

Family Communication Technology Design in Rural and Low Income Parts of Kenya

by

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Abstract

This dissertation focuses on understanding how families communicate over distance when using technology in Kenya, and how we should think about designing technology to support family communication over distance between rural and urban settings of the country. It is divided in two parts with first part exploring family communication practices in rural and urban Kenya, while the second uses the results from the first part to inform the design of communication technology for these families.

Results from the first part of this dissertation reveal that family communication focuses on economic support, well-being, life advice, and everyday coordination of activities. However, infrastructure challenges and social factors such gender and reduced access to technology complicates family connection efforts using technology. As a result, families living in rural and low income urban regions of Kenya are not able to share experiences beyond phone and textual exchanges. I help address this problem in the second part of the dissertation by using findings from the first part of this dissertation to inform the design of a photo-sharing application and service called TumaPicha. TumaPicha supports rural and low income urban families to share common experiences and feel connected with each other using intermediaries to overcome connectivity and literacy issues. TumaPicha also supports rural families in using technology to capture activities in the village and share these experiences with relatives who live in urban areas.

The results, together with the five design recommendations presented here, articulate the opportunities that designers will face while exploring family communication technologies in rural and low income urban areas of Kenya. This work shows promise for simple media sharing applications in Kenya that rely on a mixture of technology opportunities and existing social processes.

Keywords: Family Communication Routines; Rural Kenya; ICTD; TumaPicha

Dedication

This work is dedicated to my parents for bringing me into the world and my siblings for always wishing me well.

To my late dad (Reuben Oduor) – I always remind myself that “life has no short cuts” and that “when one asks for something, they should expect either a Yes or a No” and gracefully take the response they get.

To the American citizen himself - Mr. Michael Nelson (Onnndieek!), *“everyone can rise above their circumstances and achieve success if they are dedicated to and passionate about what they do”*. – Nelson Mandela

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List of Acronyms

| Term | Initial components of the term (examples are below) |
|-------------|---|
| HCI | Human Computer Interaction |
| CSCW | Computer Supported Collaborative Work |
| ICT | IC |
| ICTD | Information Communication Technology for Developing Countries |
| TF | Text Free |
| AR | Audio Repository |
| IS | Information Systems |
| IT | Information Technology |
| UI | User Interface |
| HDDR | Human Driven Design and Research |
| SMS | Short Message Service |
| MPesa | Mobile Money Transfer Service in Kenya |
| SPARCs | Exploring Sharing Suggestions to Enhance Family Connectedness |
| MP | Mega Pixels |
| HP | House Pair |
| XAMP | Open Source Cross-Platform Web Server Solution Stack Package |
| MySQL | Open Source Relational Database Management System |
| PHP | Hypertext Preprocessor - a server-side scripting programming language |
| CS6 | Adobe Creative Suite Version 6 |

Publications

Materials, ideas, and figures from this dissertation have appeared previously in the following publications.

Peer Reviewed Conference Papers

- Oduor, E., Neustaedter, C., Judge, T., Hennessy, K., Pang, C. & Hillman, S. (2014) **The Reasons Behind Kenyan Family Communication Patterns**, GRAND Conference Research Note (2014). PDF
- Oduor, E., Neustaedter, C., Judge, T. K., Hennessy, K., Pang, C. & Hillman, S. (2014) **How Technology Supports Family Communication in Rural, Suburban, and Urban Kenya**, Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems New York, NY, USA, ACM, 2705-2714. 10 pgs
- Oduor, E., Neustaedter, C., T. K., Hennessy., Hillman, S., and Pang, C. (2013). **Family Communication in Rural and Slum Regions of Kenya**. Extended Proceedings of the ACM Conference on Computer Human Interaction, ACM Press, 6 pgs. Work In Progress

Workshop Papers

- Oduor, E. and Neustaedter, C. (2014) **The Family Room: A Multi-Camera, Multi – Display Family Media Space** Video Proceedings of Conference on Computer Supported Corporative Work AND Social Computing (CSCW) ACM Press, 4 pgs.+ Video

Chapter 1.

1.1 Introduction

This dissertation focuses on understanding how families communicate over distance when using technology in Kenya and how we should think about designing technology to support family communication over distance between rural and urban settings of the country. There is a growing body of research that documents the role that technology plays in connecting distributed family members in developed countries. Yet little work has been done to understand how technology supports family communication for marginalized communities in developing countries such as Kenya. Over the past several years, research on Information and Communication Technology for Development (ICTD) has mainly focused on understanding how technology-related interventions can help marginalized communities in developing countries move towards global economic growth. My research builds on the existing literature to extend and provide research that is focused on the design of technologies that can enable distributed family members in rural and low income urban areas of Kenya connect with each other over distance.

1.1.1 Technology and Family Communication in Developed Countries

Extensive research has looked at the design of technologies that support family communication in developed countries. These systems aim to promote awareness and connectedness between distributed family members (Hindus et al., 2001, Judge et al. 2010, Mynatt et al. 2001 and Neustaedter et al., 2010). Some focus on the exchange of pictures or textual messages between family members via mobile devices (Romero et al., 2006) or special-purpose digital frames (Hindus et al., 2001, and Mynatt et al., 2001). Other systems focus on supporting parent-child interaction over distance (Yarosh et al. 2010.), while some also focus on connecting adult children with their elderly parents (Mynatt et al., 2001.). There have also been systems designed to provide next-generation

video connections between family members (Judge et al. 2010, Neustaedter et al., 2010. and Yarosh et al., 2010). Therefore, we see a lot of work being done on how technology supports family communication in developed countries. However, the illustrated studies do not provide an understanding of whether such knowledge would carry over to family communication in developing countries. This is because a large number of families in developing countries face various challenges that have not been documented in the mentioned studies. Similar studies are required for regions that face intermittent Internet and limited access to computers as a result of high poverty levels and lack of the knowledge to use advanced technology such as videoconferencing especially in rural areas where there exists an infrastructure that is still in its infancy.

1.1.2 ICTD Projects for Communities in Developing Countries

There exists a growing amount of research on communication practices in developing countries (Kwake & Adigun, 2008, Murphy et al., 2011, Sambasivan et al., 2011, Smyth et al., 2010 and Williams et al., 2008) with a specific emphasis on the effects of poverty, educational levels, and a lack of technological infrastructure. Some of these studies highlight the importance of understanding the dynamics and needs of local communities in developing countries before designing technology for them (Taylor, A., 2011; Reitmaier, 2012). Research exists on how rural communities embrace the use of mobile phone entertainment (Liu et al., 2010), on the local cellphone practices of individuals who live in slum communities (Rangaswamy & Sambasivan, 2011) and even on how the roles of women in slum communities are influenced by use of technology through intermediated interactions (Sambasivan et al., 2010). In South Africa, young people were reported to share digital media using their mobile phones extensively with close friends while this changed to involve the sharing of resources when a wider network that involved elders was involved (Walton et al., 2012). Other studies have also described how technology supports social networks in slums (Smyth et al., 2010), family life (Horst, H., 2005), financial remittance (Horst, 2005 and Horst and Miller 2006) and communication with distributed family members who live in other countries (Vertovec, 2004 and Wyche and Grinter, 2012).

In Sub-Saharan Africa, studies have reported on the use of cellphones and callback in rural African communities and gender segregation of space, social policing and economic dependence on husbands (Burrell, 2010). Attempts to design technology that resonates with local communities have also been documented through various studies. Studies have also been conducted in South Africa to investigate the interactions with an Audio Repository (AR) prototype (Bidwell et al., 2013) while Marsden et al., (2010) examined how digital technology could be used to present oral African stories. Other studies have also documented the reasons behind cell phone usage in the rural regions of post war Liberia, (Best et al., 2010), and how Namibians use Facebook not only to share religious and political views, but also to share posts about personal matters such as death (Peters et al., 2012).

Overall, this research space provides a solid foundation for understanding technology usage in developing countries including Sub-Saharan Africa. To contribute to this field of work, I will focus mainly on how people within Kenya connect with family members who are distributed across rural and urban settings.

1.1.3 Kenyan Technology Usage

There are several studies that have focused specifically on technology design and use for connecting distributed family members in Kenya. For example, Agesa and Kim, (2001) reported on split migration while Eriksson (2008) investigated the role cell phones played in assisting people in finding jobs in Kenya. Murphy and Priebe (2011) provided an analysis of a census on the usage of cellphones in Bungoma, Kenya while Kwake and Adigun (2008) looked at the adoption of mobile phones by women who lived in rural parts of Kenya. Mobile phones are also important for promoting trade, regional cooperation and development within East Africa based on education levels, poverty, and fears of technology (Mimbi et al., 2011).

Other studies have looked at how Kenyans use social media (Wyche and Forte, 2013) for income generation through finding jobs (Wyche and Yardi, 2013). Research has also looked at how working expatriates who lived in Nairobi creatively 'got around' infrastructural challenges to connect with their families that lived abroad (Wyche et al.,

2010). A similar study had also been conducted with Kenyan migrants living in the United States who shared activities with their relatives in Kenya (Wyche and Grinter, 2012).

It is likely that the future will hold new opportunities for the design of applications in Kenya that utilize the Internet and may even mean the creation and further adoption of social networking sites and rich communication systems such as video chat. As an area that requires more research to be done, I feel that one should think carefully about the ways in which Kenyans are likely to need and use communication technologies and specifically design for such situations. Even though several studies have been conducted on the use of communication technology in Kenya, as described above, there are still open research questions around how distributed family members can use technology to support their routines. I document these in the next section.

1.2 Research Questions

The studies highlighted in section 1.1.3 show that we do not yet have detailed knowledge that illustrates how to best design technology that can support family communication over distance in a developing country such as Kenya. As a result, this dissertation will present suggestions for future direction on the design of technologies that support family communication between rural and urban areas of Kenya, and, by extension, act as a framework for future works in other similar environments. Thus, the overarching question of this dissertation is: ***How can we best design technology to support family communication over distance between rural and urban areas of Kenya?*** Present notions of design in this domain rely on designing applications that can be used within the existing network infrastructure of the region, and on how technology can amplify existing cultural practices to promote economic growth. By identifying user routines, user requirements can be generated which will be helpful in future attempts to design technology that specifically supports family communication in Kenya. The main research question is further broken down into three sub questions that are listed below:

1. *How and why do families in Kenya use technology to communicate with each other over distance and what are the social factors that affect this communication?*

Studies on how family members use technology for communication with distributed relatives have been conducted in developed countries. A variety of these studies looked at how video technology supported connection between family members over distance (Judge et al, 2010, Yarosh, 2010, Neustaedter et al, 2006 and Ames, 2010). Other studies on inter-country communication have looked at how Kenyans who live in the USA used technology to communicate with their relatives back home (Wyche and Grinter, 2012) and even between expatriates who lived and worked in Nairobi with their families that lived abroad (Wyche et al., 2010). The latter set of studies provides us with a foundational knowledge on the use of communication technology in regions of Kenya that experience limited infrastructure for technology use. However, they do not provide a general theory for communication using technology that can be used to present: a common understanding of the varying types of technologies used by families in developing countries, the different types of activities these families share, and the social factors that affect this form of communication. With this information I will get an understanding of people's routines and needs which can inform future design work.

2. *How can we apply an understanding of local communication routines to the design of communication technology for Kenyan families?*

Existing research on the use communication technology in developing countries (Kwake & Adigun,. 2008; Murphy and Priebe, 2011; Sambasivan et al., 2010; Smyth et al., 2010; Williams et al., 2008) has mainly focused on highlighting challenges of designing technology for rural communities in developing countries due to poverty, low digital literacy levels, and a lack of proper technological infrastructure in place. Other studies have also looked at how local communities have adopted various forms of technology (Patel et al., 2010, Rangaswamy and Sambasivan, 2011, Bidwell and Siya, 2013, Liu et al. 2010, Gitau et al, 2010 and Bidwell et al, 2011) to support activities of local populations. Thus, most prevalent form of technology projects in this domain aim to incorporate local communities into the wider global digital map (Petland et al., 2004). We therefore see that studies that provide insight on how to design communication technology for Kenyan families currently

do not exist. The aim of my work is to formulate this insight for future designs in this research domain.

3. *How will Kenyan families use technology that is specifically designed to support their communication routines?*

Generally, no studies exist on documenting how Kenyans use technology that has been designed based on their communication routines. An overview of existing ICTD work by Ho et al. (2009) reveals that studies on developing countries have mainly focussed on how technology addresses specific social, cultural, or infrastructural challenges but not family communication routines. This creates the opportunity for conducting research that explores the design of technologies that can specifically support family communication in Kenya. The temptation of redeploying technologies developed for industrialized countries in developing regions has also hampered the need to conduct research on technologies that could support family communication routines in rural and urban Kenya. In this dissertation, I aim to use information gathered from deploying communication technology with rural and low income urban Kenyan families to provide recommendations for future communication design of communication technology for Kenyan families.

1.3 Research Objectives

Overall, creating better designs and user experience for technology that supports family communication in rural and low income urban areas of Kenya is this dissertation's main goal. Therefore, the overarching objective for this dissertation is to: ***provide a foundation for understanding how to best design technology to support family communication over distance between rural and urban areas of Kenya.*** To achieve this goal, I address the research problems raised in the previous section of this chapter through the completion of three research objectives. These research objectives build on past research in the fields of Computer Supported Cooperative Work (CSCW), ICTD, and domestic computing to present new insights and knowledge that is pertinent to understanding family communication routines and technology design to support it. Each objective matches the corresponding problem in Section 1.2.



Figure 1.1: Rural home (Left), low income (Middle) and middle class (Right)

1. Describe the reasons behind the social practices of technology use for communication over distance by families in Kenya.

To address Research Question 1, I conducted an exploratory study using in-depth contextual interviews (Holtzblatt et al., 2004) with families in rural, suburban, and urban Kenya (Figure 1.1) to understand how they shared activities with remote relatives using technology. A total of 24 participants; eleven from rural Migori, nine from Githurai (low income urban) area of Nairobi and four from suburban Kisumu, Kenya were interviewed in this study.

My goal was to uncover family communication practices that were technology-based and understand how families adopted the use of technology when faced with infrastructure limitation. Participants were provided with paper and along with my guidance, asked to draw their family communication networks (Horst and Miller, 2005; Horst, 2006). Participants then filled in the type of technology and kind of information that was exchanged with their kin who were listed in the charts. I then asked the participants a series of questions about their communication routines with their family members. All interviews were audio-recorded and handwritten notes were kept. My findings are based on 24 transcribed interviews, 69 photographs (depicting participants' homes and areas of communication) and 92 pages of field notes. I analyzed our interview transcriptions and notes using open, axial, and selective coding (Strauss and Corbin 1998). From this analysis, the reasons why participants used technology to communicate with immediate and extended family members were revealed. I also uncovered the social situations that influenced family communication routines and activities.

My findings revealed that family communication focuses on economic support, well-being, life advice, and everyday coordination of activities. I also outline social factors that affect family communication, including being an eldest child, having a widowed sibling, and having reduced access to technology because of gender, literacy, or one's financial situation.

2. Use the understanding of local communication routines to inform the design of technology that supports communication for Kenyan families.

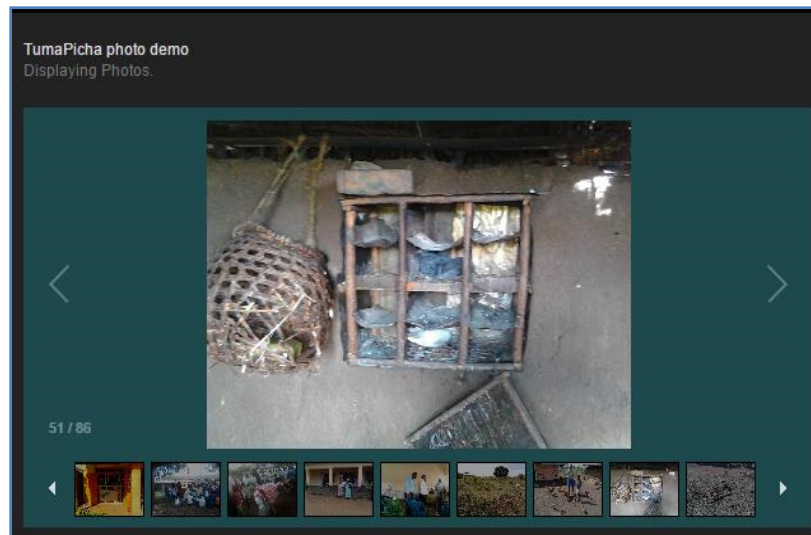


Figure 1.2: Migori: A caption of TumaPicha web display page showing a section of the kitchen in a rural hut

In addressing Objective 2, I took the lessons learned from the completion of Objective 1, and applied it to the design of a new system called TumaPicha. To do this, I first conducted discussions of low fidelity prototypes of the system with other collaborators that included my supervisors and graduate students working in my research laboratory (detailed information about the collaborators is provided in Chapter 5). Together, we reviewed existing prototype design ideas that I came up with. The process providing me with insight that I further design iterations. Based on this iteration, I then created a medium-fidelity prototype of TumaPicha. The final design of TumaPicha lets rural family members who have limited IT knowledge to share photos of activities that have been conducted in the village with their relatives who live in low income urban areas of Kenya. The photo page is shown in Figure 1.2.

The next research stage involved presenting the medium fidelity prototype to my research laboratory collaborators to get their views on any design improvements that should be made before deployment. This activity enabled me to review any hardware or software issues that I could have missed during the redesign of the initial prototype. The collaborators also shared their views on how they could have used the system if it was deployed with them. The system design process is highlighted under methodological approach in the next section.

3. Evaluate the designed communication technology service to understand how it will be used by families in Kenya as a part of their communication routines.

During the third research step, I investigated the deployment of TumaPicha with families in Kenya for a period of five weeks. The goal of this study was to understand how the system would be appropriated by users and gain insight into whether the design would enhance or disrupt existing family communication routines. The field evaluation of TumaPicha was conducted with 4 families from the rural setting of Migori, and a low income part of Nairobi called Githurai. The family members using TumaPicha also completed diaries during the study along with a series of semi-structured interviews that I conducted. The findings from the field evaluation provide additional insight on how to best design communication technology for families in rural Kenya.

1.4. Methodological Approach

In this section I briefly highlight the description of the methods used to explore the research questions outlined above. The methods applied to meet Research Objective 1 primarily focused on using semi structured-interviews to gather data about users' daily activities and communication routines using technology (Strauss and Corbin 1998). The qualitative data collected from the semi-structured interviews were then coded and analyzed by domain. By conducting open coding, described as the process of uncovering, naming and developing concepts to open up text and expose the participant's thoughts (Strauss and Corbin, 1998), patterns are discovered, then organized into smaller categories. Axial and selective coding is then used to reorganize the data into unified

information chunks within identifiable themes. A qualitative approach fit best with the exploratory nature of the research questions I was addressing because of limited previous research on designing technology for families in rural and low income urban areas in Kenya. The results from this process were complemented with design studies, a design exercise and field evaluation to refine the concepts for the design of TumaPicha. Due to the infrastructural disparity of ICTD environments (Burrell & Toyama 2009 and Wyche & Grinter, 2012), I also narrowed the focus of my research to the design of a system for the local families in my study settings. To do this, I captured and then transferred cultural practices and knowledge from a setting in a marginalized community (Burrell & Toyama, 2009) using ethnographic data collection practices (Bidwell et al. 2011, Gitau et al. 2010, Liu et al. 2010 and Bidwell et al. 2013).

To support the design of TumaPicha, Research Objective 2, I also reviewed existing systems designed for use by local communities in other developing countries. These systems included Avaaj Otalo (Patel et al., 2010) and DakNet (Petland et al., 2004) in India and Audio Repository (Bidwell and Siya, 2013) in South Africa amongst others. I also researched local practices of access, owning and sharing of technology in low income communities (Rangaswamy & Sambasivan, 2011; Sambasivan et al., 2010; Sambasivan et al., 2009; Burrell, 2010; Murphy & Priebe, 2011; Agesa & Kim; Eriksson, 2008; Kwake & Adigun, 2008). This body of work, along with my understanding of family communication routines in Rural and Urban Kenya, led to ideas behind the design of TumaPicha.

The TumaPicha field evaluation, Research Objective 3, was conducted with a small set of families (two families in a rural area and two other families in the urban areas) to manage the challenges that would occur while monitoring technology use with a bigger set of families. Such problems include ensuring a deployment is oriented to participants' needs' and that the system is treated as an integral part of the home (Tolmie & Crabtree, 2008). The research process used for the entire TumaPicha design process is similar to how prototype testing is used in both engineering and software development to identify any design shortcomings that could be improved through an iterative process (Holtzblatt, 2004). This undertaking is also backed by existing research practices such as observation and technology probes (Hutchison et al, 2003, Dourish 2006, Yarosh & Abowd 2013 and Tolmie et al. 2008) as examples of acceptable HCI core practices that also broadly fall in

the field of Computer Supported Cooperative Work (CSCW) and computer science in general. Results from all the studies conducted to address my research questions and objectives helped me formulate recommendations for the design of family communication technologies for rural and low income urban areas of Kenya.

1.5. Organization

The remainder of this dissertation is presented in eight chapters. Chapter 2 reviews the critical points of past research on family communication in developed and developing countries, describes the impact of ICT in developing countries and, specifically, Kenya and finally discusses ICTD design projects that I borrow from to support the design of TumaPicha.

Chapters 3 and 4 presents a detailed study on how technology supports family communication in rural urban and sub urban Kenya (Research Objective 1). Chapter 3 describes the study methods and Chapter 4 presents the results and discussion of them.

Chapters 5 describe the design of TumaPicha based on the findings from the first study in this dissertation. I also document the design exercises conducted to inform the TumaPicha service.

Chapters 6 and 7 describe the deployment of TumaPicha with families in rural Kenya. Chapter 6 describes the study method and Chapter 7 presents the results and discussion of them.

Chapter 8 describes the overall study implications based on the three research stages presented for the design of technology that can support family communication in developing countries.

Chapter 9 concludes the dissertation with a list of my research contributions, articulation of limitations, and presentation of future work.

Chapter 2. Related Work

This chapter outlines prior research that has been conducted to unearth the key points that need to be addressed while thinking about designing technology for communities in rural and low income urban areas of developing countries. My aim is to reference this work with the goal of understanding the pertinent issues raised in this realm of work while thinking about designing technology that can support Kenyan families to share activities between rural and urban areas. Generally the literature review is presented in four parts. First, I describe research that provides direction on what we should think about as we design technology for use in developing countries. Second, I present work that describes aspects of technology infrastructure for consideration while deploying technology in rural and urban communities of developing countries. Third, I describe how Kenyans use technology with the aim of situating the work conducted in this dissertation with existing research on how families used technology to connect with distributed relatives. Fourth, I discuss five prototypes that have been designed to support communication between distributed relatives in initiating communication and maintaining awareness with each other.

2.1 Designing for Developing Countries

Numerous ICTD studies have documented challenges that need to be considered and navigated in efforts to design and deploy technology in rural and low income communities (Bidwell & Siya, 2013; Taylor, 2011). Here, they have pointed to the need to think critically about the notion of a “Digital Divide”, paying attention to local capacities, and supporting the adoption of technology that amplifies the existing practices of local communities (Ginsburg, 2008). It is therefore necessary to conduct research with marginalized communities to understand unique needs that can in turn inform the design of technology that will support the user’s existing cultural practices better (Bidwell & Siya, 2013; Toyama, 2011). This literature guides me in understanding that technology that is specifically designed for rural and low income families should be tested with the families intended to use it since it should aim to extend usage beyond the technology savvy (Heeks, 2002; Rangaswamy et al., 2011) and to include opportunities for illiterate users.

As a result, the literature presented in this chapter enables me to explore how to design communication technology for families that live in marginalized communities (Agesa & Kim, 2001; Ginsburg, 2008). I describe the work mentioned in this paragraph in detail next.

2.1.1 Conducting Field Research with Rural Communities

An overview of Information Communication and Technology for developing nations (ICTD) highlights pertinent issues for consideration in the investigation of the impact of technology use by local communities. A set of grand challenges in the field of research in developing countries that need to be addressed include education, healthcare and agriculture (Ho et al., 2009). The unique design needs that need consideration include lack of electricity in rural and low income parts of developing countries, lack of access to computers, and illiteracy (Ho et al., 2009). Therefore ICTD projects should be designed with aim to address specific social, cultural, and/or infrastructural challenges that affect such communities (Ho et al., 2009).

To better understand these challenges within context of local communities, researches who investigate technology use in situ should apply methods that might not fit within established HCI borders but still resonate with those living in marginalized settings in the quest to understand “Out There” (Taylor, 2011). In using methodologies established in the west to conduct research in marginalized communities in terms and language of technology (Taylor, 2011), HCI risks in missing out on actually presenting work that highlights gaps that exist in such areas. Working in ICTD environments require that we pay critical attention in terms of the study methodologies and researcher views while working on collecting information from external communities (Taylor, 2011). Reflective thinking therefore deepens our thinking around efforts to investigate the communities in developing countries and other marginalized regions.

2.1.2 Repurposing Technology for Marginalized Communities

Participatory design can promote the potential of creating sustainable technology projects for communities that live in rural parts of developing countries (Ho et al., 2009, Huang & Truong, 2008). There is a need for an ecosystem around affordable computing

through the design of low cost technology solutions that build on existing local infrastructures and only rely on minimum external support for sustenance once implemented. To design appropriate technology, several evaluation methods on the investigation idea, usage scenarios, case studies, and participatory critiques should be applied (Bidwell et al., 2011; Greenberg and Buxton, 2008; Holtzblatt et al., 2004). The applied methods should encompass the Cross cultural HCI focus on how User Interfaces (UIs) can be designed objectively in ways that users from different cultures can derive benefits when exposed to such systems. Effort should also be put towards developing (UIs) for illiterate and semi-literate users (Greenberg and Buxton, 2008; Huang & Truong, 2008; Prasad et al., 2005; Ho et al., 2009).

Challenges such as adapting to local cultures unfamiliar to the investigators and mistrust of using technology to solve local problems need to be addressed during ICTD research. On a wider scale, a lack of funding to carry out comprehensive long term investigations also hampers the opportunity to elaborately involve people in various investigations (Dias and Brewer, 2000). It is necessary to initiate sustainable projects in developing communities by addressing the issues of costs and cash flow awareness through marketing and providing localized ongoing support for continuity once the projects are initiated (Warshauer, 2003).. Local communities have supported ICTD projects that provide health services via rural telemedicine set ups, education technology, microfinance support and assistive technology in the past (Dias & Brewer, 2000). Here, researchers worked in conjunction with local organizations to solve problems and provide services that the local communities actually needed. Technology was also customized to fit within the requirements of the local communities and, as a result, a heavy engagement with the projects from the local communities was seen.

2.1.3 Addressing the “Digital Divide” Question

In terms of empowering local communities using technology, Ginsburg (2005) argues against the notion that less privileged cultures are simply waiting to catch up to the privileged west and thus simply falling further behind technologically. Usually seen as the uneven distribution and use of ICT for excluded people, technologies considered to be meaningful have been taken by local communities with both uncertainty and enthusiasm

in the recent past (Ginsburg, 2005). Digital technologies depend on elements that stratify a number of communities to use and so rely on literacy in English, electricity, and affordable technology among other things. Thus, they are bound to be more expensive for many populations in the marginalized parts of the ICTD community. The basic possibilities of digital vs, analog technologies are rarely discussed despite the significance of such differences in remote communities that might be culturally rich but still exposed to infrastructural limitations. Anthropologists looking at the uptake of media in remote indigenous communities are discouraged with the unexamined ethnocentrism that undergirds assumptions about the digital age (Ginsburg, 2005). Therefore, researchers should ensure that they think about handling community research in a manner that builds on the existing way of interactions and activities being carried out.

An understanding of how people in developing countries can use computing to achieve social inclusion is necessary for the successful implementation of ICTD projects. The “Digital Divide” concept “is simplistic” and can lead to well-meaning but incomplete attempts at a solution” based merely availing technology to communities without proper understanding of how the locals would be expected to benefit (Warshauer, 2008). For instance, a lot of funding has been used to provide computers to rural communities with the hope that by bringing technology to the local, communities will embrace such technology and use it as intended (Warshauer, 2008). To avoid such solutions that do not resonate with local communities, local organizations that already work in these regions should be incorporated at the planning stages of such ICTD projects. Technology should also be “considered within a specific context that includes hardware, software, support resources, infrastructure” (Warshauer, 2003). On a positive note, the Internet and other cross platform use of digital technologies have also been taken up by indigenous communities to inform the world of their stories from their own cultural perspective. Some examples in this realm include the *Igloodik Isuma* and *Sila.nu* project, *Us Mob* (*aboriginal movies*) in Central Australia and the *Raven Tales* in the Northwest Coast of Canada (Ginsburg, 2005). In these communities, digital technologies have been taken up because of the possibilities that they offer the locals to tell their stories (Ginsburg, 2005).

2.1.4 Local Researchers and Community Informatics

Conducting ICTD research in marginalized and understudied regions requires the understanding of cultural practices of the local communities. Insight that could help external researchers to continually adapt investigative methods in response to local values and practices while conducting studies in Africa is one strategy that could be used (Bidwell et al., 2013b). As an illustration, (Bidwell et al., 2013b) engaged researchers with diverse backgrounds in long term participatory research, design and deployment of technology with local inhabitants. While conducting studies in Mankosi, South Africa, they worked in partnership with the local governing structure by consulting the tribal authorities at the beginning of their investigations to gain information about the community they planned to work with (Bidwell et al., 2013b). The local researchers gathered and translated data culturally between local and non-local meanings and also shared their views during design activities. The researchers had also lived in the community for long periods which meant that they observed practices through participation and their accountability in this tight-knit community affected them. Through adaptation to the local culture, “researchers were able to engage and connect more deeply with how the local community perceived time which was task related with no stringent work clocks” (Bidwell et al., (2013b). Documenting such research procedures and availing the information to external investigators could inform ICTD research funding institutions and academic report delivery deadlines when setting up to work in understudied regions.

For meaningful deployment studies, technology informatics advocates that designers consider technology solutions for marginalized communities that will anchor on available hardware and stakeholder relationships (Toyama, 2010). Gyandoot, was a project in rural India that provided local people with updates on prices of regular crops at the district level so that small scale farmers would be able to decide when to harvest the crops, when to sell, where to sell and even provide the option of choosing the point for sale. Villagers could also report local complaints related to teachers failing to show up for work or even malfunctioning water pumps (Warshauer, 2003). While setting up this project, networked Internet kiosks were provided to various villages where local entrepreneurs serviced them. Government officials provided the content for use in the networked system based on the needs of the local communities in the various villages

(Warshauer, 2003). This project showed how infrastructure that already exists in communities could be leveraged to reduce the costs of implementing ICTD projects.

2.1.5 Importance of Mobile Phones in Design

International migration has resulted in scenarios that involve users in the *developed countries* sending used technologies (phones or computers) to relatives in developing countries. The phones that users discard in *developed countries* are often not outdated based on the frequency by which technology is replaced and can still be used in developing countries (Huang et al., 2008). Participatory design can be applied to redesign the interfaces of such technology for reuse in marginalized communities thus providing an opportunity to explore low cost sustainable mobile phone adoption practices in low income communities (Huang & Truong, 2008; Prasad et al., 2005; Ho et al., 2009). Participatory design with phone owners can also raise ideas for the useful repurposing of technology. Comparative studies of phone usage in countries could also yield additional sustainable design practices based on how foreign cultures' use and discard technology.

Investigations in Uganda looked at technology adoption in the peripheries, mainly referring to the rural regions of Sub Sahara Africa. The work reported how mobile phones are received, and the cultural understanding behind phone usage in rural Ugandan households and villages (Burrell, 2010). Cellphones have also been documented to serve "as potentially transformative and emancipatory as well as divisive forces in sub-Sahara Africa". The gendered dimension of cellphone usage by communities in low income regions of developing countries reveals a "complex nuanced picture of access, usage patterns and impacts on populations" (Burrell, 2010). The widespread use of mobile phones in developing countries (Wyche & Grinter, 2012) is an important part of implementing solutions that support distributed family connections. The value of mobile phones for promoting trade, regional cooperation and development within East Africa based on education levels, gender, poverty, and fears of technology has also been reported (Burrell, 2010; Murphy & Priebe, 2011; Sambasivan et al., 2010). Research on mobile phone use in Sub Sahara Africa reveal a complex gendered disparity in access (Gilwald et al., 2010) and aggravation of existing inequalities in Zambia (Kutoma and Wakunuma, 2007). In post war Liberia, in addition to connecting with family and friends,

cellphones were also used as sources of personal security (Best et al., 2010). Studies have documented on the exclusion of technology use by women in Uganda after moving outside their personal networks such as after separation from their husbands have also been documented (Burrell, 2010). In another study, Ugandan women were reported to have a lower access to cellphones than their male counterparts while in Ghana, women were reported to have a higher access to mobile phones than men (Burrell, 2010).

