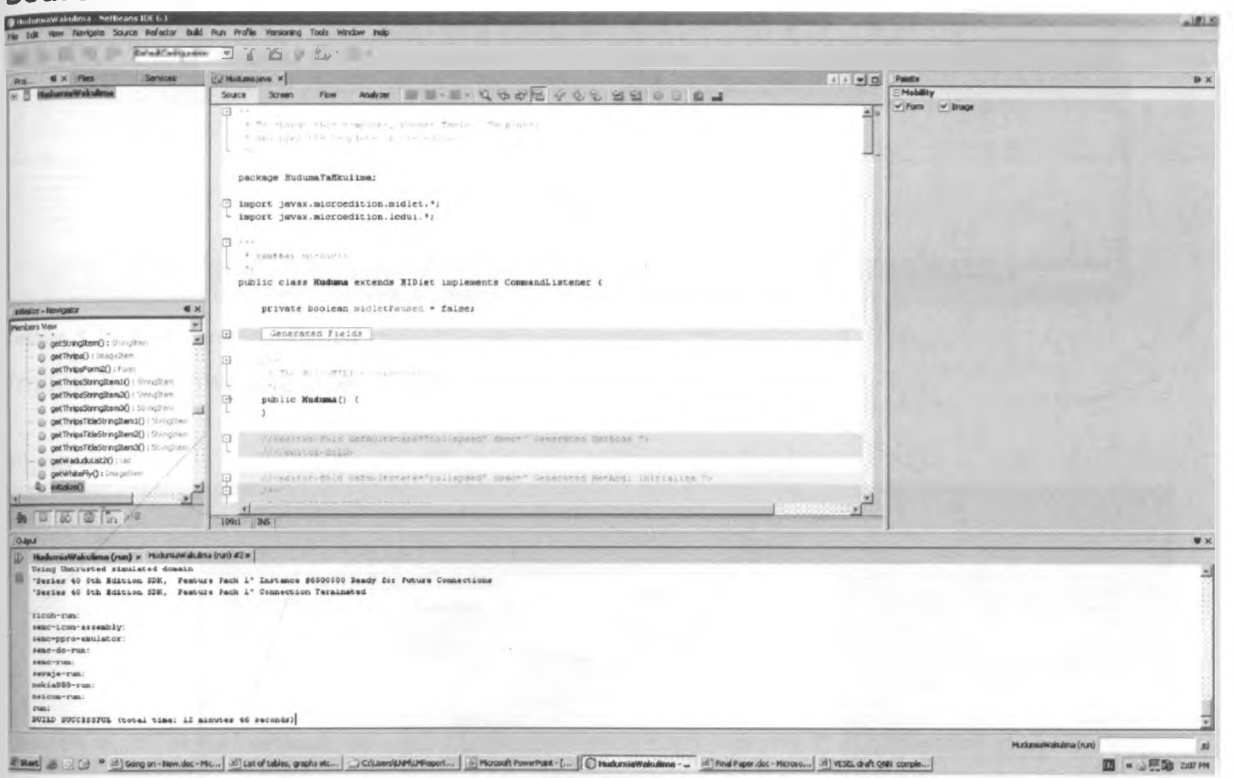


Image 3.1 - Source

Following this screen capture of the source code, image 3.2 shows the mobile user interface design.

Screen

Image 3.2 – User Interface Design

Image 3.3 shows the user interface flow design.

Flow

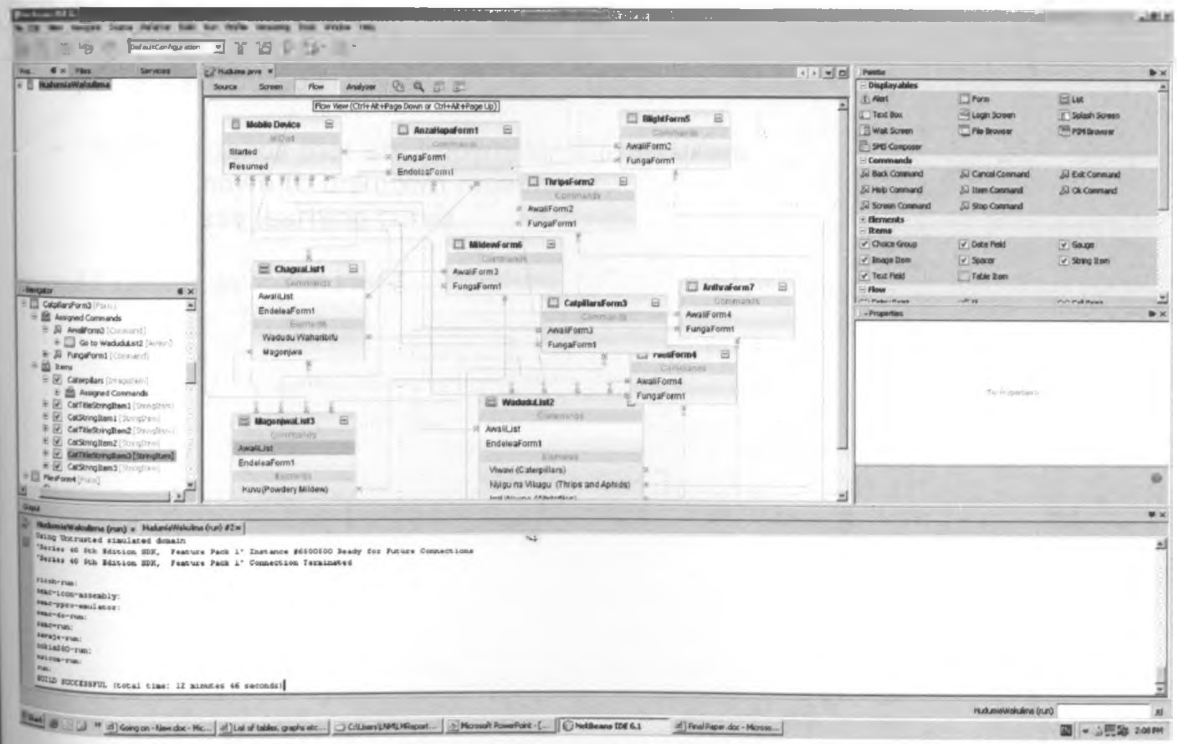


Image 3.3 – Interface Flow Design

Application

Image 3.4 – Mobile Application View 1

- Menu progression mapped to social environment of user
  - Create relevance, acceptance, adoption

- Use option of Kiswahili language
  - Encourage exploration of app,
  - encourage usage

- Iconic legends that are known/familiar to users
  - Known to unknown movement,
  - Ease learning curve

Image 3.5 – Mobile Application View 2

- Simple menu structure
  - Ease navigation
  - Enhance use confidence

- Straight-forward menus
  - Enhances literacy, ease of use,
  - Negate fear of app, increase confidence

- Seamless system to interface to transparency to user
  - Technology a friend not frightening adversary

CHAPTER FOUR

4 RESULTS AND DISCUSSIONS

'When you can measure what you are speaking about and express it in numbers, you know something about it. But when you cannot measure it, when you cannot express it in numbers, your knowledge is of an unsatisfactory kind: It may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of Science.' -Lord (William Thompson) Kelvin.

