Simplicity, Consistency, Universality, Flexibility and Familiarity:
The SCUFF Principles for Developing User Interfaces for Ambient Computer Systems

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ABSTRACT

This paper describes the user interface design, and subsequent usability evaluation of the EU FP6 funded Easyline+ project, which involved the development of ambient assistive technology to support elderly and disabled people in their interaction with kitchen appliances. During this process, established usability design guidelines and principles were considered. The authors’ analysis of the applicability of these has led to the development of a new set of principles, specifically for the design of ambient computer systems. This set of principles is referred to as SCUFF, an acronym for simplicity, consistency, universality, flexibility and familiarity. These evaluations suggest that adoption of the SCUFF principles was successful for the Easyline+ project, and that they can be used for other ambient technology projects, either as complementary to, or as an alternative to more generic and partially relevant principles.

Keywords: Ambient Design Principles, Assisted Living, Evaluation, SCUFF, Usability

1. INTRODUCTION AND MOTIVATION FOR RESEARCH

We have developed user interfaces situated in modified familiar home devices, specifically television sets, mobile devices and interactive digital photographic frames, as part of the EU FP6 IST Easyline+ project (Low Cost Advanced White Goods for a Longer Independent Life of Elderly People).

Sensors using radio frequency identification (RFID), ZigBee, powerline communication
and infra-red technologies enable the Easyline+ system to interact with the home environment. Human activity is monitored by an intelligent server, which we call the e-servant. The e-servant recognizes and adapts to changing needs as the user grows less able over time.

A simple example of an Easyline+ interaction is the scenario of a cooker hob being left on either with no pan on it or after a pan has been removed. The message Hob left on with no pan is conveyed to the user (wherever they may be in the home). The precise nature of the interaction and the range of options available to the user are adaptive, flexible and dependent on their level of ability, which can be assessed on a number of scales. However, the essence of the dialogue in this case would be that the user could turn off the hob remotely or respond: Yes, I know; leave it on (if they are permitted to according to their profile). Other scenarios include: Food has expired in the fridge, The washing cycle has finished, This food cannot be microwaved, and so forth. Additionally, a standalone RFID reader advises the user what to do with an item of food or clothing, an innovation particularly useful for visually impaired people. To support the international dimension, a range of European languages is also supported. The system is also adaptive in that it can modify the user interface for changing physical and cognitive abilities.

During the project’s development, a number of user-centred exercises and events were undertaken to tune the design requirements, including workshops, focus groups, interviews, and evaluation sessions (Picking et al., 2009). We also employed personas (Cooper, 2004; Blythe & Dearden, 2009) to help us stay focused on the expectations of the end users. Summative testing of the ranges of devices and interface designs took place in a purposely developed usability laboratory, which simulated an elderly/disabled person’s living space.

Satisfying the user and functional requirements are of course critical in any computer system development project, and good design augments these by referencing design principles relevant to the domain of enquiry. This paper describes the rationale for how we framed our user interface design decisions, and how this framing provided us with a structure which we propose here as a set of principles specifically for user interface design practice in the domain of ambient computer systems.

2. USER INTERFACE DESIGN GUIDELINES AND PRINCIPLES

The process of user interface design can be highly complex, as typically there are many competing variables involved. We could describe those variables as the who (the user population), the where (the environment the proposed system will be used in), the how (the style of user interaction, and the design of the tasks), and the what (the technological nature of the devices as well as the software/hardware constraints). Most user interface designers champion the who as the most important of the four variables, and consequently advocate a user-centred approach to their work.

To support designers in their consideration of users, a number of guidelines have been published over many years. Such guidelines aim to steer designers by keeping them on the track of developing quality, consistent user interfaces that conform to the standards expected by the owners of the guidelines. Examples of these include Apple’s I-phone Human Interface Guidelines (Apple Inc., 2010) and Microsoft’s Inductive User Interface Guidelines (Microsoft Corporation, 2001). As they tend to be for specific styles of interaction, for known types of devices, and for tasks that take place in typical environments (in other words the how’s, what’s and where’s are predictable), such guidelines are always highly detailed.

At a further level of abstraction, design principles seek to cover a wide range of applications and application domains. Most sets of design principles are relatively short, comprising typically between six and ten individual principles. A well-known example is Shneiderman’s eight golden rules of design (Shneiderman, 1999), summarized in Table 1.
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