2.1.6 Opportunities around the Sharing Practices

In the rural communities of developing countries, the acquisition, sharing, and the use of information communication technologies has been documented to follow distinct practices. An investigation around how technologies were accessed, used and shared in urban slums in India highlighted three technology ownership and sharing processes that I describe below (Rangaswamy & Sambasivan, 2011). *Cutting Chai* (sharing technology ownership and costs) represents the understanding that the ownership or use of technology can be single or collective signaling the importance of technology in these regions. *Jugaad* (workaround on resource constraints) enables local repairers to assemble technology from available scarce resources. *Here Pheri* (Grey market activity that subvert legal business activities) shows how informal social networks are used to purchase technology using non legal business processes to meet the community's needs. The authors also reported that low income communities will acquire quality technology that is symbolically and functionally meaningful in their lives. The meanings and uses of technology in slum environments provide an inspiration for the design of technologies that can achieve mass impact with low income communities (Rangaswamy & Sambasivan, 2011). In the same breadth, the complex and dense information environments in urban slums of developing countries show patchworks of social actors, technologies, and cultural norms. Limited technology penetration in these regions leads to the expansion of information boundaries within the community through human mediation (Sambasivan et al., 2009). The authors also reported that the sharing norms found in the family and community spaces such as kitchens, shops and informal neighborhood spaces extend into usages of technological goods. For instance, a group of industry workers sharing a hostel in the urban slums used multiple ringtones to distinguish call recipients for a common phone that was shared within the group (Sambasivan et al., 2009).

Research presenting insights on how to counter poor literacy and low education levels which are major barriers in the process of designing technologies for rural communities should be pursued. This is because designing technology (such as games) for rural communities requires the consideration of various factors such as low entry barriers, appealing game themes, and transferring community relations (such as the way elders communicate with younger people) into the design of technology that will be used in the same communities (Kow, et al., 2012). In a study, rural families from separate regions of China embraced the use of mobile phone entertainment based on patterns of the socio economic structure. Comprehensive models that provided the possibility of predicting rural users' acceptance of technology based on socio economic variables were used to conduct this investigation (Liu et al., 2010). Study results showed that in the northern farming society, the interdependent social structure ensured high efficiency, high safety and steady collaborative association. While in the relatively independent industrial based Eastern society, there was more emphasis on the self. These individuals were more concerned with economic development and interest in social systems such as banking and insurance (Liu et al., 2010). Rural communities in developing countries have embraced and repurposed technologies that make meaning to them often turning UI challenges into mere bumps (Smyth et al., 2010). This means that it is necessary to discern the reasons why marginalized communities would need to adopt technology, which would in turn provide the necessary information required to inform the design of systems for use in such communities.

In this section, I described the importance of conducting field research with local communities and also highlighted how populations in rural and low income urban areas of developing countries acquire, share, renew and extend ICTD according to distinct practices. This section also highlighted issues that need to be taken into consideration while thinking about conducting informative research in marginalized communities. The last part of the section discussed how rural communities use mobile phones and explains why they are an integral part of technology designs in developing countries. The next section describes design avenues that generate discussions about designing technology that builds on the existing infrastructure of marginalized communities.

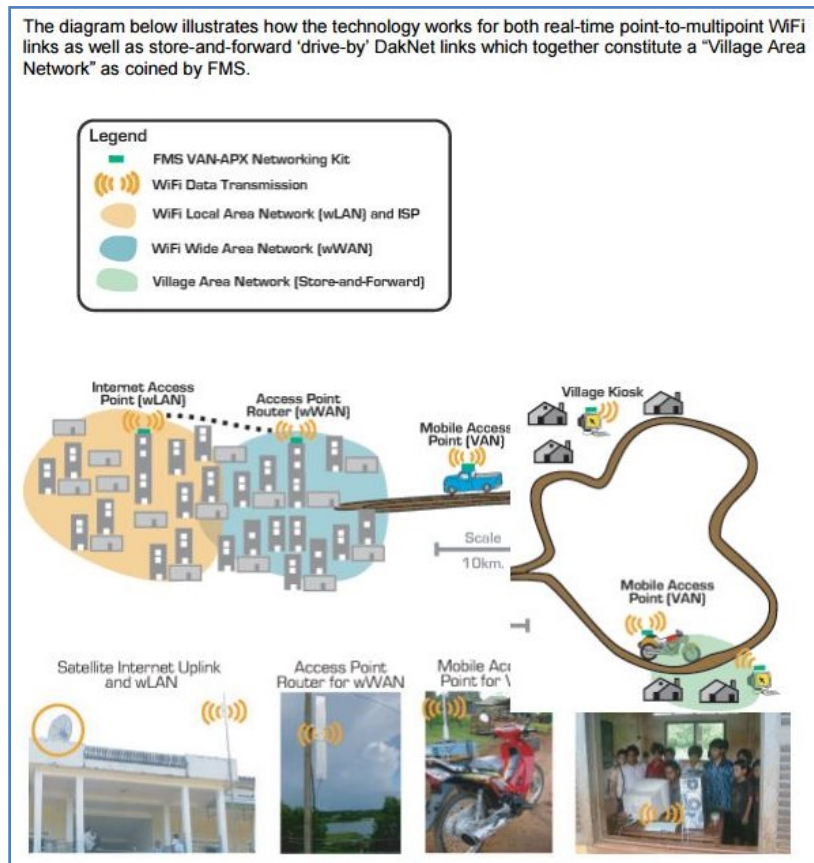


Figure 2.1: DakNet network (Copied with permission from Chyau & Raymond, 2005)

2.2 Technology Deployment in Developing Countries

In this section, I discuss research that explores potential avenues that can be pursued while designing technology for marginalized communities. Here, I highlight sample ICTD projects that incorporated rural communities in their design processes for a successful implementation eventually. I discuss ways through which initiated technology projects can be sustained after implementation and describe design approaches that can be explored for successful implementation of ICTD projects that are meaningful to local communities.

The use of desktop computers and the support of technology savvy individuals should certainly be considered while designing and deploying communication technology for rural and low income communities in developing countries (Rangaswamy et al., 2011).

Computer literate family members have been reported to mediate technology use for other relatives (Patel et al., 2010; Sambasivan et al., 2009). Low income communities have also been reported to appropriate scarce technology resources through single or collective ownership (Sambasivan et al., 2009; Sambasivan et al., 2010). Studies in Indian and Chinese remote communities also revealed that the real-life social status of people in the community should be reflected in the design of technology for the maintenance of the status quo in the village (Kam et al., 2010). I describe the mentioned studies in more detail next. In Cape Town, first time mobile Internet users ran into technical challenges while accessing Internet on their phones since the error codes on their phones directed them to a desktop computer even though they had never used one (Gitau et al., 2010). These studies highlight the necessity of actually designing and testing technology with actual real end users especially when they belong to marginalized communities that face unique challenges.

2.2.1 Sample Technology Design Solutions for Developing Countries

Asynchronous broadband Internet offers an opportunity for rural communities to experience wireless connectivity as they prepare to experience synchronous wireless connectivity in the future. To investigate this idea, a low cost digital Internet connection project was conducted in a rural village in India by Petland et al. (2004). The DakNet project challenged long held views that village telephones were the best model for poor communities and that poor people do not need computers (Figure 2.1). The study revealed that in rural villages of developing countries, some situations were actually served better using asynchronous communication avenues. For example, telephone use requires that an individual is present at the other end of the line for communication to occur. In some cases, this is not possible in rural communities where technology infrastructures are unstable (Petland et al., 2004). Other studies also highlight the importance of asynchronous communication. For example, a report by McKinsey Consulting mentions that in the near future 50% of all existing rural mail will convert to email. Therefore offline technology applications provide rural users who face intermittent connectivity with an opportunity to use technology when they are able to (Petland et al., 2004).

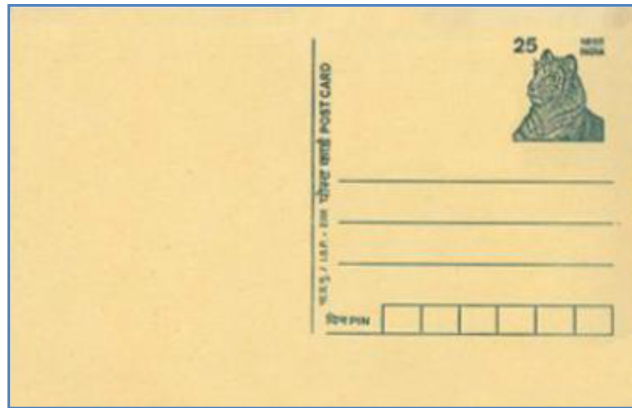


Figure 2.2: Indian postcard (Copied with permission from Prasad et al., 2005)

In India, principles gathered from past studies on Text Free (TF) user interfaces guided the initial design of a video integrated mail system for a rural community in India (Prasad et al., 2005). “Strong mental association with existing models” was employed in designing the prototypes such as using an Indian postcard (Figure 2.2) that participants were familiar with in the initial designs. The rest of the interface was significantly simplified by removing the audio, and text mail formats since they were confusing participants (Figure 2.3). Thus, only the video mail feature was left (Prasad et al., 2005). Study results showed that a combination of photos and number logins worked well for the users and it would be opportune to use a consistent login page to limit recognition confusion. The study highlighted the fact that significant challenges need to be overcome to make even the simplest applications usable by the illiterate users (Prasad et al., 2005). This study illustrates that providing a personalized asynchronous communication system for illiterate users works better if technology is designed based on existing ways of communication. Also, it is important to note that challenges faced by illiterate users do not manifest when tests are conducted with a more literate population.

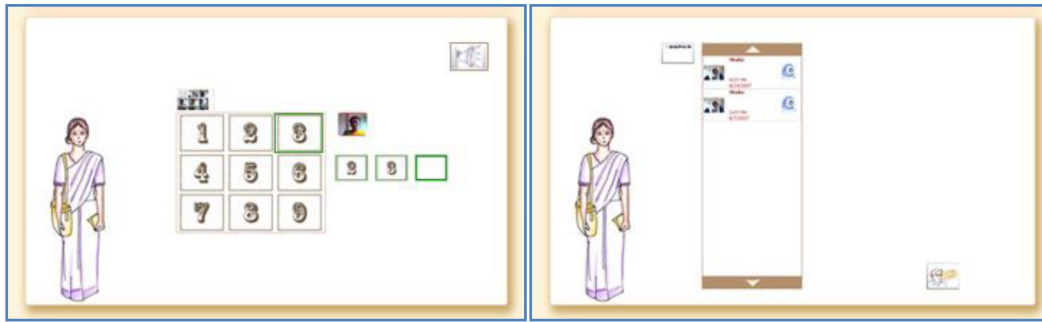


Figure 2.3: Final prototype (Left) & login screen (Right) Inbox (Copied with permission from Prasad et al., 2005)

In India, the Kelsa+ was conducted to explore the digital literacy of low income office workers who spend most of their time in IT offices when provided with PC Internet (Ratan, et al., 2009). A group of service staff from an IT firm was provided with computers that had been installed with a logging application which tracked all their activities once they logged in to use the systems. Internet use was measured using the number of launches and time spent on websites. Motion and detecting videos were also installed around the computers to record user actions (Ratan, et al., 2009). The study showed that providing computers to the workers lowered the barriers to accessing technology and learning how to use it considerably. However, it was also observed that the responses from the participants may have also been influenced by the peer relationship they shared with the researchers thus preventing the reporting of negative experiences.

Other studies have been conducted to document experiences of lessons learned from deploying technology in low income communities of developing countries. For instance, a study was conducted in India on how communities used TF user interface (Huang & Truong, 2008; Prasad et al, 2005; Ho et al., 2009) on mobile phones that were free of heavy text usage (Donner et al., 2009). In this study, participants were supposed to use the UI to find a job form an imaginary friend on a clone of Monster.com. In-depth interviews were used in addition to observation of the surrounding environment of study. It was found that through the addition of movie clip demonstrations, task completion in the study improved from an initial value of 30% to near 100% (Donner et al., 2009). The authors recommended that lots of time should be spent in the field to establish rapport and bridge the gaps created by diverse participant backgrounds. The author also suggests that while thinking about effective ICTD intervention measures, it is necessary to approach

solution implementation from both cultural and social angles that can complement the standard computer science approaches to design (Donner et al., 2009).

Other projects have also been designed to support communities in achieving success in local practices such as farming while sharing information using technology. For example, an investigation was conducted on the use of a voice message system called “Avaaj Otalo – AO” (Patel et al., 2010). Used by rural Indian farmers, AO provided a forum where successful farmers would provide their less successful counterparts with knowledge that could help them improve on their yields (Patel et al., 2010). Even though farmers were able to use the interactive system relatively well, some users indicated that menu navigation caused them difficulties while using the system. The Akshaya project is also another example of a successful initiative set up with involvement from the local community. The state subsidized e-literacy training, trained entrepreneurs for economic strategies, and also provided kiosk owners with loans to start a business. The kiosk owner’s role was to leverage the programs to support the sustenance of the project by involving the community who would then provide the financial resources to sustain the project (Kuriyan et al., 2008). These projects highlight the notion that while thinking about building technology for marginalized communities, designers should remain open to the idea that sometimes simple solutions that build on existing local infrastructures can motivate the local people to embrace such technology (Kuriyan et al., 2008).

2.2.2 Types of Infrastructure

The “*amplification theory*” identifies three mechanisms: “differentials in access, capacity and motivation” that should be targeted for technology implementation (Toyama, 2011). In differential access, ICTD projects should aim to implement existing development capacity. In differential capacity, empowering people with appropriate skills will enable them to derive more from technology. In differential motivation, low income and illiterate people in rural communities often suffer from very low efficacy and need confidence building to have strong motivation to improve their lives. The *amplification theory* therefore supports the idea that it is necessary to first capture the ways of life within a community and then design technology that build on the existing infrastructures of local communities (Toyama, 2011).

An exploratory study with groups to determine infrastructure adoption was conducted to determine people's daily routines and how they used technology (Mainwaring et al., 2004). Informal interviews were conducted with people who were somewhat living in ways beyond the traditional boundaries of one or more infrastructures especially in groups of secluded communities (Mainwaring et al., 2004). The participants were asked about their motivations to live in particular neighborhoods, such as gated communities. Infrastructure adoption was found to be strongly related to a community buying into a new way of living. Two of the types of infrastructure described by Mainwaring et al. (2004) included *appropriable* and *empowering* infrastructures. In *appropriable infrastructures*, Ubicomp's strength lies in its potential to create gaps of technology design and use and also be able to fill them. For example, only amateur knowledge would be required to set up Wi-Fi communication networks in situations where rural family members require the setup of such systems. The assembly and maintenance is therefore the way through which the service provider engages the community. In *Empowering Infrastructures*, Ubicomp systems should aim to provide resources to individuals and communities for continuous change and exercise (Mainwaring et al., 2004). Such an approach has been seen through the provision of technologies such as blogs and appropriation of social media to promote political struggles of the underprivileged. ICTD projects should aim to use infrastructures that have already been set up in place so as to build on practices that local communities have already set up (Mainwaring et al., 2004).

2.2.3 Sustaining ICTD Work Beyond Initiation

Telecommunication centres have extensively been discussed as avenues that have attempted to support health, banking and governance initiatives in developing countries. Setting up these kiosks faces significant challenges such as illiteracy, lack of information provision in the languages spoken by the rural communities in addition to poverty. The use of an individual who liaises between the external organization and local communities is necessary to transform corporate research ideas to the local community's social goals and vice versa. The local liaising individuals assist in matters such as fund raising, addressing problems or even creating tie ups with institutional bodies thus ensuring confidence in initiated projects (Kuriyan. 2008). The success of the kiosks also required an entire supply chain of other services that the local community would be

interested in, so that individuals could use these structures as one stop shops (Kuriyan. 2008).

It is necessary to have competent individuals who are able to support the translation of local user routines into design needs that ICTD projects can help address (Kuriyan. 2008). This way, technology solutions that are geared towards addressing local needs will build on gaps that have been identified by individuals who actually understand the local ways of life. Using locals to help define the needs that technology should address is necessary in the implementation of successful ICTD projects since Infrastructure adoption is majorly related to a community buying into a new way of living.

2.2.4 Design Models for Developing Countries

Research in developing countries has highlighted the challenges that are experienced when measuring the extent of the impact of a large number of “Information Systems (IS) projects in developing countries” due to lack of literature on evaluation methodology for such projects. However, there have also been attempts to set standards that could be used to evaluate the success or failure IS projects in these settings. For example, the *Design – Actuality model* is based on an assessment of the match or the mismatch of IS project goals in the present in comparison to how these goals are met in the future (Heeks, 2001). It can be used as a determinant of the likelihood of a system falling into one or more of the success or failure categories (Heeks, 2001). According to the model, the role of local improvisation can be leveraged to enhance the success of IS projects by doing two things: One, by changing the *local actuality to make it closer to IS actuality*, and two, by changing *the often imported IS design to make it closer to the developing country user actuality* improvisation. Direct importation of technology solutions from *developed countries* to local communities in developing countries often leaves little room for maneuvering in terms of bridging the gap between user design needs and new technology goals. Therefore, in cases where importation becomes necessary, doing so with modularity (i.e. implementing the technology in parts as needed by local communities) should be considered. Local capacities that understand the role of information systems should be incorporated to improve success rates by enacting improvisation that fits into the local communities (Heeks, 2001).

2.2.5 Designing For Local Populations

To ensure the sustenance of ICT projects in rural communities, Human Driven Design and Research (HDDR) ensures that locals get involved in the formulation of ICTD projects that aim to support their needs (Brand and Schwittay, 2006). The involvement of intended technology users in the design process can help highlight potential challenges in good time before the eventual solutions are rolled out for implementation. For instance, Gitau et al., (2010) reported on how an attempt to provide low income women in the slums of Cape Town, South Africa with mobile Internet hit glitches when errors on their mobile devices would direct them to desktop computers even though they had never used one before. Lessons from such studies provide reasons for designers to deploy applications with the understanding that in some regions, people might not have the opportunity to address technical issues via alternative technologies (Gitau et al., 2010).

In this section, I described work that illustrates the use of the Internet and repurposing technology as pertinent issues that need to be considered when designing technology for marginalized communities. I have also described solutions (HDDR and the Design – Actuality model) that could help inform the design process of communication technology to be used in developing countries. I have also discussed the importance of conducting investigations with local communities to make use of infrastructure that is already in place and get community buy-in so that locals can embrace the technology during implementation and even work to sustain it in the future.

2.3 How Kenyans use Communication Technology

In this section, I discuss studies that report on how Kenyans have used communication technology to connect with family members who are distributed over distance. I highlight issues that need consideration while thinking about conducting informative research to inform the design of meaningful technology for rural and low income communities in Kenya.

Families that experience challenges related to infrastructure, illiteracy and lack of access to technology in marginalized communities of developing countries have remained

understudied (Wyche & Grinter, 2012). Still, other studies have attempted to determine how people use technology for work or connecting with distributed family members. In Kenya for example, expatriates who were working and living in Nairobi creatively navigated limited connectivity by preplanning their online communications (Wyche et al., 2010). They regularly used technology in a setting characterized by poor infrastructure in terms of limited bandwidth, high data pricing and meaningful offline preparation before accessing the Internet (Wyche et al., 2010). In the findings of this investigation, Wyche et al. (2010) suggested that future technology designs should consider creating UI's that could allow a user to control web downloads to minimize bandwidth data consumption when necessary. This could be done by providing the user with an option to download sections of a web page while stopping the download of other parts of the web page that one might not interested in. The results from this investigation motivated an interaction based on a carefully planned and deliberate use of technology to maximize efficiency in sharing information quickly within a limited infrastructure environment thus reducing the cost of accessing technology,

In an investigation to enrich the HCI literature on how social media was used in sub-Saharan Africa, Wyche et al. (2013) set to investigate the Facebook experience of Kenyans from different social, economic, and technical context backgrounds who frequently used rural cyber cafes. The study set to determine the social media use in ways that were different than *developed countries* where social media was already widely accepted (Wyche et al., 2013). The results of this investigation showed that costs to access the Internet and limited access to technology (smart phones) hindered online participation. However, Kenyans navigated these challenges via workarounds such as multi-tasking browsing activities while accessing Facebook to connect with friends and find jobs (Wyche et al., 2013). This work provides information about local technology usage that designers can build on while thinking about designing technology for use by Kenyan families that live in low income urban areas.

In another study, Wyche & Grinter (2012) conducted an investigation on how Kenyans living in *developed countries* and their relatives back home, navigated infrastructural challenges related to connectivity and high costs while using communication technology to connect with each other. The extent of knowledge of

technology use by families in rural and urban Kenya affected their communication with their relatives who lived abroad. For instance, family members living in developed countries opened email accounts for the technologically illiterate relatives back home. The family members in Kenya still asked the relatives living abroad to check emails on their behalf. Elsewhere, Awori et al. (2015) investigated how mobile chat applications, calling and videoconferencing technologies supported Kenyans living in Melbourne who wished to sustain cultural knowledge in their foreign settings. The study highlighted how the Kenyans living in Australia maintained a connection with their ancestral homes through travelling back for visits, organizing meetings with people from same tribes, and cooking traditional meals to bridge gaps that technologies could not bridge while sharing “Indigenous Knowledge” (Awori et al. 2015).

This set of studies outlines how Kenyans who live abroad and expatriates working in Kenya communicate using technology in limited infrastructure environment. However, the studies do not focus on family communication routines. Overall, the related work presented in this section provides a foundation for understanding technology usage in Kenya and also gives an insight into the challenges that need to be addressed when thinking about deploying appropriate technology for marginalized communities. My work borrows from past research and also builds on Wyche’s work (Wyche et al., 2010; Wyche & Grinter, 2012; Wyche et al., 2013) by focusing on how people within Kenya connect with family members who are distributed across the country in a mixture of rural, suburban, and urban settings. I specifically explore family communication practices where I identify how and why technology is used and what social factors affect this communication. The next section of related work describes research that has been done in the realm of designing technology that supports family communication routines.

2.4 Family Communication Prototypes

As described in the previous section, studies have explored how Kenyans living abroad use technology, especially mobile phones, to communicate with their families who are in Kenya (Wyche & Grinter). Studies have also documented the various ways through which Kenyans use technology in comparison to the people in *developed countries* (Wyche et al., 2013), how gender impacts cellphone adoption (Eriksson, 2008; Murphy &

Priebe, 2011), how rural–urban migration (Agesa & Kim, 2001) along with rural access of technology by women (Kwake & Adigun, 2008) affect communication. The highlighted set of research on technology use in rural and urban communities of sub-Saharan Africa provides information about technology usage in developing countries that future studies can extend from. Specifically in the area of family communication using technology, more research that is largely focused on understanding design and its usage should be conducted in rural and low income urban settings.



Figure 2.4: The Whereabouts Clock showing family members locations (Left) and placed in the kitchen (Right) (Copied with permission from Sellen et al., 2006)

To bridge this gap, I aim to explore the design of media-based communication technology that could support family members who want to share media of their activities with distributed relatives living across rural and urban regions of Kenya. An extensive literature review in this realm of studies reveals that there are no known prototypes designed for dedicated sharing of activities between families that live in rural and low income urban areas of developing countries and more specifically, Kenya. To explore this body of research, I borrow design and prototype ideas from existing research that has been conducted in *developed countries*.

Therefore, this section provides insight into family communication technology (designed in *developed countries*) that does not use high bandwidth requirements, yet can still support distributed family members to obtain awareness of each other. I describe five such applications as examples: Whereabouts clock, Family Circles, SPARCs, Hermes Photo Display and Digital Family Portraits. Even though the systems discussed in this

section were used in *developed countries*, they provide background knowledge that is necessary for the exploration of technology designs that are dedicated to family communication in rural and low income areas of Kenya. I describe the listed prototypes next.



Figure 2.5: The Family Cycles prototype showing three messaging tokens and a simplified docking station (Copied with permission from Schatorje & Markopoulos, 2009)

2.4.1 Whereabouts Clock

Various studies have investigated the design of technology that could enhance connectivity between distributed families in *developed countries*. For example, the Whereabouts Clock (Figure 2.4) is a situated display for the kitchen which shows family members' whereabouts using cell phone data. It is a situated display designed for the home and placed somewhere like the kitchen to fit in the family routine much as a home clock does. A field trial method was conducted with 14 individuals about their use of the system, challenges experienced while using the system, privacy, and design related questions regarding the adequacy of the activity labels in the design. Unlike personal mobile devices, the clock broadcast information to the whole family, rather than to individuals. The clock shows where a family member is located such as at home or work but does not provide more information about the activities that the family members would be doing in order to promote further communication via other devices or in person. Technology similar to the Whereabouts Clock could be useful in rural communities where infrastructural challenges require technology that uses limited bandwidth. This prototype

therefore provides an insight into exploring the use of location information to provide awareness for distributed family members.

2.4.2 Family Circles

Family Circles (Figure 2.5) is a portable and flexible voice messaging solution that enables people to record messages and leave them at any desirable place in the home. In the design of the Family Circles, colored lights are used to convey different types of information for the intended receiver. The use of colors is left to the interpretation of the participants so that they can set their own habits and patterns and customs around it. Tokens are designed to simulate the notion of a push button to play a message. The idea of creating message-threads at the docking station provides a visual overview of messages and their relation to each other to encourage people to join a conversation. The notion to charge the tokens at the docking stations also provides an additional motivation for users to collect tokens at the docking station. The design's open endedness allows users to appropriate its use in their own way.

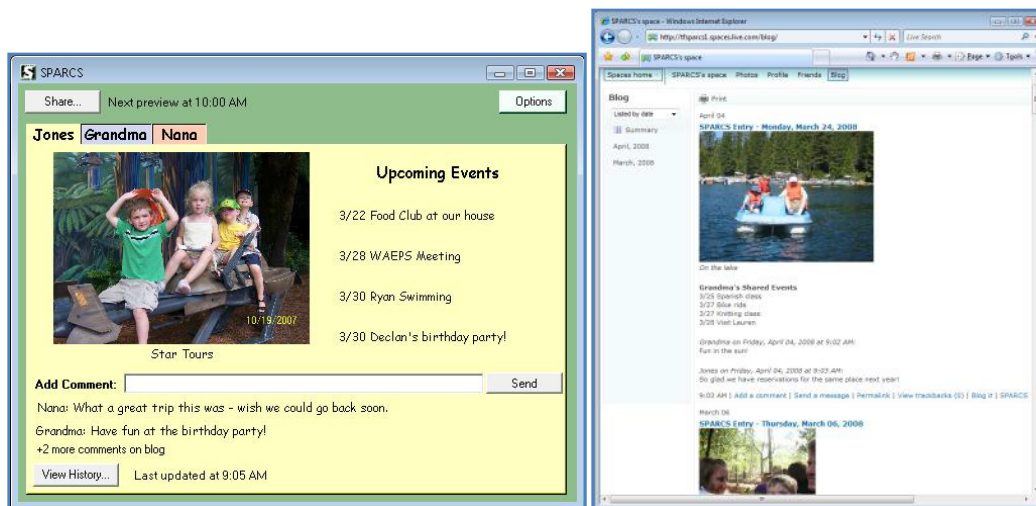


Figure 2.6: SPARCS (Copied with permission from Brush et al., 2009)

Implementing a similar prototype technology in rural communities of *developing countries* is challenging due to documented illiteracy, electricity and access to technology challenges (Ho et al., 2009; Mainwaring et al., 2004; Wyche & Grinter, 2012). I borrow two design ideas from the Family Circles design. First, SPARCS generated discussions along the lines of designing communication media that are flexible and expressive enough to

allow users to appropriate them. For example, family members could assign their individual meanings to the different light colors provided with system to attract people to use it. In my study settings, this could be achieved through providing families with technology that supports calling, while also allowing them to explore other applications beyond calling. Second, the use of asynchronous voice messaging also informs designers of technology for marginalized communities to think about using designing technology that can be used asynchronously by distributed families.

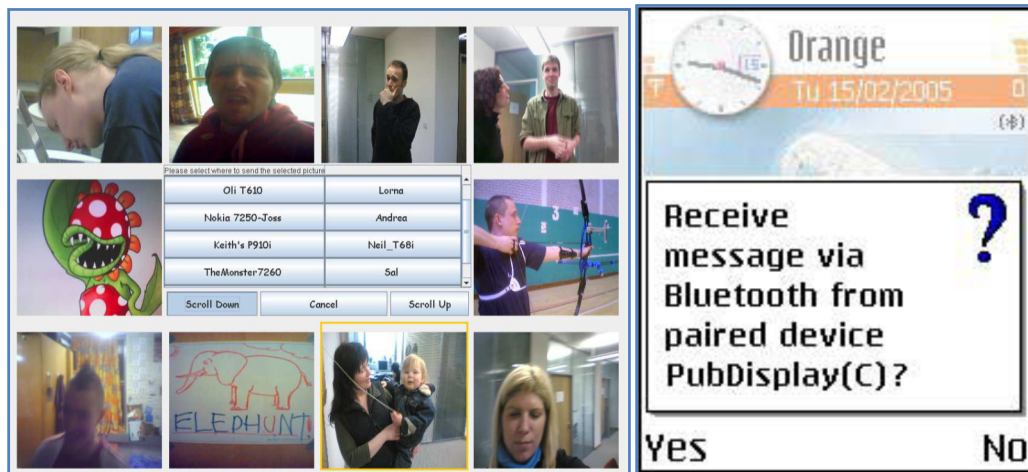


Figure 2.7: Hermes Picture Display: Selecting device to receive image (Left) & mobile display to receive selected message (Right) (With Permission from Cheverst et al., 2005)

2.4.3 SPARCS

Prototypes that support the sharing of family photos with other family members based on past experiences and calendar events such as SPARCS, (Figure 2.6) have been designed and evaluated (Brush et al., 2009). SPARCS was built to investigate how families initiated information sharing with distributed relatives (Brush et al., 2009). The prototype provides a set of photos to a family member that aim to generate an interest to discuss upcoming events. A member can select a photo that illustrates a past occurrence that is important to the whole family. A person can also modify the information (photos and calendar entries) before SPARC presents this information to the other family members. The results of this study revealed that the photos that were shared between family members created increased feelings of connection without the feeling of obligation to do so. The study also highlighted the need for further exploration on how asynchronous

communication could support connectivity between distributed families. For my work, I gain insight into more application areas as I explore how photos could play part in the design of expressive technology that supports the sharing of family moments in rural and low income parts of Kenya.

2.4.4 Hermes Photo Display

Research has looked into how existing family practices could guide new designs of technology to support family communication (Sellen et al., 2006, Yarosh et al., 2010, Judge et al. 2010 and, Moffat et al. 2012). Family communication is greatly supported when designers provide communication media that are flexible and expressive. Such technologies can then be appropriated by distributed family members to fit their communication routines (Schatorje & Markopoulos, 2009). For example, emails support the sending of typed messages while at the same time, it provides an opportunity for one to attach photos and even audio files if need be (Kirk et al. 2010; Tee et al. 2009). However, this is only possible in regions where the technology infrastructure is advanced. In the remote parts of developing countries, the limited infrastructure environment calls for the need to develop technology that uses low bandwidth and technology that local populations could access. Even though the Hermes Photo Display was designed in *developed countries*, the way it uses photos to share family moments provides a viable design opportunity for exploration when considering the design of low bandwidth technology systems.

The Hermes Photo Display is a wireless smart screen photo display that interacts with a built in mobile phone application (Figure 2.7). Users can use the built in application to send photos to a Hermes display or receive photos sent from the photo display on their mobile phones over Bluetooth (Cheverst et al., 2005). Cheverst et al. (2005) illustrated the existing technical challenges experienced during the use of the prototype while also highlighting the possibility to implement acceptable forms of interaction using current technology (e.g. mobile phones). Results from this study reveal that users were not overly distracted with the delays due to the Bluetooth pairing and file transfer while engaging with the photo sharing experience. This was because the desire of users to share image experiences was the overriding motivation to technical challenges experienced during the

use of the display (Cheverst, et al., 2005). This work provides an opportunity for exploration while thinking about the design of low bandwidth technologies that could make use image sharing between families in rural and low income parts of developing countries.