4.1 Introduction

In chapter three, we discussed the importance of using a relevant model to appropriately guide design in our rural context, which must be able to cater for design in a continually changing environment or community. We observed that there is a continuous impact of technology implementation on the technology gap in the rural areas; leading to a socio-technical environment in the rural areas that is continually translating. To capture and accommodate these unique aspects of design in the rural areas, we adopted our new model – *'The Translating User Design Model'* to guide the research design process. In the discovery activity, we generated a set of 5 hypotheses arising from analysis of field work done in the inspiration activity. In this chapter, we look at the results of the transforming evaluations stage that sought to evaluate the *Translating User Design Model* and test the hypotheses.

4.2 Evaluating the Design Model

The 6 C's framework condensed from the Pro-poor ICT's framework (UNCTAD 2006) has been used to evaluate whether the *Translating User Design Model* is pro-rural users and therefore appropriate for design of mobile applications targeted to them. It has been analysed within the user acceptance parameters (Venkatesh V. et al 2003) to assess its ability to guide the design process to meet usability needs of a mobile application targeted to rural areas.

- The 6 C's parameters used in evaluating if the model is pro-rural users are as follows: (UNCTAD 2006)
  - Context
  - Continuity
  - Content
  - Commerce

- Community Control

- They have been analyzed within the User Acceptance parameters (Venkatesh, et al 2006) as follows:
  - Performance Expectancy
  - Effort Expectancy
  - Social Influence

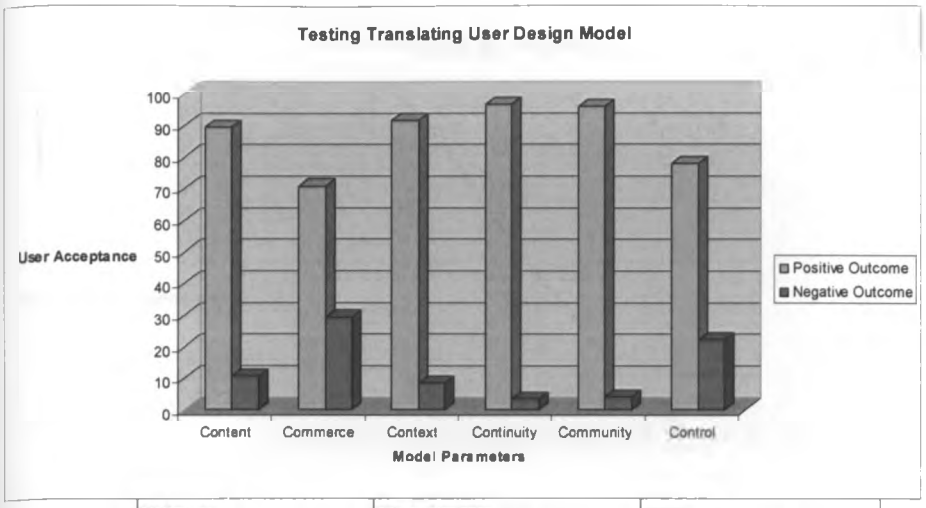
Results from the transforming evaluations were mapped into a matrix with questions that were asked being mapped to the user acceptance parameters requirements. The resultant matrix is shown in figure 3 below.

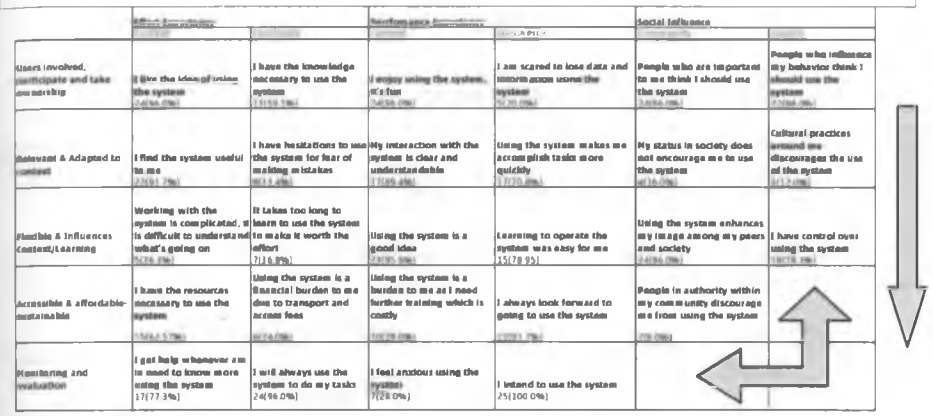
Evaluation Matrix

	Effort Expectancy		Perrfomance Expectancy		Social Influence	
	Context	Continuity	Content	Commerce	Community	Control
Users involved, participate and take ownership	I like the idea of using the system 24(96.0%)	I have the knowledge necessary to use the system 13(59.1%)	I enjoy using the system, it's fun 24(96.0%)	I am scared to lose data and information using the system 5(20.0%)	People who are important to me think I should use the system 24(96.0%)	People who influence my behavior think I should use the system 22(88.0%)
Relevant & Adapted to context	I find the system useful to me 22(91.7%)	I have hesitations to use the system for fear of making mistakes 8(33.4%)	My interaction with the system is clear and understandable 17(89.4%)	Using the system makes me accomplish tasks more quickly 17(70.8%)	My status in society does not encourage me to use the system 4(16.0%)	Cultural practices around me discourages the use of the system 3(12.0%)
Flexible & Influences Context/Learning	Working with the system is complicated, it is difficult to understand what's going on 5(26.3%)	It takes too long to learn to use the system to make it worth the effort 7(36.8%)	Using the system is a good idea 23(95.9%)	Learning to operate the system was easy for me 15(78.95)	Using the system enhances my image among my peers and society 24(96.0%)	I have control over using the system 18(78.3%)
Accessible & affordable-sustainable	I have the resources necessary to use the system 15(62.57%)	Using the system is a financial burden to me due to transport and access fees 6(24.0%)	Using the system is a burden to me as I need further training which is costly 10(28.0%)	I always look forward to going to use the system 22(91.7%)	People in authority within my community discourage me from using the system 2(8.0%)	
Monitoring and evaluation	I get help whenever am in need to know more using the system 17(77.3%)	I will always use the system to do my tasks 24(96.0%)	I feel anxious using the system 7(28.0%)	I intend to use the system 25(100.0%)		

