SHOP-Net: Moving from Paper to Mobile

Michael J. Talbot, Gary Marsden
Department of Computer Science
University of Cape Town, Private Bag X3 Rondebosch 7701, South Africa
email: {mtalbot, gaz}@cs.uct.ac.za

Abstract

This paper describes the SHOP-Net system, a mobile handset-based stock ordering system. SHOP-Net replaces a paper-based system with a digital screen-based system. We present how it was developed and evaluated using a user-centered design methodology with associated Human Computer Interaction (HCI) methods, in conjunction with a Non-Governmental Organization (NGO) that works with micro-enterprises. The importance of engaging both users and managers in design and evaluation is highlighted. A short pilot study has been conducted. Despite early teething challenges regarding the management of information made available to the server, the system seems promising and easy to learn. Furthermore, the various stakeholders at the NGO are enthusiastic for it to be put into full use.

Index Terms—mobile, HCI, ICT4D

I. INTRODUCTION

Mobile applications hold great potential for African micro-enterprises [2; 6]. Africa has seen a rapid adoption of mobile handsets, provision of cellular services, and increases in mobile penetration [5]. Micro-enterprises have benefited greatly from this, especially in four particular areas: increased access to communication [1]; market information services; mobile payment services; and direct livelihoods [2]. There is, however, a distinct lack of mobile applications that directly contribute to business management in the African context.

There are examples of these systems on other continents, such as the Frogtek system in Latin America [3], which runs on Android-based phones. It is a point-of-sale application that allows shops to record expenses and revenues. Such systems may not be ideal for micro-entrepreneurs, however. For instance, if the target user group is the shop owners themselves, then the requirement of an Android-based mobile phone is an expensive one. Where such systems are not available, or the mobile phones required are too expensive, shop owners keep informal records on pieces of paper; sometimes no records are kept at all.

In South Africa, a common example of micro-enterprises is the "*spaza*" shop. *Spaza* shops are small cash shops typically run from the owners' homes and are common in rural and township communities. When conducting research in such communities it is often beneficial to work with an NGO already working in the area because they generally have better local knowledge and a better understanding of user requirements [4; 6]. There are a number of NGOs that work with *spaza* shop owners to provide training, advice and micro-loans amongst other services.

One such NGO is Triple Trust Organization (TTO) [10]. TTO provides training and advice to the *spaza* shop owners as well as acting as a supplier of stock items. A group of TTO field staff drive from the office to the spaza shops twice a week to collect their stock orders. The orders are recorded on A4 order sheets and then driven back to the offices to be data captured into their accounting package. The round trip is typically between 60 and 100 kilometers, depending on the *spaza* shop. The forms usually arrive at the office in batches late in the afternoon, which puts much strain on the admin staff, since the forms need to be processed before the wholesalers close for the day. This work aims to find an appropriate method of moving this process from paper sheets to a mobile application by developing the SHOP-Net system.

There is a small body of related work in this area. Parikh et al. [9] modified their paper forms by adding two-dimensional barcodes to the pages. They then used a mobile phone to photograph and process the barcodes. Merz [7] developed a system that allows small shops to order stock via SMS. Their system requires orders to be sent using structured SMSes so that they can be parsed by a server.

This paper describes how TTO's paper-based process was converted to a screen-based process; and the methods used to engage with the NGO as a design and evaluation partner.

II. DESIGN PROCESS

A. Triple Trust Organization

TTO's work is in poverty alleviation through enterprise development. Apart from giving advice and training, they also act as a wholesaler for the *spaza* shops. TTO is able to give shops reduced prices on some items because they are able to buy in bulk due to the collated shop orders. More than 100 *spaza* shops order goods through TTO. The orders are collected from the shops by the team of five TTO field staff twice per week. The orders are recorded on A4 order sheets with approximately 250 stock items printed on each sheet.