Figure 2.8: Family Digital Potrait examples showing many activities bottom of photo (Copied with permission from Mynatt et al., 2001)

2.4.5 Digital Family Portraits

The Digital Family Portrait is a service that provides awareness information about the activity level of an elderly family member's daily life. A common household object such as the picture frame is populated with icons that aggregate the daily activity level of a family member over a month. In the design, the family member's photograph that is held by the frame remains untouched while the frame itself is populated with icons that show the activity level of the remote elderly family member (Mynatt et al., 2001).

| | Lessons from Existing Research on ICTD | Research Gaps |
|--|--|--|
| Designing For Developing Countries | Infrastructural challenges affect deployment of technology (Bidwell & Siya, 2013; Taylor, 2011; Burrell, 2010; Murphy & Priebe, 2011; Sambasivan et al., 2010) | We do not know how to design technology that families could use to connect with their distributed relatives within the current infrastructure limitations in rural parts of Kenya |
| | Examples of challenges that need to be addressed with technology: healthcare, education, agriculture, poor electricity, little exposure to computing technologies, low literacy (Ho et al., 2009) | We do not know how technology that is designed for use by Kenyan family members who have limited exposure to technology will be used to address infrastructural challenges related to education, agriculture and healthcare. |
| | Technology design should be guided by local needs and not notions of a Digital Divide (Bidwell & Siya, 2013; Toyama, 2011; Kow, et al., 2012; Ginsburg, 2008; Warshauer, 2008). | We do not know how results collected from family communication practices of rural and low income urban families in Kenya can be used to design technology that supports family connection between rural and urban areas. |
| | Technology for marginal communities should be designed and tested with real end users from the same communities. (Heeks, 2002; Rangaswamy et al., 2011; Aagesa & Kim, 2001; Ginsburg, 2008) | Designs for family communication in Kenya have not been explored and tested with Kenyan families where they are key contributors as part of the design process.. |
| | Using local researchers, considering local ways of acquiring, sharing and using technology can inform the design of sustainable technology projects (Dias & Brewer, 2000; Bidwell et al., 2013b; Rangaswamy & Sambasivan, 2011) | |
| Technology Deployment In Developing Countries | Technology projects designed along local needs have been carried out (Brand and Schwitay, 2006; Kow, et al., 2012; Liu et al., 2010; Toyama, 2011). Examples include video mail (Prasad et al., 2006), Akshaya (Kurlyan et al., 2008), Kelsa+ (Ratan, et al., 2009) and DakNet (Petland et al., 2004). | Research on technology design in Kenya has not focused on family communication to address issues such as illiteracy and lack of interest in learning about technology. |
| | Technology designs should build on existing foundational infrastructure while also marrying local and sponsor goals for the projects actuality (Toyama, 2011; Heeks, 2001). | We do not know how local community representatives from rural and low income urban areas of Kenya can marry local community needs with communication technology design goals to inform the design of technology that can support distributed families in sharing activities over distance. |
| | The use of liaises and intermediaries should be considered for remote ICTD technology projects (Patel et al., 2010; Sambasivan et al., 2009; Rangaswamy et al., 2011) | We do not know how intermediaries can be used to support the use of new communication technologies in Kenya. |
| | Local populations have a unique culture of acquiring, sharing and repairing technology (Sambasivan et al., 2009; Sambasivan et al., 2010). | We do not know the best way to explore the design of technology for the diverse communities from different tribes that exist in rural parts of Kenya |
| | Real life social interactions should be represented in technology designs (Kam et al., 2010) | We do not know the best way to capture real life social interactions as guided by local cultures to incorporate such in the design of family communication systems in Kenya. |
| | UIs for illiterate and semi-literate users should be designed with considerations for their limitations (Huang & Truong, 2008; Prasad et al., 2005; Ho et al., 2009; Smyth et al., 2010; Huang & Truong, 2006; Prasad et al., 2005; Donner et al., 2008; Gitau et al., 2012). | |
| How Kenyans Use Communication Technology | Kenyans mainly use technology to communicate locally and internationally amidst infrastructural challenges (Wyche & Grinter, 2012; Wyche et al., 2010, 2013) | We do not know the best way to approach technology awareness in the rural and outlying communities in the remote parts of the country. |
| | Mobile phones are widespread but can also be used as tools of exclusion at times (Burrell, 2010; Wyche & Grinter, 2012; Gilwald et al., 2010; Best et al., 2010; Eriksson, 2008; Murphy & Priebe, 2011; Kutoma and Wakunuma, 2007) | We do not know how designers can build on the widespread low end mobile phone usage in remote and low income urban areas of Kenya to better support family communication. |
| | Technology access, ownership, and sharing of use is affected by gender (Kwake & Adigun, 2008) gender (Burrell, 2010; | We do not know whether families that face challenges in accessing technology are even interested in learning about new technologies in rural and low income areas of Kenya. |

Table 2.1: A summary of past research and missing gaps in ICTD design for family connection systems

The portrait was designed with the aim of providing daily awareness of remote family members to maintain connection that provided room for the provision of social support to elderly family by distributed relatives. Digital Family Portraits therefore aimed to reconnect extended family members by allowing them to remain aware of each other over distance (Mynatt et al., 2001). The system showed the activity level of an aging parent (Figure 2.8) where inactivity would indicate health problems. Study results revealed that family members would glance at the system a couple of times per day. 'Busy' activity in the portraits also led family members to initiate calls that revolved around this observation. This work shows that adding visual awareness information can help support phone conversations between distance-separated family members.

This section provided insight into attempts to design technology that does not use high bandwidth requirements, yet can still support the distributed family members to obtain awareness of each other in *developed countries*. The work discussed in this section showed how photos were used to generate interest in discussions between distributed family members. I aim to borrow design ideas from some of the systems described in this section as my research settings are characterized by poor infrastructure in terms of bandwidth and data costs (Wyche et al. 2010).

2.5 Summary

This chapter presented a comprehensive literature review helps in understanding the overarching phenomenon, as well as guidance on the missing gaps that can be explored further to *provide a foundation for understanding how to best design technology to support family communication over distance between rural and urban areas of Kenya* (Table 2.1). The literature review also provides an in-depth academic background through a review of pertinent issues that researchers are encouraged to observe while working in marginalized and rural communities of developing countries. In the first part, I review issues to think about while planning to conduct technology related research with marginalized communities, work on the repurposing of technology projects that resonate with the cultural practices of these rural communities and also described studies that show how opportunities of local interactions create opportunities that are important when designing technology that can be accepted by rural and low income communities of

developing countries. To ensure that implemented technology designs fit well with local populations, I also discuss why it is important to understand the concept of the “Digital Divide” as it is important for designers should mainly think about designing technology that builds on existing cultural norms of given communities. In the second part, I describe existing research sustaining ICTD projects beyond implementation; I also describe studies that encourage designers to build on existing infrastructure to promote the chances of successful implementation of new technology projects in rural and low income communities of developing communities. I also provide examples of some projects that have been successfully implemented and embraced by local communities after successful implementation. Finally, the third part of the chapter describes research that has been conducted to understand technology use in Kenya. This work investigates how expatriates, Kenyan youths living in the urban areas, and even families that are distributed across the country use technology for communication. The work also investigates how the spread of mobile phone use and the uptake of social media such as Facebook, have influenced the way youths living in Nairobi communicate. Finally, I discuss five system designs that were investigated with families in the developing countries. The results from these studies show that adding a visual dimension to communication provides opportunities for family members to initiate and sustain communication hence promoting connectedness.

In the next chapter, I provide an account of a study methodology that I used to conduct an exploratory qualitative investigation to determine the communication practices of family members between rural, suburban, and urban settings in Kenya. In the subsequent chapter, I discuss the findings from Study 1 of this dissertation, and then use these results to inform the design of a communication service for families in rural and low income areas of Kenya.

Chapter 3. Family Communication Routines Methods

This chapter presents a detailed description of the methods, data collection and analysis used in my first investigation of this dissertation. I conducted an exploratory qualitative investigation to determine the communication practices of family members between rural, suburban, and urban settings in Kenya. My aim was to uncover family communication practices that were technology-based and also understand how these families adopted such usage in a limited infrastructure environment. This goal maps directly to the first objective of my dissertation that seeks to *describe how families in Kenya use technology to communicate with each other over distance and the social factors that affect this communication*. This objective also addresses Research Question 1. This study was mainly conducted using semi structured interviews.

3.1 Participants and Study sites

3.1.1 Participants

A total of 24 participants between 19 and 59 years of age were recruited across three study sites in Kenya for Study 1 (Table 3.1). I was interested in a wide range of ages, different study locations, and a variety of occupations so as to gain a representation of typical rural and low income Kenyans. This participant selection also holds for study 2 whose participants were selected from the original pool of participants already selected in this initial investigation. The broader representation was necessary for such an exploratory research activity and to support the generalizability of any eventual findings. I describe participant distribution together with the details of rural, suburban and urban study sites next.

3.1.2 Study Sites



Figure 3.1: Mahena - Sheep grazing in front of a traditional Luo home with a granary in the background

3.1.2.1 Migori (Rural – Mostly Low-Income)

Eleven participants (6 women) from rural Migori lived in Mahena village which is part of Awendo division. Awendo division is part of the larger Migori District that lies 360 km from Nairobi and has a population of ~47,000. It is predominantly the home of the Luo, Kisii and Kuria communities (Wikipedia). A typical home in Mahena Village would consist of two or more huts built in the same compound and enclosed by a natural shrub fence. The structure of the home depended on the number of houses that had been built in the same compound. For instance, a polygamous family consisting of two wives and three grown up sons would require two houses for the wives and three huts for the sons. Figure 3.1 shows a home of the father of a participant who had not yet built his hut. Families in this district cultivate tobacco and plant sugarcane as cash crops while those that do not own large parcels of land engage in subsistence farming of maize, beans, coffee, groundnuts and vegetables. I included two participants from polygamous families in our studies since polygamy is part of the cultural practice of the Luo community. The education levels of my study participants from this region varied from no schooling to high school. The study participants included a community leader, a woman who sold medicine without proper medical training as a chemist and a kindergarten teacher who was the second wife in a polygamous home.

3.1.2.2 Kisumu (Suburban – Mid-Income)



Figure 3.2: Githurai: a sitting room in a suburban setting

I selected four participants (2 women) from suburban Kisumu. Figure 3.2 shows the living and dining room in the home of a senior civil servant in a suburban area. Kisumu is a port city in western Kenya with a population of ~409,000 and is the major commercial center in Western Kenya that also connects the country to Uganda and Tanzania (Wikipedia). The population in Kisumu is predominantly the Luo and the Indian Sikh community. Fishing, agriculture (both large scale and subsistence sugar and rice cultivation), textile (mainly run by the Indian community) and fish processing industries are located in this city. Our participants from Kisumu included a businessman, a senior civil servant, and two recent university graduates who were seeking employment opportunities. The civil servant was actually taking career advancement courses at a University that was situated away from his family and would visit them once every four months.

3.1.2.3 Githurai (Low Income Urban)

I also selected nine participants (5 women) from Githurai area in Nairobi. Githurai is a multilingual mixture of slums and suburbs that lies in the eastern part of Nairobi with a population of over 800,000 (Wikipedia). Githurai's largest population is the Kikuyu and it is served by the newly built Super Highway and a branch of the Kenya-Uganda Railway from Nairobi central district (Wikipedia). People living in Githurai engage in merchandise sales conducted in small retail shops/stores, operate open air cloth stores and also engage in *Jua Kali* activities such as welding, building and construction and carpentry.

Our mid-income participants from Githurai included a civil servant, an owner of rental flats, and a graphic designer while the low-income participants included a tailor, and a woman who sold vegetables at the local market (Figure 3.3).



Figure 3.3: Githurai - women selling Sukuma Wiki (kales)

3.2 Recruitment

Having lived in all of my study settings at some point and coupled with the fact that rural Migori serves as my ancestral roots, this study provided the study participants with an opportunity for sustained involvement with further investigations that would follow the first study. In the rural settings, two of my participants (the community leader and local chemist) assisted me in identifying rural interviewees who had limited education. Other participants were recruited through word-of-mouth and notices and posters that I displayed at the local village chief's office and at the chemist shop entrance. After identifying my participants, I requested permission from the elders of the homes that I visited especially in cases where women were to be interviewed while their husbands were not around the home. This action was important since the elders had to be informed as to why I would spend time in the company of one's wife or a widow without

| # | Participants | Participant Description and technology ownership | | | |
|-----|--------------|--|-----|---------------------------------------|----------|
| P | Name | Gender | Age | Occupation | Location |
| P1 | Waithera | Female | 56 | Owns rental houses in Githurai | Urban |
| P2 | Patrick | Male | 44 | Acrobat and gymnast | Urban |
| P3 | Obango | Male | 42 | Councilor (Aspiring politician) | Urban |
| P4 | Joel | Male | 52 | Civil servant & tailor in Githurai | Urban |
| P5 | Okayo | Male | 50 | Businessman in Kisumu | Suburban |
| P6 | Opondo | Male | 58 | Retired teacher living in the village | Rural |
| P7 | Jagem | Male | 59 | Consultant | Rural |
| P8 | Adul | Male | 49 | Civil servant | Suburban |
| P9 | Peace | Female | 29 | Graduate | Suburban |
| P10 | Robina | Female | 34 | Immigration | Urban |
| P11 | Mama Baron | Female | 26 | Vendor | Urban |
| P12 | David | Male | 29 | Subsistence farmer | Rural |
| P13 | John | Male | 25 | Motorbike taxi | Rural |
| P14 | Jeremiah | Male | 22 | Subsistence farmer | Rural |
| P15 | Lavender | Female | 23 | Taylor/housewife | Rural |
| P16 | Min Onyango | Female | 46 | Widow/ farmer | Rural |
| P17 | Nyakambare | Female | 56 | Community leader | Rural |
| P18 | Akinyi | Female | 24 | Graduate | Suburban |
| P19 | Rashidi | Male | 29 | Designer at home | Urban |
| P20 | Alice | Female | 41 | Food vendor | Urban |
| P21 | Jane | Female | 28 | Nursery teacher | Urban |
| P22 | Margaret | Female | 23 | Rural chemist | Rural |
| P23 | Godana | Female | 31 | Roadside vendor | Rural |
| P24 | Shiru | Female | 22 | waitress | Urban |

Table 3.1: Participant details

the presence of man from the home. Other participants like the chemist were interviewed at their places of work. Three participants from Githurai and two from Kisumu were recruited through posts on Facebook and Twitter while one participant from Kisumu was recruited through Email. The remaining participants from both regions were recruited through posters that were placed in small retail shops and by word-of-mouth. I also called participants once they had shown interest in the study to explain what would be involved in case one signed up to be part of the study. The participant selection was conducted iteratively where I reached out to people of different occupations as I continuously learned about family practices while conducting studies with those who had already signed up. It is necessary to also point that our participant selection was intentionally non homogeneous as we wanted to capture the communication practices of a cross section of families from rural, sub-urban and urban areas of Kenya. A detailed description of the study participants is provided in table 3.1.

3.2.1 Household Composition

Overall, eighteen participants lived with immediate family that included a partner together with children. Within this group, three participants lived with both immediate and distant family members under the same roof (one from the urban region and two from suburban regions) and two participants (from the rural setting) had two wives who both had young children aged between one to 10 years. The remaining six participants were either single or lived away from the rest of their family members alone.

3.2.2 Technology Ownership

Seventeen participants (10 rural out of 10, 5 urban out of 10 and 2 suburban out of 4) owned a single mobile phone. On the other hand, seven participants (2 rural, 2 suburban and 3 urban) reported the ownership of more than one mobile phone where each phone was used for a different purpose. For example, one participant had a phone that he used to call family members and a second one dedicated for non-family related discussions. Another participant from suburban settings had an iPhone that she used to access social media and another low end phone that she mainly used for calling. There was also a case where one rural participant who owned a desktop computer did not actually use it but kept it in storage. All the four suburban participants in Kisumu owned laptops while two owned desktop computers either for work or for use by other family members in addition to the laptops. In one case, the civil servant attending university away from his family (described under suburban study settings) purchased a mobile phone that was permanently left at home for contacting his kids in case he called when his wife was away with her personal phone. Three urban participants also reported the ownership of a laptop; thus, we see only suburban and urban participants owning a form of computer, while rural participants mainly owned mobile phones.

3.3 Methods

I conducted an interview-based study (Holtzblatt, 2004, Martin 2012) not only to understand how and why Kenyans used technologies to communicate with family members in rural, urban, and suburban areas, but also to discern the social factors that

affected this communication. Even though past studies stress the need to use a mixture of methods that include both diary entries and semi structured studies (Nylander et al., 2009), I used semi structured interviews to gain more insight into the use of technology by my participants. I did not use diary entries as a method of data collection, especially in the village, since my participants did not feel comfortable recording information but preferred to provide me with detailed explanations instead.

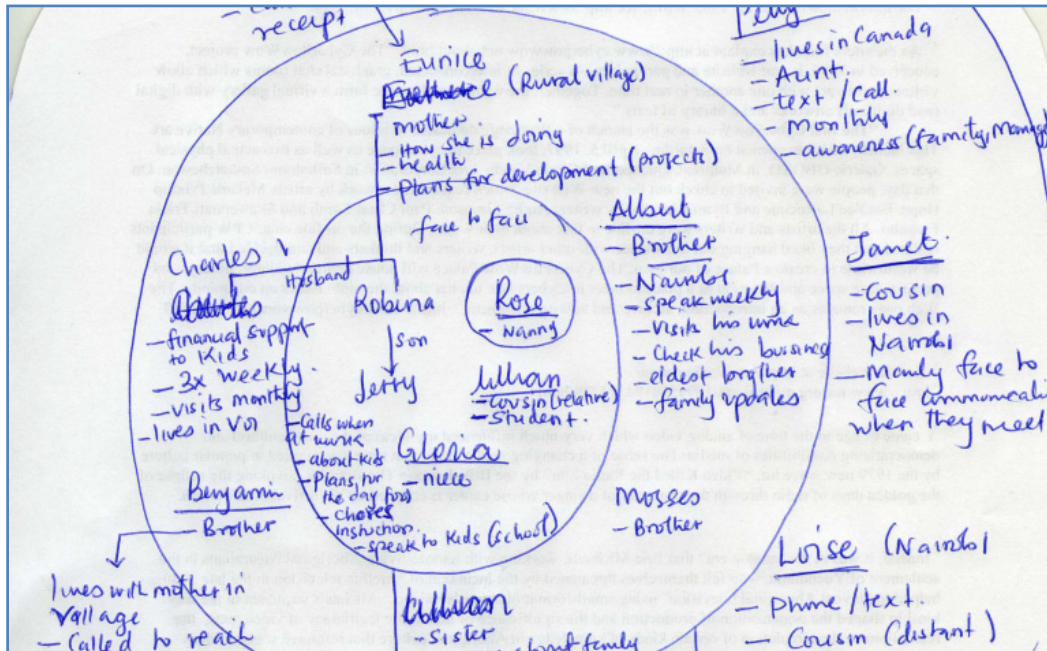


Figure 3.4: Participant relationship map

The semi-structured interviews were conducted with participants over the course of two visits. Each visit lasted between 45 and 60 minutes. During the first visit, I conducted an in-depth interview with the participant about his or her family and communication practices. Participants were provided with a plain A4 size paper for drawing their family communication networks since studies have used mapping techniques for similar objectives in the past (Horst and Miller, 2005, Neustaedter et al., 2006, Strauss & Corbin, 1998, Tee et al., 2009). Together with the participants (sometimes using the local Luo language), we filled in the type of technology and kind of information that was exchanged with their kin as illustrated in Figure 3.4. This was necessary because some of the rural participants were reluctant to draw the communication maps for fear of messing up the diagrams. Following this step, participants were asked a series of questions about their communication routines with the listed family members. This included questions about

when and how often a participant contacted each remote family member and what type of technology was used during that communication.

The second visit happened approximately one week after the first visit where I mainly discussed findings from the first interview and asked follow-up questions to gain clarity on aspects of communication using technology that had not been clear from the first study. This stage also involved confirming facts that could have been reported by the participants and misreported while recording my study notes while also allowing participants to voice any additional insights. Questions asked during these visits aimed to understand what prompted the participants to engage in specific ways of technology use, the activities performed before and after technology choice for communication and the familiarity of the participants with the chosen medium of communication. These types of questions allowed me to gain responses that would help me to understand the participants' motivations to select technology to convey specific types of information. A full list of interview research materials that includes, ethics application forms, participant questions, participant remuneration, and study consent forms is provided in the Appendix A.

Rural participants were mainly interviewed within their homes while urban and suburban participants were interviewed either at their workplace or homes. One suburban participant was interviewed at his business premises, the senior civil servant at his home, while the university graduates were interviewed in their relatives' homes. Participants spoke in a range of dialects and languages that included Luo, Kiswahili and English that I all understood and later translated. Overall, the participant selection gave insight into the family communication practices of five different tribes in the city and two tribes in the rural settings.

| Message Delivery | |
|---------------------------------|---|
| [Msgs] | Messages shared over Email, SMS or voicemail |
| [MsgSucc] | Message successfully reaches the intended recipient |
| [MsgFail] | Message does not reach the intended recipient |
| [NtwrkFail] | Network failure |
| [Mteja] | Call fails to go through since the receiver is unreachable |
| [PlseClme] | A message that asks another family member to call back |
| [Sambaza] | Sharing phone credit with another individual with the same carrier |
| [Beepng] | Short phone call that lasts long enough to avoid incurring call costs |
| [PromCalls] | Phone calls often made during cheap promotional call offers |
| Technology / Communication Mode | |
| [Mphne] | Mobile phone selected as the preferred communication technology |
| [LapComp] | Laptop |
| [DesComp] | Desktop computer |
| [F2FCom] | Face to face communication as a means of sharing information |
| [Phshare] | Sharing phones between families in the rural villages |
| [WoM] | Word of mouth that is transmitted after receiving message over the phone or otherwise |
| [Vmail] | Voicemail services |

Table 3.2: Analysis codes for message delivery and available communication technology

3.4 Data Collection & Analysis

In total, my findings were based on transcribed interviews with 24 participants across rural, suburban and urban Kenya. All interviews were audio recorded so that I could revisit the data while analyzing study results. I documented participant homes and areas where they used technology to communicate in 69 photographs along with 92 pages of field notes summarizing the participant responses. The photos added a visual component aiding recollection of actual activities captured with participant during study visits. The handwritten notes also described the types of technology participants used to support family connection as well as the type of information that was shared and any challenges that were experienced during the process.

| Reasons for Using Technology | |
|------------------------------|---|
| [InfoRural] | General discussions about the village activities |
| [InfoUrbanL] | General discussions about the activities in the low income urban areas |
| [MsgClose] | Share information with close family |
| [MsgDistant] | Share information with/about distant family, neighboring homes (in the village). |
| [InfoFarmng] | Report on the progress of farming activities shared by relatives |
| [InfoWellBeing] | Discussion of health related issues |
| [InfoFamily] | Discussion of family related issues (Parents children conversations) |
| Ways of Using Technology | |
| [MsgBegin] | Initiate information sharing process |
| [MsgSharing] | Information sent/ received via intermediaries (People intervening technology use) |
| [InfoSharingMediums] | Sharing information beyond mobile phones (Social media, email etc) |
| [MPesa] | Using mobile phones for mobile money remittance |
| [PlanCommunication] | Scheduling communication times |

Table 3.3: Analysis codes for reasons for using technology

All the qualitative data collected was coded and analyzed by domain. I applied open coding while iteratively reviewing study notes and transcripts, and then used hand written codes on common themes. Open coding was used as the first step of interpreting the study results since it would enable the uncovering, naming and developing of concepts to open up text and expose the participant ideas (Strauss & Corbin, 1998, Holtzblatt, 2004). For example, when participants were asked how they chose a specific tool for communication, the coding process enabled responses to be classified into three possible areas: The first option was because the participants only had a specific type of technology at their disposal, while the second related to cost and the third was about knowledge and convenience (Table 3.2). In the rest of the chapter, I provide a detailed illustration of the coding analysis that was used to come up with the reasons why families used communications technology in Table 3.3. The codes used to determine the social situations that affected communication technology usage are also provided in Table3.4.

| Social Situations from using technology | |
|---|--|
| [InfoDistributor] | Tasked with distributing information to other family members (siblings, parents etc) |
| [PartLoc] | Participant location i.e urban members are expected to distribute information from rural areas |
| [MsgPrep] | Preparing for communication using technology (i.e reaching out to many people) |
| [InfEmmergency] | Information about unplanned urgent activities such as funerals |
| [MsgType] | Private or general information between family members |
| [CommCircle] | Coordinating activities for relatives one is responsible for (many relatives mean more challenges) |
| [InfrastructureIssues] | Infrastructure challenges faced during communication (Network, Technology ownership etc) |
| [LearningComp] | Interest in obtaining knowledge about using alternative technology (Internet, Social Media, etc) |
| [CompLit] | Computer literacy and ability to use technology beyond mobile phone making and receiving calls |
| [FemaleCell] | Female participants owning a mobile phone as a communication tool |
| Costs & Technology Access | |
| [Comm\$\$\$] | Cost of selected communication technology |
| [JobIncome] | Participant occupation or income status in terms of meeting communication obligations |
| [CallStrategies] | Calling strategies (please call me, Beeping and cheap calling periods) |
| [InternetCost] | Amount spent on using technology for communication over Internet |

Table 3.4: Analysis codes for social situations from using technology

On completion of the coding process, patterns were grouped and then sub grouped through collecting participant responses and recording the listed codes and then grouping them into categories. For example, I would look at the times when an individual would decide to use a particular technology, the actual technology they would decide to use and the satisfaction level of using a specific method in terms of accomplishing the task they intended to achieve. I also used affinity diagramming to link the data into information that reveals relationships between ideas (Strauss & Corbin, 1998, Holtzblatt, 2004, Martin, 2012). I then drew out the categories and themes to get a visual picture of how the ideas were connected. Affinity diagramming allowed me to discern misplaced categories and rearrange any concepts e. I provide a discussion of the resulting themes in the next chapter.

3.5 Summary

This chapter presented the strategies I used to recruit total of 24 participants across rural, suburban and urban study sites in Kenya. I also provide a detailed description

of the participant demographics, household composition and a breakdown of participant technology ownership. A description of the recruitment process, an explanation of data collection process and result analysis has also been detailed. I used semi-structured interviews with participants over the course of two visits where I applied in-depth interviews to gather information about their communication practices using technology. I also have also described the reasons behind using family mapping techniques to obtain information about the participant communication networks. I finish by explaining the coding techniques used to come up with themes from Study 1. In the next chapter, I outline the results from Study 1, while focusing on several themes that stood out from study results.

Chapter 4. Communication Routines & Practices

This chapter describes findings from Study 1 of this dissertation that focuses on understanding how families communicate over distance when using technology in Kenya and how researchers should think about designing technology to support this communication over distance. I describe the reasons behind family communication routines using technology and also discuss the social factors that affect this usage over rural suburban and urban areas. These findings address the first research objective of this dissertation while also answering research question 1. The chapter is organized as follows. First, I describe how study participants conceptualize the term 'family'. Second, I describe the reasons for communication with technology that include economic support and coordination of family activities. Third, I discuss the social situations and challenges that affected family communication routines such as gender and phone usage via intermediaries. Fourth, I provide a discussion and conclusion of the chapter with focus on family communication and the social challenges earlier described in the chapter.



Figure 4.1: A section of a rural village home showing sheep granary and main house

4.1 Conceptualizations of 'Family'

In the rural communities, our participants described their family as being made up of all the people who lived within a traditional-style village home (Figure 4.1). These would include children, siblings and their wives if married. Female siblings' husbands would also be considered close family even though they lived at their husbands' homes. Cousins and relatives that lived in the home would also be considered close family. A typical home in the rural areas I studied consisted of about two or more huts all built within the same compound and enclosed by a fence. In eight of the homes that I visited, there were at least four huts in each meaning that there were at least four families in the homes. Two of my participants in the village were polygamous and had two wives. According to them, close family consisted of all the children belonging to both wives and a wide range of in-laws from both homes where the wives came from. The number of people that participants needed to keep in touch with on a regular basis varied depending on the activities they shared with each other.

In the city, five participants were either single or separated while the remaining six participants had 'nuclear families' that had an average of five people. This generally consisted of the parents and three children. One older participant had an unusually large family of eight children living under one roof and one daughter who was studying in the USA. In the context of the city, the 'term' family meant the people who lived in the participant's house. Thus, it was conceptualized as being a much smaller group than was typically found in the village setting. For wealthier family members, their description of family included a lot of extended relatives. For example, one wealthy businessman from Kisumu, Kenya gave us the response illustrated below.

"My family is very large. Immediate family would be my wife and three children. However, I also live with my 35 year old brother and two of my sisters-in-law. We also live with a househelp. In the village, I have my step-mother, my siblings and a few more half-brothers. Most of these people contact me occasionally for assistance and so I can say that my family is very large since I need to ensure that I am able to support them economically. I also assist the daughter of my best friend who died a few years ago by paying her education, so she is also part of my family."- Okayo (P5), Male, 50.



Figure 4.2: Communication maps for Patrick (P2)

Therefore, in addition to the desirable definition of family to include husband, wife and children as in a nuclear family, my participants in rural and urban Kenya at times classified relatives who provided financial support as close family. This was also revealed in the communication maps drawn by the participants (Figure 4.2) when asked to explain the relatives they would communicate with using technology. In Figure 4.2, the center circle shows Patrick (P2) listing his wife, two sons and step daughter as the people living with him under one roof as immediate family. The second circle outwards represents close family that includes his mother, siblings and eldest son who did not actually live with him under the same roof but were still considered as close family. The outer part of the diagram represents family (cousins and distant uncles) who he only communicated with occasionally.

4.2 Reasons for Communication with Technology

In rural areas, family communication was focused around in-person exchanges and technology was used only occasionally to communicate with the people that one lived with. While out working in places such as the farms, most participants did not communicate with their family members unless there was an important message to discuss. Mobile phones would then be used to coordinate urgent matters. In the suburban and urban regions, family members had more frequent opportunities for exchanges of information throughout the day through the use of technology. Across these three areas, I found that technology-based communication generally focused on four topics: economic support, life advice, well-being, and, sometimes, family coordination of activities. I describe each next.



Figure 4.3: Mahena: A photo showing farm (Left) and cows being taken to graze after ploughing (Right)

4.2.1 Economic Support

Like findings from previous studies (Agesa & Kim, 2001; Francis, 2000; Ginsburg, 2008; Horst & Miller, 2005; Hughes & Lonnie, 2007; Mimbi et al., 2011; Wyche & Grinter, 2012), participants reported that the most important reason for communication with technology was for economic support. This occurred frequently where people living in rural areas would communicate with their suburban and urban family members. This included situations such as parents receiving financial assistance through MPesa (also documented in (Hughes & Lonnie, 2007)) from their adult children who were working away from home. There were cases where participants were supporting a niece or a nephew through payment of fees (also found in (Morawczynski, 2013)) and even others where

siblings and cousins were supported with money to sustain subsistence farming (Figure 4.3) or small scale business endeavors. The use of MPesa to send money to aged and unemployed parents living in the villages was reported by seven participants (2 from suburban and 5 from the urban areas).

Moving beyond other study's findings, I also found that family members who were considered wealthy were more likely to focus communication around economic support. This sometimes created feelings of obligation or emotional struggles because conversations tended to overly-focus on economic support at the expense of other topics. For example, a successful suburban businessman explained to us that he felt obligated to financially assist both his immediate and extended family members.

“Most of my family members see that I have a successful business, they always call me whenever they need financial assistance. Sometimes I call them too, but most of the discussions will end up on some sort of money needed somewhere. Because I am able to assist them most of the time, I do not have a problem with this. However, I do not remember one person who called me just to know how I am doing over the past four months.” – Okayo (P5), Male, 50.

Since P5 was considered to be wealthy by local standards, he felt socially compelled to financially assist both his immediate and extended family members. He reported that most of his communication involved remotely located family members asking for financial help and not about his family life or other activities of his interest. Participant P5's quotes therefore reveal that even though some family members were in a position to support their relatives financially, they felt that their desire for connection beyond financial need was not being met.

4.2.2 Well-Being, Life Advice and Guidance

I found that family members used technology to communicate about the well-being of others. For example, an urban participant reported that she would call her mother who was living in the rural home to discuss any health challenges she was facing or just to know how things were faring with her. This practice was limited and only occurred for people who were considered to be in a better economic situation. It was also more

secondary in terms of importance when compared to communication around economic support. When asked how he communicated with his family in the village and the type of information they shared, a participant had this to say:

“Apart from my wife, the next important person that I talk to is my mother who lives in the village. She will always give me updates on how immediate family members are generally doing ... I also call my siblings every other time to check on the well-being of their families. I tend to call the others often since I am the eldest in the family.” – Obango (P3), Male, 44.

Communication between rural and urban family members also focused on parents providing advice to children and siblings and close friends encouraging each other about the challenges of life. This was especially the case for parents of adult children who had moved away from home. For example, one participant who was a retired teacher explained to us that, together with his wife, they called their children who worked and lived in other urban regions around the country to provide advice on how to face marriage and life’s challenges and problems. They also provided parental advice to their children on the importance of Christian fellowship to build a united family.

“This is because as parents, we feel obliged to make sure that they live respectable lives in whichever part of the world that they are in.”– Opondo (P6), Male, 54.

In another situation, Lavender (P15), a housewife living in rural Migori, described how she called her mother, sister and her childhood friend to discuss their marital challenges and difficulties.

“I communicate a lot about family life and express my love to both my mother and sister who lived away from me. I also do the same with my husband while I am away from home while visiting my mother, sister or other close relatives. We talk about the wellbeing of the kids and private family issues over the phone if there is need to do so. I also talk to my sister and close friends who are all married to discuss issues within our respective marriages over the phone. This helps us to get encouragement that will enable us to overcome our marital challenges.” – Lavender (P15), Female, 23.



Figure 4.4: Awendo - Motobike taxi driver delivering gallons to the village

As a tailor, Lavender (P15) could not afford to spend much money on calling. She would reach out to her relatives and friends occasionally when she received extra income from repairing clothes in addition to finances that her husband would provide for family upkeep. Thus, her calls greatly depended on the availability of funds after ensuring that basic housing needs such as food, children’s medicine, and school equipment such as books and pens for her children had been purchased. Her family and friends would also call her occasionally to know how she was faring. She would also call her friend who was married in a nearby village to set up a day to meet and catch up since they had grown up together and were now married in neighboring villages. During these meetings, they would discuss challenges that most young couples faced in the village. They would discuss issues ranging from polygamy to suspicion that their husbands would be looking to marry other wives. Alcohol abuse and adultery, prevalent among young adults, also formed part of the discussions of Lavender (P15) and her friend.

4.2.3 Coordinating Family Activities

For households containing multiple individuals, it was important to coordinate the daily activities of family members. Face-to-face interaction was the widely used mode of communication between such families. While rarer, there were specific cases where technology was used for coordination purposes.

