

HCII-2003 – Summary

Thematic track: Human Computer Interaction (usability testing, architectures for interaction)

Title: Visibility and accessibility of a component-based approach for Ubiquitous Computing applications: the e-Gadgets case.

Introduction

e-Gadgets (e stands for extrovert) is an EU IST/Future Emerging Technologies Research project that is part of the Disappearing Computer initiative. The project extends the notion of component-based software systems to the world of tangible objects by transforming objects in people' s everyday environment into autonomous artefacts (the **eGadgets**). The ubiquitous environments formed by such artefacts can be directly accessible and manipulated by people themselves.

eGadgets have a tangible self and a software self. They are everyday objects enhanced with sensing, communication, processing, and possibly intelligent capabilities. They range from simple objects (tags, lights, switches, cups) to complex ones (PDAs, stereos) and from small ones (sensors, pens, keys, books) to large ones (desks, TVs). eGadgets offer their capabilities through collaboration points called Plugs; people can associate eGadgets by connecting Plugs in order to form functional clusters of artefacts. Thus, any person can actively shape his/her environment simply by associating eGadgets into collaborating collections (the **Gadgetworlds**) and re-arranging their associations.

The paper presents the concepts and the infrastructure that have been developed within the extrovert-Gadgets research project, so that experience designers and at a second level people themselves, can implement applications by composing tangible eGadgets. The proposed concepts and the current implementation were evaluated in the course of an expert appraisal.

Concepts and infrastructure

A Gadgetworld is a functional cluster of collaborating eGadgets, which exhibit collective behaviour that exceeds the sum of their individual capabilities. It is intended that people should purposefully associate the Plugs of different eGadgets and synthesize Gadgetworlds as ordered sets of Synapses; in this context Synapses can be described as invisible links between the objects. People can create, edit or destroy a Gadgetworld. Because eGadgets can communicate and interact, peoples' environments exhibit a highly dynamic, emergent, possibly intelligent behaviour. Intelligent mechanisms are employed, aiming to learn from people' s use of a Gadgetworld and (transparently) optimize it and ease the formation of Gadgetworlds.

The e-Gadgets project is developing and validating GAS (Gadgetware Architectural Style), an architectural style for engineering eGadgets and Gadgetworlds. GAS-OS, a system (software and hardware) implementation of GAS as a distributed system, a set of concepts defined within GAS, and the tools to manipulate them has been delivered and used in the expert appraisal. The design of this novel hardware / software architecture supports computation with limited resources, ad-hoc networking, and collaborative capability.

A set of sample e-Gadgets has been created, as test implementations of embedding the proposed platform into everyday objects without drastically altering their physical form. Yet, in order to use eGadgets, people have to adapt their task models to include the newly offered possibilities.

Evaluation procedure

A central research question for the e-Gadgets project is whether the end-user will be inclined and able to use GAS to serve his/her needs. A series of formative evaluations is planned for the iterative improvement of the concept and its implementation. At this early stage of a project the implementation is not sufficiently developed to allow end-user testing. Instead, an expert appraisal was carried out for evaluating the proposed interaction concepts and technology, with respect to the end user requirements. It focused on two main issues: a) Comprehensibility of the underlying concepts and interaction b) Willingness to use such technology.

Unavoidably this expert appraisal addressed issues and made suggestions that relate to the wider area of Ubiquitous Computing applications, highlighted its potential pitfalls, benefits, and effects on peoples lives.

The appraisal involved four HCI experts and was organized as follows: first they were introduced to the main concepts, then discussed four scenarios that highlighted different ways of constructing Gadgetworlds, and finally were asked to sketch out their own Gadgetworld, as a pen and paper exercise. Afterwards, a video prototype of a sample Gadgetworld was shown and some initial design of the graphical user interface for making synapses was discussed. For each of the above, the experts highlighted potential problem areas.

Evaluation results

The feedback to the project, was captured as 5 tentative design principles:

1. The Gadgetworld behavior should not surprise the user, i.e. any automation or adaptation actions should be predictable (or at least justifiable).
2. Everyday objects should be augmented to become eGadgets parsimoniously and only in cases where clear benefits justify inconsistency with user's mental models of the object.
3. The use of intelligence is justified only when it simplifies complex tasks. Simple tasks should remain simple even in an intelligent Gadgetworld.
4. Treat users at least as good as programmers (in a broader sense) and provide them with tools that increase comprehensibility in Gadgetworld construction and manipulation: e.g., debuggers, object browsers, help, etc.
5. If the user defines behaviors, behavioural abstractions should be supported rather than structural (architecture).

Conclusions

A component-architecture directly visible and accessible to people is a novel form of end user programming, especially suitable for Ubiquitous applications.