Figure 3: Evaluation Matrix

Two matrix indices within each of the 6 C's parameters in the 3 user acceptance were then charted on a graph representing the applications impact on the users' ability to use it in order to analyze the performance of the design model. The results are as follows:





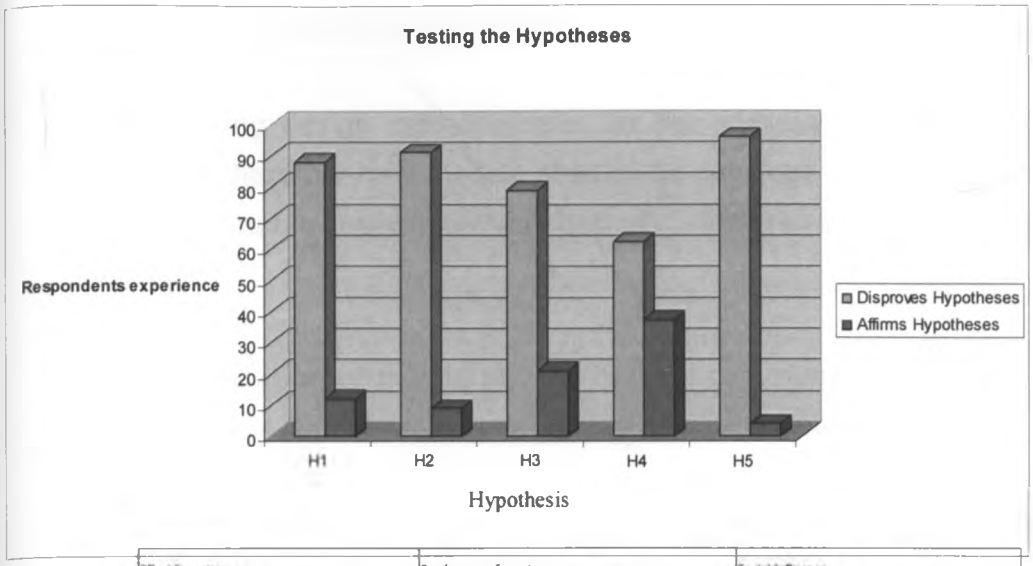
Evaluating Transforming User Design Model

Graph 10: Translating User Design Model

As shown in graph 10 above the positive outcomes arising from the user's interaction with the system validate that indeed, the Translating User design Model has been successful in guiding the design of a mobile application that is usable by rural users

4.3 Testing of the Hypotheses

The same evaluation matrix (see figure 3) was used in the testing of the hypotheses. In this case however, the user experience was matched against the user acceptance parameters. Two matrix indices along each of the five aspects of the three user acceptance parameters representing each hypothesis were then charted on a graph representing user's use experience the in order to analyze the hypotheses against what was experienced. The results are as follows in figure 4:



	Effort Expectancy		Performance Expectancy		Social Influence	
Users involved, participate and take ownership	I like the idea of using the system 24(96.0%)	I have the knowledge necessary to use the system 13(59.1%)	I enjoy using the system, it's fun 24(96.0%)	I am scared to lose data and information using the system 5(20.0%)	People who are important to me think I should use the system 24(96.0%)	People who influence my behavior think I should use the system 22(88.0%)
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Monitoring and evaluation	I get help whenever am in need to know more using the system 17(77.3%)	I will always use the system to do my tasks 24(96.0%)	I feel anxious using the system 7(28.0%)	I intend to use the system 25(100.0%)		

Testing Hypotheses

Figure 4: Testing the hypotheses

Based on these results, we can therefore conclusively that this study has disproved the hypotheses and we see that:

- **H1:** The rural community/environment technology gap is not being continually changed by the impact of technology implementation – ***they are being continually changed***

- **H2:** It is not critically important that mobile applications designed are well adapted to rural users – ***it is critically important***

- **H3:** Mobile user interfaces need not be unique to specific contexts of use - ***need to be unique to contexts of use***

- **H4:** Existing design methodologies do not address the unique needs of the rural user and therefore new models need to be developed or adapted from existing ones to guide mobile user interface design - ***there is need for relevant design models***

- **H5**: Proliferation of mobile phones in rural communities does not mean active use or demand - ***it indeed means active use or demand***

CHAPTER FIVE

5 CONCLUSIONS AND FURTHER WORK

'The only thing we know about the future is that it will be different.' -Peter Drucker

We have been able to validate that the Translating User Design Model is appropriate in guiding design for rural users in our local context. While this is a great achievement of this research work, several issues were observed that lend to further work in this area.

5.1 Achievements

This study has successfully met the three of the objectives that we set out to achieve at the beginning.

The Objectives of this study were as follows:

a) To gain a deep and expansive understanding of the diverse and unique needs and perceptions of the target users in the local rural context.
b) Based on the results, to identify usability methods that can be employed to inform a design framework relevant for rural users mobile interface development.
c) And finally, in order to examine the research findings, design and develop a mobile user interface to demonstrate the vital relevance of this research work.

Through an in-depth study of the two selected communities living in rural Kenya and a comprehensive analysis of the results in a multi-disciplinary process; we were able to identify usability methods which guided this study in developing a design framework designed for rural users in the local context. The resultant framework named the 'Translating User Design Model' was further used to evaluate and test findings arising from the research.

As we can see from the achievements listed below, this study has not only successfully met its objectives but has also opened more opportunities for further studies in this area.

- The greatest achievement of this research work has been the development and subsequent validation of a design model that is useful in guiding mobile application design in the rural context.

- We have also been able to demonstrate that due to the effects of the technology gap, the social-technical environment does not stabilize but rather, continues translating.