In rural settings, technology was not widely used for family coordination because it was too costly or simply not needed (since family members would see each other in person in the morning and evening). Instead, only people who had specific jobs that required them to use a mobile phone for work would do so. For example, John (P13) used his mobile phone while conducting his motorcycle taxi business (Figure 4.4) to run small errands for his family members who lived in the village with him. He received calls from either of his two wives (whoever had enough credit for calling on her phone), his mother or his siblings (or their wives) who lived in the village while driving customers on his motorcycle. They would ask him to buy commodities such as bathing soap or sugar packs while taking customers to or from Awendo. He would then purchase the requested commodity and bring it home if he was dropping a customer off close to his home.

Suburban and urban participants who lived with other family members used technology more often for coordinating family activities in comparison to the rural participants. Parents reported using technology to get in touch with their children for shopping, dinner planning, and household chores. For example, Alice (P20) lived in the slums of Githurai and sold fish in the evenings after 5 pm to those returning home from work in the city and its environs. This meant that she would be at her stall when her teenage children returned home from school. Her eldest daughter had a phone and would beep her since she did not have phone credits to actually place the call. “Beeping” occurs when a person makes a call from his cellphone to another individual and then hangs up before the remote phone owner can receive the call (Donner, 2008). P20 would then call back with focus on providing instructions to the children about what to do around the home, such as purchasing food for dinner and cooking it.

In another example, Adul (P8), a suburban participant and senior civil servant, was constantly travelling for training across the country. He bought mobile phones for all of the adults in his household so that whenever he called he could reach his children who ranged in age between 10 to 16 years. In these cases, he wanted to ensure that the children were working on their school assignments or working on chores that had been assigned by their mother. He would mainly reach the children on this mobile phone while their mother was not at home, otherwise he would speak to his wife and gain this information.

4.3 Communication Strategies

Like other research (Wyche & Grinter 2012), I found communication was often carefully timed based on cheap calling time periods, when lots of family members would be present, an individual's economic situation, and electricity availability and access to communication technology. I also saw instances of beeping, 'please call me texts,' and a focus on conversation brevity, which is also reported by others (Vertovec, 2004; Wyche & Grinter, 2012). Beyond these practices, participants reported that they used mobile phones to communicate with their remote family members because they were convenient and cheaper in comparison to other technology such as computer. In the absence of mobile phones, especially in the village, people would routinely walk to meet with their family members in person in case they had something to discuss. I saw several interesting ways in which mobile phones were used as communication devices. This related to whether or not someone had a mobile phone, when people were available for calls and how they would time them, and the social pressures of having to stay in contact with others or initiate calls. The alternative ways through which mobile phones were used included sending "Please Call me Texts", "Beeping" and timing calls during promotional hours are explained next. This was also found by (Wyche & Grinter, 2012; Wyche et al, 2013).

Rural participants reported that whenever they did not have enough phone credit to call their remote family, they could send "Please Call Me" text messages or even make brief calls to ask for phone top-up credits or ask to be called back. A "Please Call Me" message is a free text that one is able to send from his mobile phone that is provided by major phone carriers in Kenya such as Safaricom, Orange, Yu and Kencell. The recipient of the message would then receive a text message asking them to call you back (Wyche et al., 2013; Vertovec, 2004).

In other instances, an individual's economic situation dictated who initiated mobile calls. Village family members tended to expect longer calls from their relatives who lived in the larger cities and were in relatively better financial situation. This was demonstrated by the fact that they would 'beep' and ask to be called back. A rural participant had the following to say about reaching remote family members whenever she had information to share, yet not enough credit on her phone to accomplish making calls.

“When my credit is low, I can send text message or make a brief call that only passes the direct message while avoiding greeting aspects of a conversation. This is not very expensive since a text message will cost me Kshs 1 and a brief message that is less than a minute would cost me about Kshs 4. Otherwise I could send a ‘Please Call Me’ message, Sometimes I just beep.” – Godana (P23), Female, 31.

I also found that participants would aim to maximize talk time while calling their remote relatives so as to prolong discussions beyond the usual short periods that aimed at passing only necessary information, For example, a retired teacher living in the village would make calls to his distributed children late in the evening when calling rates were cheap. We therefore see an unconventional technology user who did not solely depend on receiving financial support from his distributed family but used promotional offers to communicate cheaply with his children. When asked to describe his calling routines, he had this to say:

“All of our children live away from here. Since they are also married and work across the country, we tend to call them at night after they have got back home from work and the phone rates are cheap. Currently there is a Safaricom promotion that charges Kshs 1 per minute between 10 pm to 10 am. So we time our calls around these periods. It is also important for us to call when our children are together with their wives and husbands so that we are able to know if things are going well”. – Opondo (P6), Male, 58.

Timing of calls to coincide with promotional hours or cheap calling rate periods enabled parents to engage in much longer discussions and conversations with their children. Even better was the fact that these promotional hours occurred in the evenings when their children would be back home from work and all gathered after dinner. This offered the parents the opportunity to talk to their children, partners and even grandchildren all at the same time.

4.4 Social Challenges

I also learned about various social situations, described next, that affected family communication routines ranging from being the eldest child, to supporting the families of dead siblings (from a different perspective from Peters et al. (2012)), to gender.

4.4.1 Eldest Children

Generally, parents were in charge of coordinating family activities. However, the dynamics of this situation changed when adult children moved away from the rural areas and migrated to suburban or urban areas. In these situations, parents would entrust the eldest children with the duty of passing information to their siblings who were also working or studying away from the rural villages.

For example, four participants (one female) who reported to be the eldest in their families were always prepared to communicate with any member of their family in case an emergency or important issue arose. Issues ranged from holding discussions aimed at solving an economic problem that needed financial intervention or even engaging in a serious discussion to solve family disputes and quarrels. Because of this, the eldest children (from the participant pool) who all lived in Githurai often felt obligated to have their mobile phones on as much as possible in order to receive information from their rural village and then share the same with dispersed family members. If the eldest child worked at a job that did not allow them to be constantly available, messages would then be shared through other family members. But seniority in terms of age, would dictate who was expected to handle sharing such messages.

“As the eldest in my family, my phone must always have credit because I have to keep in touch with my parents who live upcountry. I am always the first one they will contact if there is any information that needs to be sent to my brothers and sisters who live away from home. I also receive calls at any time from my siblings and extended family. My phone must be on all the time to ensure that I am able to receive all information and then pass any important ones to other family members.”—Alice (P20), Female, 41.

Sometimes this created additional monetary burdens on the eldest children. If cases arose where one of the adult children was more financially well off than the eldest child, the obligation as 'information hub' moved to this child. For example, in one case, a civil servant participant who was seen to be financially well off in comparison to her eldest brother was expected to disperse information from her mother in the village to her siblings who lived in Nairobi.

4.4.2 Death and its Effects on Communication

Participants also talked about ways in which surviving relatives who worked away from home would use scarce financial resources to communicate with the families of their deceased siblings left behind in rural homes. This was a cultural obligation described by some participants.

For example, a participant named Joel (P4) who was in his early fifties was the only surviving male out of his entire family. His parents and siblings had all passed away and he lived in Githurai with his wife and six children. He was a low income clerical civil servant and lived on a very tight budget. He had to take out loans to meet his financial obligations and also engaged in a small tailoring business in the evening after work and during the weekends to make ends meet. Despite this, Joel (P4) was still culturally responsible to communicate with his siblings' widows to ensure the smooth running of the rural home as the surviving eldest male in his extended family. He purchased mobile phone credits worth \$0.60 (Kshs 50) to make phone calls whenever his siblings' widows from the village beeped him or sent him a please call me message. He would then call between 8 pm and 6 am when the special Telkom service provider rates could allow him at least 20 minutes worth of 'talk time' for this amount of money. To get the best value out of the discussion using the little phone credit available, he would let the eldest widow briefly explain the issue at hand before quickly giving his opinion and advice over the matter. This happened at least once or twice a month unless there were other pressing issues that required continuous consultation such as planning to attend a relative's funeral. In such cases, there would be a brief exchange of updates every now and then in an attempt to coordinate issues.

4.4.3 Gender

My data analysis also revealed that gender affects family communication practices. I found that women often had to rely on their husbands for access to mobile phones; Murphy and Priebe (2011) also report this finding. Building on their work, I saw how husbands and wives created workarounds in order facilitate communication.

First, I found that husbands often used their male siblings as communication 'intermediaries' when they wanted to initiate communication with their wives. In cases where one's wife did not have a phone in their possession, the husband would contact his other male siblings in order to reach his wife. Thus, gender played a dominating role in who would be contacted as an intermediary in order to connect with one's wife. For example, two male participants in the rural setting reported that their wives did not own mobile phones. In one case, the participant and his wife would share one phone, though it routinely stayed with the husband. Thus, he claimed 'ownership' over the device. The other participant reported that in addition to sharing his phone with his wife, he would occasionally call his siblings to reach his wife in case he was away from home for casual work. This meant that rather than being able to directly contact his wife to converse, he relied on other people, specifically his male siblings.

"When I am away from home and need to speak to my wife on the phone, I will call my brother and ask him if he is able to pass his phone to my wife so that I can speak to her in private. Once our discussion is finished, she will return the phone and thank my brother."– Jeremiah (P14), Male, 22.

Second, I learned that some women would purchase SIM cards to enable them to call family members. SIM cards were cheaper than mobile phones and easier to conceal from husbands, if needed. For example, one female participant told us that she kept a SIM card with a small amount of phone credit on it (e.g., Kshs 20) in case she needed to contact a relative. She would borrow her husband's phone to call her female family members (e.g., sisters). This sometimes included sharing information about her husband to a close family member without the husband's knowledge. Her husband was aware that she kept her own SIM card and would occasionally ask to use it if he did not have enough credit on his own phone. In case her husband was out with his phone and the participant

needed to make a call, she would walk for about 20 minutes to borrow a handset from her brother in-law's wife. This example reveals the ability to have communication access without the need to have a phone per se. Instead, one can use shared phones and a personally owned SIM card. It also reveals the lengths and 'workaround' strategies that women might go to in order to communicate with other female family members to gain life advice.

Third, I found that female participants who lived in urban or suburban areas were more likely to own mobile phones on their own. In some low income families, they often had to conceal their use of it from their husbands. For example, a female participant who was running a small scale fish selling business told us about the use of her mobile phone for discussing financial discussions with her sister. Her sister would supply her with fish from their rural home, and then deliver the fish overnight by a bus to Githurai. What was interesting about this case was that all communications between the participants and her sister had to be done without the participant's husband knowing.

"When I need to discuss my business progress with my sister, I have to make sure that my husband is not around the house if I have to make that call."– Mama Baron (P11), Female, 26.

She explained that this secrecy was necessary because if her husband overheard communication related to profits, he would stop providing money for use within the house and let her take care of such expenses. This could result in her business 'going under' since she made little profit which was mainly used to support poor family members who lived in the village. Thus, she delicately negotiated the unequal relations of economic power with her husband through economic discussions without his knowledge.

4.4.4 Phone Sharing and Connecting through Intermediaries

Like other research (Smyth et al., 2010; Wyche & Murphy, 2012), I also found that rural participants shared phones because of a lack of ownership, loss of service network, and a lack of battery power. On the other hand, urban and suburban participant did not report sharing of phones because of better infrastructure and ability to purchase additional

phones. This finding is different from (Smyth et al., 2010), where factory workers shared phones in slum areas mainly due to lack of cellphone ownership in urban India.



Figure 4.5: Migori - Rural home showing collocated family houses for different siblings

In this study, I found that phone sharing created several interesting social situations. First, shared phones created additional obligations on others to pass along messages. For example, I found that, in some cases, if a person being sought after was not available, the receiver would take the information over the call and then share it with the relevant family member later. This information had to be remembered and later shared. If the information was private and only intended for the recipient, the caller would ask the owner of the mobile phone to alert him through a “please call me” message or a beep whenever the intended recipient of the message was located. This created additional work for the owner of the phone who would then receive replies to the “please call me” and have to transfer the information to call back the original caller.

Second, urban participants reported that they frequently faced network problems while trying to reach their relatives in rural areas (Figure 4.5). Some participants said they would keep trying until they were able to connect. Another practice was to try calling other family members, starting from immediate family including siblings and then progressively moving out to cousins and other relatives until a person was reached. Once they got a hold of someone, they asked them to tell the person being sought to get in touch with the

individual calling from the urban area. Again, this created additional work beyond simply contacting one individual. Such behaviors were reported by seven urban and two suburban participants. All participants from urban areas owned mobile phones and could easily communicate with them. Yet in remote villages this was not always the case. For instance, elderly village members did not have mobile phones. Thus, it was normal for people to reach other family members within the home by calling a cousin, brother, or even uncle. In such situations, the close family member would be called on his or her mobile phone, and then asked to go and hand over their handset to the person of interest. One participant explained,

“My grandmother does not charge her phone because she believes it will get lost. She therefore receives calls that are directed through my father’s cell phone. When my father receives such calls from my uncles and aunts he will pass the phone to my grandma if he is home, otherwise he will ask the remote family member to call at a later time.”— Akinyi (P18), Female, 24.

The idea of calling people and asking them to pass on information was a practice that all the rural participants engaged in and understood to be the norm. This could have been as a result of families living close to each other within a home or in neighboring homes that were located next to each other.

4.4.5 Finances and Access to technology

All participants communicated with their family members by calling on their mobile phones. Urban and rural participants did not typically use text messages for communicating with one another because, in most cases, an immediate response was required due to a heavy focus on economic support. As a result they relied on voice communication. Illiterate participants also relied on voice communication because they simply could not read or write text messages.



Figure 4.6: Cyber café in Awendo – rural (Left) and in urban area (Right)

I also found that one's financial situation affected what technologies were owned and used. While mobile phones were certainly the most popular communication tool, some urban participants also used computers, social media, and video conferencing to communicate with remote family members. This was because they were typically more financially well off than their rural family members. It also meant that computer-based communication did not occur between urban and rural areas because those in rural regions could often not afford computer technology and, even if they could, infrastructure issues and a lack of electricity, would create usage problems. Instead, computers were primarily used to connect with family members living abroad. For example, five urban and four suburban participants used their own laptops to connect to the Internet to send emails and use social media such as Facebook for chatting. This occurred either in their home or workplace and communication was mainly with family living outside of Kenya. Two suburban graduates reported the use of social media on their phones in addition to laptops to chat with their sibling, cousins and friends who lived within the country and abroad.

One suburban graduate who lived in the suburban study setting had this to say regarding technology usage for family communication:

"I use Facebook a lot. When I log on to my account through the phone or laptop and find my cousins online, I have to ask them how they are doing." – Peace (P9), Female,

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4.4.6 Computer Literacy

Computer literacy varied amongst my participants. Four urban participants and eight rural participants reported that they did not know how to use computers either due to lack of education or lack of motivation, while four rural participants mentioned that they had basic experience with computers. The distance to cyber cafes (Figure 4.6) from rural areas (~20 km) made it difficult for computer literate participants to access the Internet (also reported in Wyche & Grinter, 2012). Other low income participants would have been willing to gain knowledge in using computers but other economic related challenges seemed more important at present. Similar observations were also made in the outskirts of the urban areas where older participants who did not have prior experience with using technology thought it was not worth spending time to learn something that would not improve their lives economically. For example, a woman who lived in the urban areas had this to say when asked whether she was interested in learning about technology:

“I am aware that the Internet is useful for communication and making friends, however I would need to be trained on how to use it. I might take classes in the future. For now I do not think that it is important for me. I have other important things to think about regarding my work, business and family.”– Waithera (P1), Female 56.

On the other hand, all twelve rural participants reported that they did not use other forms of technology beyond the mobile phone for communication. This was expected because the village participants had little experience with using computers and lacked Internet access unless they went to a cyber café located a way from the village. As a result, these rural participants did not have an idea of other communication avenues that included social media. One rural participant had this to say, when asked about Facebook:

“I have never seen a computer and do not even know what Facebook is. However, I believe it is a big book that contains a lot of information.”– Lavender (P15), Female, 23.

Older participants both in the urban and rural areas who did not have prior experience with using technology thought that it was not worth spending time to learn something that would not improve their lives economically. Joel (P4) had this to say on learning to use social media:

“I hear about Facebook but I do not have time to learn about this type of technology. People with large families are busy working to make ends meet here and we believe that Facebook is for idle people.”– Joel (P4), Male, 52.

On the contrary, some participants who heard about their friends using social media planned to use it at some point. One such participant mentioned that if she could access the Internet and get the time to learn how to set up Facebook, she would gladly do it.

“Some of my fellow teachers use Facebook to contact their lost friends. I believe my husband also uses Facebook from his phone. I would like to get time one of these days to learn how to use the Internet so that I can also meet old Friends who are on the Internet.”– Jane (P21), Female, 28.

4.5 Discussion and Conclusions

The goal of my study was to articulate the family communication practices of my participants with a focus on understanding when technology was used and why, and what social and technical factors affected this usage. In this section, I compare my study findings to related work and also point to design implications.

4.5.1 The Focus of Communication

First, I highlight how Kenyans conceptualize the notion of family. This was revealed through participants' communication routines with their immediate family (parents, spouses, children, and siblings) and extended family (nieces, nephews and cousins).

In addition to face-to-face interaction, technology-based family communication focused largely on four main areas: providing and discussing economic support, providing life advice and guidance, maintaining an awareness of well-being, and, sometimes, the coordination of everyday family life.

Communication focused on economic support (e.g., subsistence farming, assisting relatives with payment of education fees (Hughes & Lonnie, 2007; Eriksson, 2008) has been previously reported for Kenyan migrants living abroad and connecting with rural family members (Wyche & Grinter, 2012). Using mobile phones for economic support had also been reported between Jamaican migrants in the United States and those living 'back home' (Horst & Miller, 2005; Brown & Grinter, 2012; Brown, 2013). I describe this activity for Kenyan family members connecting between rural and urban areas within the country. I also illustrate that this can lead to feelings of obligation, in some cases, if family members are not asked about more personal topics such as one's well-being. Family communication focused on life advice is similar to El Salvadorian communication practices over distance (Vertovec, 2004). I build on this by showing how participants remotely oversaw family growth and development between rural and urban settings in Kenya.

I have yet to see any literature that describes family communication in Kenya that is focused on the coordination of everyday activities. In Study 1, this was found for suburban and urban participants who lived with other family members, as well as rural participants who had jobs that required constant access to a mobile phone (e.g., motorcycle taxi driver). Other rural participants coordinated daily activities either in the morning or at night because they did not have access to technology during the day.

At a surface level, these results illustrate that family communication design should focus on one of four main areas of communication. Other research has suggested the coupling of financial transactions with communication (Wyche et al., 2013) as a basic point of design. The results shed light on the idea that while economic support was critical to life in Kenya for most participants, they also found value and participated in communication exchanges on other topics that helped create a sense of well-being and allowed them to discuss, gain advice, and come to terms with life challenges (sometimes even related to their own spouses). This suggests a broader understanding of what family communication practices may be important for Kenyans. Solely focusing technology design on providing economic support may neglect the 'human' need of connecting with others for less utilitarian purposes. Certainly Kenyans need to earn money and negotiate financial help from remote family members, but they also have inherent human needs that need to be filled through the connection with others.

4.5.2 Social Challenges

I also found that a variety of social situations affect how families communicated using technology. First, I found that additional pressures are placed on the eldest children in the family and the siblings of widows to connect with family members. In these situations, Kenyans were socially and culturally obligated to stay aware of the activities of additional family members and coordinate the exchange of information. This presents results that move beyond past work that shows the obligations faced by those family members who are considered to be more 'well off' financially (Wyche & Grinter, 2012) to show what additional social factors affect cultural obligations. This brings forward the idea that new technology designs will be used differently by users depending on their social role within a family. Certain users may face additional needs to be 'always available' with a technology, while others may not. Usage may similarly increase for some individuals.

Second, I found that access to technology and usage will differ between men and women, those with different literacy rates and computer experience, and those with different levels of technology access due to connectivity and finances. This illustrates that technology cannot be designed with a 'one size fits all' mentality. I also describe a pattern where participants used alternative means to share information with their remote relatives. These include "Please Call Me texts" and Beeping (Donner et al., 2008; Wyche & Grinter, 2012) and also calling remote relatives when phone providers offered low calling rates.

This study also revealed a contrast in computer accessibility, use, and knowledge between the people who lived in the rural communities as compared to those who lived in the urban regions. In the rural areas, a large number of Kenyans did not have knowledge about computers. This was partly because they were occupied with subsistence farming and small-scale income generating activities that were barely enough to support gaining knowledge about computers. On the other hand, the working class (civil servants and business men), and college graduates and, to some extent, low income individuals living in urban areas, were already using more advanced communication technologies (e.g., Facebook, Skype).

The challenge is that the rural and urban areas have different technological infrastructure, education, and understanding of computers. There will continue to be a

disparity that needs to be designed around if family members are to easily communicate between the villages and cities. Currently, mobile phones support this because they are simple to use. Yet as technology advances, in particular in the cities, designs may move away from mobile phones to other devices such as computers. This could easily create a new challenge for family communication in Kenya. Even though family communication routines that we report are mainly tied around the use of mobile phones, it is likely that existing practices (e.g., a focus on economic support) will stay consistent as the low income families both in the rural and urban areas become exposed to technology avenues that they have not been able to access. This creates a challenge where researchers and designers of technologies will need to understand how to translate the unique cultural practices of Kenyans to the next wave of technological advancements to continue to create technologies that are uniquely Kenyan and balance disparities in education levels, income, electricity, and connectivity.

Moreover, designers should consider how any future designs might affect these social and cultural issues. For example, one would need to carefully navigate the delicate gender balance and cultural norms related to social hierarchies in families. In this case, while it may seem beneficial to design technologies specifically for women, doing so could easily create an undesired shift in the traditional male-female roles found in Kenyan families. Gender is a very complex subject with many subtleties and certainly requires additional research.

4.6 Summary

This chapter explored participant communication routines with their immediate and extended family, either co-located or remotely located in rural, suburban or urban parts of Kenya. The chapter also provides a description of how Kenyans conceptualize the notion of family while using technology for communication.

The study results highlight how communication was often carefully timed based on cheap calling time periods, while at the same times, also aimed at reaching a wider family audience amidst economic challenges. I have also described various social situations that

affected family communication routines ranging from being the eldest child in a home to gender among other reasons.

This chapter also describes how technology-based family communication in Kenya focused largely on providing and discussing economic support, providing life advice and guidance, maintaining an awareness of well-being, and, sometimes, the coordination of everyday family life.

In this chapter I described the finding and key discussion points from Study 1, which focused on understanding how families communicate over distance when using technology in Kenya and how I should think about designing technology to support this communication over distance. In the next chapter, I build on these results by using *the understanding of local communication routines to inform the design of technology that supports communication for Kenyan families* (Chapter 1, Objective 2).

Chapter 5. The Design of TumaPicha

In order to explore *technology design to support family communication over distance between rural and urban areas of Kenya*, I describe the design of a service for photo sharing, TumaPicha. This includes the TumaPicha design and the rationale behind building systems that families can use to share activities between rural and urban areas of Kenya. This chapter addresses this dissertation's Objective 2: *use the understanding of local communication routines to inform the design of technology that supports communication for Kenyan families*. This also answers research question 2.

5.1 Design Directions and Motivation

The findings gathered from Study 1 showed that family communication technology design for rural and low-income urban families in Kenya could focus on the following four areas of communication: providing and discussing economic support, providing life advice and guidance, maintaining awareness of well-being, and, sometimes, the coordination of everyday family life. Beyond conducting Study 1, my aim was to explore ways of designing communication technology that would provide family members with an opportunity to share family moments beyond financial remittances and economic activities. I was also interested in exploring design avenues that would support rural and low income families to discuss personal hobbies, celebrations, and activities of personal interests. Initially, I explored three potential application areas derived from Study 1's results.

1. **Bidirectional Sharing** - The first option was a mobile application that would enable bidirectional sharing of activities between rural and urban family members beyond calling and texting (these were already being used). For example, this might involve sharing photos. In this way, *both* rural and urban family members could share information about their lives in a visual way with one another. The reason behind this application idea was that Study 1's results showed that Kenyan family members who lived in rural villages communicated using text/voicemail messages, word of mouth, and phone conversation. The family members who lived in urban areas were found to use more advanced technology that included the

- computer, Internet and social media. Therefore, it was felt necessary to design technology that both sets of families could access.
2. **Video Sharing** - A second option was to explore designs around the sharing of short video clips between families that lived in rural and urban areas using mobile phones. The reason behind this application area was that Study 1 had reported that some urban Kenyan families had used video conferencing materials to communicate with their relatives who lived abroad. Investigations into how Skype, FaceTime, and Google Hangouts had been used by individuals in developed countries to keep in touch while away from home have been conducted (Judge et al. 2010). Results revealed that video enabled families to stay connected with those members who were located away from home and they especially enjoyed being able to see each other. Therefore, my intention was to provide families living in rural and low income urban areas with video based systems that they could both access over mobile phones.
 3. **Low Bandwidth Photo Sharing** - A third option was to explore the design of systems to integrate mobile phones and desktop computers while also using low bandwidth to share activities. For example, this could be done in the form of designing a photo sharing application that could transfer photos from the mobile phone to a desktop computer. Past research had revealed that the strength of Ubicomp lies in its ability to fill gaps between design and the needs of local communities (Ginsburg, 2005) while appropriating technology (Mainwaring et al., 2004). Study 1 showed that intermediaries could also be an important part of complementing technology use in rural settings. Therefore, the motorbike taxi drivers could deliver mobile phones to the local cyber café to alleviate the need for rural family members to learn about using technology. This was necessary because rural and low income participants had indicated that they were not interested in learning about technology beyond mobile phone use.

Study 1 showed that rural and urban users of technology both faced challenges that included limited and costly access to Internet, lack of access to computers, and illiteracy during technology adoption. Also, Study 1, alongside other studies (Wyche & Grinter, 2012; Bidwell & Siya, 2013), showed that a lack of electricity was a major issue that needed addressing when designers explore ways of implementing technology projects in

developing countries. Building on these results, I settled on pursuing design around Application Area 3. Application Area 1 and 2 would require the rural family members to spend a considerable amount of time learning about using technology, something they were not ready to partake in just yet (Study 1). Next, I came up with design goals that I describe in the following section.

5.2 Design Goals/Principles

In this section I list and briefly talk about the goals and principles that guided my system design process. Based on Study 1 of this dissertation, I knew the design should:

1. **Support Low Bandwidth Information Sharing:** The infrastructure and lack of access of technology in rural parts of developing countries cannot support families and close friends who intend to use communication technology that uses high bandwidth (Wyche & Grinter, 2012) such as videoconferencing tools (Judge et al., 2011; Yarosh et al., 2010; Raffle et al., 2010). This led to exploring technology designs that required low bandwidth such as short video clips. This also led into thinking about designs that could support the sharing of activities between rural and urban family members via photo applications.
2. **Build on Existing Community Practices:** The system design should aim to use existing community practices of information and technology sharing (Liu et al., 2010; Sambasivan et al., 2010). Study 1 revealed that family members living in the village relied on various ways to send and receive information. These included the use of word of mouth, sharing of mobile phones and even asking relatives conducting motorbike taxi business to deliver information to and from the local town while conducting their business.
3. **Minimize Technology Costs:** Study 1 revealed that family members moved to urban areas for work in order to economically support their relatives in the village. The family members in the city still bore the major cost of technology usage even while seeking information from the village. As a result, the service should be used alongside existing modes of communication than include mobile phones in some way to minimize the cost of communication.

4. **Combine Ubiquitous and Desktop Technology:** Study 1 and prior research (Huang & Truong, 2008; Prasad et al., 2005; Ho et al., 2009) revealed that mobile phones are already extensively being used in the rural parts of developing countries while people living in low income urban areas did not own computers (Study 1) and, instead, used them in alternative places such as cyber cafés (Study 1; Wyche & Grinter, 2012; Wyche et al., 2013). Technology that incorporates the ubiquity of the mobile phone while addressing the issue of technology access in low income urban areas presents a viable design opportunity for pursuing.
5. **Explore the Design of Systems that Address Multiple Socio- Technical issues:** Studies have identified the challenges that are faced with phone battery charging in remote parts of developing countries (Study 1; Wyche & Murphy, 2012). This necessitated the design of technology that could perform more than one function such as using mobile phones to capture photos while also sharing the captured family activities on a desktop computer. The mobile technologies being used would also be designed to operate within the current practices around the charging of the mobile phones in the rural communities. The systems would build on existing infrastructure (Wyche et al. 2010; Wyche & Grinter, 2012; Warshauer, 2003; Toyama, 2011) by using hardware that was accessible to families in rural and low income regions (Study 1; Petland et al. 2004; Toyama, 2011; Mainwaring et al., 2004). The systems could incorporate intermediaries to avoid the notion of rural families having to learn about technology while their interest was actually in improving their immediate economic situation (Study 1). At the same time, the systems would provide the urban families with the opportunity to use technology and information sharing avenues that they were already familiar with.

To realize the above stated design goals, I embarked on an iterative design process that involved collaboration with a team of researchers working at the Simon Fraser University's (SFU) School of Interactive Arts and Technology (SIAT) in the Connections lab. The Connections lab is a team comprised of my supervisor, Dr. Carman Neustaedter, and other graduate students working in my research group. The team included researchers from Canada (Dr. Serena Hillman, Carolyn Pang, and Daniel Hawkins), Iran (Azadeh Forghaini) and Kenya (Erick Oduor), with diverse backgrounds in

studying, designing, and evaluating a range of technologies that include communication, coordination, and video communication systems.

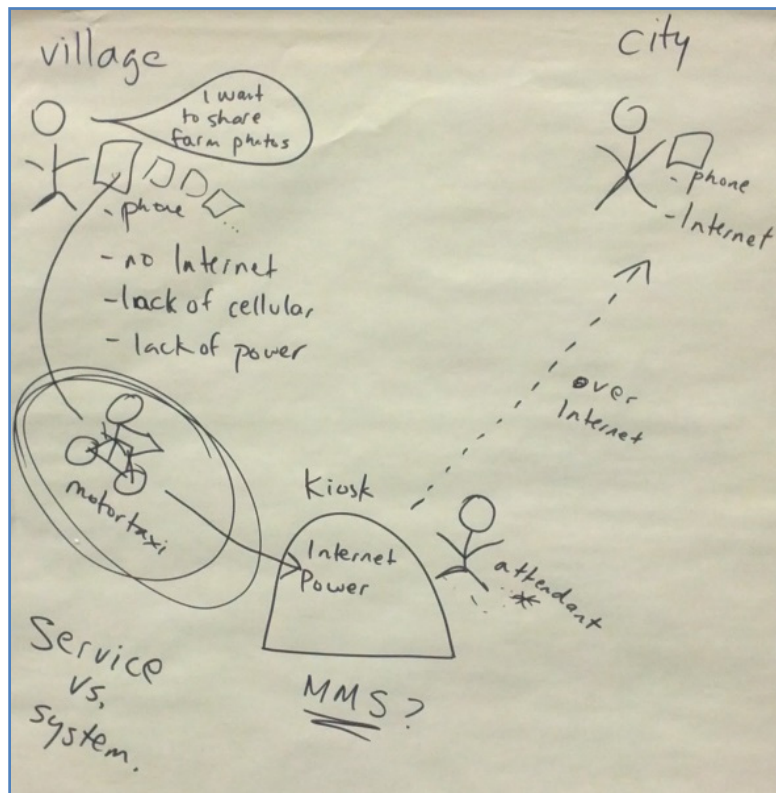


Figure 5.1: A sketch of how the photo sharing application could be used to share photos

Together, the team's research experiences spanned many disciplines including computer science, social psychology, sociology, and interaction design. I also received views from a member of my research supervisory committee, Dr. Kate Hennessy, who has vast experience in participatory culture, ethnographic research methodologies, and media production in relationships with heritage institutions, Indigenous communities, and artists. Conducting design discussions with this team guided me as I engaged in an iterative design process.

A village family member who faces limited technology knowledge and a lack of access to modern technology lives in a rural village where he/she experiencing infrastructural challenges. He/she would like to share photos with a relative who lives in the low income urban areas of the city and is able to use the internet at a cyber café. A motorbike taxi driver, who ferries passenger between the village and a local city, collects photos from the village family member (stored in the phone) and delivers the phone to a cyber café in a town (about 20 km) away as he ferries customers to and from the village. At the local town, the taxi driver delivers the phone to a cyber café where an attendant uses the TumaPicha interface to upload the photos from the phone and saving them to a database. Once photos have been saved to the TumaPicha database, the family member in the urban area is then able to accesses the photos via the TumaPicha display page at his/her convenience. (Scenario 1)

Ochieno conducts a motorbike taxi business in Migori Kenya where he ferries customers between small villages and a local town called Awendo that is located approximately 20 km away from the villages. He has just finished with a phone call at around 9.00 am on a Monday morning from Onditi who needs to be ferried to Awendo to attend a meeting within an hour. As he heads towards Onditi's home which is a km away, he sees Onyango running across his small farm towards the path he is about to drive through. Ochieno slows down and eventually stops as he reminds Onyango that he is in a hurry to pick Onditi as soon as possible. Onyango informs him that he only needs to send photos of Owuor's house to show him the repair progress that has been made over the past week since he sent money for the repairs.

