
Designing UbiComp infrastructure for deployment in life-critical environments

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Abstract

While research has focused on the development of UbiComp solutions and interaction techniques, less attention has been paid to their actual deployment. As a result, real-life deployment issues create a critical barrier in UbiComp's wider adoption. This is especially evident in task-loaded, life-threatening situations, like disaster relief and emergency management. This paper presents the general concept, first steps, and ideas towards a PhD Thesis on the topic "Guidelines for the design and deployment of UbiComp infrastructure in task-loaded, life critical environments". The topic rose out of the author's own involvement in the development of an inter-agency disaster support system; the guidelines are being developed and tested hand in hand with the end-users of this system.

Author Keywords

UbiComp; UbiComp deployment; task-loaded environments; life-critical environments

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI); Miscellaneous; H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.

General Terms

Design; Human Factors

Introduction

Ever since Weiser [2] introduced the vision of Ubiquitous Computing, a tremendous amount of work has been done on systems, interaction methods, and techniques to bring that vision to life. Over the same time span, a much smaller amount of research has focused into how to deploy these systems and services outside of the lab¹. The embedding of UbiComp technologies in our daily life is often treated as a natural outcome of their existence, not as an independent process that requires careful design and thinking. As a result, the deployment of such technologies bumps against real-life issues. The "seams" of the embedding become obvious; the system comes loudly in the foreground, reminding the user that she is dealing with a computer. Ironically, this is the opposite of Weiser's vision, where the computer should "disappear into the background".

The mundane tasks of deploying a UbiComp system (what Tolmie et al. call "digital plumbing" [1]) should therefore be anticipated and designed into the system from the start. Nowhere is this more important than in life-critical situations and systems, e.g. UbiComp systems for rescue, firefighting, disaster management, medical interventions, and other similar situations.

Towards a thesis topic

The demanding, task loaded and life-critical environments in which firefighters, emergency medics, rescuers, and similar professionals work are characterized by:

- A very high degree of trust in one's tools
- A thorough understanding of how the tools work
- A thorough understanding of the tools' limits and modes of functional degradation (e.g. a hammer with a broken handle can still be used as a hammer but with less force and precision).

Professionals in such fields tend to resist the introduction of IT in the "line of fire", even though they accept it willingly in the command post and other places away from the intervention front. Over the course of a project spanning 8 countries we noticed that such professionals feel that IT in the line of fire complicates their task, is cumbersome to deploy, or fails at the most inopportune moment. A user-centered approach helps to some degree, but it often focuses on the user who carries out a certain task and does not take into account the preparation and infrastructure that makes the task possible in the first place.

As an example, there are at least 10 electronic triage² approaches that have been researched and shown to improve triage time and correctness. None of them has found widespread use, in part because they are not easy to deploy on the disaster field. Some approaches propose sensors that are too cumbersome to carry, some are too time-consuming to configure. Other approaches need a working Wi-Fi connection or a functional power grid, but these are among the first things to stop working in a disaster.

¹ Searching for "Ubiquitous computing" or "pervasive computing" returns 80,000 papers on ACM, while "ubiquitous computing deployment" or "pervasive computing deployment" returns only 18,000.

² Triage is the sorting of victims into severity categories and their marking with a color code accordingly. The scarce medical resources are then prioritized according to the triage category, most urgent first. The aim is to save as many lives as possible.

My thesis is inspired by the difficulty of putting IT to use in such environments. I would like to develop guidelines for the design and deployment of UbiComp in task-loaded, life-critical environments, paying particular attention to the deployment issues and the impact they have on the design requirements. The topic is still open to refinements; in fact that is why I want to take part in the doctoral school.

The work I have done so far focuses on learning about the difficulties that first responders have with existing IT solutions and the requirements that UbiComp should fulfill in order to be accepted by these professionals. I have talked to firefighters and medical personnel involved in disasters and have tested a few prototypes with them. As responsible for electronic triage in the previously mentioned project, I am developing some general guidelines for design and easy deployment and I am applying these guidelines to the triage prototypes. Any feedback from the users is directly applied to improving the guidelines themselves. This process of researching guidelines, prototyping, and refining with actual users will be iterated during the dissertation.

An initial, very rough, set of results and lessons learned is also subject of a paper to be presented in MobileHCI 2013.

Next Steps

The next steps I foresee are:

- Talk to more firefighters and doctors in the next demo of the project (End of September 2013)
- Present initial prototypes resulting from the rough guidelines and get feedback (End of September 2013)

- Define the topic and aims better (Doctoral Seminar August 2013, maybe Doctoral School in Zurich)
- Present the topic to my peers for feedback
- Create an expose' and start work in depth

Objective for attending the Doctoral School

I want to attend the Doctoral School in order to get feedback regarding the choice of the topic, or to define the topic better if necessary. I also would like to learn more about what difficulties to expect during my research work and how to overcome them.

Biographical Sketch

I have a BA in Computer Science and an MSc in Human Computer Interaction. My main interests are implicit interaction, UbiComp, and task-loaded or otherwise difficult environments. This latter interest stems in part from my hobbies of flying and diving. At the moment I have no advisor, as I have not yet officially started my PhD. I feel there is room for improvement in my topic formulation and would appreciate feedback on it. My goal is to start the PhD this year already, and finish it within the next 3 years.

References

[1] Tolmie, Peter, Andy Crabtree, Stefan Egglestone, Jan Humble, Chris Greenhalgh, and Tom Rodden. "Digital plumbing: the mundane work of deploying UbiComp in the home." *Personal Ubiquitous Comput.* (Springer-Verlag) 14, no. 3 (04 2010): 181-196.

[2] Weiser, Mark. "The computer for the 21st century." *SIGMOBILE Mob. Comput. Commun. Rev.* (ACM) 3, no. 3 (07 1999): 3-11.