- Through the use of the 'Translating User Design Model' we have been able to establish that indeed, there is need to for a process that handles the transformations resulting in application implementation in rural areas.

- We have established that the translating user model meets this need effectively

- Finally we have established that Mobile application user interfaces need to be designed with the rural user context in mind to achieve usability and acceptance

From these stated points, we see that the research objectives have been met and the study has generated new hypotheses that may be examined as further work.

5.2 Future work

Having examined users during the entire research work, a number of issues come out. First is that users, typically interact briefly with an interface during testing and evaluation. This period is clearly too short to quantify evidence regarding how usable an interface is in the long term, hence the need for transforming evaluations. This would be able to capture how usability develops as the user spends more time interacting with an interface over time. Additionally transforming evaluations enable researchers and developers to know more about how measures of effectiveness and satisfaction (Hornbaek K. 2005) develop over time.

Results of a short usability study also need to be studied to examine if they remain comparatively the same over time. Other questions are bound to arise like whether usability measures may converge over time (Hornbaek K. 2005) and whether users are

able over time to compensate for most of the usability problems that lead to initial satisfaction.

From these assessments our research has demonstrated that it is not possible to walk away after the first evaluation straight into redesign of software. The evaluation is not a single task, but a continuing activity which transforms and translates with each translation in the social-technical environment. Clearly, various aspects of evaluation progressively impact other aspects in a social technical network and causes some new form of translation. Translating evaluations are seen here to effectively address this challenge in our rural environments. This in turn informs evaluation of the design methodology used as well as evaluation of the design techniques used and finally, evaluation of the design solution.

5.2.1 Reflected hypotheses for future work

Based on this results as well as reflections and discussions of the researcher and users, a new set of reflected hypotheses have been developed.

- H1: Ongoing translations in the rural environment have no substantial relevance to future interface developments

- H2: Users do not find it hard to use any kind of interface, provided they are able to learn how to use it

- H3: The time it takes to use an interface to accomplish a task is trivial in view of an application's usefulness

These reflected hypotheses are starting point for future work in this area of study.

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Appendix A – User Manual

Mobile Farm Support 1.0 - User Guide

Overview

MobiFarmSupp is an application MIDlet that runs on mobile phones. It is designed to work as a standalone mobile phone application. MobiFarmSupp runs on any J2ME enabled phone (CLDC 1.1 and MIDP 2.0) with storage facility like memory cards or in-phone memory. MobiFarmSupp does not need GPRS connectivity, as it contains a lightweight embedded database for storage. GPRS will only be needed to update the knowledgebase when there new changes.

Installation

The MobiFarmSupp runtime consists of two files that need to be copied to your phones application folder and then invoke the install action. MobiFarmSupp.jar is the java archive that contains the platform environment while MobiFarmSupp.jad is the application descriptor file that is needed during installation. MobiFarmSupp can be installed like any other java application on your phone, please refer to your phone documentation for specific installation instructions.

Phone Requirements

- Platform: Java (J2ME)
- CLDC version: 1.1, or higher
- MIDP version: 2.0, or higher

Launching MobiFarmSupp

MobiFarmSupp will be installed as a java application on your phone. You can launch MobiFarmSupp application, by going to your phone's Applications menu and selecting it by clicking on it.

On starting MobiFarmSupp, you will be shown a welcome page in the Kiswahili language introducing the purpose of the MIDlet (Image 1). The menu options on this page are all in the Kiswahili language. You may exit the application by selecting Funga on the menu options or proceed on to use the application by selecting Endelea.

Image 1

Using MobiFarmSupp

Once you have selected the option Endelea, the application opens up its main application menu with the options of looking up either crop pests or crop diseases. From this screen onwards, the phone selection options are both in Kiswahili and English (Image 2). The purpose being to train the user to recognize menu options written in English having presented the same in earlier screens in Kiswahili, through the process of familiarization.

Image 2

Selecting either menu option will provide the user with a list of the common pests and diseases, especially known to be troublesome. From the user may scroll up and down using the phone keys until he identifies the pest or disease of interest (Image 3). This crop pests and diseases are all listed in Kiswahili with the English name provided in brackets to aid in easier identification of the problem. Note that you may be able to go back to previous menu listings by clicking on the Awali option provided on the phone screen.

Image 3

Once a selection is made the use will now get a screen page discussing the pest or disease as well as available preventive measures available in the market that he could use to control the disease or pest (Image 4). Where the control measures are chemicals, the chemical application rates are explained and the crops to which these rates are applicable. Additional information is also given regarding the Pre-Harvest Interval to guide the farmer further about safely in the pesticide usage.

Image 4

Image 5

To access more information that is not directly visible on the phone screen, the user may scroll down with the phone keys and thus is able to read more. The screen remains on focus even when the phone goes on standby, locks the screen or initiates a screen saver. As such, when the user unlocks the screen, the same screen is still available for use.

The user may exit the application by going back to the main menu and selecting the Funga menu option.

Editing information or deleting Information

The user may not edit or delete any information from the knowledge base and as such, the options are not made available from the phone menu. However, new information (previously unknown) is collected from farmers, which is then added to the

knowledgebase. Further, advances in pesticide use and biological control is constantly added to the knowledge base and consequently made available to the further.

Appendix B – Data Collection Questionnaire

TITLE: Rural Research Needs: Baseline Appraisal
PROJECT: VESEL

PARTICIPATING INSTITUTIONS: UoN

SITE: .....

INTERVIEWER.....

DATE: .....

SECTION A: DEMOGRAPHICS

RESPONDENT NAME..... **GENDER:** ☐ **MALE** ☐ **FEMALE**

NAME OF COMMUNITY GROUP: .....

PHYSICAL ADDRESS .....

PHONE NO. .....

AGE. .....

OCCUPATION .....

EDUCATION LEVEL:

☐ No Formal Education [1]
☐ Primary, Standard_____ [2]
☐ Secondary Education, Form [3]
☐ University, Degree [4]
☐ Tertiary College [5]
☐ Other, specify_____ [6]

MARITAL STATUS:

☐ Single [1]
☐ Married [2]
☐ Divorced [3]
☐ Widowed [4]
☐ Separated [5]

How many children do you have? .....
Do these children live with you? .....
Do you get assistance from them for your day to day activities? ☐ YES ☐ NO
Activities of assistance:

_____
_____
_____
_____

Section B: French Beans

1. (a) What are French bean varieties grown in this region?

   i) ii) iii) iv) v)
   vi)

   (b) Among the above varieties, which four are the most preferred and grown from time to time?

