Engineering Interactive Computer Systems for Medicine and Healthcare (EICS4Med)

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ABSTRACT
This workshop brings together and develops the community of researchers and practitioners concerned with the design and evaluation of interactive medical devices (infusion pumps, etc) and systems (electronic patient records, etc), to deliver a roadmap for future research in this area. The workshop involves researchers and practitioners designing and evaluating dependable systems in a variety of contexts, and those developing innovative interactive computer systems for healthcare. These pose particular challenges because of the inherent variability — of patients, system configurations, and so on. Participants will represent a range of perspectives, including safety engineering and innovative design.

The **focus** is: ***engineering safe and acceptable interactive healthcare systems***.

The **aim** is: ***develop a roadmap for future research on interactive healthcare systems***.

Author Keywords
Medical devices; healthcare; HCI; interaction technologies; handheld devices; advanced user interfaces; mobile computing; modeling; formal methods; safety.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g. HCI): Miscellaneous.

General Term
Human Factors.

THEME, GOALS, AND RELEVANCE

Modern healthcare is relying increasingly on a variety of devices, both in hospitals and by patients or their carers at home. It is vital that they are both reliable and easy to use: that they are well-engineered dependable systems that inter-operate with many other systems in the context of use. Yet healthcare systems are increasingly characterized by the diversity of devices and use contexts. Systems exploit evolving technologies such as mobile devices, location and tracking tools, as well as wearable, portable, and implantable medical sensors. Furthermore, healthcare systems are increasingly characterized by the diversity of their users. Designing highly interactive computing systems to take advantage of the potential of such a variety of devices and contexts to deliver reliable solutions to real problems is a major challenge. Estimates of the number of preventable adverse events in healthcare vary, but are generally agreed to be around 10% of patients in most advanced healthcare systems. Many of these events involve errors with interactive medical systems. Some of these systems are used by people without extensive training; if nurses, doctors or patients misread the systems or, for example, make slips when setting up drug doses then this can result in incorrect treatment, and may even kill.

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The design requirements of interactive medical systems are different to the main thrust of interaction design, which is often more concerned with user experience and efficiency. Instead, dependability is essential: trustworthiness of a computing system that allows a user to rely on the service it delivers and on the data that is provided; this includes predictability (for the user), rigor (for the developer), and appropriate integration between the two: solid engineering that results in interactive systems consistent with their documentation and requirements of use.

Healthcare is certainly complex. Designs are regulated and (most) systems certified by national and international organisations. Typically, systems are procured by hospitals in large quantities, and consistency, compatibility and interoperability between systems is a serious issue. Features appear to make devices more useful, yet increasing numbers of features increases risks of feature selection errors during use. Manufacturers are businesses, and commercial pressures do not yet significantly drive dependability, particularly in areas of user error identified after a system design is certified, since certification implies that the design is "right" and that any resultant harm is the responsibility of the medical practitioners.

The purpose of this workshop, then, is to build a community of researchers developing complementary but

interconnected approaches to engineering dependable and innovative interactive medical systems.

The EICS community is centrally concerned with rigorous approaches to the design and evaluation of interactive computer systems, across a range of domains. Medical systems (by which we mean configurations of medical devices and information systems, together with professionals and lay people working to improve the health of a patient) are particularly challenging examples of such systems, being safety-critical, highly reconfigurable, and diverse. These systems therefore "stress" the disciplinary approaches being explored within the EICS community by presenting particularly challenging examples for modeling, especially with highly-complex non-computerised contexts.

This workshop will bring together members of the EICS community, and others working in related fields, to exchange insights into approaches to designing, engineering, representing and reasoning about interactive medical systems to ensure their dependability. This will result in fertile knowledge exchange, the identification of synergies between approaches, and the development of a roadmap for future research in this area.

FORMAT

The workshop will be all day, with a (self-pay) meal in the evening. Participants will present their position papers briefly as a form of introduction and to set the context. Most of the workshop will be devoted to breakout group activities, focusing on approaches to ensuring dependability, complementarity between approaches, gaps in the research agenda, and to specify future directions. The later afternoon session will draw threads together and develop a roadmap of future research agenda, including a consideration of future events to develop this community. A web report of the workshop will be made available after the event, summarizing key points from the discussions and activities.

ORGANIZATION

Ann Blandford is Professor of Human–Computer Interaction and Director of UCL Interaction Centre, and is Deputy Chair of IFIP WG2.7/13.4. She leads major EPSRC research projects on interaction design for medical devices.

Giuseppe De Pietro is a Senior Researcher at the ICAR-CNR and a grant professor of Information Systems at the Second University of Naples. His research interests cover pervasive computing and Virtual Reality environments.

Luigi Gallo is a Research Fellow at the ICAR-CNR. His current research is focused on human interface aspects of medical visualization. He is a member of ACM and a featured member of KES Intelligent Systems Society.

Andy Gimblett is a Research Assistant in Swansea University's Future Interaction Technology Lab. His current research is focused on linguistic approaches to user interface design and analysis.

Patrick Oladimeji is a Research Assistant in Swansea University's Future Interaction Technology Lab. His research interests include safety-critical interaction design and interactive information visualisation.

Harold Thimbleby is Professor of Computer Science in Swansea University's FIT Lab. He is the author or editor of a number of books, including *Press On* (2007) and *User Interface Design* (1990), and nearly 400 other publications.

WORKSHOP CONTENT

Contributors to the workshop have submitted the following position statements and papers. This gives an indication of the breadth of interest and topics the workshop addresses.

1. Blandford, A., Cauchi, A., Curzon, P., Eslambolchilar, P., Furniss, D., Gimblett, A., Harrison, M., Huang, H., Lee, P., Li, Y., Masci, P., Oladimeji, P., Rajkomar, A., Rukšenas, R. and Thimbleby, H. Comparing actual practice and user manuals: a case study based on programmable infusion pumps
2. Cabitza, F., Corna, S., Gesso, I. and Simone, C. WOAD, a platform to deploy flexible EPRs in full control of end-users
3. Carbone, M., Condino, S., Ferrari, V., Ferrari, M. and Mosca, F. Surgical simulators integrating virtual and physical anatomies
4. Catarci, T., D'Addario, M., Felli, P., Franceschetti, L., Lembo, D., Mecella, M., Pipan, T., Russo, A., Vestri, A. and Villari, P. User-centered design for citizens' empowerment through the portal of the italian ministry of health
5. Cauchi, A., Curzon, P., Eslambolchilar, P., Gimblett, A., Harrison, M., Huang, H., Lee, P., Li, Y., Masci, P., Oladimeji, P., Ruksenas, R. and Thimbleby, H. Towards dependable number entry for medical devices
6. Chehri, A.: Survivable and scalable wireless solution for e-health and e-emergency applications
7. De Mauro, A. Virtual reality based rehabilitation and game technology
8. De Paolis, L.T. and Aloisio G. Visualization and interaction system of virtual organs for surgical planning
9. Dittmar, A., Kuhn, R. and Forbrig, P. Coordination in perioperative systems – a tacit view
10. Ferrari, V., Ferrari, M. and Mosca, F. Video see-through in the clinical practice
11. Forsslund, J., Pysander, E-L.S. and Palmerius K-J.L. Design of perceptualization applications in medicine
12. Furniss, D., Blandford, A., Rajkomar, A., Vincent, C. and Mayer, A. The visible and the invisible: distributed cognition for medical devices
13. Mentler, T. and Kindsmüller, M.C. Care & prepare – usability engineering for mass casualty incidents
14. Wicht, A., Meixner, G. and Klein, U. Design and prototypical development of a web based decision support system for early detection of sepsis in hematology