Striking a Balance between User Comfort and Maximizing Benefit in Developing World Information Systems

Brian DeRenzi †
Tapan S. Parikh §
Neal Lesh ‡
Marc Mitchell ‡
Gaetano Borriello †

† University of Washington
Box 352350
Seattle, WA 98195-2350
{bderenzi, gaetano}
@cs.washington.edu

‡ D-Tree International
52 Whitney Tavern Road
Weston, MA 02493
neal.lesh@gmail.com
mmitchel@hsph.harvard.edu

§ School of Information
University of California Berkeley
Berkeley, CA 94720-4600
tparikh@gmail.com

ABSTRACT

In recent years there has been an increased interest in investigating how technology can be used to aid the millions of people living in low-income countries [2]. Mobile phones are emerging as powerful, affordable and pervasive computing devices that can serve the needs of widely deployed applications in resource-constrained environments.

Previous work has emphasized the importance of working closely with local partners and maintaining fidelity with existing paper-based processes [3, 4]. While we agree with these principles, computing technologies can provide fundamentally new capabilities that argue for changing processes to benefit from these advantages. We base this reasoning on experience in designing, developing and evaluating a mobile system to aid health workers in Tanzania in classifying and treating child illnesses. The question we face is how to introduce these new processes and improve outcomes while taking into account the effects they may have on the workforce.

Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Human Factors.

Keywords

Tanzania, participatory design, IMCI, mobile devices.

1. INTRODUCTION

Conducting technology research in low-income countries introduces a new set of resource constraints in terms of power, connectivity and basic infrastructure. Designing software for such settings where users have little to no prior experience with computers presents several user interface challenges. For example, user interface metaphors that are easily communicated in developed countries may not be so easily assumed in this context.

In response, previous user interface research in this domain has underscored the need to include users in the design process, and to maintain fidelity with users' current understanding and work processes [3, 4]. This has extended to retaining current paper formats as an integral—and minimally altered—element of the user interface and overall information system. An important consideration in layering technology on top of current work practices is that this approach minimally alters the existing trust and power relationships.

However, it is often the case that moving from a manual, paper-based system to an automated system provides an opportunity to make significant gains by improving the efficiency of processes and by introducing context-sensitive, demand-driven information. In this paper, we briefly present our work introducing mobile computing as a way to aid practitioners following medical decision algorithms (referred to as medical protocols) in primary health care facilities in rural Tanzania. We argue that by using the computing capabilities of the mobile device we can provide more complex and dynamic treatment protocols than are possible using manual, paper-based methods. We conclude by pointing out the need for participatory design to understand the amount and type of change users can tolerate.

2. IMCI AND e-IMCI

To address the problem of child mortality in low-income countries, where almost 10 million children die before their fifth birthday [5], the World Health Organization (WHO), United Nations Children's Fund (UNICEF) and other partners developed the Integrated Management of Childhood Illness (IMCI) protocols. Over 80 countries have adapted IMCI for their own use in addressing child mortality rates. A multi-country evaluation found that IMCI can significantly improve health indicators for children under 5 [1]. While IMCI is a multi-faceted approach, the core of the system includes a set of medical algorithms that help health workers quickly classify and treat a child with a cough, diarrhea, fever, ear ache or malnutrition. Also included in the IMCI protocol is information on immunizations as well as advice and counseling for the caretaker—often the mother. These guidelines are currently implemented through extensive training and chart booklets. As these paper-based artifacts can be cumbersome to use and index, many practitioners quickly adapt to using them only as occasional reminders, following IMCI from memory. It is not uncommon for IMCI-trained practitioners to deviate from the protocol.

CHI'08, April 5–10 2008, Florence, Italy.

To aid health workers, we developed an electronic delivery of IMCI (e-IMCI) with Dimagi, Inc[1] and D-Tree International[2]. e-IMCI runs on Windows Mobile 5.0 and supports a large subset of the IMCI protocols. The system guides health workers step-by-step through the algorithm, prompting each question to ask or investigation to perform and ending with a classification and treatment. From July to September 2007, we piloted the system in southern Tanzania, working with four clinicians to discover and fix usability problems, while measuring the effect of the software on protocol adherence when compared to current practice. The clinicians that tested the software all reacted positively and preferred to use e-IMCI over paper chart booklets. The results of our study indicated that adherence to the protocol's decision processes was increased while not adversely affecting the time required to classify each patient. The software has many other advantages besides usability. Electronic delivery of medical algorithms allows for dynamic updating of algorithms, data collection as a byproduct of delivering care and remote monitoring and feedback.