Since Ochieno is constantly taking customers to Awendo, he takes Onyango's mobile phone, puts it in his pocket and tells Onyango that if he is not able to get the phone back from the cyber cafe today, he will bring it the next day. Ochieno proceeds to pick up Onditi and then drops him in Awendo 30 minutes later. Ochieno then goes to a cyber café where he hands over Onyango's phone to the cyber attendant. He asks the attendant to charge the phone batteries and also then upload four photos that show a house under repair to TumaPicha. The attendant connects the phone to his computer via a USB cable and then confirms to Ochieno that he has transferred the photos to the communication system. He asks him to come for the charged phone right before he finishes work for the day while on his last trip to the village.

Over in Nairobi at about 5 pm, Owuor alights from a matatu (public transport vehicle) and is walking to his house in Githurai. He stops by a cyber café to check whether the money he had wired to Onyango using MPESA was used for purchasing fertilizers as planned. He feels that it is important to ensure that the money was spent for the right reasons and so he had asked Onyango to send him pictures of the farm after the manure has been spread on it. He therefore walks into the cyber café, selects an empty computer space and then logs into the family communication system's web page to access any recent photos from the village. Once logged on, Owuor sorts the photos by date and sees new photos that were uploaded this morning by Onyango as agreed in a previous conversation. After viewing the photos, he selects a couple of photos, right clicks the selected photos, copies them and then pastes the selected photos to his personal folder. Once he completes this process, he logs out of the system and pays for the provided web services. As he continues with the walk to his house, he briefly calls Onyango to confirm seeing the photos and ends the conversation by promising to send money for the purchase of seeds to facilitate the next stage of farming. (Scenario2)

Scenarios 5.1 and 5.2

TumaPicha was designed over the course of a year and included sketching activities, scenario development, and design discussions between collaborators. As part

of this process, I also applied my experience of having lived in all of the study settings where TumaPicha would be explored to provide viewpoints from a native's perspective. The first activity in the TumaPicha exercise involved a series of design brainstorming discussions that I conducted with my senior supervisor (Dr. Carman Neustaedter). Between us, we asked questions that aimed to determine the purpose of the system, and specifically, what family members would have wanted to accomplish with the system (guided by the design goals already discussed in the previous section). We also discussed the people who would be involved in using the system based on their level of technology apprehension (rural family member, urban family member, cyber attendant). After a couple of brainstorming sessions, we agreed on the interactions that would be required in the transfer of media between the rural and urban settings. These interactions are illustrated in the sketch in Figure 5.1. In the figure, a family member in the village (top left), who is experiencing infrastructural challenges, would like to share activities using technology with a relative who lives in the city (top right) and has access to modern technology.

The village family member can only send information over the Internet if he/she goes to a cybercafé that is about 20km from the village at the local town. At the cyber café in the local town, a cyber-attendant could then assist with sending the media to urban family members. To save time and money, the village family member would need to rely on the services of a motorbike taxi driver to get to the cybercafé. The interactions between the village family member, the taxi driver and the cyber attendant guided the descriptions of user scenarios (Scenario 1 & 2) for media sharing between rural and urban settings as explained next.

A discussion of Scenario 1 was conducted with my collaborators after which it was recommended that I detail the photo sharing processes right from the moment a photo gets captured until the city family member actually views the shared photo, so as to capture the complete chain of events required in TumaPicha design process. This led to the description of Scenario 2 (Table 1).

Scenario 2 is a refined version of Scenario 1, and highlights the steps involved in capturing and transferring photos between the rural village and the low income urban area using TumaPicha. In the first step, the rural family member saves photos on his/her phone

and then hands it over to the taxi driver. In the second step, the taxi driver picks the phone from the family member and takes it to the cyber attendant at the local town. In the third step, the cyber attendant takes the phone, connects it to a computer via a cable, saves the photos to the TumaPicha database and confirms whether the photos have been saved and are accessible online. In the fourth and final photo transfer process, the city family member goes to a cyber café and accessed the photos on a web page.



Figure 5.2: The Huawei Android Phone Version 4.2.2

As I was reviewing Scenario 1 and Scenario 2, I realized that the sharing of photos between the rural family member and the taxi driver required the use of more advanced technology than the mobile phones that Kenyan families were currently using (Study 1; Wyche & Grinter, 2012; Bidwell & Siya, 2013). I explored recent mobile phone developments in Sub – Sahara Africa (specifically Kenya) by reading online articles (Ford, 2011) and held discussions with contacts located back in Kenya to determine what phones could be used by rural family members without experiencing challenges with learning how to use the technology and cost. I eventually chose an affordable low-end phone—Android 4.2.2 (Figure 5.2) —that is popular and increasingly becoming accessible to rural Kenyans. Designing for the phone enables the rural family members to build on existing practices of calling and receiving calls while also providing the opportunity to capturing photos when required to do so.

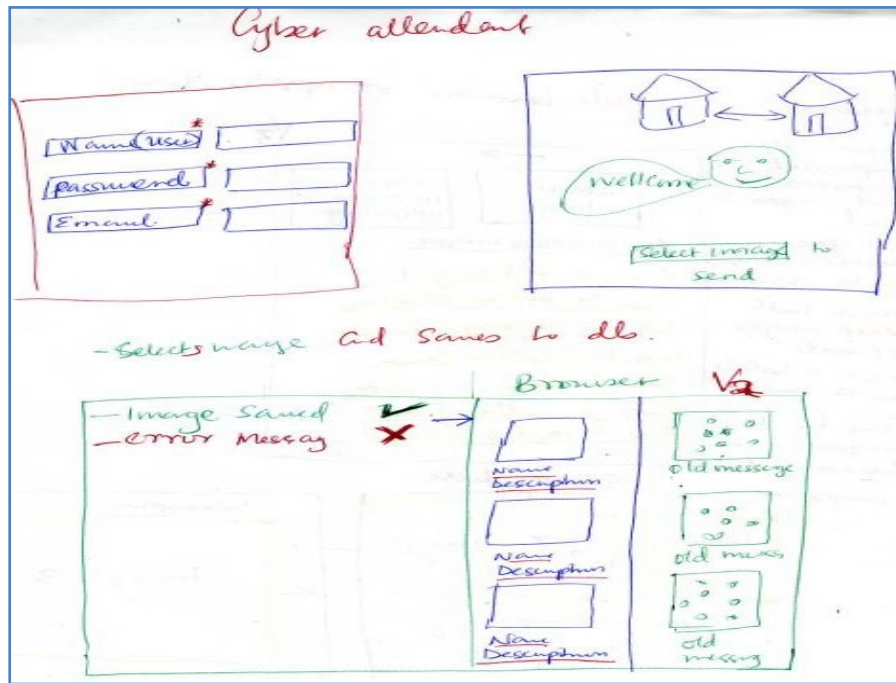


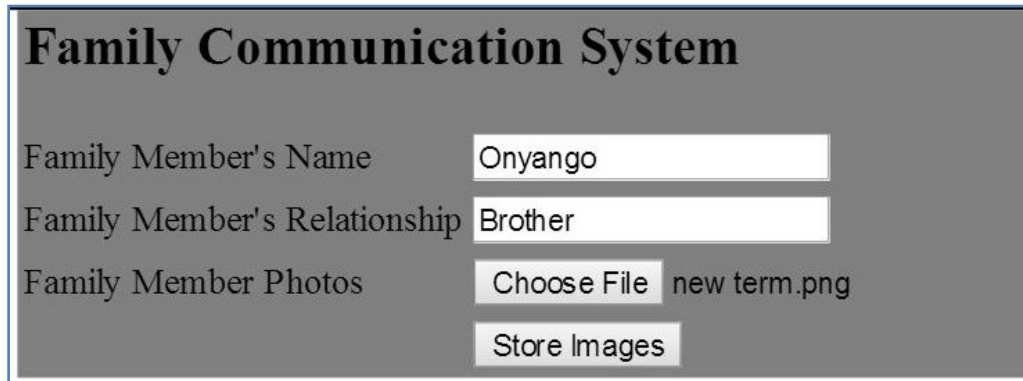
Figure 5.3: Low Fidelity: Sketches exploring photo “Upload” and “Save” interfaces

After generating the user requirements and system functionalities, I reviewed my design progress with the research team in readiness for the sketching of interfaces to support the functionalities identified so far. Figure 5.3 shows a low fidelity sketch of the TumaPicha upload page. The idea behind the sketch (top two photos) was to explore the use of images instead of text as icons that illiterate technology users could comprehend (Prasad et al., 2005; Ho et al., 2009). For the lower photo in the sketch, we see that once photos were uploaded to TumaPicha, the attendant would receive a message to confirm success or failure of photo upload. The right side of the bottom sketch (“Browser V2”) shows what the viewer would see on the browser after the photos had been saved using TumaPicha. In the next section, I provide a description of subsequent design steps next that I took to realize the design of TumaPicha service.

5.3 Early Design

In this section, I document the early design explorations conducted to realize the development of TumaPicha. I describe the initial prototyping activities that I conducted,

discuss the collaborative activities carried out to gather more insight into the system designs and also describe the process followed to develop the early version of the TumaPicha service.



Family Communication System

Family Member's Name

Family Member's Relationship

Family Member Photos new term.png

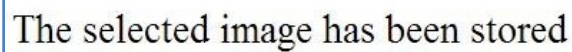
Figure 5.4: TumaPicha: Early design photo “Upload” and “Save” interface

As part of the design iterations to implement the design of technology that addresses the scenario described above, I considered two main avenues for transferring media between devices and people. The first was an automated approach where photos would automatically transfer from a rural family member’s phone to a device carried by the motorcycle taxi driver when in close proximity with the rural family member (e.g., within Bluetooth range). A similar transfer could occur between the taxi driver and the cyber café attendant’s computer. The second approach was the manual transfer process that was described in the scenario and selected. I decided to not pursue the automated transfer, even though it required less user interaction, because it was important for people themselves to perform the transfers as revealed in Study 1’s findings. Cyber attendants in Kenya already act as a form of intermediary of technology appropriation, so I felt that continuing with this trend was important to create meaning for the technology within the rural communities and for its intended users (Liu et al., 2010; Patel et al., 2010; Sambasivan et al., 2010).

In the next iteration after more discussion with my design team, I developed the early design interface of the TumaPicha “Photo Upload” page (Figure 5.4). This interface provided the cyber attendant with options for uploading photos from the phone. On this page, I included the family member’s name and family member’s relationship because this

would support the matching of a photo with the sender while also describing the relationship with the recipient.

I also added a buttons for selecting and uploading a photo and another to be used to save it to the database. Text captions would describe the selected file once it was saved on the database. For example in Figure 5.4, “new term.png” has been uploaded and is ready for saving in the TumaPicha database. According to the photo, Onyango captured a photo labeled as “new term.png” and he intends to share this photo with his brother (Figure 5.4).



The selected image has been stored

Figure 5.5: TumaPicha - Photo has been succesfully stored in the database

The next step after uploading the photo was to click the “Store Images” button. Upon successful storage, a confirmation statement would appear at the top left corner of the browser (Figure 5.5). I opted to present received photos on a web page because low income family members would be able to access computers in places such as cyber cafes at affordable costs (Study 1; Wyche & Yardi, 2013).

After designing the photo uploading and saving interfaces, the next design activity was to sketch the TumaPicha web browsing interfaces where users would be able to view the shared photos. I explored this by sketching interfaces that provided the option to list photos via hyperlinks (Figure 5.6) on the web page. Listing photos as hyperlinks in descending order from the top would provide a family member with the notion of quickly realizing that the newest photo links appeared at the top of the list, while older links would be found further down the page. The link would lead one to a collection of photos all grouped together and presented together on a separate web page. Another discussion with the collaborators guided the iteration of this idea. Instead of providing links to access photos on another web page, I chose to display the photos on the initial web page by replacing the hyperlinks with actual photos that had been stored in the database. This way, family members would see all photos that were uploaded from the village. This would also enable me to explore the way urban participants used the displayed photos.

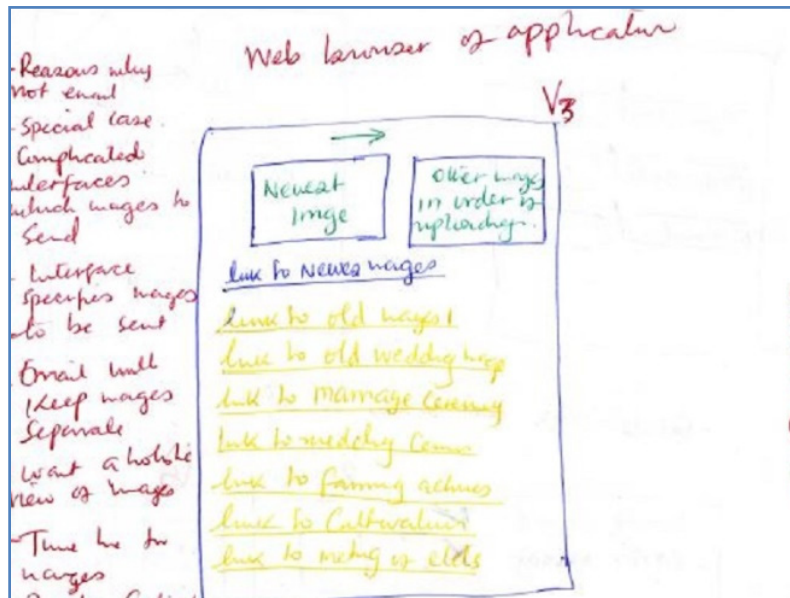


Figure 5.6: TumaPicha: hyperlinks sketch

I removed the text descriptions from the displayed photos, but still kept them in the database, so that I could keep track of the different pairs of families that shared photos with each other (for use in the upcoming field deployment). The next research stage involved refining the early design so it would be ready for testing and deployment with families in Kenya. This activity enabled me to review any hardware or software issues that could have been missed during design iterations on existing system designs.

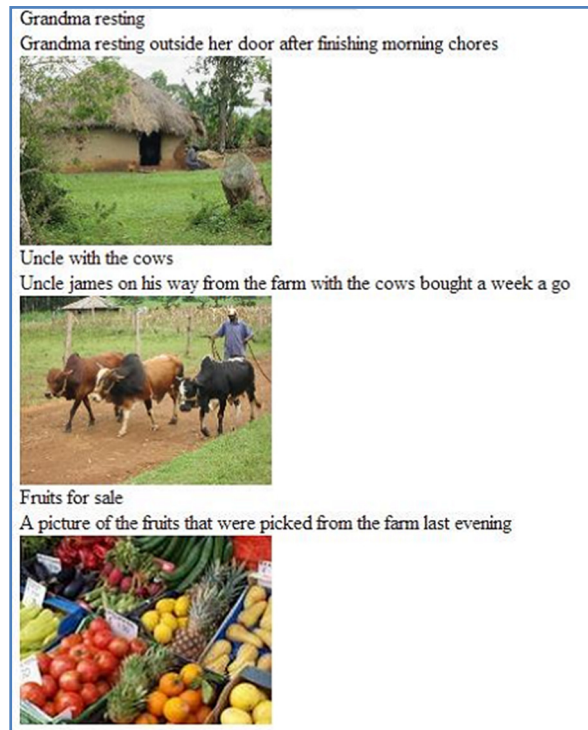


Figure 5.7: Early TumaPicha Service display page

My collaborators also shared their views on how they would use the system in case it was deployed with them. I recognize that this is somewhat problematic because none of my collaborators are from Kenya and they all have an advanced understanding of technology. Yet this activity still helped to notice potential usability problems with the design ideas. At this point, I applied thoughts that came out of such discussions regarding how a user could accomplish their intended tasks with TumaPicha. To apply this to my design, I sketched various photo display and browsing options that would be incorporated into the TumaPicha display page (Figure 5.7). I developed the photo browsing component for TumaPicha based on the Figure 5.8 sketch because it provided a user with the ability to browse photos while viewing thumbnail images. The thumbnail images provided a variety of photos that could be clicked on for focus on the main viewing pane of the display page.

5.4 Refined Design

Lastly, I refined the design and developed the system. The refined TumaPicha service is designed to support family members in a rural location of Kenya use a mobile phone to capture photos of their surroundings and activities. Intermediaries, in the form of a motorcycle taxi driver and a cyber café attendant, are then involved in the transfer process of the photos. The system is deliberately simple, uses technology that is presently available to Kenyans, and relies on intermediaries as service providers. The system consists of a web interface that supports the uploading of photos from a mobile phone or computer along with optional annotations including a title and description (Figure 5.9, left), and a separate web page where photos are viewed (Figure 5.9, right). The TumaPicha interface is accessible on web browsers (accessed as separate links) that are widely used in Kenya such as Internet Explorer, Firefox and Chrome. The interfaces that support uploading and browsing of photos has only the most basic options which provide a high probability that a user with basic computer literacy would be able to use it. While the application may seem simple, if not already available using other existing technologies, the manner in which I designed TumaPicha and anticipated it would be used is premised on the assessment of the needs of rural and low income urban Kenyan families found in prior literature (Wyche & Grinter, 2012). I describe the design next by exploring its interactions and usage.



Figure 5.8: TumaPicha - A sketch of refined design photo browsing interface

1. **Photo Capture by Family Members in Rural Areas:** First, family members living in rural areas use a mobile phone to capture photos of things they want to

share with family members in the urban centers. This might include photos captured by multiple family members within the same village area—extended relatives often live together within a single village. I anticipated that photos would likely relate to the subsistence farming activities of rural family members since they are often supported by remittances from urban family members (Study 1). Once rural family members are ready to share their photos, they hand over their phones to a motorcycle taxi driver, described next.

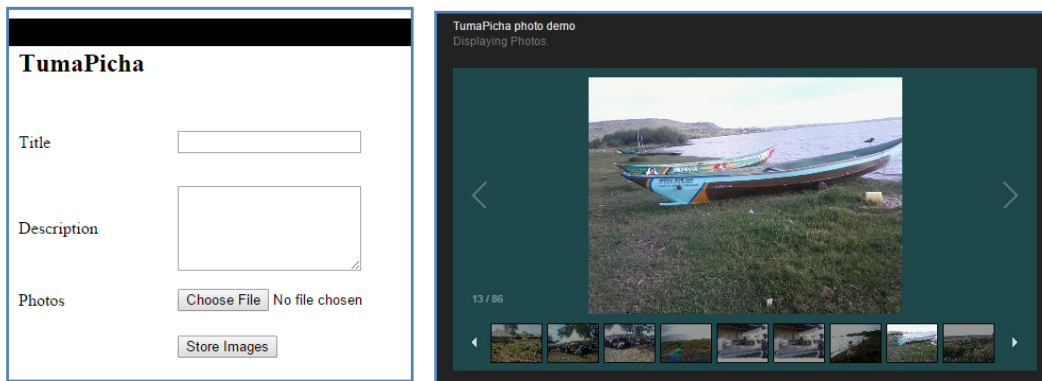


Figure 5.9: TumaPicha - Refined photo “Upload” (Left) and “Display” pages (Right)

- 2. Physical transfer by a Motorcycle Taxi Driver:** Motorcycle taxi drivers transport people and commodities to different locations as reported in Study 1. Given that they already carry people and commodities between rural areas and the local town where one can find cyber cafés, I decided to incorporate them in TumaPicha as intermediaries who could perform a physical transfer of the photos/phones to locations containing Internet connectivity. Thus, a motorcycle taxi driver collects the phones from rural family members (with the photos on them) and delivers them to a cyber café in the local town. This also serves a second purpose: Family members in rural areas often lack electricity so they cannot easily charge their mobile phones. As such, the taxi driver also brings the phones to the café for charging. The physical phone transfer approach builds from current practice where rural family members take their phones to charging booths and sometimes collect the phones after a few days due to electricity outages.
- 3. Data Transfer by a Cyber Café Attendant:** At the cyber café, an attendant uses the TumaPicha web interface (Figure 5.9, left) to upload photos from the

mobile phone to a server. There are no special login or access identification requirements for families as I wanted to remove the complexity that might come with login accounts and the remembering of passwords (Rangaswamy et al., 2011). Studies conducted in South Africa revealed that women who used mobile Internet for the first time experienced challenges in differentiating between pin numbers and login passwords (Gitau et al., 2012). Building on such study findings, TumaPicha is designed with basic uploading interfaces that do not require elaborate authentication for first time novice users.

Data bandwidth is still relatively limited with a dial-up connection of 100 Kbps and below. For this reason, I chose to use photos and not video clips. The act of handing the phones to a cyber-attendant to upload photos builds on current practices in rural communities in Kenya where family members take their phones to local charging booths in rural areas as reported in Study 1 and also in (Wyche & Murphy, 2012). The system design also incorporates the use of the cyber attendant's computer knowledge to upload the photos to the server. Once done, the attendant returns the phone to the motorcycle taxi driver who delivers it back to the rural family members.

4. **Viewing by an Urban Family Member:** Urban family members view the shared photos over a dedicated web page on a computer desktop that could be accessed even in a cyber café. The family member only needs to launch the application page and access the photos that have already been shared by the rural family members. The display page (Figure 5.9, right) provides thumbnails for browsing. When a thumbnail is clicked, the selected image is displayed in a larger screen that also provides an arrow on either side for browsing stored photos. The lack of access permissions by the urban family members means that they can view all photos being sent from rural families using the system. The effects of presenting the photos this way are explored in Chapter 7 as part of the TumaPicha deployment.

5.5 TumaPicha Design Rationale

As can be seen, the cyber attendant has access to view the photos and is an integral component in the data transfer. In Study 1, family members in the rural communities would send motorbike taxi drivers to the local town and ask them to purchase commodities and bring them back to the village. TumaPicha builds on such practices by providing family members with the opportunity to share photos between rural and low income urban settings via the use of intermediaries. The urban family members were provided with the TumaPicha display page via a link that was emailed to them to ensure that they logged into their emails before accessing the TumaPicha link. I explore the above situation and privacy in the deployment described in Chapter 7.

Study 1 revealed that cyber café attendants and the motorcycle taxi driver played an important role of mediating technology use between the rural and urban family members. The role played by intermediaries for technology sharing and information exchange in developing countries was also reported in India (Sambasivan et al., 2009). I explore the extension of technology mediation beyond the family unit to include other service providers.

Study 1 also revealed that rural family members not typically have access to computers, Internet and lacked the IT knowledge required to use the application. For this reason, I did not intend for rural family members to use the TumaPicha web application to upload photos themselves. Even though they were at times able to purchase data to use with their existing mobile phones in rural areas, it would have been with a cellular carrier and expensive. Cheaper options would involve walking to a cyber café, which could take about 2.5 hours to get to.

Study 1 and other studies (Dias & Brewer, 2000; Ho et al., 2009; Gitau et al., 2012) also revealed that rural family members often faced problems with learning how to use even simple technology interfaces. Thus, TumaPicha solves two problems. First, it overcomes the lack of technology understanding by having the cyber café attendant transfer the photos rather than the rural family members who may easily not understand the upload interface. Second, it overcomes high cellular phone data rates by having the motorcycle taxi driver transport the phones to a place with cheaper Internet access. Within

our service setup, rural family members would only need to pay for using the computer to upload the photos at a cost of Kshs 200 (~\$2.5 USD) to submit an average of 18 photos per visit.

Study 1 had also revealed that urban family members were more interested in following the progress of projects going on in the village (Wyche & Grinter, 2012) since they occasionally remitted money to their rural families to support various projects. The same level of interest in following activities of urban families beyond receiving information about their well-being was not seen with the rural families. As a result, I envisioned that rural and urban family members would use the shared photos to provide visual context to the already existing short conversations that were being conducted over the phone. I focused on rural family members sending photos to urban family members—and not bi-directional sharing based on findings from Study 1. In Study 1 findings, older family members had shown a lack of interest in learning about new technology that required time to master, while the younger population who were interested in doing so faced a lack of access to smartphones and lack of electricity among other infrastructural challenges. Instead, I wanted to start with a base case that I could learn about and understand first, and then consider bi-directional sharing as a part of future systems or deployments.

5.6 Implementation

TumaPicha runs on XAMPP, which is an open source cross platform webserver that contains the Apache server, MySQL database and PHP development environments in addition to other applications all compiled together. I operated the server locally on my laptop during the early development phase of TumaPicha. The XAMPP platform provided me with an integrated development environment that supported the testing of different system iterations locally without the need to access the Internet.

The photos uploaded to the TumaPicha service and the accompanying textual descriptions of these photos as described to the cyber attendant by the taxi driver, will be briefly entered in the upload fields and then saved to the TumaPicha database. The initial photo descriptions would have already been provided by the rural family member over a brief general chat with the taxi driver as he took the phone for delivery to the cyber

attendant. The photo descriptions were only stored in the database and not displayed for the urban family member. This way I would use the descriptions to compare whether the urban family members were able to identify photos that had been shared with them from the rural villages. Information about uploaded photos and photo descriptions were stored in the database. The MySQL database was compatible with Dreamweaver CS6 which was also used for PHP and HTML development. Whenever accessed, the photos were rendered using JavaScript to rearrange the photos accordingly (Figure 5.9, right).

5.7 Comparison to Existing Systems

In this section I briefly describe existing photo sharing applications and then compare these to TumaPicha.

Existing photo sharing applications provide both website and application interfaces that facilitate the upload and display of images. These applications are designed to provide thumbnails and slideshows, the ability to organize photos into albums, as well as allow users to add comments to uploaded photos. For example, flickr is a photo-sharing and hosting service that supports sharing and exploration of a community of other user's photos (similar systems include Photobucket, Snapfish, and TinyPic). These applications use an online uploader to create albums or require installation of software that lets one publish from desktop computers. Other systems provide a plug-in for iPhoto (Macintosh computer photo viewer) viewing.

All of these applications require online registration to create user profiles to be able to share images. For instance, flickr requires a Yahoo account in order to use it (Loweshon, 2008). TumaPicha is different than these applications because it provides family members with a one step process to access uploaded photos via a dedicated link. A local technology intermediary (cyber attendant) and urban family members are the ones who access this link.

More recent image sharing systems such as Facebook and Instagram focus on sharing images with friends in one's social network. While Facebook allows one to share photos and various digital materials such as videos, Web links, and personal views,

Instagram only lets people post photos (and until more recently, short videos). Instagram is also similar to Picasa, a free program from Google that one can download (using a Google email account) and install on a computer to organize and edit digital photographs. Instagram saves photos from one's camera or phone in square form thus giving it a uniform, well organized and symmetric feel (Jesdanun, 2012). Instagram also provides the ability to save photos with a variety of 'styles' that can be previewed as you browse through the system's built-in filters. One can also caption or briefly describe photos before posting them for Instagram friends or even strangers to see. Instagram also provides an option to share posted photos on other social networks such as Facebook and Twitter (Jesdanun, 2012). TumaPicha is different than these applications since it shares family activities with immediate family and close neighbors and does not provide plugins for sharing on social media with a wider audience.

The prototypes described in Chapter 2—*Whereabouts* clock, *Family Circles*, *SPARCS*, *Hermes Picture Display* and *Digital Family Portraits*—are similar in some ways to TumaPicha, given their low bandwidth requirements. Yet they are much different given the specific needs of Kenyan families. First, the *Whereabouts Clock* provides basic awareness information about family members, yet it is focused only on a person's location (Sellen et al., 2006). TumaPicha is not designed to provide the general awareness of a family member's location since family members already know each other's general location. Second, *Family Circles* enables family members to record messages and leave them at any desirable place in the home for their close ones to interpret (Schatorje & Markopoulos, 2009). TumaPicha does not share messages in this way since it adds a visual component to phone conversations or even initiates new topics of discussions based on shared photos. Third, *SPARCS* provides calendar information to suggest photos that family members should share with one another (Brush et al., 2009). TumaPicha does not link calendars with photo sharing suggestions because people do not readily use digital calendars in rural and low income urban areas of Kenya. Fourth, *Hermes Picture Display* enabled users to send and receive pictures on their phones over Bluetooth (Chevrest et al., 2005). TumaPicha does not use Bluetooth technology for sharing photos since it encourages the incorporation of intermediaries as important channels through which the existing interactions that promote sharing of tasks and use of available technical know-how is maintained in the local communities. For example, through the involvement

of cyber attendants in implementing technologies for rural communities, their invaluable technical knowledge becomes necessary when future technology projects need to be managed within these communities. Lastly, *Digital Family Portraits* is a system that shows the activity level of an aging parent with an indication for inactivity that might raise concerns about the health condition of the user (Mynatt et al., 2001). TumaPicha is designed to act as a complimentary communication avenue that provides a visual dimension in addition to existing weekly phone communication between distributed families.

| | Facebook | Instagram | Picasa | Flickr | TumaPicha |
|--------------------|----------|-----------|--------|--------|-----------|
| Photo navigation | Yes | Yes | Yes | Yes | Yes |
| Intermediaries | No | No | No | No | Yes |
| User profiles | Yes | Yes | Yes | Yes | No |
| Friendship Network | Yes | Yes | Yes | Yes | No |
| Authentication | Yes | Yes | Yes | Yes | No |
| Video | Yes | Yes | No | No | No |
| Plugins | Yes/No | Yes/No | Yes | Yes | No |

Figure 5.10: TumaPicha: Comparison with existing systems

TumaPicha design is implemented to combine the latest photo browsing techniques by displaying photos to an urban family member in an interface that supports thumbnail browsing similar to flickr and Picasa on one end, while using technology intermediaries in the transfer of photos from rural family members on the other end. Its implementation incorporates ideas that assist people living in rural settings of developing countries use a service that through the assistance of intermediaries. In the TumaPicha design, the rural populations get to experience new technology that is only slightly more advanced than they are used to (Android phones that capture photos), rather than being overwhelmed by technology that is new (uploading photos to the TumaPicha interface) and likely outside their scope of understanding and learning. The differences between TumaPicha and other existing photo sharing applications currently used are provided in Figure 5.10.

Using intermediaries in the system's design also generates discussions on how rural populations that lack IT literacy and face infrastructural challenges can share family moments with their relatives who have access to the latest technologies.

5.8 Summary

In this chapter, I described the design of TumaPicha based on the findings from Study 1 in this dissertation, related work research, and design discussions that involved collaboration with my lab members and supervisors. I also document the design exercises conducted to inform the system development and iterations of early designs. The early iterations of the design process, through sketches and low fidelity designs that guided the initial discussions towards the design of prototypes have also been described. Based on further reviews and discussions with collaborators, I improved the TumaPicha design in subsequent stages to reflect design suggestions. Also, I discussed the various goals that guided the design of the final system after weighing options that were explored in the early design phases. Lastly, I described the final system design and finished by providing a rationale for the design components chosen for TumaPicha.

Chapter 6. TumaPicha Deployment Methods

This chapter presents a detailed description of the methods, data collection and analysis used during my second investigation of this dissertation. I conducted the deployment of TumaPicha with families in Kenya for a period of five weeks. The aim of this study was to understand how the system would be appropriated by users and gain insight into whether the design would enhance or disrupt existing family communication routines. This goal maps to the third objective of my dissertation that seeks to *evaluate the designed communication technology service to understand how it will be used by families in Kenya as a part of their communication routines*. This objective also addresses the research methods applied to answer research question 3. The main methods used were diaries and semi structured interviews.

6.1 Study Sites and Participants

As a native of Migori district, my research provided participants with an opportunity for sustained involvement with further investigations that I planned to carry after Study 1. Participants for this study (names anonymized) had been selected from an initial pool of 30 people already identified from separate families initially recruited for Study 1. The two rural participants who eventually participated in this study (Jekonia and Consolata) were well placed to provide rich study data and perspectives related to the use of technology in sharing activities between rural and urban areas of Kenya. The urban participants were identified during in-depth interviews that I conducted with the rural participants in my initial study visit. The demographic information of my participants is provided in Table 6.1. I provide a description of participant study sites next.

| # | Participants | Participant Description | | | |
|----|-------------------------------|-------------------------|-----|---------------------------------|--------------|
| | | Gender | Age | Occupation | Location |
| | Household Pair 1 (HP1) | | | | |
| P1 | Jekonia | Male | 25 | Subsistence farmer | Rural |
| P2 | Ben | Male | 39 | Designer (Free hand artist) | Urban |
| | Household Pair 2 (HP2) | | | | |
| P3 | Consolata | Female | 53 | Community leader and farmer | Rural |
| P4 | Maurice | Male | 28 | IT technician | Urban |
| | Intermediaries | | | | |
| P5 | Ondiek | Male | 32 | Motorcycle taxi driver / farmer | Rural |
| P6 | Akinyi | Female | 28 | Student / Cyber attendant | Rural (Town) |

Table 6.1: Participant demographic details

6.1.1 Study Sites

6.1.1.1 Study Site 1: Migori (Rural)

Two families lived in rural Migori in a village called Mahena which is ~ 20 km from the local town, Awendo. Migori District lies 360 km from Nairobi with a population of ~47,000. Sugarcane is the main cash crop in this region. Other families engage in subsistence cultivation of maize, beans, pineapples, groundnuts and vegetables. Polygamy is also practiced in this region. Rural participants selected for this study had not completed primary school education. The cyber café used for uploading pictures to the TumaPicha application was located in Awendo.

6.1.1.2 Study Site 2: Githurai (Low Income Urban)

Two families in our study lived in Githurai, a multilingual mixture of slums and suburbs that lies in the eastern part of Nairobi with a population of over 300,000. People engage in small-scale businesses by selling foodstuff, groceries, clothing and other commodities in small retail shops and roadside kiosks, while others work in the nearby Kenyatta University and a brick making company called Clay Works. Participants were comprised of four focal family members and their households (names changed for anonymity). Detailed participant descriptions are provided next.

6.2 Participants

In this study, my aim was to investigate how families in rural and low income urban areas of Kenya appropriated and used the TumaPicha service through a field deployment. My goal was to understand how, when, and why families would use the system, and gain insight into the challenges they might face, if any, when doing so. I deployed the design to two families in rural Migori and two families in the low income Githurai area of Nairobi (urban) where they connected as pairs between the rural and urban areas.



