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# A Resource Kit for Participatory Socio-technical Design in Rural Kenya

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**Abstract**

We describe our approach and initial results in the participatory design of technology relevant to local rural livelihoods. Our approach to design and usability proceeds from research in theory and practice of cross-cultural implementations, but the novelty is in beginning not with particular technologies but from community needs, and structuring technology in terms of activities. We describe our project aims and initial data collected, which show that while villagers have no clear mental models for using computers or the Internet, they show a desire to have and use them. We then describe our approach to interaction design, our expectations and next steps as the technology and activities are first introduced to the villages.

**Keywords**

development, usability, mobile, culture, agriculture.

**ACM Classification Keywords**

H.5.2 User Interfaces, J.4 Social and behavioral sciences, K.3.1 Computer Uses in Education

**Introduction**

In rural communities in Africa, most people rely upon farming to provide food, yet lack valuable information — about soil conditions, the weather forecast, or the

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location of the best market for their goods. They also lack basic literacy skills, and have little or no knowledge about digital technologies.

One technology is nearly pervasive however — the mobile phone. It is used by most of the population, even in rural areas, and is projected to be the main platform for accessing the Internet [1]. Mobile technologies can provide a two-way flow of information as rural farmers can not only receive data about markets, pests and methods; but also collect local biodiversity data to send to scientists or shared databases.

Many projects have attempted to introduce digital technologies to the developing world, but are often driven by the technologies themselves, run up against literacy or usability barriers, or simply the lack of power and other infrastructure. Sustainability and self-sufficiency are often hampered by hardware or software that require ongoing support or whose interfaces are designed for very different contexts, since existing technologies, interaction design methodologies, and usability testing techniques are all developed by and for the developed world.

Our research explores the interface and interaction design of mobile, two-way information systems, initially in two rural villages in Kenya. Mobile technologies are employed to bridge remote sensor networks and centralized access points, with novel power solutions, usage scenarios, and device interfaces — all aimed at end users with little or no knowledge of digital technology, but with rich local agricultural and cultural knowledge.



Kiangwachi, on the slopes of Mount Kenya, receives ample rainfall, while Kambu is in a very dry area.

It is unclear that methods devised for the developed world will prove appropriate in the developing world. For example, in the context we are working, it is more useful not to consider individual “users” but community-centered design. Furthermore, the focus should not center solely on design, but on deployment. Design methods must be revised to fit local cultures, as there is often a massive social divide between designers and end users. One approach is to train local people to take on design roles and self-report their progress with the technology as participant ethnography.

Recent research on cultural differences has focused on user acceptance of technology, and draws from a body of research known as the sociology of technology which examines what happens when software developed in one culture is implemented in another; the result is that technology is used in unexpected ways and the users are observed working around the system. For example, Gilbert [2] examines the clash between local knowledge (the interpretive frameworks and knowledge derived from taking part in the everyday activities of a community of practice) and exogenous knowledge during periods of social transformation. The extent, at a cognitive level, to which this conflict leads to negative outcomes (domination, damage to self-esteem, and the “loss of familiar metaphors, models, and tools for thinking”) or becomes a constructive force for change, depends on what happens during the “dislocation,” or period in which local people engage in new activities originating outside the local context. Thus local knowledge must be explicitly acknowledged, and activities constructed in ways that give local stakeholders time and space to safely explore options and make choices in times of change, so that they can gradually, if

they so choose, alter their practices to incorporate outside knowledge.

### The VeSeL project

VeSeL (Village e-Science for Life) [3] is a research project, part of the Bridging the Global Digital Divide network sponsored by the Engineering and Physical Sciences Research Council (EPSRC) in the UK. It runs for three years from September 2006. The aim of the VeSeL project is to enable rural communities in Sub-Saharan Africa to use advanced digital technology to improve their agricultural practices and literacy levels, with particular emphasis upon educational barriers.