   © What are the Agronomic attributes in the four varieties that make them preferred? (i.e. High yield, good taste, longer shelf life, pod size and colour, resistant to pests and diseases, tolerant to drought and cold)
   i) ii) iii) iv)

   d) Are there extension officers in this are?

   e) If yes, are they government or private employed?

   f) If no, from whom do you get your farming knowledge/advice or guidance?

2. What kind of inputs do you use in French bean farming, when and at what cost?

INPUT	TIME	TYPE OF INPUT (kg/acre)	COST	SOURCE
Fertilizer	Planting			
	Top dressing (1)			
	(2)			
Folia feeds				
Pesticides and insecticides				
Herbicides (Weed control)				

3 What is the average yield of French bean per acre in this area? ---------

4. Given a scale of 1-5, where 5 means highly preferred for the attribute and 1 means least preferred for the attribute, Rate the following varieties on the basis of the attributes given.

VARIETY	GOOD TASTE	HIGH YIELD	SHELF LIFE	POD SIZE	RESISTANT TO PESTS/DISEASES	TOLERANT TO COLD/DROUGHT.
Paulista						
Amy						
Teresa						
Samantha						

5. (a) Name the common diseases affecting French beans in this are and how they are controlled.

DISEASE	CONTROL (BY USE OF PESTCIDES/MECHANICAL METHODS)

(b) Among the diseases named above, which ones occur frequently in the field?
i) ii) iii) iv) v)

© Quantify the field loss caused by the following two diseases.
Anthracnose--------. Angular leaf spot-------.

(d) Name the insects that affect French bean farming in this area and how controlled.

PEST	CONTROL BY INSECTICIDE/ MECHANICAL MEHODS

6. a) What are the best times for planting and harvesting French beans in the region?

b) What is the source of your seeds and cost per kg?

SOURCE/SUPPLYER	DISTANCE FROM FARMER	COST PER UNIT

7. Where and whom do you sell your French bean harvest, how much per kg?

BUYER	PLACE LOCATED	PRICE PER UNIT (KG/CRATE/SAC

8.a) Incase of drought what kind of irrigation system do you use and how much does it cost per 1 acre for all production period?

_____

_____

_____

b) What are other problems hindering full potential French bean production.

_____

_____

_____

9. What suggestive solutions do you think should be used?

_____

_____

_____

Section C: Jatropha Curcas

1. a) When and from who did you learn about Jatropha plant.

_____

_____

_____

b) Do you receive extension services from Extension officers? ☐ Yes ☐ No

private employed	government employed

2. a) Do you grow it? ☐ YES ☐ NO

b) If yes, list its benefits to you.

3.What varieties of this plant do you know (local names) and are grown in the country?
i) ii) iii) iv)

4.What is the source of your seeds and how many kg or plantlets do you grow per acre?

SEED SOURCE	DISTANCE FROM FARMER	COST PER UNIT

5. a) What is your total land size? ---------

b) How much land have you devoted to the crop? --------

6.How much input do you use (water, fertilizer, manure, other costs)?

INPUT	SOURCE	AMOUNT	COST
Water			
Fertilizer/Manure			
Pesticides			
Labour			
Others (Specify)			

7. a) What are the pests attacking the plant and what control measure do you apply?

PEST	PART OF PLANT AFFECTED	TIME OF THE YEAR/WEATHER CONDITION	CONTROL MEASURE	COST

b) How long does the plant take to mature for first harvest and for how long will it continue being productive?

_____

_____

_____

8. a)What are the products you harvest or processed from this plant?

i) **ii)** **iii)** **iv)**

a) What is the yield harvested per acre of land? --------Kg/acre

b) To whom, where do you sell your produce and how much per unit?

PRODUCT	**BUYER**	**LOCATION OF BUYER**	**PRICE PER UNIT OF PRODUCT (KG)**

9.What are the major problems that you face in the production of this plant?

_____

_____

_____

10. a) Are you aware of tissue culture? ☐ YES ☐ NO

b) What is your perception about tissue culture crops?

_____

_____

_____

11.Incase Jatropha is generated through tissue culture, what do you suggest should be the price per plantlet. ----------

Section D: Information & Communications Technology

Computers

1. Are you conversant with the following ICT facilities? Indicate the ones that you often use.

Type of ICT	Known	Used	Comment
Fixed telephone			
Mobile telephone			
Facsimile			
Photocopy			
TV			
Radio			
Stand alone Computer			
Electronic mail (e-mail)			
Internet			
Computer aided design and manufacturing (CAD/CAM)			
Other, specify			

2. Do you use any of the ICT to communicate with the anyone? □ Yes □ No
3. If yes to question 10, please specify who

   _____
4. Do you have a personal/family computer? □ Yes □ No
5. If no to question 4, how do you access computers and internet facility?

	Computer	Internet	Comment
Office			
Cyber Café			
Friends			
Neighbours			
Relatives			
Others, (specify)			

6. Do you pay for using it, how much? _____
7. Do you like using a computer □ Yes □ No
8. What functions/packages do you use mostly?

   _____

   _____

   _____
9. What are the complications you encounter when using a computer?

   _____

_____
_____
_____
_____

10. According to your knowledge, how many computer centers are there in this location and how many individuals' own computers?

    Computer centers_____ Individuals with computers_____

TV and Radio

1. Do you own a TV or Radio? □ Both □ Radio □ TV □ None
2. If you do not own any, do you have access to them? □ Yes □ No
3. Which one? □ Radio □ TV
4. Who owns it? _____
5. How often do you listen / watch it? □ Daily □ _____**Days per week**
6. What stations do you listen to / Watch?

TV	Radio	Time

7. Is the reception of the stations clear? □ Yes □ No

Mobile phones

1. Do you have access to a mobile phone or other handheld device for communication? □ Yes □ No
2. How frequent do you access mobile phone/Hand held device? □ Daily, □ Weekly □ Monthly
3. Have you ever used a mobile phone? □ Yes □ No
4. Who owns it? □ Parent, □ Neighbor, □ Relative, □ Community phone
5. If you do not own it, how often are you allowed to use it? □ Daily _____Days/Week □ Weekly _____Days/Month
6. Among the following features and functions of a phone, state how frequent you use them to achieve your needs.