Once the field staff has received all of the orders for the day, the forms are driven back to the office. The data-capturing can usually only begin at about 2:30pm when the field staff return. This is usually a rushed process so that the collated orders can be sent to the wholesalers before they close that day. The field staff usually arrives back at similar

times with ten to fifteen order sheets each. The sudden spike in workload with the short deadline from the wholesalers puts much strain on the admin staff.

With the use of a mobile application, the TTO field staff would be able to capture orders on their mobile handsets and send the order forms back to TTO via the cell phone network. This would allow orders to arrive at the office throughout the day, rather than altogether at the end.

B. Related work

Parikh at al. [9] used mobile phones to photograph and process barcodes printed on their forms. The barcodes would inform the mobile application what data value was to be input next or what values were to be calculated. This allowed values such as incomes and expenses to be input with an associated meaning. Some calculations could then be performed by scanning in barcodes corresponding to a balance, for example. Toward the end of their project, it was decided that it would be faster if the users just entered the value corresponding to the barcode using the keypad. This eliminated the need for the camera on the phone. It seems though, that the information given by these barcodes or values could have been codified into an application rather than having to scan or enter them each time.

Merz [7] developed a system in South Africa for ordering stock using structured SMSes. An example of an order is "10 times a washing powder". A benefit of this system is that no software needs to be installed on the mobile handset.

Although this gets the information from the mobile phone to the server, it is an unintuitive way of communicating in English. Also, SMSes are relatively expensive compared to using data traffic. Most feature phones, which are common in South Africa, are able to access the internet.

The SHOP-Net system addresses some of the drawbacks of these systems by coding the logic of the forms into the application and by using data traffic rather than SMSes.

C. Methods and Methodology

The user-centered design (UCD) methodology has value in many contexts, especially when working in the developing world where assumptions about user requirements do not often hold. The aim of UCD is to build technology around the users to support their tasks.

A number of methods associated with UCD were employed during this work, namely: participatory design (PD), contextual enquiry (CE), and conceptual model extraction (CME). These will be expanded on later.

D. The Design-Implement-Evaluate Cycle

Development cycles that include design, implementation and evaluation can be valuable in quickly discovering and addressing problems. With each iteration, the system can be improved and re-evaluated for further improvements.

1) Iteration one

The scope of the project was set in initial meetings with two of the management staff. One is a senior manager and the other manages administration. These meetings gave initial user requirements, with more discovered later when meeting with the field staff.

One key question to be addressed was whether the shop owners themselves should be able to order via their mobiles or whether the field staff would still take orders, but via their mobiles. It was communicated that TTO would prefer to have their field staff still taking the orders but with their mobiles, and that if it was successful, a later project could be aimed at the *spaza* shops themselves. They also particularly wanted their staff to be working with smart-phones. The latter option is less scalable, still requiring field staff to drive out, and more expensive, since smart-phones would need to be purchased for their staff. Prior to these meetings, the former option was expected as using J2ME applications for the feature phones that are so common in these communities is a published trend in ICT4D projects.

It was somewhat surprising initially that TTO wanted to use smart-phones, but it became apparent that there were a number of reasons for this. The field staff also collect cash payments for the orders and give business advice when they go to the *spaza* shops. These functions would still need to be performed, regardless of the order method. TTO also expected that their staff would come across as being more professional when using smart-phones to take orders. Sometimes order sheets get tatty from lying on the back seat while staff drive between *spaza* shops. It also allows TTO to continue the type of relationship they have with the *spaza* shops by maintaining control of the ordering process.

Based on TTO's request to use smart-phones, it was decided that the mobile application was to be implemented using Android. This would allow a wide range of handsets to be purchased, depending on how they prioritized cost or ease-of-use.

While the meetings with the management were proceeding, a CE was carried out with 2 of the field staff. Two days were spent with these staff to gain information about how the ordering process is carried out – there are often differences between how management understands processes and how they are carried out in practice. Therefore, this time was spent observing the field staff interacting with the shop owners while recording orders and giving advice. The field staff were asked to explain aspects of their tasks that weren't initially understood by the researcher. Notes were taken regarding the process of ordering, the interaction between the field staff and the shop owner, and the life-cycle of the order forms.