Figure 6.1: Consolata's mobile phone (Left) and Jekonia's phone (Right)

6.2.1 Household Pair 1 (HP1) - Jekonia and Ben

Jekonia (25 years old) is a married peasant farmer and caretaker of a rural home in Migori who also works as a fisherman during the evenings. Jekonia is married with two children and lives with his family and nine other relatives within a home. Jekonia already used an Iplus i110 Chinese-made phone purchased for Kshs 1,499 (\$17) (Figure 6.1). The phone had a dual SIM card and a 0.3 MP camera. He used TumaPicha with one of his three brothers, Ben, because he felt closest to him in terms of information exchange and sharing of activities that they both had common interest in.

Ben (39 years old) is a freehand graphic designer who lives in a low income urban area of Nairobi with his wife and three children (6, 10, 15 years old). For Study 2, he mainly

communicated with Jekonia and two other siblings. He mainly used his mobile phone to access his emails and other Internet services (downloading design related attachments) at a cyber café that is a 10-minute walk from his house. Ben paid Jekonia a monthly salary for managing activities in the home. He was also the focal point for all communications exchanges that relate to passing information between his rural village and other siblings living away from home including in the United Kingdom.



Figure 6.2: Motorcycle taxi driver getting ready to pick a customer

6.2.2 Household Pair 2 (HP2) - Consolata and Maurice

Consolata (53 years old) is the first wife of a polygamous primary school teacher with eight children, four of whom live away from home. She is on the board of a local primary school in addition to being a community leader who heads various local groups focused improvement of rural women's living standards through provision of non interest loans. She mainly shares information with her eldest son, Maurice, who lives in Nairobi. Consolata also coordinates church activities, and is also a peasant farmer in addition to managing a small-scale business. She regularly uses her mobile phone, which is the Vodafone 150 (Figure 6.1) that offers basic voice and SMS facilities along with support for mobile payment services.

Maurice (28 years) is an IT technician who is married with a two-year-old daughter and lives in the low income area of our study settings (Githurai). He reported using email,

Facebook, Instagram, Skype and general Internet browsing on the computer. He also used his smartphone to access Facebook, WhatsApp and Instagram.

Overall, our participants represented a relatively young demographic (25, 28, 39, and 53 years old). This was because prior research has shown that younger adults in Kenya tend to be more interested in trying out new technologies. I also specifically chose to work with only a small number of families so that I could monitor their usage of TumaPicha closely.

6.2.3 Intermediaries

I recruited a motorcycle taxi driver (Figure 6.2), Ondiek, to deliver the mobile phones between the village and the cyber café as part of TumaPicha set up. Ondiek was 32 years old and had been ferrying passengers and commodities in the area for the past two years. I paid him a small amount of money (Kshs 200 = ~\$2.50) for his work throughout the study. That said, Ondiek explained that he was willing to do the task on an ongoing basis for no fee because he was already making the trip between the village area and the cyber café when ferrying his regular customers. Even though this assumption might change and need to be reevaluated in case the system was to be used by a wider audience, currently the views of the rural family members support the design of a service based on the sharing of tasks in rural communities as reported in Study 1. Transporting the phones did not require any extra work. Moreover, because Ondiek was from the same village area as the rural participants, he knew them well and simply liked to help out his friends.

The cyber café attendant, Akinyi (29 years old), was a communications major and taking a one-year break from university studies. She was familiar with technology and able to use the computer and Internet at the café to upload photos using TumaPicha. She worked at the cyber to keep busy and raise some money for personal use while away from school.

6.3 Methods

I conducted an initial visit with families to describe the study and show how TumaPicha worked. Participants were told the goal of the system was for them to be able to share photos of locations and activities that they felt the remote family would like to see. Semi-structured interviews were conducted with participants during this initial visit for 45 to 60 minutes. I asked about their communication routines and how they communicated with distributed relatives to get an idea of their engagement with communication technology. Example questions included: why do you choose a particular technology for communication? What challenges do you face with the technologies you currently use for communication? The full set of questions are listed in Appendix B Rural participants were given a Huawei Android version 4.2.2 (Figure 6.3) phone for the duration of the study. Thus, they did not have to purchase the phone themselves. Huawei phones are available for sale in Nairobi and one of the options selected by some Kenyans as a basic smartphone. Some people in rural areas of Kenya use them, but would not typically have data plans for them because of the high cost.



Figure 6.3: The Huawei Android Version 4.2.2 (Left) being used (Right)

I met with the motorcycle taxi driver and cyber café attendant and explained the study to them and how they would be involved. This included us showing them how to use the TumaPicha service. Following this, participants took part in the field trials. They were told to use the system as they saw fit throughout a five-week period. One of the participants was able to read and write English while the other wrote her diaries in Luo. During this time, they kept handwritten notes in a diary (Figure 6.4). I also met with them on a weekly basis to discuss their diary entries and the usage of TumaPicha. For example,

I asked questions such as: how did TumaPicha support you in sharing your activities over the past week? What challenges, if any, did you face? I also followed up on unclear diary entries to seek clarifications about such.

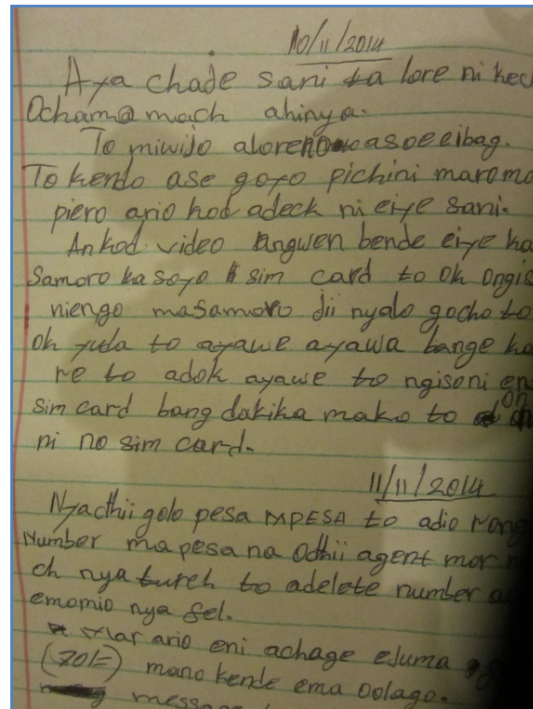


Figure 6.4: A page from Consolata’s diary entries

Once the five weeks were over, I waited one further week and then conducted a final interview with all participants, including the taxi driver and cyber café attendant. The goal of this step was to give them some additional time to reflect on their usage and also to see what their experience was like after withdrawing the system for a week. As compensation for the family members’ participation, we paid for the fees at the cyber café to upload the participant’s photos. These fees are quite small (~\$2 USD per phone uploads where this amount can be used to purchase a $\frac{3}{4}$ kg of sugar) and, thus, I did not feel they largely impacted how many photos participants shared. Moreover, this amount is similar to what urban family members often already transfer to their rural family members in order for them get air time for their phones. They do this so they can communicate with rural family members about the farming activities that other remittances support. At the end of study, I also gave the mobile phones to each rural participant as a thank you; however,

they did not know I was going to do this at the start of the study so it did not motivate them in any way to participate.

6.4 Data Collection & Analysis

Handwritten notes were kept while all interviews were audio-recorded. My findings are based on transcribed interviews, over 300 photographs depicting participants' homes and areas of activity, and field notes. I also analyzed interview transcriptions that had been recorded in Luo and Swahili in addition to the study notes using standard coding techniques (open, axial, and selective coding) to help capture the main themes in the data (Strauss & Corbin). I applied open coding while iteratively reviewing participant diaries (for rural participants) in addition to study notes (for all participants) recorded during the study visits and transcripts prepared every evening after field visits. Open coding, used as the first step of interpreting the study results enabled the uncovering, naming and developing of concepts to open up text and expose the participant ideas (Strauss & Corbin, 1998, Holtzblatt, 2004). Basically, I created tentative labels for information that summarized documented study activities from participant data. I illustrate the coding process and resulting themes next (Table 6.2).

In the table, examples of actual words collected from participant data are used to establish properties of each code. The Axial codes have been identified based on relationships among the open codes initially derived from participant data. The selective codes represent a high level overview of all the participant data (after several reviews) relating to already identified themes. The resulting themes including a list of the ways that TumaPicha was used (e.g., the types of photos captured and shared with remote family), the reasons behind this usage, and a categorization of social situations and practices that emerged are described in Chapter 7.

| Themes from Selective Codes | Axial Codes | Open Codes | Examples of participants' words |
|-----------------------------|--|--|---|
| Subsistence activities | Coordination of activities in the village | Financial support update information manage work repair and maintenance | Planting maize ploughing and repair plough Rainy Season and granary Money to plant seeds Selling of farm produce chicken project for kids Always looking for a new thrill Grow quickly Foot and mouth disease |
| Personal activities | Individual plans of family members in the village | Preparation for work Money transfer Learn using technology Leisure activities | Attended board meeting praying for candidates prepare fishing nets Use of headphones reading bible rest after meals in the afternoon |
| Domestication of Animals | Sharing information of cattle and farm land with remote family | Treatment of cattle Update on recovery process Manage land for grazing | Sick cow Rearing chicken Sheep and goats herding Calf recovery process Vertinerian visit Land for grazing Farm destroyed by cattle |
| Village awareness | Update of surrounding areas in the village | Developing structures Shopping for goods Latest news | Going to the beach Check market prices Welding store Neighboring home Bushy idle farm land New buildings in local market |
| Support with technology | Technology Usage by rural family members | Technology mediation Sharing photos Phone usage | Cyber café lady Electricity black out Charge mobile phones Cost of charging mobile phone Upload the images Delayed uploads and phone delivery Demonstrate app usage |
| Well - being | Hobbies and duties of rural family members | Weekly meetings Prayers activities | Attend funeral Clinic visit Church visit Engage in women's activities Church activities |

Table 6.2: Resulting codes and categories

6.5 Summary

This chapter presented the strategies I used to recruit two sets of participants between the rural and urban areas of Kenya. I also provide information about the participant study sites, household composition and a description of technology used during Study 2. I have also described the recruitment process, explained the data collection process with an illustration of the coding techniques used during this investigation stage. I used semi-structured interviews with participants over the course of five weeks in addition

to the use of diaries for rural participants while gathering information about their communication practices using TumaPicha. I have also described the use of intermediaries who assisted rural family members to collect photos and deliver them to a cyber café for onward transmission over the Internet. I finished by illustrating the coding techniques used to come up with themes from Study 2. In the next chapter, I outline the results from Study 2, while focusing on several themes that stood out from investigation results.

Chapter 7. Deployment of TumaPicha

This chapter describes findings from Study 2 of this dissertation that focuses on the evaluation of TumaPicha, a communication technology service, deployed to understand how it would be used by families in Kenya. I describe how Kenyan families used TumaPicha, specifically designed to support their communication routines. I also look at the social factors that affected this usage over rural and low income urban areas. These findings address the third research objective of this dissertation *by providing findings that help in understanding how TumaPicha was used by families in Kenya as a part of their communication routines* while also answering research question 3. The chapter is organized as follows. First, I describe how both rural and urban study participants adopted the communication technology during deployment. Second, I describe the reasons for using TumaPicha that include subsistence awareness, village awareness and health and wellbeing awareness. Third, I discuss the chapter with a focus on the appropriation of TumaPicha to share family activities, to provide them with an opportunity to learn using affordable technology and explore potential privacy issues arising from this investigation.

7.1 Communication Technology Adoption

7.1.1 Rural Usage and Reactions

My rural participants used the study phones throughout the deployment to capture photos and found TumaPicha beneficial for sharing their environments and activities in a new way with their urban-based family members. Despite their lack of technical knowledge, the rural participants began using features of the phones beyond just TumaPicha. Each used the phone in a somewhat different way. Jekonia (HP1) took 115 photos and 4 videos while Consolata (HP2) took 108 photos. The number of photos shared by the participants is illustrated in Table 7.1.

| # | Participants | Participant Description | | | |
|----|-------------------------------|-------------------------|-----|---------------------------------|--------------|
| | | Gender | Age | Occupation | Location |
| | Household Pair 1 (HP1) | | | | |
| P1 | Jekonia | Male | 25 | Subsistence farmer | Rural |
| P2 | Ben | Male | 39 | Designer (Free hand artist) | Urban |
| | Household Pair 2 (HP2) | | | | |
| P3 | Consolata | Female | 53 | Community leader and farmer | Rural |
| P4 | Maurice | Male | 28 | IT technician | Urban |
| | Intermediaries | | | | |
| P5 | Ondiek | Male | 32 | Motorcycle taxi driver / farmer | Rural |
| P6 | Akinyi | Female | 28 | Student / Cyber attendant | Rural (Town) |

Table 7.1: Study participants and intermediaries

First, Jekonia (HP1) carried the phone nearly everywhere he went because he used it as a communications device for phone calls and text messaging, in addition to using it for TumaPicha photos (Figure 7.1). Carrying the phone around and attempting to use it whenever possible showed how Jekonia (HP1) was eager to use the technology and make it an important part of his daily routines. He would also carry it to the farm, to the beach during the day and even to the local shopping center when going to run errands. However, he left the phone at home during the night when he would go fishing. Jekonia was also careful to not let his children near the phone because he was worried it might get damaged since it was new. Jekonia (HP2) also reported that he had not used any form of social media or the Internet prior to my deployment but was eventually able to connect to the Internet after being shown how to do so. Jekonia felt he had improved his technical literacy during the study by learning how to type messages using two fingers on the large phone screen. At the end of each day, Jekonia would often play around with the phone while resting at home. He wanted to try and test its capabilities and see what else he could learn. This included capturing videos and even viewing videos on YouTube—for this he used his own cellular credits, which he did not realize was very expensive for data usage. This was a surprising learning for him after the fact. The taxi driver would often pick Jekonia’s (HP1) phone from home or any other part of the village where he would meet with him such as at the beach. The taxi driver often picked Consolata’s phone at her home either in the mornings or afternoons.

In terms of challenges experienced during deployment, Jekonia (HP2) had been told earlier by others that, generally, smartphones had good coverage and reception. He still experienced poor connectivity with the Android phone and wasn’t sure whether it was

a network issue or a phone reception issue. Speaking about this challenge, he said that he would have preferred to use a twin SIM card phone (the study phone was single SIM card) since that would provide with him with the option to switch to an alternative SIM card at any given time. Communication wise, Jekonia (HP2) mostly called relatives using mobile phones and their talks would last between 2 to 10 minutes. He considered current call costs to be expensive and at times preferred using text messages when not able to call from the village.



Figure 7.1: Jekonia taking photos while herding cattle

On the other hand, Consolata (HP2) used the phone in addition to her usual phone. This was because she was not comfortable in using the study phone without direction from her husband and sons since she wanted to make sure that she was doing the “right things” with the phone. This reflected her unfamiliarity with “newer” technologies and the fact that she was most comfortable with her existing phone.

“These new phones are not easy for me to use. However, my husband has used cheap touchscreen phones made in China. I therefore use my phone in his presence in case I get stuck while using the study phone and require his help”. - Consolata (HP2), Female, 53.

Consolata (HP2) would use the TumaPicha phone right after meal times or when the family had just completed reading the bible together. During these times, her husband

and children would be around to provide help with the phone. In addition to capturing photos, she used the phone for MPESA transactions during the day when accompanied by one of her kids or husband. Consolata's reliance on her kids or husband to using technology was similar to Study 1 findings where women often had to rely on their husbands for access to mobile phones. In Study 1, husbands and wives created workarounds such as sending one's siblings to pass a message to a wife when she did not own a phone and needed to be reached while the husband was away.

Consolata (HP2) would use the study phone to speak to teachers, family members and her co - wife. For example, she called often to coordinate prayers for primary school students who were preparing for their qualifying exams and also to coordinate matters related to a savings and credit organization she was overseeing. In addition to calling and taking photos (after initial training) for the deployment with TumaPicha, Consolata (HP2) reported to have used only text messages for money transfer. As a small scale business owner, she would have liked the study phone to have a modern calculator application that could help her with profit calculations.

About general technology use, she was now aware that the study phone could be used to access the Internet in addition to taking photos as demonstrated by her husband and kids. Before the deployment of TumaPicha, she had not used social media and had no idea what the term even meant. Now, she was able to recognize the Facebook application even though she did not have the motivation to use it. Despite of all these issues, she stressed the importance of initial training before using smart phones since they were more advanced than what many people around the village were currently using or were even aware of. Also, she strongly believed people should overcome the fear of using technology so as to learn about it and enjoy its benefits, something she says she could personally attest to.

Both rural participants found that the phone consumed a lot of power, more so than their existing phones. This caused them to need to charge them frequently and turn them on only when needed. Jekonia (HP1) talked about having to charge the phone at a local charging station every few days. Sometimes Jekonia's younger brother would also take the phone to the charging station for him. The quick consumption of power by the mobile

phones that were deployed for our studies was unanticipated and meant that the planned service for TumaPicha's charging (at the cyber café) was not enthusiastically embraced by the participants. However, this was not seen as a negative challenge by the rural families since they were already using the local charging stations where their phones would occasionally stay for a day or two before they got them back.

Once the deployment ended and after taking back the phones for a week, the rural participants found it more challenging to describe what was happening in their village because they could no longer rely on photos to show the situation to their remote family members. They also told us that they missed using the new technology due to its clearer audio when compared to their old phones, and trying to learn what other features the phones supported. Both rural participants also reported that their learning about new technology would be hindered since it would be difficult to get access to similar phones to use in their daily communication routines. I compare the rural usage of technology to Study 1 findings next.

In Study 1, it was reported that rural participants shared phones because of a lack of access to technology, due to network problems or even because of lack of electricity for powering phones. Study 2 revealed that Consolata (HP2) mainly used her phone in the presence of her husband and kids since she needed assistance with technology and not because of issues related to a lack of accessing it or gender. She however reported that she would keep her phone off when she did not intend to use it so as to conserve battery power. Unlike Study 1 findings on the lack of using text messages, Jekonia (HP1) reported that he used text messaging to communicate with distributed family.

Study 1 also reported that rural family members preferred voice calls to texting since this allowed them to pass urgent information faster. Some rural family members also preferred the use of voice calls and voicemails since they were not able to respond to text messages due to illiteracy. Both rural and urban family members also mentioned that people tended to respond to calls faster than they would to text messages. These results were not reflected in Study 2 since the participants focused on the sharing of images in addition to calling. However, Jekonia (HP1) told me that he occasionally used text messages while communicating with relatives.

7.1.2 Urban Usage and Reactions

Both urban participants accessed TumaPicha at cyber cafes. This was because they did not have computers with Internet connections at home. For example, Ben (HP1) used TumaPicha from a cyber café that was located in Githurai. He would access the system while visiting the cyber to check on his emails or to download and print documents related to his work. He always went to the same cyber since he had established a good relationship with the owners. Ben and Jekonia (both HP1) would talk about the photos on the phone after Ben saw them. In addition to talking with Jekonia (HP1), Ben (HP1) also referred to photos during phone conversations that he had with his other brother who lived in London. Thus, the photos became a conversational artifact beyond just discussions with Jekonia. Overall, Ben felt that TumaPicha was a valuable system and felt its usage should be extended to other people in the village to spread an awareness of technology.

“People should be educated about technology use in the rural villages to understand how the whole TumaPicha process works. I believe that people should overcome fear of using technology to enjoy the benefits it brings to sharing information.”
– Ben (HP1), Male, 39.

Before the TumaPicha deployment, Ben (HP1) had used the email, the phone, the Internet and desktop forms of technology either for communication or for work related duties. He said that he does not use social media but follows stories that make the news online to keep in touch with what is happening. He thought that social media was unregulated and so it was his duty to know what was happening in case he needed to advise his children about things to look out for while using social media. Before the TumaPicha deployment, he had difficulty in sharing photos from the village with his other brother who lived in the United Kingdom. Ben (HP1) mentioned that the brother would send financial assistance to him to spend on activities related to the general care of the home. As a result it was important for Ben (HP1) to keep him updated about things happening in the rural home. Occasionally when Ben (HP1) needed to show the progress of developments in the rural village, he would have to travel home to take photos, scan them and then email them to his brother. TumaPicha therefore addressed this issue effectively by providing him with an opportunity to share the photo display link with his brother rather than scanning the pictures.

TumaPicha allowed Ben (HP1) to discuss monthly updates over the phone with Jekoniah (HP1) in a more complete manner since it provided a visual complement to phone conversations. Their discussions revolved around the progress of farming activities, cattle rearing and general awareness about the home. In terms of using technology for communication, Ben (HP1) felt that a lot of people in the village needed to gain more information about the use of technology as a result of the advantages that he felt mobile phones did not provide. He thought that, if rural family members could use the Internet, the cost of communication between distributed family members using technology would greatly reduce. However, Ben (HP1) stressed that a lot of work needed to be done so as to address the technology limitation in rural communities through the provision of more bandwidth to such regions.

Maurice (HP2) accessed TumaPicha from a number of different cyber cafés since he was in the IT field and needed to check his email often. Even though he frequently accessed Facebook, Instagram and WhatsApp from his mobile phone, he still frequented cyber cafes to send emails and look for freelance IT jobs. Maurice (HP2) valued the photos he received but said that it would have been a good idea to add video uploads to the system. This would be more similar to what he was used to seeing on social media sites. He also thought that it would be a good idea to have bidirectional sharing within TumaPicha; thus, he wanted to also share pictures of his activities with Consolata in the village. He wanted his mother to be able to see his family and children occasionally since it was a while since his whole family had returned to the village home. This was a clear limitation with TumaPicha, in Maurice's opinion.

TumaPicha enabled phone conversations to begin at a level where both family members were aware of the situations being discussed. For example, Consolata (HP2) and Maurice (HP2) were able to hold a discussion about the progress of a poultry rearing project that he had initiated for his younger siblings. This discussion had been initiated by Maurice after seeing the photos of chicken being fed that had been shared by Consolata (HP2). Here, we see that the shared photos created awareness that led a family member who was living away from home, to follow up on a specific issue happening back in the village.

Both urban participants were able to see all of the photos shared using TumaPicha, since, as mentioned, I did not use access controls or user accounts to associate the pictures with a particular recipient. My rural participants told us that they were not concerned with this aspect since the photos they shared were relatively mundane in their minds. Similarly, Ben (HP1) and Maurice (HP2) in the urban area did not have any issues with having access to all of the pictures in the system. They were quickly able to know which ones were sent specifically for them, and tended to focus on these while using the other photos to get an awareness of the village.



Figure 7.2: Customers lining up at a cyber café in Awendo

During the week following TumaPicha's deployment, my urban participants, Ben (HP1) and Maurice (HP2), both told us that they missed using the system. The field deployment had built up the expectation that they could see photos of what was happening at their family's village. The awareness that the photos brought was harder to achieve through phone conversations with the rural family members. For example, Ben (HP1) mentioned that he would now revert to only holding mobile phone conversations with Jekonia (HP1) to obtain information about the village activities. He also mentioned that he would now need to explain issues to his brother living abroad over the phone whenever his brother called him to get information about the village. This wait was necessary since it was expensive for Ben (HP1) to make calls from Kenya. Ben (HP1) also mentioned that he would have to describe other information over email in case he needed to share such information with his brother living abroad urgently. He explained that the TumaPicha

withdrawal would clearly affect how he would receive information (photos and phone conversation) and share it with his brother.

Maurice (HP2) and Ben (HP2) both felt that it was important to provide technology awareness for their rural family members since they would then be able to use much cheaper communication mediums in comparison to costs of sharing information through calling. Just like Ben (HP2), he also said that infrastructure improvements and reduction of illiteracy needed to be addressed before rural families could meaningfully learn and use technologies beyond the mobile phone.

7.1.3 Intermediaries and Privacy

To facilitate TumaPicha's usage, I used the services of the motorcycle taxi driver, Ondiek, to deliver phones from the rural homes to the cyber café (Figure 7.2). At the cyber café, the attendant, Akinyi, would upload the photos to TumaPicha.

Ondiek came by the village homes and was given the phones roughly once per week. He would ride his motor bike along footpaths passing through the village to pick up or drop off his customers and would be stopped when needed by the rural participants. This was the usual time period in which the rural families would update the urban families about what was happening back in the village. This was also because many photos were about work activities and situations only changed every few days.

Ondiek would hang around the cyber café after handing over the phone to Akinyi and was able to see the photos being uploaded. He purposely stayed around to see this happen because it was a new experience for him. He told us he was "fascinated to see the photos uploaded from the phone to the web" within a very short time. He had never been to a cyber café before and so he was able to see a computer in use for the first time. At times he would be forced to keep checking whether the Internet could support photo uploads. Whenever there were power blackouts, he would also need to come back at a later time. For example, in the third week of my studies, there was a power outage that began at 8 am and lasted until 6 pm. On that day, he would keep checking the cyber to see whether the lights were back on every time he brought a customer to the town.

The cyber café attendant, Akinyi, found TumaPicha to be simple and straightforward for uploading and accessing the photos. She said that my service was an interesting perspective that could be used to share photos to a wider audience unlike Bluetooth that shared photos just between two phones. However, she told us that power interruptions were frequent during the rainy season and this would hamper photo uploads. Slow Internet connections delayed photo uploads at times requiring the purchase of expensive data bundles for USB powered Internet. Akinyi was also able to add a title for each photo that was uploaded and she used this to write a short description of what was shown in the picture, e.g., “Cow and calf in good health.” Such content did not add a lot of additional knowledge to the photos though.

As mentioned, both Ondiek and Akinyi saw the photos that were being uploaded. Rural participants were generally not concerned with this act and potential issues of privacy since the photos they captured were mostly updates about their life and area, which was not deemed to be private. There was a sense of trust in the sharing process and the remote family members, such that they did not worry about photos being seen by others outside of the small group using TumaPicha. Together, rural participants captured 213 photos but shared 86 using TumaPicha with Ben (HP1) correctly identifying 44 photos that were meant for him, while Maurice (HP2) identified the remaining 42 photos that had been sent for her to see. An analysis of the photos shared and those not shared did not reveal any specific photos that were left out due to privacy concerns. The photos that were not eventually shared using TumaPicha were either similar to ones already uploaded or identified other similar activities to those already shared. For example, Jekonia (HP1) shared a photo of fishing nets (Shown in Appendix B) and a boat (Shown in Appendix B) but did not include 5 other photos that were of the same general activity, while Consolata (HP2) shared photos about rearing chickens (Shown in Appendix B) out of a possible 6.

Jekonia (HP1) and Consolata (HP1) told us that private matters about financial issues or other topics would be discussed over the phone and such details were not present in the photos they shared. Jekonia (HP1) and Consolata (HP2) would even briefly browse the photos with Ondiek when he arrived to pick up the phones to ensure that photos had actually been saved on the phones. This further shows that they were not

concerned that he could see them. Akinyi, the cyber café attendant, similarly felt that the photos did not contain anything sensitive that others should be concerned with her seeing.

"I do not think that the photos I uploaded onto the system and labeled were that private. Most of them showed the farm, home, animals and people. In any case, Ondiek would not have been given a phone with private information to bring over here to me. I think the photos are meant to inform their relatives in the city of things that are going on these sides." – Akinyi, Cyber Café Attendant, Female, 28.

Among other reasons, it is possible that costs related to sharing of photos, or the focus on specific activities of interest between relatives affected the number of photos shared to some extent. When asked whether privacy issues affected the type of photos shared, the rural participants told me that private family matters (i.e. financial issues) would normally be discussed over the phone and did not affect types of photos captured. When asked whether he worried about privacy while capturing photos, a rural participant had this to say:

"I do not worry about sending photos to Ben since he is already waiting to receive them. Once I send them to him, he is in charge of the photos at his disposal and can share them with anyone that he likes to." – Jekonia (HP1), Male, 25.

7.2 Reasons for Using TumaPicha

Within the aforementioned usage patterns, we found that TumaPicha was used by family members to share three main types of photos resulting in three main uses for the system: subsistence awareness, village awareness, and health or well-being awareness. These reflect the ways in which participants found value in the system.

7.2.1 Subsistence Awareness: Farms, Farming, Animals

My participant families that lived in the rural villages engaged in subsistence farming, fishing and domestication of animals. These activities were often supported by remittances from family members living in the city. As a result, the primary use of

TumaPicha was to share photos of these activities and provide an awareness of one's subsistence activities. This was one of my anticipated uses of TumaPicha, based on past research (Wyche & Grinter, 2012) and Study 1 of this dissertation.

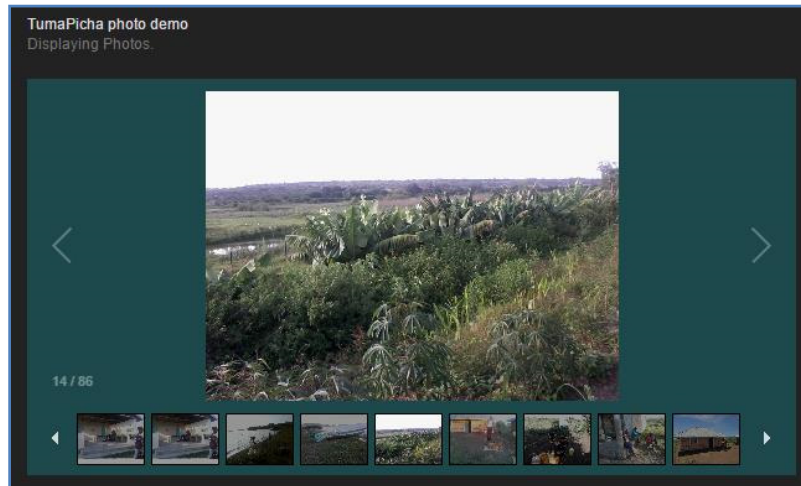


Figure 7.3: TumaPicha - Screenshot of a banana plantation and thumbnails for browsing

For example, Jekonia (HP1) shared photos describing the different stages of recovery of a calf that had been suffering from foot and mouth disease. He also shared photos of his home in addition to a cultivated maize plantation and uncultivated farmlands (Figure 7.3). Other pictures shared along the lines of farming included that of a plough that needed to be repaired. Generally Ben (HP1) was interested in these photos because he would send finances to ensure that the home was maintained in a good condition, that the sick cow was treated, and that farming activities (including repairs to the plough) were going well.

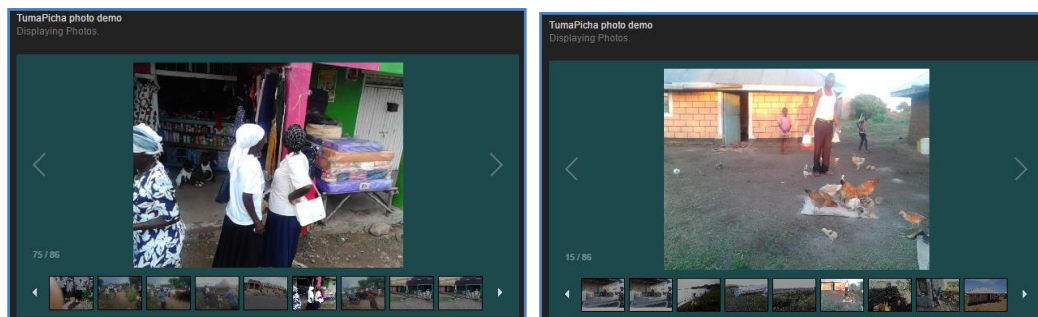


Figure 7.4: TumaPicha - Screenshot of mattress shop (Left) & Man feeding chicken (Right)

Consolata (HP2) shared photos related to subsistence farming that were similar to those already described for Jekonia (HP1). For example, she shared photos of a shop selling mattresses, chicken, and goats grazing in a field (Figure 7.4). As a result, Maurice (HP2) received an awareness of joint farming and chicken rearing activities that he was doing with his mother and younger siblings.

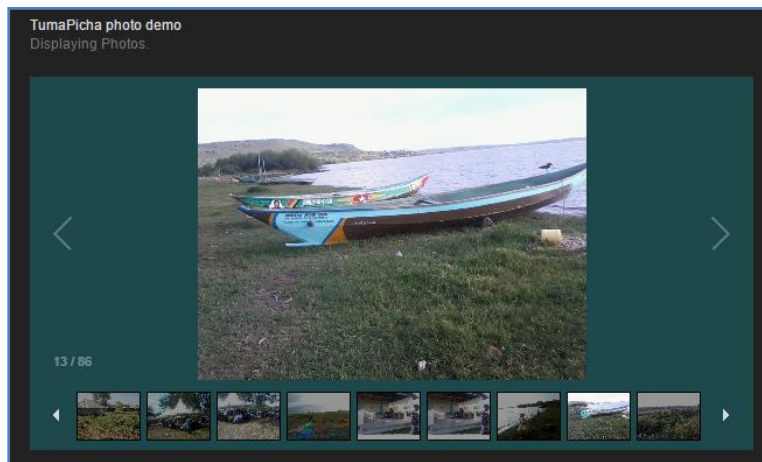


Figure 7.5: TumaPicha - Screenshot of fishing boats and thumbnails for browsing

“Sometimes it is important to show the people in the city that we are actually using money that they are sending our way for development purposes. For example Maurice sent money for his siblings to use in this chicken project and that is why I shared photos of the chicken.” - Consolata (HP2), Female, 53.