3. EXPANDING e-IMCI

In this first version of the system we followed previous research by replicating the paper-based process using a mobile device. Clinicians were able to easily follow the process, as they had experience with the paper version of IMCI and a resulting mental model of what question should come next. While the electronic medium was new, the clinicians were eager for a tool to ease their heavy workload and adapted very quickly.

3.1 Dynamic Protocols

In the future, we plan to take more advantage of the computing capabilities of the mobile device. Previously, the complexity of the algorithm was limited by the affordances of the paper chart that practitioners were supposed to follow with every patient. The system was not able to generate dynamic questions based on previous input. Using a computing device we can generate questions based on statistical data, including the patient's own longitudinal history.

As a practical example, let us imagine the case when a child presents with symptoms including fever and cough. Assuming the breathing rate of the child is considered normal by IMCI, the child will not be treated for pneumonia and unless the cough has been present longer than 2 weeks would not probe further for other causes of cough such as tuberculosis. However, if tuberculosis had been diagnosed in a family member, the software should ask more detailed questions to determine if a referral to a hospital, which may be quite far away, to check for tuberculosis is necessary. Further, the device could use dynamic information about what tests and treatments were available at neighboring facilities to ensure that the child is referred to the closest facility where a sputum sample can be collected.

3.2 User Comfort

However, by creating a dynamic system that diverges from the previous process, we are also deviating from the user's mental model of what question should come next. We need to better explore this continuum to determine the amount of change with which users are comfortable. For example, are users more tolerant of high-level changes (the structure of the overall questionnaire itself), or low-level changes (the phrasing of individual questions)? Moreover, we hypothesize that different users, with different ages, educational backgrounds and exposure to computing technologies; will tolerate differing levels of change.

The level of resistance to change has wide-reaching implications for the deployability of computing technologies. An easy to understand system will have reduced requirements in training, long-term maintenance and support. Of particular importance in an environment with limited trained human resources is how this will affect the recruitment and retention of health workers.

4. CONCLUSION

Previous work exploring user interface design for developing regions has stressed the need to maintain conformance with existing paper-based processes. Our experience has shown us that there are certain applications where computing technology can have the largest impact by *changing* those processes. To resolve this design dilemma, we need to conduct further research to understand the kinds of changes different classes and backgrounds of users will tolerate, and the resulting implications for training, support and long-term maintenance.

5. ACKNOWLEDGMENTS

The authors would like to thank the Ifakara Health Research & Development Centre[3], the Ministry of Health in Tanzania and the clinicians who tested the software for their involvement and commitment to this work.

6. REFERENCES

[1] Armstrong Schellenberg, J; Bryce, J; de Savigny, D; Lambrechts, T; Mbuya, C; Mgalula, L; Wilczynska, K. The effect of Integrated Management of Childhood Illness on observed quality of care of under-fives in rural Tanzania. *Health Policy and Planning* (2004), 1-10.

[2] Brewer, E; Demmer, M; Du, B; Fall, K; Ho, M; Kam, M; Nedevschi, S; Pal, J; Patra, R; Surana, S. The Case for Technology for Developing Regions. IEEE Computer. Volume 38, Number 6, pp. 25-38, June 2005.

[3] Parikh, Tapan S. Designing an Architecture for Delivering Mobile Information Services to the Rural Developing World, Ph.D. Dissertation, University of Washington, 2007.

[4] Schwartzman, Y; Parikh, T. Establishing Relationships for Designing Rural Information Systems. Experience Report, ACM Conference on Computer-Human Interaction (CHI). April 30-May 3, 2007, San Jose, CA.

[5] UNICEF. Child deaths fall below 10 million for first time. (2007). http://www.unicef.org/media/media_40855.html

[1] http://www.dimagi.com/

[2] http://www.d-tree.org/

[3] http://www.ihrdc.org