This combination of observation and questioning exposed a number of extra requirements that the meetings with the management had missed. The CE was also a tremendous help in building relationships between the researcher and some of the field staff.

After these initial design requirements, a horizontal

prototype was developed to explore user interface (UI) possibilities with some basic functionality in place.

2) Iteration two

In ICT4D projects, applications are often developed by employing PD and co-design methods between those implementing the software and the users and stakeholders. Both methods seek to include the users in the design process from the start, from user requirements right through to UI design, in an attempt to avoid large changes later. The users also gain a sense of ownership over the new system.

Early on, a PD workshop was run with the members of the field staff. After some explanation of the aim of the workshop and what they were being asked to do, they were asked to start putting some ideas of the system they would like to use down on paper. This was met with some hesitation and confusion from the field staff. After a short while one of the field staff said that it was a waste of time and suggested we rather talk about desired functionality and that the design and layout of the system be decided on by the researcher. Not wanting to lose the fledgling interest and support of the field staff, the rest of the workshop was spent discussing desired functionality. The contributions made during the workshop were dominated by two of the staff. Often their suggestions were met with agreement from the other staff, but there may have been other issues that were not raised by the quieter staff members.

Most of the requirements discovered in this workshop agreed with the list of required functions given while meeting with the management. There were additional desired functions though, as is to be expected when meeting with the end-users.

The unexpected result of the PD workshop was that the end-users expressed total disinterest in being involved in the design process. They would rather communicate their needs and wait and see what system they were given. This is in contrast to many other examples where users have really taken an interest in design and taken ownership of a project during these workshops.

With this information, the full system was implemented. The TTO field staff log in to the mobile application and enter the relevant *spaza's* client number. Information such as the *spaza's* opening balance and contact details are retrieved from the server. Items are then added to the order list using a searchable drop-down menu. A summary of the order is then displayed along with the *spaza's* updated account balance. If both the field staff and the *spaza* owner are happy with the order, it is submitted to the TTO server.

The UI (as seen in Figure 1) was developed with heuristic evaluation techniques in mind since no preference was given by the users. The mobile application was developed using Android 2.1 and was to be run on a Vodafone VF845 Android handset. The mobile client communicated with a Common Gateway Interface (CGI) server written in Python that was set up to run on the TTO server at their office. All communication was done via Hypertext Transfer Protocol (HTTP). Because TTO's accounting package is proprietary, the Python server was unable to interact directly with it at the time of writing this paper. Instead, the relevant information was exported from the accounting package as .csv files, which are used by the server. This provides a drawback in that this information must be exported regularly to ensure the SHOP-Net system has correct information such as opening balances of shop accounts. The Python server also outputs the orders as .csv files since these are easily opened and manipulated using Microsoft Excel, which the administration staff are familiar with.

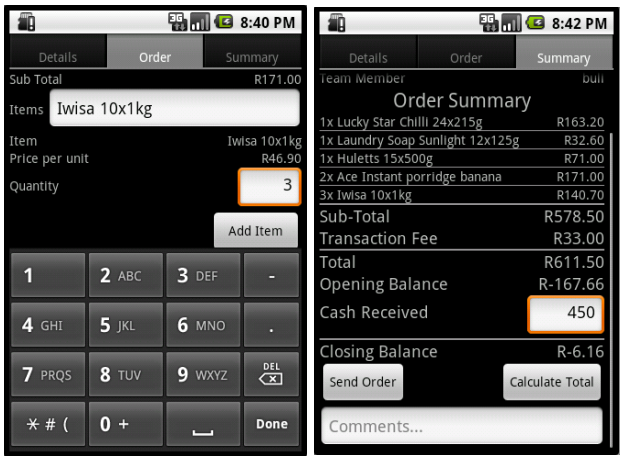

Figure 1 – Interface Overview

3) Iteration three

Once the first full system implementation was complete, a CME workshop was run with the field staff. A CME is used to evaluate how the users understand the user interface. It exposes the users' expectations of what functions the user UI elements relate to. Users are typically asked to perform a number of tasks using a system while their method is recorded. The method they attempt suggests what the user expected and highlights differences between that and the actual user interface.