### Initial findings

Initial field research was carried out in 2007 in the Kenyan village communities of Kiangwachi and Kambu, by researchers from the University of Nairobi and Thames Valley University who are versed to some extent in the local languages and cultures. The methods included evaluations of interfaces of existing mobile devices such as phones, cameras and iPods; a structured survey of technology usage and coverage; and ethnographic study of local agricultural and community practices among 36 adult farmers in Kambu, and 40 in Kiangwachi; in both communities the farmers are part of agricultural self-help groups. We discovered the following:

- There is a lack of familiarity with digital technology to the level



that most have no clear mental model of how many technologies work or of how they could be useful.

- Farmers show signs of wanting to exuberate their farming prowess or other achievements, for example presenting their best crops, water collection technologies, or techniques to maximize revenues. Some were given a camera with brief training on its use, and took pleasure in capturing their best animals or the size of their plot. By contrast, full details of their major problems are also depicted.
- Maps are not used for traveling because there is not much on the land apart from farms and paths that can easily be negotiated. Most people are born and raised in the same locality and so are familiar with the area. If going to a new area, someone familiar to the new area typically accompanies the new person.
- Agricultural knowledge sharing issues frequently come up. Since the communities practice mixed farming based on interest, it becomes difficult to find out everything to know about a crop before investing in it. Consequently, halfway through the process, farmers sometimes realize that they do not have all the knowledge required. The next major agricultural problem after finding better markets is the issue of plant diseases.
- Literate and older professionals tend to record their farming activities (i.e. when planted, when to expect the harvest, how much harvested, how much spent of a particular crop, etc.). Others do not keep track of this and therefore can often not tell if they are operating at a profit or loss.
- Less than 10 percent of villagers comfortably read English. However, 50 percent in one village, and 90 percent in the other, indicate they have used, and like using, computers. On the other hand, less than 20

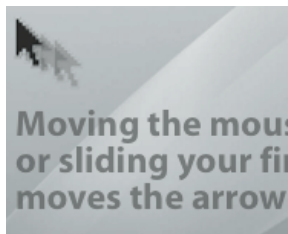
percent have heard of email or the Internet. Nearly all have access to and have used mobile phones. This use is almost exclusively for voice, not text. 85 percent are not aware of money transfer and other mobile services.

- Despite their familiarity with phones, villagers consistently expressed the desire to have access to a computer and to learn to use it in order to improve business practices and access to information.
- Users indicate a preference in user interfaces for color, iconic legends, text, and representational icons, in that order. Numeric keypad interfaces fare poorly — illustrating a dislike for current mobile phone interfaces.
- 80 percent of adults live with their children and discuss what the children learn at school. 70 percent of children assist with day-to-day tasks.

It is easy — but flawed — to focus merely on the introduction of technology. Influenced in part by Activity Theory [6], our stress is not on technology itself but what is done with it, and why. Thus we focus instead on activities that structure the use of technological tools. These are characterised as 'socio-technical experiments,' following [7] Along with the hardware, we have designed targeted activities designed to familiarize users with the technologies and the concepts underlying them. These follow from the data collected in the villages, described previously, and from our previous research [8]. For example, farmers are encouraged to collect and send data daily or weekly from a technology-enhanced agricultural plot as a simple blog posting or audio podcast.

Some activities were piloted in the communities in 2007:

- *Community blogging*: Designed to enable the villages to tell the world about themselves, one motivation being to solicit further aid, while learning about the web and mobile technologies. Due to literacy and language issues this can be done with audio recording and photos [9]. Initial data suggests that the technology is challenging but there is some positive appeal.
- *Water education*: Water usage is a major issue in both communities. In this activity, students research strategies and methods for effective water management, and record their findings using an iPod with microphone attached. The recording is then broadcast to the rest of the community using an FM radio transmitter attached to the iPod, or from the local community radio station in the case of Kambu. This form of audio journalism was found to be effective with students in outdoor activities [8]. In this case the activity was of interest to the villagers, and will be conducted more fully later in the project.
- *Community mapping*: Participants learn about their



Excerpt from printed training poster

own community and can teach others about it while learning about mapping technologies. Mapping was perceived to be irrelevant by the communities, for the reasons stated previously — in essence, maps are not regarded as an important tool. However, this activity may be revisited later, perhaps as a non-technical activity or framing maps as a communication medium, since maps are the primary initial way that outsiders familiarize themselves with the villagers.

