chi+med
making medical devices safer

Update 5

15 September 2011

Introduction

Welcome to the fifth CHI+MED newsletter. Since the last update, we have hosted two workshops for manufacturers and other stakeholders, and a workshop at Engineering Interactive Computer Systems 2011 (Pisa) – see reports below. We have also had a major presence at the British HCI conference (where we presented four full papers, and Gregory Abowd, Chair of the Steering Committee, gave the closing keynote address), and at the Formal Methods for Interactive Systems workshop (four papers). These, and other papers, are all available from our research publications page.

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Reports

EICS4Med was held in conjunction with EICS2011 in Pisa. Many challenges to designing innovative healthcare applications were identified, including the tendency to design conservatively to avoid patient harm and the difficulties of establishing rich communications between clinicians and engineers. In considering the timescales for developments, the group concluded that technical developments are more easily achieved than the equally essential cultural changes, such that errors are accepted and regarded as learning opportunities, and investment is directed toward the design of safer, more usable systems. The workshop report is available here.

Working with the Medical Device Industry

A CHI+MED Workshop for Medical Device Developers and Manufacturers was held at UCL between the 11th and 12th of July 2011. Twenty individuals representing a balance of industrial and academic interests were present from across the EU and US. Participants attended from three multinational companies and two specialist consultancies. Delegates provided a range of skills relating to the design, development, manufacture, evaluation and assurance of medical equipment (infusion pumps).

During the two days, participants discussed ways in which the CHI+MED project could support industrial practice. The dialogue was based upon the project research output including consideration of the utility of User Centred Design (UCD) tools and techniques. These included automated checking routines, interaction design patterns, design checklists and guidelines, persona, scenario, evaluation heuristics and commentaries on relevant standards. Delegates provided feedback regarding what works and doesn't work in practice, missing resources and opportunities for improvement. For more information see the workshop summary.

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On 12th August 2011 Swansea University hosted the second Stakeholder Engagement Workshop targeting a large spectrum of medical device stakeholders. Participants from MHRA, Cedar, NHS, ABHI, GE Healthcare and a number of other medical device companies, design houses and testing agencies joined us to explore barriers to User Centred Design in medical device context, and to comment on a roadmap for future research in medical devices. Apart from sharing their insights on current practice, participants also raised their concerns on the current status of communication between each other, and expressed the need of further engagement opportunity.

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New papers published

Harold Thimbleby had a paper accepted at hci2011 called "**Don't use 7-segment displays**" (*paper number 32*). Such numeric displays are often used in healthcare, and other devices, but are likely to create confusion and danger when used in safety critical machines. With decimal points that are too small (making it difficult to distinguish 50 from 5.0) and the ease with which 9 might look like 4 (if a segment is missing or obscured) this type of design for numeric displays is best avoided in medical devices.

Huayi Huang (QMUL), Rimvydas Ruksenas (QMUL), Maartje Ament (UCL), Paul Curzon (QMUL), Anna Cox (UCL), Ann Blandford (UCL) & Duncan Brumby (UCL) published **Capturing the distinction between task and device errors in a formal model of user behaviour** (*paper #30*) in the Proceedings of FMIS-2011, Fourth International Workshop on Formal Methods for Interactive Systems.

Sarah Wiseman (UCL), Paul Cairns (York) & Anna Cox (UCL) had **A taxonomy of number entry error** (*#29*) accepted for the BCS HCI conference.

"We are aware of many instances of number entry error when using medical devices that lead to injury and deaths in hospital wards, but as yet we don't have a comprehensive idea about what number entry errors are happening. This paper classifies a set of entry errors into a taxonomy that aims to group them according to the cause of error.

The errors were classified according to the point at which they occurred in the number entry process: whilst reading the number, storing the number in memory, or typing the number on the keypad.

The result is a set of 13 types of number entry error; all linked by their cause and the result of error. Some errors can occur at just one of the stages of number entry whereas others can occur at multiple stages."

Patrick Oladimeji (Swansea), Yunqiu Li (Swansea), Abigail Cauchi (Swansea), Parisa Eslambolchilar (Swansea), Andy Gimblett (Swansea), Paul Lee (Singleton Hospital) & Harold Thimbleby (Swansea) published **Visualising medical device logs** (*#28*) at the First BCS Health in Wales/ehi2 joint Workshop at the 4th International Conference on Internet Technologies and Applications (ITA-11).

Patrick Oladimeji (Swansea), Harold Thimbleby (Swansea) and Anna Cox (UCL) had **Number entry interfaces and their effects on error detection** (*#27*) accepted for the Interact 2011 conference.

"Drug dosing errors arising from incorrectly entered numbers account for a significant portion of the adverse drug events in hospitals. This study compared two different types of number entry system to see which resulted in fewer errors.

While having their eye movements tracked study participants were asked to enter a number using either a numeric keypad (like those on calculators) or an incremental entry system which uses up and down arrows.