In this study, the CME workshop was conducted with the field staff at the end of a working day in place of a regular staff meeting. Due to time constraints, it was run as a group workshop, rather than individually. The staff were shown images of the user interface and asked how they would go about performing a number of tasks, most of which were common tasks they performed using the paper sheets. The tasks that were not a part of their regular routine included logging in to the system and submitting the order form without being at the office. After some encouragement during the first three questions, they became quite responsive in providing answers. They also encouraged each other to participate in the workshop when one of the members seemed disinterested.

This was in stark contrast to the PD session run earlier. It was expected that the staff who contributed so much in the PD workshop would dominate the CME workshop and, in doing so, would stifle feedback from the rest of the group, making the workshop less valuable. This did not end up happening. Instead, all of the field staff present gave

feedback.

The CME workshop highlighted six user interface elements that were confusing:

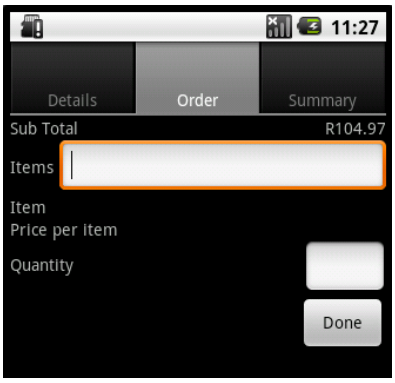

Figure 2 - Initial Order window design

The most problematic feature was the "Done" button, as in Figure 2. Most of the field staff understood this to complete the order. The intention was for it to add the item to the order list. The "Price per item" was intended to mean "price per unit" but was misunderstood, not surprisingly.

The rest of the problems were related to confusing labels of text fields, an unexpected input type, and an expectation of additional functionality that could be added later. A picture of the updated interface is shown in Figure 3.

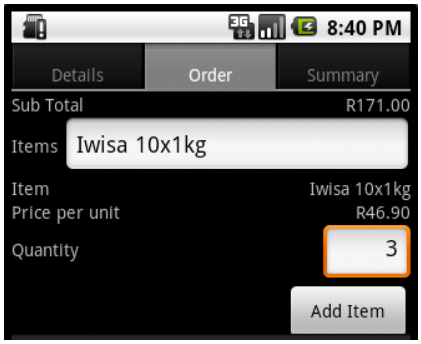

Figure 3 - Updated Order window design

During this iteration a heuristic evaluation was performed on the user interface by the second author [8]. This type of evaluation uses usability "best practices" and guidelines to bring to light obvious oversights in development. This evaluation exposed a number of instances where users would perform an action and receive no feedback, such as when synchronizing the order form with the server. To remedy this, short popup messages were implemented to signal to the user that a process had begun. This improved the feedback given to users while executing tasks.

With the feedback from the CME workshop and the heuristic evaluation, the user interface was modified accordingly.

4) *Iteration four*

Once the user interface changes had been completed, a group training session was run with the field staff. They were shown the mobile application running on an emulator as a group. The emulator was projected onto a screen to allow the group to see while listening to the researcher. The same list of tasks as those used for the CME workshop was used for the training session. The mobile application was then demonstrated to the field staff again on the mobile handsets in pairs to allow them to be close enough to see. The field staff seemed excited to start using the system.

III. Evaluation

At the time of writing this paper, only two days of the pilot study had been completed. One of the days was spent at the TTO office working largely with the administrative staff. The other was spent in the field with one of the field staff.