SMS	Access and Storage of Information	Calls	Calculator	Phone Book	Calendar	Alarm clock	Digital clock	Voice Calls

7. Are you able to achieve your goals or desires with the phone you use? □ Yes □ No
8. If not, what hinders you from effectively using the phone to achieve them?

_____
_____
_____

9. What do you suggest should be done to help you achieve effective use of phone?

_____
_____
_____

10. What problems do you encounter while using the phone?

Week Network	Lack of credit	Phone complexity	Poor screen	Many steps	Restricted accessibility

11. Do you like how your phone presents things? □ Yes □ No
12. What would you change if you were given a chance?

_____
_____
_____

13. What kind of presentation on your phone would you like?

Text interface	Numerical key interface	Tabular Data Organization	Representational Icon	Icon Legends	Colour	Language	Audio Input, Output

14. Do you enjoy using a phone? □Yes □No
15. What stops you from enjoying it?

_____

_____

_____

16. What makes you enjoy using a phone most?

Appearance	Processing speed	Accuracy	Error Recovery	Human interaction	Fun	Capacities (Specify)

17. What other things would you want to do if you were informed you could be able to achieve them with a phone?

    i)

    ii)

    iii)

18. How do you normally achieve those things at the moment without a phone? (The steps)

    i)

    ii)

    iii)

19. What phone make do you use? ---------

20. How frequently do you change your phone? (Years/Months) -------

21. What network operator do you subscribe to?

Safaricom	Celtel	Telecom wireless (CDMA)	Telecom Landline

22. Are the calls clear (Please pick one)

Indoors and Out Doors	Outdoors only	On hill tops only

Section E: Agriculture ...

1. A part from above mentioned crops, which other crops in the following categories do you produce?

Cereals	Legumes	Fruits	Tubers/Roots	Vegetables

2. What inputs do you use in production of the above crops?

Input	**Source**	**Cost**

3. What diseases and pests affect this crops and at what stage and weather condition

Crop	**Disease**	**Pest**	**Stage**	**Weather / Season**

4. Can you tell when your crop is infested / infected by diseases/pests? ☐ Yes ☐ No
5. What do you do when your crop suffers from pests and diseases (Please check one)
   - ☐ Ask an agricultural officer fro advice
   - ☐ Ask a friend for advice
   - ☐ Buy pesticides recommended by an extension officer
   - ☐ Buy pesticides recommended by a friend
6. List the activities / practices you engage in from planting to harvesting of crop

Crop	**Activity / Practices**

7. How do you market / sell your produce (give the steps from farm to consumer)

8. How do you think your selling of produce can be improved?

9. What companies, Groups or associations performing various functions exist in this area?

Company/Group/Association	Function it play	Rating as per services

10. List the problems encountered in marketing your /community farm produce?

11. What do you suggest should be done to enhance marketing of farm produce in this region?

THANK YOU

Appendix C – System Evaluation Questionnaire

Evaluation of Mobile Prototype – July 2008

A. Demography

Name: _____ Age: _____

Gender: Male ☐ Female ☐

Marital Status: Single ☐ Married ☐ Separated ☐ Divorced ☐ Widowed ☐

Telephone Number: _____

Community Group: _____ Location: _____

B. Interface

1) Do you think the prototype interface is easy to use? Yes ☐ No ☐

   a) If yes, what did you find easiest to do?

_____

_____

   b) If no, what do you think made the interface not easy to use?

_____

_____

2) Did you find any specific task difficult to accomplish? Yes ☐ No ☐

   a) If yes, which one?

_____

_____

3) Is the interface appealing? Yes ☐ No ☐

   a) What do you think is most appealing?

_____

_____

   b) What do you think is least appealing?

_____

_____

4) Are the languages used in the prototype useful to you? Yes ☐ No ☐

   a) If yes, which language did you find most useful?

_____

b) If no, what language would you consider useful to you?

5) What features of the prototype interface did you find most useful to you?

6) What would you want to add to the interface to make it better for you?

7) What would you want to remove from the interface to make it better for you?

8) Did you find the prototype easy to learn to use? Yes ☐ No ☐

a) If yes, why do you think it is easy to learn to use?

b) If no, what made it difficult to learn?

C. General Application

1) Do you think this application is relevant/useful to you? Yes ☐ No☐ Somewhat ☐

a) If it is relevant, do you think you would use it frequently? Yes☐ No☐

b) If it is not relevant what do you think can be added to it to make it more relevant?

2) What do you think can be removed from it to make it more relevant?

3) In which ways do you think this application will be useful to you?

4) Is there something about this application that you think is useless? Yes ☐ No ☐

a) If yes, what part of the application do you think is useless?

_____

_____

5) Do you think you can use this kind of application to help you in knowledge gathering?
Yes ☐ No ☐ Somewhat ☐

6) Do you think you would frequently use it if it was made available? Yes ☐ No ☐

a) If no, what would stop you from frequently using it?

_____

_____

7) Do you think this application will change your life in any way? Yes ☐ No ☐

a) If yes, in which way?

_____

_____

b) If no, why do you think it will not change your life?

_____

_____

D. Other

Have you used a mobile phone before? Yes ☐ No☐

Do you enjoy using a mobile phone? Yes ☐ No☐

What model of mobile phone did you find easiest to use? _____

Please indicate the level to which you agree/disagree with the following statements based on the following rankings by ticking on 1, 2, 3 or 4 as per the rankings:

1: Strongly agree 2: Agree 3: Disagree 4: Strongly disagree

E. PERFORMANCE EXPECTANCY

	1	2	3	4
sing the system makes me accomplish my tasks more quickly				
find the system useful to me				

F. EFFORT EXPECTANCY

	1	2	3	4
earning to operate the system was easy for me				
y interaction with the system is clear and understandable				
orking with the system is complicated, it is difficult to understand hat is going on				
takes too long to learn to use the system to make it worth the effort				

G. SOCIAL AND CULTURAL INFLUENCE

	1	2	3	4
eople who are important to me think I should use the system				
eople who influence my behaviour think I should use the system				
ultural practices around me discourages the use of the system				
y status in society does not encourage me to use the system				
sing the system enhances my image among my peers and in the ciety				

H. FACILITATING CONDITIONS

	1	2	3	4
ave control over using the system				
ave the resources necessary to use the system				
ave the knowledge necessary to use the system				
et help whenever am in need to know more on using the system				