- *Agricultural and community podcasting:* Participants use iPod or other audio recorder to conduct interviews with other community members. This is then uploaded to the Internet and/or broadcast to the rest of the area. This was perceived as relevant, particularly in the Kambu radio station, which lacks sufficient content to fill all its air time.
- *Agricultural trails:* This is a knowledge-sharing activity in which farmers regularly record the status of their crops in the form of a “trail” through their *shamba* or agricultural plot. This also follows from activities successfully trialed in the UK [8]. In this case the activity is designed to orient farmers to the use of recording technology in advance of the automatic recording that will be done via sensor network to be tested later.
- Group-based activities for the schools in each community are also planned which are very low-tech but create a mental model of what the technology can do and how it works — for example in introductory networking classes we can simulate the Internet Protocol by getting the students to relay a message under very “un-natural” set of rules.

### **Interaction design approach**

Given the data collected so far, we adopt a ‘fluid design’ approach, deploying technologies which are simple,

inexpensive, modular, and easily replaced with locally sourced materials [4].

We originally set out to do participatory design directly with members of the communities. However, based on a Hofstede [5] analysis, confirmed by our initial fieldwork and anecdotal evidence, we have learned that although the communities tend to be more collective in nature than in the US and UK (which tend to be more individualistic), they have strong power structures in which organizations and institutions with formal boundaries and hierarchical structures are recognized and accepted. Therefore, the hardware is initially in the care of one prominent individual in the community, but it is important that it be viewed as collectively owned. We retain the ability to adapt our methods based on local feedback, in keeping with an ‘agile’ methodology.

The introduction of technologies is phased so that first, basic computing and networking activities are introduced; then, similar activities are carried out on mobile devices supported by a “knowledge management system”; later a sensor network adds the dimension of automatic data collection and ubiquitous computing.

Initially we provide a Macbook laptop for each community, with solar charger and GPRS modem which provides the only stable Internet access in the areas. These laptops are intended to establish a baseline Internet access in the villages in order to enable access to agricultural information, and facilitate two-way communication with UK-based researchers and the world at large. By introducing a laptop first instead of the already-widespread mobile phone, our intention is to demonstrate the capabilities and activities provided by browser-based Internet access; then later to use mobile

devices to access these same services. The laptops also act as a content hub which can be used to serve data to mobile devices even in the absence of an Internet connection.

One benefit of a Macintosh over a Windows platform is its ready access to media-based activities such as podcasting (see below). The Mac OS also creates a more “level playing field” for introducing computer use, since those few who have used computers have used Windows. The Macbook also retains the ability to run a Windows operating system in addition to or instead of Mac OS.

A further reason for introducing a computer before mobile technology is a lesson from our initial fieldwork: When tools such as iPods and digital cameras were introduced on the first field visit, there was a tendency in the communities to denounce these as ‘toys’ and a desire for something more fixed and finished.

The laptops have been delivered to the communities in February 2008. The hardware is accompanied by basic on-site training by University of Nairobi researchers, supported by printed and digital training materials designed by the London Knowledge Lab and translated into local languages. We expect that this will at least establish a hub in each village for computing and Internet access.

### Conclusions and next steps

We are receiving the first data from deployment and expect to report further results soon. The next phase of the technological resources to be deployed will be mobile and personalized to individuals. A simple sensor network

for supporting agriculture is being designed and tested in the UK for deployment at a later stage of the project.

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