A. *Pilot Study – day one*

While the TTO field staff are out collecting orders, the administrative staff often collect a number of orders themselves. They phone a *spaza* shop and take down their order over the phone. This can be quite expensive as these phone calls are almost exclusively to mobile phones and last a number of minutes.

On the first day of the pilot study, two of the field staff had stayed at the office to take phone orders. This does not seem like a common occurrence. Nevertheless, it created an opportunity to see both the field staff and the admin staff working at the same time in the same place.

After taking the first order by phone, one of the field staff members began recording phone orders using the SHOP-Net system rather than writing the order down on paper. After a few minutes, the field staff member had become more familiar with the touch-screen interface and was recording orders more confidently. After finishing his own orders, he began capturing the other field staff member's orders using the SHOP-Net system.

The first field staff member had mentioned after the training session that he'd like to be the last of the staff to start using the mobile application because he did not like new things. After using the system for about 30 minutes on the first pilot study day he said, "I prefer the app. It's much more convenient. It will just take some time to get used to."

When these orders were transferred from the server to the accounting package, they produced incorrect totals. This was due to inconsistencies between the price list on the accounting package and the price list made available to the SHOP-Net server.

B. *Pilot Study – day two*

The second day of the pilot study was spent with a field staff member driving around and taking orders at the *spaza* shops. The field staff member was unable to read the text on the screen of the handset, having forgotten his reading glasses, so the researcher operated the handset while the field staff member interacted with the shop owners.

Even after a number of evaluation sessions before deployment and the first day of pilot use, this second day

brought to light a number of issues with the system. Of the nine orders taken, there were eight errors in five of the orders – see Table 1.

Table 1 – Error results from the 2nd day of the pilot study

Error	Count
Client information missing	1
Items missing from the order list	2
Opening balance was incorrect	3
Unable to load information due to bad formatting	2
Total	8

All of these issues were server-side and could not be fixed in the field. They were also all caused by incorrectly formatted, missing, or incorrect data made available to the server. This provided frustration and embarrassment for the field staff member, especially because the administration staff were difficult to reach to correct the problems. Apart from the opening balances being incorrect, the server-side problems were slowly solved while the orders were being taken.

Even after this frustration, this field staff member stated that he was very pleased that his orders would all have been captured by the time he arrived at the office for the staff meeting that day. He also stated that he would take the mobile handset home and practice using it so that he would be able to use it for the next order day.

IV. Conclusion

In this paper, we have presented the design and evaluation process of the SHOP-Net system; a mobile handset-based stock ordering system. The importance of working with an NGO to design for our target users has been presented.

Initial meetings with the management of TTO and the PD workshop were extremely valuable in discovering user requirements. The CME workshop and the expert heuristic evaluation served to improve the UI and general usability of the system.

The SHOP-Net ordering system has shown much potential with administration and field staff both very enthusiastic about using it. From the short pilot study conducted so far, it seems that the system is easy to learn, saves the field staff time, and takes the pressure off of the administration staff.

There have of course been teething issues such as files not always being exported correctly on the server. There are also human errors such as field staff members forgetting their reading glasses, forgetting to charge the handsets the night before or forgetting to bring a pencil to improve accuracy using the touch-screen handset.

Nonetheless, the benefits seem to far outweigh the early challenges and TTO remains positive about the system. A longitudinal study is to begin in the near future.

V. Acknowledgements

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VII. Biography

Michael Talbot (B.Sc. Computer Science) received his undergraduate degree in 2008 and his Honours degree in 2009 from the University of Cape Town. He is presently studying towards his Master of Science degree also at the University of Cape Town. His research interests include ICT4Development, usability and mobile applications.

Gary Marsden is a professor of Computer Science at the University of Cape Town. His research interests are in HCI, Mobile Computing and ICT4D. He is director of the UCT ICT4D Research Centre and the Hasso Plattner Institute Research School in ICT4D