I. ATTITUDE TOWARDS USING TECHNOLOGY

	1	2	3	4
sing the system is a good idea				
like the idea of using the system				
enjoy using the system, it's fun				
always look forward to going to use the system				

J. BEHAVIORAL INTENTION TO USE THE SYSTEM

	1	2	3	4
intend to use the system				
will always use the system to do my tasks				
feel anxious using the system				
am scared to loose data and information using the system				
have hesitations to use the system for fear of making mistakes				

K. IMPACT OF POLITICAL INSTITUTIONS/INFRASTRUCTURE

	1	2	3	4
eople in authority within my community discourage me from using e system				
here is support from the government to use technology				
here is easy access to me to use computers and internet				

L. FINANCIAL FACTORS

	1	2	3	4
sing the system is a financial burden to me due to transport and ccess fees				
sing the system is a burden to me as I need further training which is stly				

THANK YOU

Appendix D – Sample Source Code

```
package HudumaYaMkulima;

import javax.microedition.midlet.*;
import javax.microedition.lcdui.*;

/**
 * @author macharia
 */
public class Huduma extends MIDlet implements CommandListener {

    private boolean midletPaused = false;

        /**
     * The HelloMIDlet constructor.
     */
    public Huduma() {
    }

    //<editor-fold defaultstate="collapsed" desc=" Generated Methods ">
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Method: initialize ">
    /**
     * Initilizes the application.
     * It is called only once when the MIDlet is started. The method is called before the
<code>startMIDlet</code> method.
     */
    private void initialize() {
        // write pre-initialize user code here

        // write post-initialize user code here
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Method: startMIDlet ">
    /**
     * Performs an action assigned to the Mobile Device - MIDlet Started point.
     */
    public void startMIDlet() {
        // write pre-action user code here
        switchDisplayable(null, getAnzaHapaForm1());
        // write post-action user code here
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Method: resumeMIDlet ">
    /**
     * Performs an action assigned to the Mobile Device - MIDlet Resumed point.
     */
    public void resumeMIDlet() {

    }
    public void commandAction(Command command, Displayable displayable) {
        // write pre-action user code here
        if (displayable == AnthraForm7) {
            if (command == AwaliForm3) {
                // write pre-action user code here
```

```
            switchDisplayable(null, getMagonjwaList3());
            // write post-action user code here
        } else if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == AnzaHapaForm1) {
        if (command == EndeleaForm1) {
            // write pre-action user code here
            switchDisplayable(null, getChaguaList1());
            // write post-action user code here
        } else if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == BlightForm5) {
        if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        } else if (command == backCommand) {
            // write pre-action user code here
            switchDisplayable(null, getMagonjwaList3());
            // write post-action user code here
        }
    } else if (displayable == CatpillarsForm3) {
        if (command == AwaliForm3) {
            // write pre-action user code here
            switchDisplayable(null, getWaduduList2());
            // write post-action user code here
        } else if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == ChaguaList1) {
        if (command == AwaliList) {
            // write pre-action user code here
            switchDisplayable(null, getAnzaHapaForm1());
            // write post-action user code here
        } else if (command == EndeleaForm1) {
            // write pre-action user code here

            // write post-action user code here
        } else if (command == List.SELECT_COMMAND) {
            // write pre-action user code here
            ChaguaList1Action();
            // write post-action user code here
        }
    } else if (displayable == FliesForm4) {
        if (command == AwaliForm3) {
            // write pre-action user code here
            switchDisplayable(null, getMagonjwaList3());
            // write post-action user code here
        } else if (command == FungaForm1) {
```

```
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == MagonjwaList3) {
        if (command == AwaliList) {
            // write pre-action user code here
            switchDisplayable(null, getChaguaList1());
            // write post-action user code here
        } else if (command == EndeleaForm1) {
            // write pre-action user code here

            // write post-action user code here
        } else if (command == List.SELECT_COMMAND) {
            // write pre-action user code here
            MagonjwaList3Action();
            // write post-action user code here
        }
    } else if (displayable == MildewForm6) {
        if (command == AwaliForm3) {
            // write pre-action user code here
            switchDisplayable(null, getMagonjwaList3());
            // write post-action user code here
        } else if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == ThripsForm2) {
        if (command == AwaliForm2) {
            // write pre-action user code here
            switchDisplayable(null, getBlightForm5());
            // write post-action user code here
        } else if (command == FungaForm1) {
            // write pre-action user code here
            exitMIDlet();
            // write post-action user code here
        }
    } else if (displayable == WaduduList2) {
        if (command == AwaliList) {
            // write pre-action user code here
            switchDisplayable(null, getChaguaList1());
            // write post-action user code here
        } else if (command == EndeleaForm1) {
            // write pre-action user code here

            // write post-action user code here
        } else if (command == List.SELECT_COMMAND) {
            // write pre-action user code here
            WaduduList2Action();
            // write post-action user code here
        }
    }
    // write post-action user code here
}

public Form getAnzaHapaForm1() {
```

```
        if (AnzaHapaForm1 == null) {
            // write pre-init user code here
            AnzaHapaForm1 = new Form("              Karibu", new Item[] { getStringItem() });
            AnzaHapaForm1.addCommand(getFungaForm1());
            AnzaHapaForm1.addCommand(getEndeleaForm1());
            AnzaHapaForm1.setCommandListener(this);
            // write post-init user code here
        }
        return AnzaHapaForm1;
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: stringItem ">
    /**
     * Returns an initiliazed instance of stringItem component.
     * @return the initialized component instance
     */
    public StringItem getStringItem() {
        if (stringItem == null) {
            // write pre-init user code here
            stringItem = new StringItem("\n\nUsaidizi Shambani", "\nHuduma ya kutatua shida za
magonja na mimea");
            // write post-init user code here
        }