With the numeric keypad, users must focus on the keypad itself (in order to find the next key to press) and may not notice errors on the display, whereas with the incremental interface, users tend to monitor the display resulting in higher error detection and consequently better entry accuracy. The incremental system produced significantly more accurate entries although entry took longer."

Dominic Furniss (UCL), Ann Blandford (UCL) & Astrid Mayer (Royal Free) had **Unremarkable errors: Low-level disturbances in infusion pump use** (*#17*) accepted to the British HCI 2011 conference.

"We undertook 5 days of observational work to see how nurses use infusion pumps and administer treatment in an Oncology and Haematology Day Care Unit. Whilst there we observed 10 minor 'disturbances' during the administration of treatment. In all cases the nurse rectified or recovered from the disturbance, and often did not pay much attention to it or remark upon it.

We call these disturbances 'unremarkable errors' to denote something going wrong which is not picked up as a problem and so not remarked upon or reported. But these 'sub-threshold' minor errors may be instructive. Inclusion of these errors in research studies can provide useful information and gives a truer picture of reality. A small error can escalate to something more serious and device design changes that could mitigate the effects of such errors could improve safety."

Dominic Furniss (UCL), Jonathan Back (UCL) & Ann Blandford (UCL) had **Unwritten Rules for Safety and Performance in an Oncology Daycare Unit: Testing the Resilience Markers Framework** (*#16*) accepted for the 4th Symposium on Resilience Engineering.

"While studying how nurses use infusion pumps and administer treatment on an Oncology and Haematology Day Care Unit we noticed that there were practical behaviours they exhibited that reduced the likelihood of errors being made. For example organising their medication trolley well before administering treatment, tidying up their trolley after treatment, and separating medicines to prevent confusion all made the system safer. We call these behaviours resilience strategies, and in this paper we use the Resilience Markers Framework to help analyse them. Using this framework is novel in this domain and our paper provides support that it is useful for this purpose. By using this framework we get a better idea of the positive strategies that nurses use to manage and mitigate error in practice."

Public and stakeholder engagement

Dom Furniss was awarded a UCL Provost's Teaching Award in August for his work in using digital stories to engage and teach MSc students learning about human-computer interaction.

Harold Thimbleby gave the keynote talk to the Annual Joint Conference of the Guild of Healthcare Pharmacists (GHP) and the UK Clinical Pharmacy Association (UKCPA) in May.

Paul Lee (Singleton Hospital) and *Frankie Thompson* (Castle Hill Hospital) have developed a poster and a talk called "Mind the Gap", based on infusion pumps' error logs. These have been presented at the national EBME seminar, the NIVAS (National Intravenous and Vascular Access Society) and the European Medical Physics and Clinical Engineering conference.

Paul Curzon has delivered CHI+MED core messages to over 2,500 school students and to thousands more of the general public at a number of science festivals using a number of approaches including a magic show: The magic of CHI+MED: Safer medical devices.

Upcoming events

Ann Blandford will be giving a Lunch Hour Lecture at UCL on 3 November 2011 - "When technology design provokes error" will look at the causes and consequences of errors and how the design of technology can provoke or mitigate them.

Harold Thimbleby will be giving a public lecture with a CHI+MED theme to the Cardiff Scientific Society on 30 November 2011. "Numbers, Numbers Everywhere, and None you can Trust – Not Yet!" will consider the unreliability of numbers in a range of contexts, the serious problems this can cause and suggest some solutions.

"My PhD"

Understanding interruptions

Interruptions can increase the chances of someone making an error but unfortunately interruptions are a permanent feature of working environments, including those in healthcare settings. As we can't eliminate interruptions, we need to focus on identifying what we can do to minimise their effect. I have been investigating how the attributes of an interruption affect whether people attend to an interruption immediately or not. I've been able to replicate previous findings in a new context, although there have been some interesting results that have made me re-evaluate the next steps for my research. I want to be able to come to some conclusions about the kinds of design interventions we need to make interruptions easier to manage, and my next experiments are going to reflect this by systematically varying task environments.

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Photo credit: ***Interruption***, by Sebastiano Pitruzzello (via Flickr)

Understanding context: situated research

My research investigates the situated use of interactive programmable medical devices by patients, carers and healthcare professionals in settings outside of the hospital, such as people's homes and hospices. I focus on understanding the contexts in which the devices are used, the difficulties that users experience while interacting with the devices, and how users adopt certain strategies to facilitate their interactions with the devices, depending on constraints and opportunities presented by the contexts and by device design.

Currently, I am studying the use of home haemodialysis machines by lay patients and carers in their homes. I am visiting patients and carers in their homes to interview them on their broad experiences of using the machines, to conduct short observations while they use the machines, and to hand out pocket-size camcorders to them so that they can keep video diaries of incidents. This first study is exploratory, and will lead to potential focus points for subsequent studies.

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