Chapter 20

Clustering User Data for User Modelling in the GUIDE Multi-modal Set-top Box

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20.1 Introduction

The EU GUIDE project is aimed at developing a research-based prototype of an inclusive and accessible set-top box running on conventional hardware. It utilises advanced user modelling and simulation in conjunction with a single layer interface that permits a wide range of input devices and modalities and output formats and modes. This paper addresses part of the research behind the development of an advanced user model in order to develop the software framework, namely the user profile clustering. A range of user centred design techniques, including focus group, survey and several iterative stages of design trials have been used overall to create the requirements specification for the technology framework under development. However, a key module is the inbuilt user model that allows the system to classify users on the basis of their impairment level, user interface (UI) behaviour, preferences and context. These profiles are pre-generated using an advanced cognitive, perceptual and movement simulation, using parameters clustered from the actual user data. This chapter examines the contextual background literature, briefly describes the inclusive user centred design process and shows how this process generated the data necessary for clustering for cognitive, perceptual and motor-impaired user modelling.

20.1.1 Background and Motivation

GUIDE primarily addresses end users who have mild to moderate impairments. This target group is identified within the context of literature concerning inclusive design, accessibility and the digital barriers excluding older technology users from access to digital technology. An inclusive approach considers the visual, hearing and touch perceptual capabilities of users in combination and attempts to quantify capability variation. This approach is well suited to multimodal interface design
where capability impairment in one modality may be compensated for using other modalities (e.g. hearing impaired users may use visual captioning, avatars and sign language) or where multiple impairments can be addressed using the performance gains arising from multimodal interfaces. For instance, gesture, speech and face recognition for input can be used with sound, touch and graphical output displays to enhanced effect.

### 20.1.2 User Centred Design and the Design Process

End user requirements for ageing people and those with impairments were collected using a mixed methods approach based on the advantages of triangulation of data sources (Langdon et al., 2003; Flick, 2006). In essence, this approach does not commit to a single source of data or a single data collection approach. Instead data is collected from multiple approaches, for example: literature review, quantitative analysis of data from forums, user trials, user surveys, and questionnaires, qualitative analysis of observational data from user forums or interviews, video from user trials and usage ethnography (Langdon et al., 2003; Flick, 2006). In the case of GUIDE, the framing of the project as a design problem constrains the triangulation and assists it by directing the focus of comparison on the design of the final interactions between user, system, and technology and usage context. The particular methods used are shown in Figure 1. The sampling strategy employed was opportunistic, and stratified, choosing data sources according to convenience and resource limitations. In particular, much of the work took advantage of empirical and observational trials. However, the combination of multiple sources permits triangulation and thus increased validity and reliability of qualitative findings (Miles and Huberman, 1994).

We focus on the lower region of Figure 20.1, on the data sources and processes of clustering user data from: objective performance data from user trials; user screening survey data; existing data from input device validation trials. The clustering of data from these sources was intended to define groupings that could be traced by membership to specific capability levels in specific modalities.