        return stringItem;
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: EndeleaForm1 ">
    /**
     * Returns an initiliazed instance of EndeleaForm1 component.
     * @return the initialized component instance
     */
    public Command getEndeleaForm1() {
        if (EndeleaForm1 == null) {
            // write pre-init user code here
            EndeleaForm1 = new Command("Endelea", Command.OK, 0);
            // write post-init user code here
        }
        return EndeleaForm1;
    }


    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: ChaguaList1 ">
    /**
     * Returns an initiliazed instance of ChaguaList1 component.
     * @return the initialized component instance
     */
    public List getChaguaList1() {
        if (ChaguaList1 == null) {
            // write pre-init user code here
            ChaguaList1 = new List("Magonjwa na Wadudu", Choice.IMPLICIT);
            ChaguaList1.append("  Wadudu Waharibifu", getImage7());
            ChaguaList1.append("  Magonjwa", getImage8());
            ChaguaList1.addCommand(getAwaliList());
            ChaguaList1.addCommand(getEndeleaForm1());
            ChaguaList1.setCommandListener(this);
```

```
        ChaguaList1.setSelectedFlags(new boolean[] { false, false });
        // write post-init user code here
    }
    return ChaguaList1;
}
//</editor-fold>

//<editor-fold defaultstate="collapsed" desc=" Generated Method: ChaguaList1Action ">
/**
 * Performs an action assigned to the selected list element in the ChaguaList1 component.
 */

//</editor-fold>

//<editor-fold defaultstate="collapsed" desc=" Generated Getter: AwaliForm3 ">
/**
 * Returns an initiliazed instance of AwaliForm3 component.
 * @return the initialized component instance
 */
public Command getAwaliForm3() {
    if (AwaliForm3 == null) {
        // write pre-init user code here
        AwaliForm3 = new Command("Awali", Command.BACK, 0);
        // write post-init user code here
    }
    return AwaliForm3;
}
//</editor-fold>

//<editor-fold defaultstate="collapsed" desc=" Generated Getter: ChaguaList2 ">
/**
 * Returns an initiliazed instance of ChaguaList2 component.
 * @return the initialized component instance
 */
public Command getChaguaList2() {
    if (ChaguaList2 == null) {
        // write pre-init user code here
        ChaguaList2 = new Command("Chagua", Command.OK, 2);
        // write post-init user code here
    }
    return ChaguaList2;
}
//</editor-fold>

//<editor-fold defaultstate="collapsed" desc=" Generated Getter: WaduduList2 ">
/**
 * Returns an initiliazed instance of WaduduList2 component.
 * @return the initialized component instance
 */
public List getWaduduList2() {
    if (WaduduList2 == null) {
        // write pre-init user code here
        WaduduList2 = new List("Wadudu Waharibifu", Choice.IMPLICIT);
        WaduduList2.append("  Viwavi (Caterpillars)", getImage1());
        WaduduList2.append("  Nyigu na Vikugu  (Thrips and Aphids)", getImage2());
        WaduduList2.append("  Inzi Weupe (Whiteflies)", getImage3());
        WaduduList2.addCommand(getAwaliList());
```

```
            WaduduList2.addCommand(getEndeleaForm1());
            WaduduList2.setCommandListener(this);
            WaduduList2.setSelectedFlags(new boolean[] { false, false, false });
            // write post-init user code here
        }
        return WaduduList2;
    public Form getThripsForm2() {
        if (ThripsForm2 == null) {
            // write pre-init user code here
            ThripsForm2 = new Form("Nyingu na Vikugu", new Item[] { getThrips(),
getThripsTitleStringItem1(), getThripsStringItem1(), getThripsTitleStringItem2(),
getThripsStringItem2(), getThripsTitleStringItem3(), getThripsStringItem3() });
            ThripsForm2.addCommand(getAwaliForm2());
            ThripsForm2.addCommand(getFungaForm1());
            ThripsForm2.setCommandListener(this);
            // write post-init user code here
        }
        return ThripsForm2;
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: ThripsStringItem1 ">
    /**
     * Returns an initiliazed instance of ThripsStringItem1 component.
     * @return the initialized component instance
     */
    public StringItem getThripsStringItem1() {
        if (ThripsStringItem1 == null) {
            // write pre-init user code here
            ThripsStringItem1 = new StringItem("", "Nyunyiza moja ya haya madawa na wa
usiyachanganye madawa");
            // write post-init user code here
        }
        return ThripsStringItem1;
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: ThripsStringItem2 ">
    /**
     * Returns an initiliazed instance of ThripsStringItem2 component.
     * @return the initialized component instance
     */
    public StringItem getThripsStringItem2() {
        if (ThripsStringItem2 == null) {
            // write pre-init user code here
            ThripsStringItem2 = new StringItem("", "Tumia kwa aina za mboga kama vilew Mishiri na
Nyanya\nKipimo: Gramu 10 kwa Lita 20 za maji\n\nKwenye Kahawa:\nKipimo: Gramu 650 hadi
kilo 1.3 kwa kila hektari\n\nMuda salama Kuvuna: Baada ya siku 3 had 7 kwenye aina za mboga");
            // write post-init user code here
        }
        return ThripsStringItem2;
    }
    //</editor-fold>


    public void MagonjwaList3Action() {
        // enter pre-action user code here
```

```
        String __selectedString =
getMagonjwaList3().getString(getMagonjwaList3().getSelectedIndex());
        if (__selectedString != null) {
            if (__selectedString.equals("  Kuvu(Powdery Mildew)")) {
                // write pre-action user code here
                switchDisplayable(null, getMildewForm6());
                // write post-action user code here
            } else if (__selectedString.equals("  Kuota/Viota(Anthracnose)")) {
                // write pre-action user code here
                switchDisplayable(null, getAnthraForm7());
                // write post-action user code here
            } else if (__selectedString.equals("  Ugonjwa wa Baridi (Blight)")) {
                // write pre-action user code here
                switchDisplayable(null, getBlightForm5());
                // write post-action user code here
            }
        }
        // enter post-action user code here
    }
    //</editor-fold>

    //<editor-fold defaultstate="collapsed" desc=" Generated Getter: image1 ">
    /**

     * Exits MIDlet.
     */
    public void exitMIDlet() {
        switchDisplayable (null, null);
        destroyApp(true);
        notifyDestroyed();
    }

    /**
     * Called when MIDlet is started.
     * Checks whether the MIDlet have been already started and initialize/starts or resumes the
MIDlet.
     */
    public void startApp() {
        if (midletPaused) {
            resumeMIDlet ();
        } else {
            initialize ();
            startMIDlet ();
        }
        midletPaused = false;
    }

    /**
     * Called when MIDlet is paused.
     */
    public void pauseApp() {
        midletPaused = true;
    }

    /**
     * Called to signal the MIDlet to terminate.
```

```
    * @param unconditional if true, then the MIDlet has to be unconditionally terminated and all
resources has to be released.
    */
   public void destroyApp(boolean unconditional) {
   }

}
```