7.2.2 Village Awareness: Personal Activities and Outings

Rural participants also provided remote family members with a sense of village awareness. This was knowledge of what the person did as part of their personal activities beyond subsistence. These acts occurred in a broader area outside of just one’s home quarters and showed the remote family members areas of the broader village. As a consequence, remote family members also saw other people in the photos beyond the main participants and their immediate family members. In some cases, these photos were of little interest to the urban family members, but still, they provided additional awareness of the general happenings in the village. Even though urban participants felt they would

not have asked their rural family members to share such information, they still perceived it to be valuable.

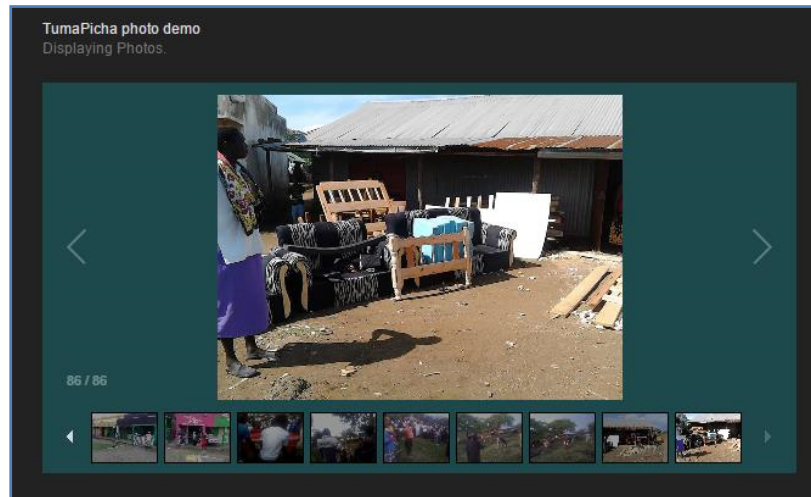


Figure 7.6: TumaPicha - Screenshot of a carpentry and thumbnails for browsing

For instance, Jekonia (HP1) shared photos of the local beach where he kept his boat (Figure 7.5) and fishing nets during the day. Jekonia also shared photos of a welding shop and a local furniture store. These photos were taken around the places where he would be going to take care of various assignments that did not directly relate to taking care of the home.

Of these shared photos, Ben (HP1) was interested in knowing the costs of welding a window and obtaining the prices of furniture (Figure 7.6) for a house that he was planning to build soon. Even though Jekonia took the fishing photos out his own interest, Ben was happy to see the areas surrounding the lake and so it did not bother him that Jekonia had sent photos that were unrelated to the jobs he was to complete.

“The photos provided me with an awareness of the village by seeing farms, funeral procession, cattle, the beach and the local shopping center. I was also able to tell photos that were meant for me”. – Ben (HP1), Male, 39.

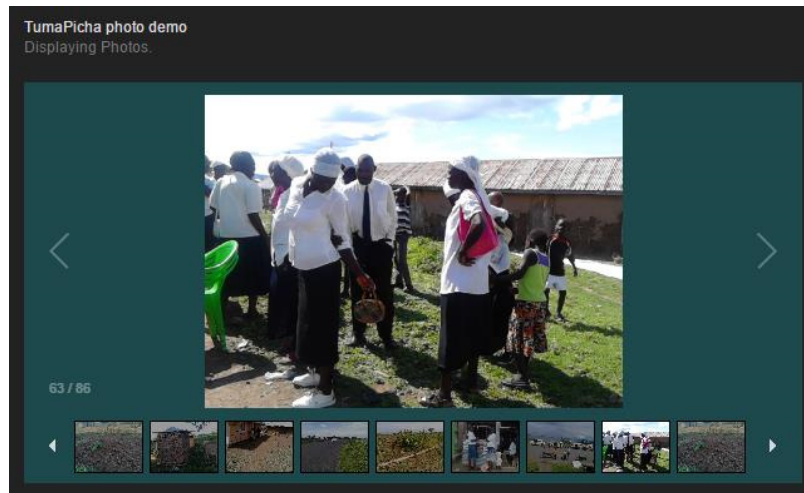


Figure 7.7: TumaPicha - Screenshot of church choir and thumbnails for browsing

Consolata (HP2) shared photos of a school board meeting that she had attended, mattresses at a local shop, and women at a local church (Figure 7.7). She wanted to give her son, Maurice, a better understanding of the things she did away from her home. Maurice (HP2) generally enjoyed the photos shared by Consolata since they provided a visual component to discussions about new information that happened in the village over the previous week. Maurice was also interested in purchasing a mattress during his next visit home hence the interest in seeing the options available at the local shop.

“TumaPicha provided photos of the village to complement my conversation with the rural family. I was able to see that my younger siblings were still doing a poultry project that we have been doing together and school related discussions.” – Maurice (HP2), Male, 28.

Rural family members were happy that their family members in the city would refer to the TumaPicha photos during phone conversations. The shared photos enabled the participants to actually visualize the situations being discussed to enrich the already short discussions that would be conducted over the phone.

7.2.3 Health and Well-Being Awareness

Lastly, rural participants shared photos that focused on the health of others, including information about deaths. In this way, TumaPicha provided urban family members with a sense of health and well-being awareness. Coupled with this knowledge, however, was also sometimes a hidden motivation of suggesting that remote family members send some additional funds to support health issues, or the photos served as a 'thank you' for such remittances.

For example, Consolata (HP2) shared photos of a dispensary (pharmacy) that she went to in order to get a prescription for her younger son. Maurice (HP2) was not particularly interested in the contents of these photos but seeing them sparked a conversation with his mother over the phone where he asked who needed medicine from the dispensary. He was glad to hear that his younger brother was now feeling better after the treatment. From Consolata's perspective, the photos also served as a suggestion to send them additional remittances.

"I took my youngest son to the dispensary and needed help in settling the bills. I took the photo of the hospital because I wanted Maurice to think about sending us some money for use in purchasing medication." - Consolata (HP2), Female, 53.

In the case of Jekonia (HP1), he captured and shared photos of a funeral procession and burial ceremony so that Ben could see it and know about the details surrounding the passing of their relative. In this case, the photos were also socially significant as a form of 'thank you.' Ben had sent money to Jekonia so that he could provide a financial contribution to the bereaved family while attending the funeral ceremony. Ben had actually used money given to him from his elder brother in London so he further described the situation to the elder brother after seeing the pictures uploaded from the village. The elder brother was also able to view the photos via the TumaPicha web page.

"Before this system, I had to physically travel to the village to capture photos, scan and then email them to him. TumaPicha helps me save on transport and time while also availing information to anyone who can view our link on the web." – Ben (HP1), Male, 39.

We therefore see that TumaPicha was used to capture photos of a funeral ceremony that was eventually shared with a family member living abroad. This highlights how TumaPicha supported families to address issues related to scarce financial resources and the cultural obligations raised in Study 1 relating to supporting the families of participants' deceased siblings. Next, I provide a reflection on the study findings and design opportunities.

7.3 Discussion and Conclusions

In this section, I compare Study 2 results to Study 1 results and then provide a reflection on both while also highlighting potential design opportunities for family communication technologies in rural and low income areas of developing countries. The section is divided into three sections. First, I review and provide insights into the appropriation of TumaPicha by both rural and urban families. Second, I discuss the impact of creating technology awareness for marginalized communities on design opportunities. Third, I discuss privacy issues regarding my investigations and explain why this should be investigated further for families living in similar study settings.

7.3.1 The Appropriations of TumaPicha

To begin, I found that rural families shared photos related to a number of themes and activities providing three main types of awareness: subsistence, village, and health/well-being awareness. I had anticipated the first type of shared knowledge since this is the main focus of family communication in Kenya using technology (Wyche & Grinter, 2012) and also in Study 1 of this dissertation. The additional uses show that Kenyan families are also interested in sharing photos about other relevant situations. Sometimes this further ties to economic support, and other times it is more simply about having knowledge of what is happening. Therefore, communication technology designers should think about ways to support the sharing of information about livelihood sustenance as well as other social situations that may arise for families that live in rural and low income urban areas of developing countries such as Kenya. This validates Study 1; I build on it to show that such needs extend to actual technology usage when media sharing is available. Along this thread, I found that TumaPicha provided the distributed families with a visual

dimension to augment their existing phone conversations. The technology was not a replacement for such calls; instead, it enhanced them. Families in the village did not necessarily understand the technical process of how photos were shared, but they were still glad that their family members in the city would refer to the photos during conversations.

Of course, TumaPicha was not without its issues. I designed the technology and service to try and solve problems related to a lack of Internet connectivity, technology literacy, and power/electricity. I was reasonably successful at the first two, discussed more later, yet electricity was still an issue as phones needed to be charged more frequently than the phone delivery service was slated to occur. This was largely a result of the high level of power consumption needed by the smartphones to fulfill rich media capture.

7.3.2 Technology Education and Learning

Rural family members also used the mobile phones from my study in other ways beyond the usage of TumaPicha (Figure 7.8). This included capturing videos and watching YouTube, which were new activities for them. This shows that rural families can adopt meaningful technologies into their practices, explore their capabilities, and even extend their anticipated usage. Thus, while designers may be focused on providing one particular type of new technology, it can also be valuable to think about how the presence of a new device may spawn additional uses. In this way, the new system can act as a catalyst for learning and exploration in rural contexts. Comparing these studies to Study 1, the use of intermediaries helped bridge the gap of technology ownership and knowledge that had hindered rural participants to engage in alternative communication avenues such as the use of Internet to send emails. In Study 1, I had reported that computer literacy challenges contributed to rural and low income urban families who avoided using computers either due to a lack of education or a lack of motivation.



Figure 7.8: TumaPicha - Jekonia (Left) & Consolata (Right) testing the phone apps

My study also revealed how the use of intermediaries can act as “vehicles” for technology learning. Each person involved in the use of TumaPicha played an important role and interacted with someone who knew more about the technology than him or herself. For example, the design focused on family members capturing pictures, the most basic of interactions in the system. They interacted with the motorcycle taxi driver who experienced the actual uploading of the photos and could describe this process to them, as he understood it. In turn, the motorcycle taxi driver interacted with the cyber café attendant who knew the most about computers and could share this knowledge with the taxi driver. Thus, the taxi driver was exposed to technology in a new way that was not already familiar to him. Each person in this process expanded his or her skills in working with technology as a result of interacting with another person.

Along the same lines, rural participants learnt that it was actually possible to use technology to share images that they took in the village thereby allowing them to describe situations to their remote family easily. They also learnt about new ways of using Android smart phones that included capturing media, accessing Internet, listening to music and even viewing videos. The urban family members were able to follow and share activities that occurred in the village, an aspect that would not be provided by the usual phone conversations they already conducted. They also saw the opportunity of making communication technology cheaper if digital literacy could be improved in the village. The cyber attendant was glad to be able to use the system to support families connect with each other. The cyber attendant would occasionally describe to the taxi driver the reasons why it was not possible to send photos (no power, slow Internet) thereby showing their

interaction as an avenue that could be used to promote technology literacy in the rural communities.

Together, this shows that one way to help the act of learning and provide increased technology exposure in developing areas of the world could involve a carefully worked out chain of actions (and people) as part of a system's design. Note that I paid particular attention to the types of roles that people already play in Kenyan family routines. In this case, it was that of motorcycle taxi drivers ferrying people or items between locations and cyber café attendants helping people use computers. Along these lines, I feel that designers should think about developing systems that do not disrupt already existing routines but rather enunciate the existing way of life in creative ways.

7.3.3 Privacy

In terms of privacy, my study revealed that both rural and urban participants were generally not concerned with potential privacy risks with sharing their photos more broadly—with intermediaries and other families—since they would capture activities that were deemed to be fairly mundane and not sensitive. The private aspects related to these photos were shared during phone conversations. What is not clear, however, is how far this level of comfort would extend. There were only two family pairs in my study and two intermediaries. In only one case did a participant tell others (his eldest brother) to also look at the TumaPicha photos. Overall, this limited the potential privacy threats to a small number of individuals. If a system like TumaPicha was expanded to include more users, one could reasonably expect that privacy concerns might begin to arise since there would certainly be more families using the system and more intermediaries may easily be needed. Such expansion is likely since it was clear from my study that the families found the system beneficial. Both of my urban participants also felt strongly that the system should support bi-directional sharing, which would mean even more photos would be stored in the system and accessible for people to see. Thus, the open question is: At what point do people begin to get concerned about the privacy of their photos?

Further studies will need to be conducted to address this question, yet I feel my study results point to one way of considering privacy models for developing areas like the

one I studied. Unlike systems designed for Western culture, which typically use single user access credentials, it may be possible in rural areas of countries like Kenya to have access restrictions at a group level containing multiple families. This might eliminate the challenge that passwords need to be remembered and entered for every single user and, instead, they could be shared by groups of people since families are typically okay with others in a small group (like my study) seeing their media. This idea should be further tested in actual practice, however.

My study also revealed a general preference by urban participants for creating technology awareness in rural areas of the country. That is, they tended to feel that technologies, even with their flaws, were important to introduce into rural regions of the country such that people would begin to be more exposed to technology. On one level, this may suggest that even if privacy concerns are present amongst users, the desire to present a greater awareness of technology may supersede such concerns. This may be another reason my participants generally did not describe privacy issues with TumaPicha. This finding also points to the fact that technology awareness is a general user need that designers should also consider fulfilling in addition to their system's normal functionality.

This study revealed that TumaPicha was highly valued by participants for gaining a sense of subsistence awareness, village awareness, and health/well-being awareness. The design focused on overcoming issues related to a lack of Internet connectivity, education, and electricity. Through the use of intermediaries, I was reasonably successful at addressing the first two problems, yet a lack of electricity was still an issue given the high power consumption of the devices used, which were needed for the media-rich application. I also revealed ways in which intermediaries can play an important role in technology education and awareness. Furthermore, I learned that within small groups, privacy concerns about media sharing generally do not exist; yet there is a chance this could change with continued usage and additional families using the system.

7.4 Summary

This chapter explored how Kenyan families in rural and low income urban areas used TumaPicha. I also discussed the social factors that affected this usage over rural

and low income urban areas. The study describes how rural participants used study phones throughout the system deployment to capture photos and found TumaPicha beneficial for sharing information with their urban-based family members. The chapter also highlights the usage of TumaPicha in the sharing of photos related to a number of themes and activities that provided awareness in subsistence farming activities, village activities and health/well-being awareness. I also highlight how electricity availability was still an issue as phones needed to be charged more frequently than my investigation had planned since smartphones needed more power to fulfill rich media capture. The use of intermediaries can as an important aspect in the loop for bridging the technology use between rural and urban regions of developing countries has also been demonstrated.

In this chapter I described the findings and key discussion points from Study 2, which focused on the evaluation of TumaPicha. In the next chapter, I describe the overall study implications based on the three research stages (Study 1, TumaPicha Design and Study 2) presented for the design of technology that can support family communication in developing countries.

Chapter 8. Discussion

The aim of this chapter is to provide reflection on the overall impact of the three steps conducted to address the overarching research question of this dissertation which seeks to answer *how to best design technology to support family communication over distance between rural and urban areas of Kenya*. Specifically, I synthesize the results about the practices of families in rural and low income urban areas of Kenya using communication technology and present six design recommendations. For each recommendation, I review work on research and designing technology for rural communities in Kenya. I also show how findings from Study 1 and Study 2 and the design work around TumaPicha support these recommendations. Together, these recommendations build on the literature on how marginalized communities appropriate family communication technologies for use in rural and low income urban areas of Kenya and how we should design technologies to support their needs and routines.

8.1 Communication Patterns and Technology Design

8.1.1 Recommendation 1: Design to Support Short Interactions Across Technologies

The first design recommendation supported by my thesis research is that *designers should explore technology that can support short interactions across one or more technological mediums*. This was supported by findings in all stages of my research.

In Study 1, family members in rural and urban areas engaged in short phone conversations that only aimed to discuss issues that required immediate response and attention. As a result when rural families wanted to contact their urban counterparts, they would send a “Please Call Me” message after which the urban family member would follow up with a quick phone call. In case a family member could not be reached in the village through his or her phone, other relatives would be called and asked to pass the message through word of mouth. These practices enabled families to use these short phone conversations to connect whenever there was need to. Thus, Study 1 shows the importance of short interactions between family members as well as how engrained this

behavior is in their existing communication routines. For these reasons, it is important to support short interactions when designing future communication tools for families.

In Study 2, phone discussions that were conducted during the TumaPicha deployment were complemented with photos that had been uploaded to the system. TumaPicha provided context to the short phone discussions that the families were used to. By referring to the photos displayed using TumaPicha, the urban families were able to share information in ways that was not possible before its deployment. TumaPicha added a dimension of sharing media that was previously missing during phone conversations. This allowed families to use the same or less communication time to share a more complete picture about activities that occurred in the rural villages.

Overall, this illustrates that it is important to design technology for Kenyan family communication that relies on their existing routine of short interactions. Yet such short interactions need not be restricted to a single technology, as was previously the case (where they would just use a mobile phone). Instead, we now know that such interactions can be coupled across multiple technologies where they are used in conjunction with one another. I believe that this recommendation can be applied more broadly by first considering what needs a family communication technology should fulfill and, second, deciding if there are multiple technologies that might be used together, in tandem, to fulfill these needs.

8.1.2 Recommendation 2: Design to Support Sharing and Archiving

The second recommendation is that *designers should explore technologies that provide rural families with the opportunity to capture, share and archive family activities that remote families are interested in following*. This was supported with findings in all my research stages.

In Study 1, I found that families were interested in financing and participating in subsistence activities thus generating a common interest in sharing updates about their progress. Discussions about these activities would revolve around financial remittances and whether such remittances had been correctly spent. The urban family members were interested in following the progress of activities in the rural village after providing the

necessary support mainly to ensure that finances were not diverted to other causes. As urban families kept tabs on the progress of activities back in the village through discussions about such activities, they would feel connected to their remote families. Occasionally these phone conversations would extend beyond the home to include sharing information about other activities occurring in the neighboring homes thereby providing awareness of the village at the same time. Thus, Study 1 shows the importance of sharing family activities that both rural and urban family members are interested in and how it is important for the sustenance of family connection through communication. Therefore, it is important to support shared family activities when designing future communication tools for families.

In Study 2, the actual sharing of photos using TumaPicha generated discussions in ways that did not initially occur between family members during phone conversations that were held before its deployment. The photos being shared using TumaPicha allowed the urban family members to play a bigger part during conversations as they could now seek clarification about specific photos or specific aspects information they wanted to be clarified to them. This provided an opportunity for the urban families to actually direct discussions from remote locations and feel more connected than when they only communicated with the rural families using mobile phones. Discussions around shared photos also enabled family members to talk about issues beyond economic activities. As a result, family members discussed their hobbies, shared information about neighbors and even talked about construction developments that were happening at the local shopping center. Such information was not possible to share over a short phone conversation centered on discussing the economic progress of subsistence activities in the village. Therefore, TumaPicha also provided an opportunity to explore how one could design technologies to share information about a large group (i.e. village activities involving any families) with a small audience (i.e. an urban family member who is primarily interested in rural family activities). This could be done through designing technology that presents information in structured layers for the urban family members to browse according to their preference. At the highest level the urban families should be able to access shared activities between immediate family members, and then, be able to access more information by browsing subsequent layers of presented shared activities. This could be done by browsing other shared information relating to specific family members and the

individual activities they shared. The urban family member could also be provided with options of filtering the collective information shared by rural families according to their preference.

Overall, this illustrates that technology designs should provide rural families with the opportunity to capture common family activities occurring in the village, and use a common platform to share these memories so that urban families can access them and even store them for future use. Such technology mediums should aim to provide the option of accessing and archiving the captured activities from rural villages for future reference. This recommendation can be applied by availing communication technology that rural families can use to capture activities in the rural home, and then share these with an urban family member who would then be able to follow archived rural activities whenever possible. Archiving shared family activities for future reference is important because it provides a collection of family memories that can promote a sense of connection and identity among distributed family members at a later time.

8.1.3 Recommendation 3: Design to Include Rural Users in Small Increments

The third recommendation is that *designers should explore how technology that is familiar to rural families can be presented with slightly advanced functionalities that they can learn to use in small incremental steps*. This was supported with findings in all my research stages.

In Study 1, all families reported that they communicated with their relatives by calling on mobile phones since mobile phones were readily available and easy to use. Families also reported that they did not typically use text messages for communicating with one another since an immediate response was often required when families called each other. Even though infrastructure challenges such as a lack of electricity affected how rural family members used their phones, small interventions by other family members ensured that information would still be shared over the mobile phones. For example, urban family members tried to call their rural counterparts while rural phones were off and their family members were not reachable. In these cases, other young family members setup voicemail for their parents to receive audio messages. These small technology

interventions were beyond basic mobile phone calls that illiterate family members performed, yet they allowed family members to continue using audio communication through their mobile phones. In this way, we see two levels of functionality in use on mobile phones. Those with less technology experience used only the basic features of the phones— calling—while those with slightly more experience used advanced features— voicemail. This incremental step of additional functionality is important and allowed family members to help one another out by relying on those slightly more experienced than them. For these reasons, I feel that designers should aim to provide two types of functionality when designing family communication systems. First, they can provide basic functionalities, which (nearly) all family members should be able to use. Second, they can provide additional advanced features, perhaps hidden away, that other more advanced users explore in addition to the most basic features presented to all.

My design work for TumaPicha built on providing rural families with technology that they were familiar with using first, and then letting the families explore other functionalities that they would be interested in. I found that family members who were initially afraid of using the Android touchscreen phones that were provided during Study 2 became more comfortable with performing tasks such as calling and receiving calls after being shown how to use the phones. Once the initial fear threshold of using technology was passed, family members would explore other functionalities of the study phones to learn how to use Bluetooth and to launch other applications that were saved on the phones main screen by default.

I also found that rural family members and the taxi driver would occasionally view the photos captured in the village together and briefly talk about them. The taxi driver would also briefly watch the cyber attendant upload photos whenever he visited the cyber café to collect the mobile phones. The taxi driver, who had never seen a computer being used before, would then go back to the village and describe what he had seen as best as he could. Such interactions can increase the desire of the illiterate technology users to learn more about how it works. The illiterate users could also build on simple steps that could be shown to them by the technology intermediaries. For example, launching the camera application worked after showing our participants that they only needed to tap the

photo application and wait until the screen changed and started focusing on the surroundings.

Overall, this illustrates that designers should provide rural families with technology designs that families are already mostly familiar with. For example, if designing a new application, provide it within an existing hardware device, such as a mobile phone. Presenting illiterate rural families with familiar technology such as mobile phones gives them the opportunity to initially engage in performing functions with these technologies as they normally would. Systems for use by rural families should also be designed with consideration of the literacy level of the users, where for example, illiterate families can be presented with applications that serve basic purposes of making and receiving calls. Beyond this point, their level of interest to explore more advanced functionalities of the technology in small steps will guide how they are able to use such technology. For example, younger rural family members, who have the desire to learn about technology, can be presented with other applications that interact with a common communication platform for families through simple step-by-step written on-screen instructions. I believe that the recommendations shows that providing rural families with technology that they are able to accomplish tasks they are currently engaging in will help them gain confidence to explore more functions that such technology could provide progressively.

8.1.4 Recommendation 4: Design to Incorporate Intermediaries

The fourth recommendation is that *intermediaries should be incorporated in communication technology designs for rural and low income urban areas of Kenya since they can play an important role in connecting two sets of families at extreme ends of the IT spectrum*. This was supported with findings in all my research stages.

In Study 1, I found that rural families relied on other people who, while performing their regular duties, would assist them with either the passing of information between relatives or even delivering a commodity from the local town shops. For example, rural family members would ask motor bike taxi drivers to purchase commodities for them as they ferried customers to the local town and back. Sometimes they would also ask other family members in the village to take their phones to local stores that had generators for

charging phone batteries. This meant that when a family member was either busy at the farm or performing other duties in the home, they would ask other family members, relatives or even neighbors to lend them a hand if it did not require one to deviate much from their intended destinations. I also found that older rural family members were not interested in learning about new technology platforms as they were more concerned with improving the economic situation of their families. This means that even though advanced technologies could provide them with an extra dimension of sharing activities beyond phone conversations, they did not want to invest the time to learn how to use such technologies. Therefore, Study 1 shows the importance of supporting interpersonal mediation when designing future communication tools for use in the rural communities, and also the need to potentially mask technology from rural users who are not interested in using it or learning how to do so.

In Study 2, the design of TumaPicha incorporated intermediaries who were already comfortable in using technology so that they could assist rural family members who had less experience with technology and (sometimes) less interest in larger activities using technology. For example, cyber attendants in the local towns were included in TumaPicha design to assist with handling technology-related aspects of photo sharing between rural and urban settings. Incorporating the cyber attendants in my design alleviated the need for the rural families to take time out of their daily routines and go to the local town and figure out or seek assistance on how to send photos to their relatives in urban areas while at the cyber café. Another set of intermediaries used in Study 2 involved using a motor bike taxi driver to deliver technology between a rural village and a local cyber café that was a little far from the rural communities where TumaPicha deployment had been conducted. The TumaPicha setup of using intermediaries ensured that photos of family activities were shared between the rural and urban families. This was mainly possible because of to the assistance of community members who were able to complement each other (while engaging in their usual jobs) to ensure the success of photo transfer between the rural and urban settings.

Overall, I feel it is important to incorporate intermediaries in the design of communication technology for family communication in Kenya. This is because intermediaries are an avenue through which designers can provide rural families with

systems that are sophisticated for them yet simple enough for them to easily use with little technology experience. My studies revealed how rural families were able to share family activities between rural homes and urban areas without the need to learn how to use technology that they were not interested in learning (e.g., the actual means to transfer photos to remote locations). This recommendation shows the potential of presenting rural families with technology that are able to use to capture rich media without the need to learn how to actually share such information due to the presence of the intermediaries.

8.1.5 Recommendation 5: Design Integrated Mobile & Desktop Applications

The fifth recommendation is *that designers should design applications that are integrated across mobile and desktop applications through a uniform platform*. This would allow people who have different levels of technology knowledge or access to choose their platform of use. This was supported with findings in all my research stages.

Study 1 revealed that rural families mostly used key pad phones to make and receive calls, and that they were reachable through mobile phones that they owned, shared with their husbands or borrowed from a relative or neighbor. I also found a major difference in terms of technology access and ownership between rural and urban settings. Apart from a few rural families that had unused computers 'put away' in stores, the rural families did not have the knowledge to use computers. On the other hand, the urban families either owned or were able to access computers in cyber cafes or at their places of work. Therefore this set of family members was able to access desktop computers even though they did not own any. Families had also shown distinct ways of passing information to intended recipients by using alternative means in case the direct call method was not applicable for one reason or another. For example, it was common practice for urban family members to use dual SIM card phones so that they could be reached in either of the lines in case network connection failed with one.

During the deployment of TumaPicha in Study 2, rural families embraced the use of smartphones because they were quickly able to use the touchscreens to take photos of activities they were undertaking in addition to making and receiving calls after being shown how to accomplish these tasks. Rural family members also reported that with continuous

use of the mobile phones, they were able to try out more applications that were clickable on the phones' main screens. The low income urban families still accessed the TumaPicha application on desktop computer at cyber cafes since they did not own computers that they could access at other locations

Together, these results show that designers should pay attention to how they support rural families that mainly use mobile phones for communication. This means that the importance of mobile phones cannot be understated while exploring the design of family communication technology for use in rural parts of Kenya. This recommendation also highlights the necessity of continuing to design mobile applications for use by rural families while continuing to design desktop application for urban families who do not own technology but can occasionally access computers and higher-end technologies through other means.

8.2 Summary

In this chapter, I have presented six recommendations for designing technologies to support family communication in rural and low income settings of Kenya. These considerations are based on the two studies and a design exercise to build TumaPicha as outlined in this dissertation. The design recommendations presented include: (a) design to support short interactions across technologies; (b) design to support sharing and archiving; (c) design to include rural users in small increments; (d) design to incorporate intermediaries; (e) design integrated mobile & desktop. The main lesson from this chapter is that designing communication technology for marginalized communities that have been understudied requires designing in a way that is specific to that community. Subsequent research steps such as informing technology design, improving design iterations and even deploying the technology should also aim to involve local representatives as much as possible since this will translate into designing technology that identifies with the locals hence more likely to be embraced.

The next chapter concludes this dissertation where I list the limitations of the studies, show how I addressed each research objective, and discuss future work.

Chapter 9. Conclusions

This dissertation has explored the design of technology to support family communication in rural and low income urban settings in Kenya. The goal of this chapter is to conclude this dissertation by summarizing the research problems I addressed by describing the completed objectives that form my research contributions. I then discuss how my studies generalize culturally and what implications exist for the design of family communication technologies for rural and low income communities, and the study of family communication in Kenya. Following this, I highlight the limitations and describe the future work that can build from this dissertation.

9.1 Research Problems

This dissertation focuses on addressing the overarching research question: How can we best design technology to support family communication over distance between rural and urban areas of Kenya? I divided this question into three parts in Chapter 1 that showed that we did not yet have detailed knowledge that illustrated the best way to design technology that could support family communication over distance in Kenya. I list the sub questions next to lead into a discussion of my research contributions.

RQ 1: How and why do families in Kenya use technology to communicate with each other over distance and what are the social factors that affect this communication?

RQ 2: How can we apply an understanding of local communication routines to the design of communication technology for Kenyan families?

RQ 3: How will Kenyan families use technology that is specifically designed to support their communication routines?

9.2 Research Contributions

The overarching objective for this dissertation was to: *provide a foundation for understanding how to best design technology to support family communication over distance between rural and urban areas of Kenya*. I completed this objective by addressing each of the previously mentioned research sub-problems with the completion of three matching sub-objectives. These present a number of significant research contributions to the fields of ICTD, CSCW, HCI, and, more specifically, domestic technology design in Kenya. I outline the three objectives, the steps I took to complete them, and the research contributions they present.

9.2.1 Family communication Routines in rural, Sub – urban and Urban Kenya

Objective 1: Describe the reasons behind the social practices of technology use for communication over distance by families in Kenya.

To complete this objective: I conducted a semi structured / contextual interview with 24 individuals from 24 families in rural, sub urban and urban areas of Kenya (Chapters 3 and 4). All the qualitative data collected was coded and analyzed by domain. I used open coding and affinity diagramming analysis methods to come up with themes from Study 1. The completion of Objective 1 presents the following research contributions:

-Conceptualize the definition of family: In the rural settings, families were made up of all the people who lived within a traditional-style village home. A typical home in the rural areas consisted of about two or more huts all built within the same compound and enclosed by a fence. In the urban settings, a family consisted of children and the parents living under one roof mainly in rented single room apartments. Economically well to do families would live together with their relatives. The size of urban families was generally smaller in comparison to rural families.

-Reasons for family communication in rural and urban Kenya: All families used technology to coordinate economic support. Some families used technologies to check on their relatives' well-being. This was mostly done by urban families while only economically

empowered rural families with retired parents would check on the well-being of their children living away from home. In cases where family members were within reach (walking distance or staying in the same home), Face-to-face interaction would be used and this was the common way of passing information in the rural settings.

-Communication strategies: Family members mainly used mobile phones for communication with relatives since they were convenient and readily accessible. Those who did not own one were still reachable through a close family member or a neighbor's phone. Some families timed their calls to coincide with promotional hours or cheap calling rate periods so that they could get longer talk times with their families.

-Social Challenges: The eldest children bore the responsibility of passing information from rural homes to family members who lived away from home. In cases where the eldest children lived in urban areas, they would call family members in the rural villages to get information, and then share this information with relatives who were distributed across other parts of the country and abroad. This sometimes created additional monetary burdens. In cases where another sibling was in a better financial state, they would take the obligation of passing information to the rest of the family members. Computer literacy varied between rural and urban families with urban families able to access computers to use current technologies such as Facebook. On the other hand, rural families did not have access to computers and generally lacked the knowledge to use computers.

9.2.2 The Design of TumaPicha Service

Objective 2: Use the understanding of local communication routines to inform the design of technology that supports communication for Kenyan families.

To complete this objective, I designed TumaPicha, a photo sharing service using an iterative design process that involved team discussions, sketching, early design, and medium-fidelity prototyping. The completion of Objective 2 presents the following research contributions:

—*A family communication system service:* TumaPicha is a system that incorporates intermediaries to provide a platform for sharing photos taken by families in rural villages and then shared with relatives who live in urban areas. This contributes to the field of ICTD and CSCW as further illustration of how existing practices can inform design. TumaPicha's design also shows that digital family communication technology in marginalized regions can be designed specifically to fit within a general understanding of family communication routines (Chapter 5). TumaPicha is a fully working application capable of being used by families as a part of their existing communication routines. It has full network capabilities to support the sharing of photos between families living in rural and low income urban areas of Kenya and can be used with family members who have access to the service's photo uploading interface.

—*Alternative ways of sharing family media:* The TumaPicha design process has uncovered findings about communication routines between rural families and their relatives who live abroad. This includes showing that the TumaPicha photo application designed to fit within existing communication routines (share activities that both rural and urban families are interested in) was also used by families to share personal and communal activities. Urban families also appropriated TumaPicha in their own way and shared family photos taken in rural homes with their relatives who lived abroad. This simplified how the urban families were currently sharing photos (via email) between the village and abroad. This shows that TumaPicha provided distributed families with an alternative rich media avenue for sharing family that was easy to use and avoided login procedures for quick access.

- *Design recommendations:* Building on both Study 1 and Study 2, I provided a series of design recommendations for family communication systems in Kenya. These included designing to support short interactions across technologies that would support the sharing of family activities between rural and urban areas in Kenya. The technologies deployed with the rural families incorporated intermediaries who would help rural users accomplish the task of sharing family activities using a common platform. These technologies would also be designed minimally to make it easy for rural users to learn about them in small incremental steps.

9.2.3 Field Deployment of TumaPicha

Objective 3: Evaluate the designed communication technology service to understand how it will be used by families in Kenya as a part of their communication routines.

I completed this objective by deploying TumaPicha with a total of four families. Two of the families lived in rural parts of Kenya while the other two lived in low income urban areas. TumaPicha was deployed with these families over a period of five weeks and I used semi-structured contextual interviews, diaries, and observations to understand how they used it. The completion of Objective 3 presents the following research contributions:

- *Real world testing with actual users:* Families used TumaPicha to share photos that distributed families were interested in following. Urban families were interested to know whether their remittances were being used to coordinate family activities that aimed to provide food and small economic sustenance projects for the rural families. Rural families used the deployment phones to capture family activities for sharing with remote families. While doing this, urban families would also gain awareness of other activities that were ongoing in the village from experiences that were shared with other families through the same TumaPicha platform.

—*Field trial method:* - The field trials of TumaPicha used an approach similar to the field deployment of other home technologies (e.g., Rowan and Mynatt, 2005, Sellen et al., 2006b, Neustaedter, 2007). Applying the field trial method in rural and low income setting of Kenya illustrates yet another application of field deployment methods in a developing country. This shows that similar field trials can be conducted to study family communication in other parts of Kenya, and eventually, other developing countries with similar infrastructure settings.

9.3 Limitations

I recognize that, while valuable, the dissertation results do come with their limitations. I focused on a country that is highly multicultural with many different ethnicities

and rural village types. Other areas of Kenya beyond which I studied have different economic foci that do not contain subsistence farming. For example, some regions engage in hunting and gathering, pastoral work, etc. Also, I only investigated families from five tribes (out of a potential 42), mainly drawn from Central Western Kenya. Thus, the communication practices that I found may differ for these areas. This suggests additional investigations into family communication routines in other parts of the country and with additional tribes. Such studies will enrich our knowledge in understanding the dynamic family communication needs of a larger representation of similarly marginalized communities.

For the TumaPicha deployment, there were only two family pairs in my study and two intermediaries. Overall, this limited the potential privacy threats to a small number of individuals. If a system like TumaPicha was expanded to include more users, one could reasonably expect that privacy concerns might begin to arise since there would certainly be more families using the system and more intermediaries may easily be needed. Further studies will need to be conducted to address this question as my work should certainly be complemented by additional studies in other parts of Kenya.

9.4 Future Work

I have studied the family communication routines of rural and urban families in Kenya, and my findings generalize more broadly to middle and low income Kenyan families. My findings also highlight recommendations for designing family communication technology in general. These findings are applicable more broadly to the appropriation of ICTD projects by local communities of Kenya and other developing countries with similar settings. The findings reveal that there are different types of interactions between people living in the village that can be incorporated in the design of communication technology. In the village, people augment the regular duties that they engage in and help others by running errands for them. At a high level, it is natural that these findings would extend to other developing countries with similar settings to my study sites. For example, it is likely that other communities focused on subsistence activities where electricity, literacy, and cost challenges would also present the same pattern of usage of communication technology to support family activities. That is, designs should be able to support families

with a common platform where novice users and experienced users can share family activities together in addition to existing communication methods. The design theory I present about family communication technology in rural and low income urban areas of Kenya, shows how we should think about designing family communication technology based on existing communication practices of the actual end-users.

This dissertation answers many questions, and also provides other designers with an opportunity to use this study as a foundation for further explorations. I have looked specifically at family communication routines in rural and low income urban areas of Kenya, with focus on how distributed families used communication technology to coordinate activities being carried out in the villages. Future studies should build on this work to understand the findings that are applicable to family communication routines of other tribes within the country. Such studies should articulate the similarities and differences of communication routines of various families from different parts of the country and backgrounds.

The design of TumaPicha presents further potential explorations in itself. TumaPicha was designed based on a paradigm similar to how family members interacted within the community and how people relied on each other to pass information from one place to another. I included these interactions by including intermediaries in the TumaPicha design. It is certainly possible that other communication and interaction paradigms exist, especially for a country that has 42 different tribes and so culturally diverse. Exploring and designing along other interaction paradigms that might manifest in different cultural settings from different parts of Kenya can highlight other designs for family communication technology. Therefore, future work should explore other design avenues by building on the design recommendations I have presented and further refining them.

In addition to the provided design guidelines, the design and evaluation of TumaPicha highlights potential cultural, economic and power relations for future exploration. For example, Kenya has several tribes (Awori et al. 2015) that are spread across the country and engage in different subsistence and economic activities. My study provides a starting point from which further explorations with other tribes (i.e. nomadic and

pastoralist communities that live in the north eastern parts of the country) can be conducted to highlight practices that inform the design of communication technology that is meaningful in settings that are different from the western parts of the country where we conducted our studies.

9.5 Final Words

In this dissertation I investigated the design and evaluation of communication technology that families can use in rural and low income areas of Kenya. I identified the context of communication technology as an avenue that could support the sharing of family activities between rural and urban areas of the country. I also formalized family communication routines to show how collaborative platforms should be designed. My results validate, expand, and question prior research on family communication. I have also illustrated that family communication in rural and low income areas of Kenya is fundamentally different than various ICTD projects that aim to bridge existing “Digital Divide” assumptions. This theory led to the design of a photo sharing platform that fits within and extends current family communication routines. The application evaluation also validated and further refined family communication theory for rural and low income communities in Kenya. Despite of this, future research should use this dissertation as a foundation for further theory and design exploration.

Finally, I have used this dissertation to identify, articulate and verify the everyday activities that rural and low income urban families in Kenya are familiar with. My aim is that the findings presented in this dissertation eventually illustrate information that many can comprehend.

Develop the capacity to enjoy less – Life is good

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Appendix A. Family Communication Patterns Study

Design Exercise 1

Study 1: Study Protocols

Italics are instructions to the interviewer. Non-italicized text is a sample of what you can say. Don't be afraid to read this script the first several times until you remember it. You can simply say, "To make sure I don't forget anything, I am just going to read my script to you." People always say, "Sure, no problem."

Introduce yourself and tell them about the study.

My name is Erick Oduor, and I will be conducting the study with you. I will also be able answer your questions should you need clarification at any point during this interview. I will conduct this study in two stages that will be approximately 10 days apart. At the end of Today's study we will fix a day for my next visit to conduct the final interview.

In today's interview, I aim to investigate the routines, needs and communication patterns of family members. I would like to understand how you define the notion of 'family,' how you currently communicate with your family members over distance, what challenges you face in doing so, and what role video communication technologies might play.

For your participation in the study, you will receive \$20.

Tell them about the study method and data collection.

The study will involve an in-depth interview about the communication patterns between you and your remote relatives. Throughout the study I will be taking notes, pictures and/or short video clips. Is that fine with you.

Let them know it's okay to quit if they are uncomfortable about anything you ask.

While I don't foresee any issues, if you should feel uncomfortable at any time, you are free to quit the study without repercussions. Just let me know.

Give them the consent form.

I now need you to read over this consent form, a copy of which is given to you, and let me know if you have any questions. The form mostly details what I have just told you. Once you have read it, you can sign the back.

Give them the \$20 and have them sign the receipt.

I'm going to have you sign this receipt and then pay you now so that I do not forget to do so after the interview. The receipt allows us to get reimbursed for the money we pay you.

Begin the study.

All right, we are all set to start the study. I'm going to turn on the audio recorder at this time.

Go through the interview questions.

1. I am going to ask you a few questions about the composition and communication patterns within your home. (Section A)
2. The next set of questions will focus on the medium of communication you use to communicate with your remote family members and relatives. (Section B)

Close the study with the participant.

As I mentioned to you earlier I need to plan for a day that I can come back to get clarification on some information that you have given me in today's interview. During that visit, I will also ask you a few more questions on a phone application that I will bring with me.

Thank you very much for your help with today's study. I really appreciate your time and effort. If you should think of anything else you'd like to tell me, please don't hesitate to contact me by phone. My number is listed in the consent form that I have left with you.

As well, if you know of anybody else who you think would like to participate, please forward him or her my phone number.

Semi-Structured Interview Questions (1st visit)

The following outline aims to list the potential questions that may be asked to encourage participants to explain their social relationships and how technology enables them to communicate with remotely located family, relatives and close friends. As such, other questions will be asked based on the responses obtained from the initial set of questions a participant is asked

Possible Questions

A. Village Home

1. Tell me about the people who live in your house/home?
2. Are you married, do you have siblings/children?
3. Do you have family members who live away from the home for other reasons?
4. Tell me about the people you consider to be your immediate family members?
(*Define to participants what immediate family means*)
5. Tell me about the people you consider to be your extended family members?
(*Define to participants what extended family means*)

Present the participants with a sheet of paper and ask them to draw their family communication networks. Tell them the following instructions:

Here is a blank piece of paper. I'd like you to create a map that shows the people you try to stay in contact with. This could be family members, distant relatives or friends. Write their names down on the paper. As you create and draw your map, please talk out loud and describe the people you are writing down. We will talk more about them after you are done.

“The drawings you are making, should give me a sense of how 'close' you feel to each person. I want to understand the strength of connection that you have with family, relatives and friends that are represented in your communication network”.

Repeat questions 6 to 11

6. Where does XYZ live? (*XYZ refers to a remote family member*)
7. On a scale of 1 to 5. With 1 representing a very close family member, could you write down a number that shows how close you feel connected to XYZ?
8. Tell me how you communicate with XYZ. (*Get a sense of mobile phone usage*)

9. Ideally, how often would you like to communicate with XYZ? (*If user is not currently doing this, ask them why*)
10. Tell me about the last time you communicated with XYZ.
11. Why is this preferred method of communication with XYZ? *Why?*
12. What do you like and dislike about the method of communication that you while communicating with XYZ?
13. Are there any other people present both at home and in the remote location when you communicate with XYZ? (Private /whole family communication)
14. What information do you share with XYZ and why? (Awareness information: activity? Location? Status, any other thing?)
15. How often does XYZ visit the village?
16. How often do you use mobile phones to communicate with remote family?
17. Do you have any concerns about privacy when communicating with remote family members (i.e. too much / too little communication)

B.1 Communication medium usage

1. Have you ever used video/ other communication tools?
2. If so, what video conferencing system have you used to connect with remote family?
3. What made you choose this video conferencing system?
4. How do you use it and with whom? , When (situation/time of day) do you use it
And when don't you use it
5. What do you like and dislike about this tool (or video communication in general)?
6. How do you update remote family members on the activities that are going on in the village?
7. What device do you use?
8. Do you have any concerns about privacy

B.2 Social Media

9. What is your experience with social Media (Facebook, Orkut etc.)? Or other information sources such as *Magazines, Community Meetings, Message Boards and Newsletters*
10. What kinds do you use and what do you use it for?
11. How often do you use it?
12. Where do you use it (where are you physically located)?
13. Through what means do you use it (laptop, mobile phone, etc.)?
14. Who do you use it with? (Audience you are communicating with)

Follow up Semi Structured Questions (2nd Visit)

As you may probably remember, I am Erick Oduor, and I will be conducting a second follow up study with you. The first part of the study will involve clarification on some answers you gave me during my last visit. With the clarifications I am seeking, I will be

able to understand how you define the notion of 'family,' and how you currently communicate with your family members over distance.

Tell them about the study method and data collection.

The study will involve an in-depth follow up interview about the responses you previously gave me on the communication patterns between you and your remote relatives. Throughout the study I will be taking notes and pictures. Is that okay with you?

Let them know it's okay to quit if they are uncomfortable about anything you ask.

While I don't foresee any issues, if you should feel uncomfortable at any time, you are free to quit the study without repercussions. Just let me know.

Begin the study.

All right, we are all set to start the study. I'm going to turn on the audio recorder at this time.

Go through the interview questions.

1. I am going to seek clarification on a few answers that you gave me about the composition and communication patterns within your home. (From the responses obtained from Section A)
2. The next set of questions (seeking clarification from your earlier responses) will enable me to understand the reasons why you choose the medium of communication you use to communicate with your remote family members and relatives. (From the responses obtained from Section B)
3. Finally, I will show you a short video, and then ask you a few more questions based on this phone application (show application on mobile phone).

Close the study with the participant.

Thank you very much for your help with both my studies. I really appreciate your time and effort. If you should think of anything else you'd like to tell me, please don't hesitate to contact me by phone. My number is listed in the consent form that I have left with you.

Possible Questions after clarification of previous responses

A. Android Application (explain how the application works on the phone)

1. What are your observations regarding this application?
2. Would you use this application? How do you think you would use this application?
3. How can this application make your communication activities easy?
4. What aspects of the application make your communication activities difficult to support?
5. Would you consider using another application that I plan to build in the future? If so, then I will need to keep your name so that I can contact you at a later date.

NOTES

Recruit people within the (20 to 60) years range

Visit #1

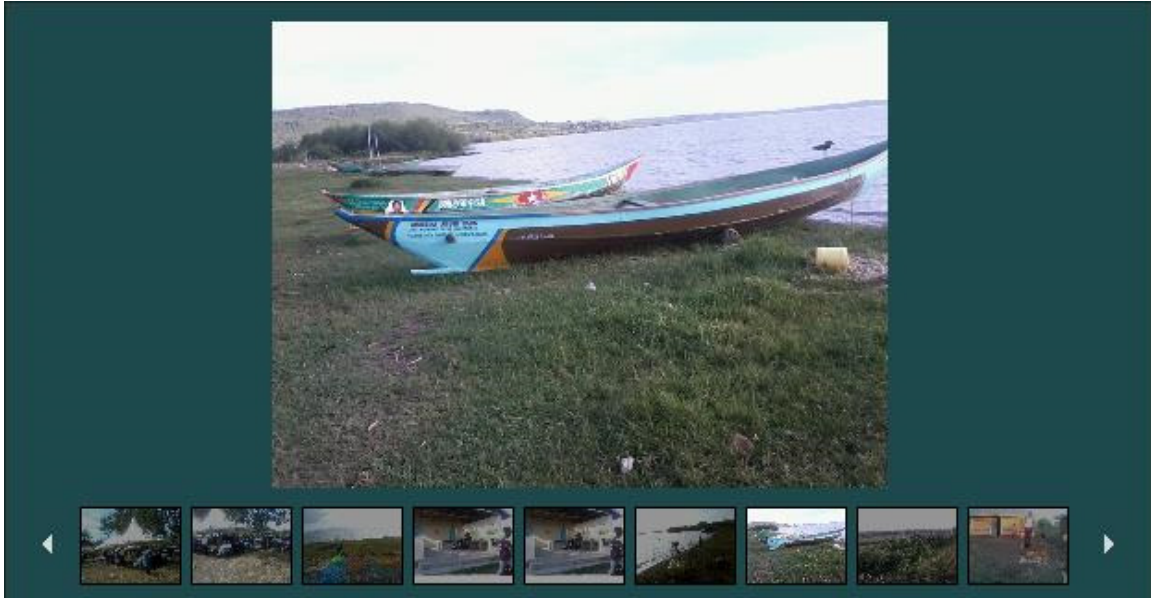
- *Make same day summaries on the interviews conducted*
- *Make two interviews per day*

Visit #2

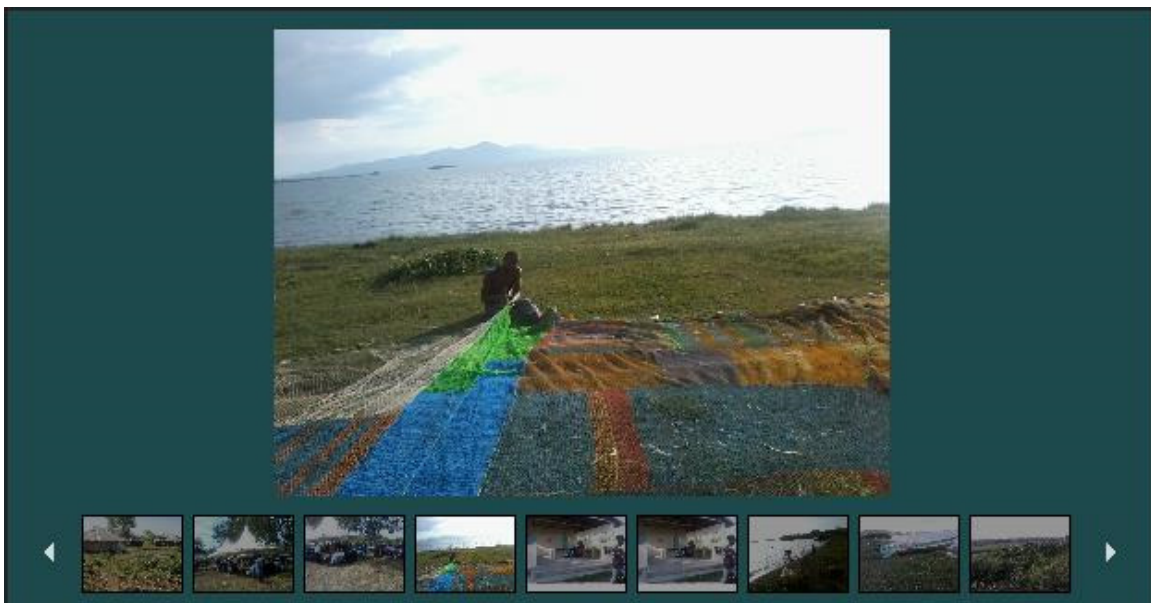
- *Recap – talk about the summary and get more details if needed*
- *Show the video/application and get reaction.*

Appendix B. Deployment of TumaPicha

Jekonia's Shared Family Photos



Jekonia's (HP1) shared photo of a boat

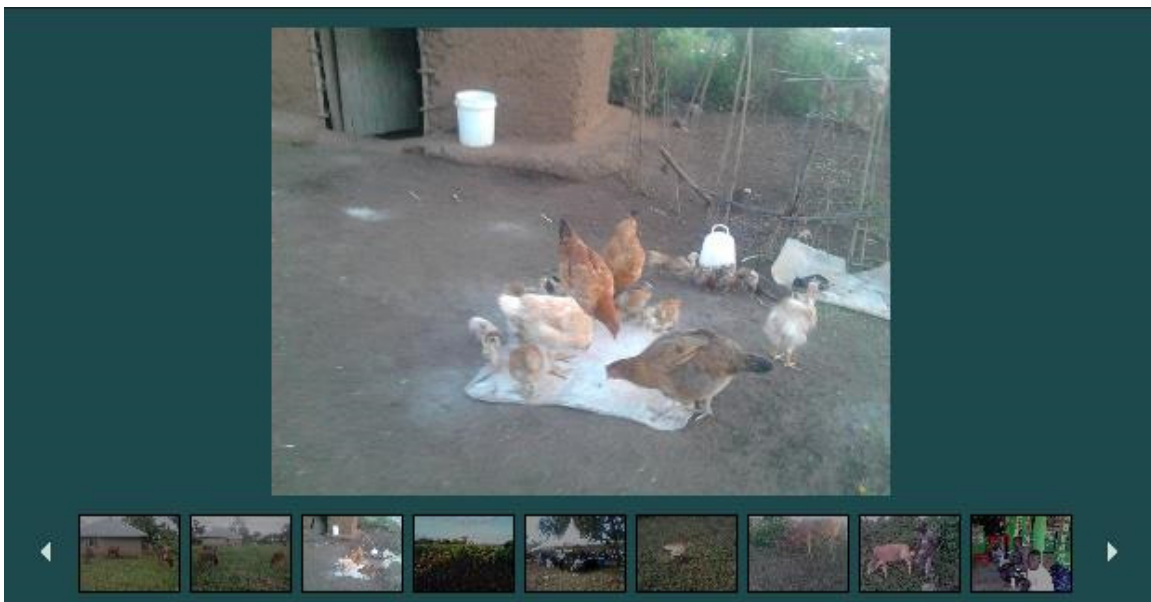


Jekonia's (HP1) shared photo of fishing nets

Consolata's Shared Family Photos



Consolata's (HP2) shared photo of Kids feeding chickens



Consolata's (HP2) shared photo of feeding chickens

TumaPicha Study Description

The following description will be read to each participant at the beginning of the study to inform participants of the study plan before giving the consent form. Italicized text is instructions to the investigator.

Introduce yourself.

My name is Erick Oduor, and I will be now explain to you how we will procede with the study for you and also answer any questions that you may have. We're researching how families will use TumaPicha service to share activities with their distributed relatives.

Tell them about the study

I would now like to describe to you how the TumaPicha service works. I will describe what the system does and then explain to you how it could be used to share photos and information with distributed relatives who live in rural or urban areas. Based on your feedback, we will be able to improve our system design and also gain information about the implications for family coordination technologies in general. The study has three main stages that your family will participate in:

1. We will need you to complete a pre-study survey then use your responses as a discussion piece and interview you about your family's current use of technology to coordinate activities. We would like you to describe to us how you share activities with distributed relatives. If it is Okay, we'd like to take pictures of the technology you currently use to accomplish these tasks
2. Next we will introduce you to TumaPicha service. We'll show you how it works and will help do a few runs on how you could use the application to share photos with distributed family. Since the application involves a two step use of mobile phones and computers, we will leave you with the appropriate component of the technology that you will need for our study.
 - a. We will give you a diary where we'd like you or family members you prefer to write down any thoughts you may have about using TumaPicha or your coordination activities using technology. Providing us with more information

- will support our interests in understanding how it affects your activity sharing routines.
- b. We will follow up with you within two days to check if the set up and usage of TumaPicha is moving on well. Once this is confirmed, we pay you a weekly follow up visit to go over your diary entries.
 - c. Should you experience any technical problems during the study, please call me so that I am able to correct the situation at the earliest convenience.
3. On completion of TumaPicha deployment, we will come back to your home to conduct a final interview with you about your experience. The aim will be to capture your overview on the use of our service to share activities with your distributed relatives.

Note –

The rural Family members will use a mobile phone to complete their tasks while the cyber attendant and city family member will use the web application part of Tumapicha. The Cyber attendant will use both the mobile and web components of Tumapicha. This implies that system description will be modified depending on the participant.

Do you have any questions about the study and the different stages?

Tell the participant that it's OK to quit at any time.

While I don't foresee any issues, if you should feel uncomfortable at any time, you are free to quit the study without repercussions. Just let me know.

Give them the consent form to sign. If it is not signed, do not proceed.

Proceed with investigation.

Setup phone photo application for the rural family member.

Run through the Tumapicha set up on the dektop with the cyber attendant

Run through the Tumapicha set up on the dektop with the urban family member

Informed consent form

Research Project Title: Designing a Video Mediated Communication System for Developing Nations

Ethics Application Number: 2012s0444

Principal Investigators: Erick Oduor, SIAT, Simon Fraser University [...], [...]@sfu.ca

The Simon Fraser University (SFU) Research Ethics Board has approved this research study. This Board aims to protect the rights of human research participants.

This consent form, a copy of which is provided to you, is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask the investigator(s). Please take the time to read this carefully and to understand the information.

This study is being completed for my dissertation work towards a graduate degree at the School of Interactive Arts and Technology, SFU.

Purpose:

This investigation is the second and final part of our research is to investigate family communication patterns in developing nations where the technology infrastructure is limited and still at its infancy.

In the first part of our study, we investigated the routines and needs of family members in developing countries to understand how they define the notion of 'family,' how they communicated with their family members over distance, what challenges they faced in doing so, and what role video communication technologies could play to support them.

This part of our investigation was conducted between June and August 2012.

We have since used such knowledge to gather observations that informed the design of a photo sharing system that supports family members in developing nations to share a sense of awareness of activities they are mutually interested in. In this segment we would like to investigate how families in rural and low income urban areas of developing countries use our service to share activities with distributed relatives.

Participant Recruitment and Selection:

To be recruited for this study, you should be living in a rural region of a developing country where there is limited technology infrastructure. You should also be comfortable describing details regarding how you use our service to share activities with relatives that live away from the region of study.

What Will I Be Asked To Do?

Through an interview that will take approximately 1-2 hours of your time, we will ask you questions about your family such as who you communicate with, where they live, and what technologies you use for communication. We will also ask you to participate in a diary study where you will record and summarize your use, activities and thoughts you may have as you use our communication service to share activities with your relatives over a period of 4 to 6 weeks. After the study is complete, the researchers will keep the diary entries.

Procedure:

The study will involve the use of a communication service within your own home or as you go about your daily routines over the course of four weeks. The study will include the following stages:

- a. An initial discussion and a survey with you and your family about your current use of technology to share activities.
- b. Demonstration of how to use our communication service.
- c. Weekly interviews throughout the course of the study to discuss the use of our communication service.

- d. A follow-up discussion at the completion of the deployment.
- e. A visit by principal researcher to your home or places you will be working at for interviews.
- f. You must also use our communication service throughout the study as your primary technology to share activities.

About Your Participation

Our aim is to conduct this study with families that did our first study but it's also important to mention that your participation is voluntary. If you agree to participate, you will be free to withdraw at any time for any reason. However, data collected up to point at which you withdraw will be retained and used by the researchers.

What Type of Personal Information Will Be Collected?

Your confidentiality will be strictly maintained. The only personally identifying information collected will be your name, which will be used for administration of payment. Any data collected will be coded. Because we will either take pictures, audio/video-record your interview, this recording will be electronically manipulated afterwards to mask the speaker's voice, and/or transcribed after which the recording will be erased. If you participate in the diary study, your diary will also be kept confidential; we will also use pseudonyms rather than your real names or those of your relatives while reporting the findings from this investigation.

Are There Risks or Benefits if I Participate?

The risks of participation are intended to be none or minimal. However, because we will be asking you personal questions, there is risk of feelings of emotional discomfort such as embarrassment, and/or concerns about privacy. To mitigate this, you can choose what information you are comfortable revealing.

Research results, such as published papers, can be obtained by contacting the investigators:

Erick Oduor, [...], [...]@sfu.ca

Carman Neustaedter, [...], [...]@sfu.ca

What Happens to the Information I Provide?

Only the research team will be allowed to see or hear any of the answers to the diary entries, questionnaires or the interview audio or video recordings. We expect to publish reports and presentations describing this research. Public presentations of the results will primarily present the results in an aggregate form or as caricatures that are composites of one or more participants. Where individual participant data is disclosed, such as exemplar comments via quotes, we will ensure that the selected data does not suggest participant identities.

As stated above, we will also be using video, audio, and photographs to record portions of your interview to aid our data analysis. These may be used within publications or presentations of our research. To protect your identity, we will mask out or obscure any information within this data so your identity is not revealed.

All data obtained, as part of the study will be kept securely both in the research servers of Simon Fraser's School of Interactive Technology (SFU - SIAT) or in a secured cabinet located in ROOM 3930 until August 31st 2015 when the overall study will be completed. At this point, the data will be permanently destroyed.

Acceptance of this Form:

Your signature on this form indicates that you:-

- 1) Understand to your satisfaction the information provided to you about your participation in this research project
- 2) Agree to participate as a research subject.

In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your participation.

Participants Name:

Participants Signature:

Date: _____

Contact for Complaints:

If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, you may contact Dr. Jeffrey Toward, Director, Office of Research Ethics at [...]@sfu.ca or [...].

Investigators:

Erick Oduor and **Carman Neustaedter**, Simon Fraser University.

Purpose: We aim to better understand how to design communication technologies for families in rural and low income urban regions parts of developing countries by observing the effects of TumaPicha application.

Procedure: The study will involve you and your family using TumaPicha as your primary communication technology for sharing of activities with distributed relatives over the course of four weeks. The study will involve the researchers interviewing you about your current coordination routines and your usage with the technology.

Objective: The research objective is to understand how families in rural and low income urban regions of developing countries use our service to share and coordinate activities. This will in turn inform us to better understand how to design coordination technologies for these marginalized communities found in most developing countries.

Commitment: Your participation in the study will last for approximately four weeks and you will be compensated for your time for using our technology with vouchers for Internet and phone credit or cash valued at approximately \$150. We will supply the TumaPicha communication system and hardware for it to run on for the duration of the study. We are looking for families of various sizes and demographics. The principal participant should spend a large portion of his or her communication with technology using the TumaPicha application.

To Participate or For More Information: call **Erick Oduor @ [...]**

Pre-study family information sheet

The questions listed here are only intended as potential and may only be asked to encourage participants to explain how they currently use technology to coordinate their activities. Most questions during deployment will be asked based on diary entry responses made by family members.

1. Tell us about the people who live in your house/home?
2. Do you have family members who live away from the home for other reasons?
3. Who do you consider your immediate family members?
4. When is the last time you communicated with your immediate family member XYZ (name will be listed on the Family relationship table)?
5. How do you communicate with XYZ?
6. Is this your preferred method of communication with family members?
7. What information do you share with these immediate family members and why?
8. What do you use to communicate with immediate family who live far away?
9. Do you own/use a mobile phone?
10. How do you use the mobile phone and which people do you communicate with?
11. What type of activities do you share with remote family members?
12. How often do you use mobile phones to communicate with remote family?
13. What other things do you use your mobile phone for?
14. How would you want the mobile phone to serve you differently for the purpose of communicating/sharing activities with remote family?
15. Are there any times of the day that you prefer to interact with others?
Are there any times of the day that you prefer solitude? How about your family?

Potential Pre-study interview questions

Communication medium usage

1. Have you ever used any technology for communication tools?
2. Have you ever mobile phones as communication tools?
3. If so, what type of mobile phone do you use to connect with remote family?
4. Why did you choose this particular technology for communication?
5. How did you use the communication technology?
6. What activities would you share with remote relatives and why at particular times?
7. How do you currently explain situations from the village to remote family member when they need to understand activities going on in the village?
8. What is your experience with social Media?
9. Do you use any of these Social Media services?
10. How does the Social Media you use influence your communication patterns with your remotely located relatives?

Other Communication Technologies

1. In case you have used other communication technology in addition to mobile phones, how do you decide what mode of communication technology to use to communicate with distributed relatives?
2. Are you interested in using a photo sharing application that can allow you to share activities with distributed relatives?
3. What aspects of communication would you like such an application to address?
4. What aspects of communication do you think the current technologies you use to not support you well in?

5. Are there activities you'd like to share with remote family members using the using current technologies accessible to you that you simply find too difficult?

Potential Weekly interview questions

The questions listed here may only be asked to encourage participants to explain how they have used TumaPicha throughout the week and how it has affected their activity sharing with distributed relatives. Most questions will be asked based on diary entry responses made by family members.

General Questions

1. Did you have any particular problems with TumaPicha over the past few days?.
2. What technology did you use to communicate with distributed relatives?
3. Why did you use this specific technology?
4. Where is this technology now?
5. Why is it located there?

Capturing Moments

1. Who did you communicate with this week?
2. What did you talk about?
3. What was the common interest of the discussion?
4. How did you describe the topic of discussion with each other?
5. Who was sharing the information required in this discussion?
6. Did the other party clearly get the picture being described?
7. How did TumaPicha support you in achieving this?
8. Tell me about your favorite experience using the TumaPicha application.
9. Tell me about the most challenging experience you encountered while using the system.

Sharing Activities

1. Did you use the application to share any activities with distributed family? Which events?

2. How did you use the system to achieve this?
3. How did the distributed family member react to your use of TumaPicha?
4. Did TumaPicha support you in describing the situation relatively easily?
5. If yes, how so.
6. Tell about how the system could support you in your communication needs better.

Initiating Communication

1. Who initiated discussion about sharing of activity?
2. What technology did they use to achieve this task?
3. Did they use TumaPicha to coordinate this task? Why?
4. Did they use a different technology to achieve this? Why?
5. Tell me about the changes you would suggest that we make to the system to support the activities you would like to use it for.

Potential Post-Study interview questions

The questions listed here may only be asked to encourage participants to explain how they have used TumaPicha throughout the week and how it has affected their activity sharing with distributed relatives. Most questions will be asked based on diary entry responses made by family members.

General Questions

6. Did you have any particular problems with TumaPicha over the past few days?.
7. What technology did you use to communicate with distributed relatives?
8. Why did you use this specific technology?
9. Where is this technology now?
10. Why is it located there?
11. Tell me about how you select the technology to use for a specific communication need.
12. Tell me the reasons why you would select/ or not select TumaPicha for your communication with distributed relatives.

Capturing Moments

10. Who did you communicate with this week?
11. What did you talk about?
12. What was the common interest of the discussion?
13. How did you describe the topic of discussion with each other?
14. Who was sharing the information required in this discussion?
15. Did the other party clearly get the picture being described?
16. How did TumaPicha support you to achieve this?
17. Tell me about how you used TumaPicha to capture moments that you shared with distributed family.

Sharing Activities

7. Did you use the application to share any activities with distributed family?
Which events?
8. How did you use the system to achieve this?
9. How did the distributed family member react to your use of TumaPicha?
10. Did TumaPicha support you in describing the situation relatively easily?
11. Tell me about your views on using TumaPicha to share activities with distributed relatives.
12. If yes, how so.

Initiating Communication

6. Who initiated discussion about sharing of activity?
7. What technology did they use to achieve this task?
8. Did they use TumaPicha to coordinate this task? Why?
9. Tell me about how you would improve TumaPicha to support your initiation of communication better?