A Task-Model for Isolating Problems in Accessing DTV Technology for Viewers with Impairments

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Abstract
This paper describes a model being developed to describe gulfs between user capabilities and the cognitive and physical demands of existing designs. The model is based on theoretical work by Don Norman (1986) describing usability problems as gulfs of evaluation and execution between the users of interactive technology and the model of use implicit in the system. In particular Norman describes a seven-stage model of interaction, which is useful in considering the key component mental and physical steps necessary in task completion. This model provides a description of the cognitive and physical sub-tasks or steps that the user must undertake in order to perform basic interactive tasks with digital TV remote controls and on-screen features.

1. Introduction

The standard design of DTV tends to be 'one-size-fits-all' based on a notion of the average or typical viewer. As a result the standard design tends to waste opportunities to design inclusively for those with impairments. One useful way of supporting innovation in inclusive design is to model the gulfs of execution and evaluation in existing designs, and in doing so pinpoint specific low level elements of interaction that innovation and improvement must address. It is this approach that the work described here supports.

This hierarchical task analysis of digital television (DTV) usage is intended to list the operations that are required by the viewer. It can then be used to examine the accessibility issues presented, and the alternative interaction modes that may remedy these.

The analysis is based on the configuration of domestic television receivers currently marketed in the UK. The particular issue here is that whilst television sets that integrate a terrestrial digital (D-Ter) receiver are increasingly available, and would typically be bought when replacing the main domestic set, to facilitate digital reception in the shorter term, external receivers (set-top box or STB) are used to upgrade analogue sets. Making use of digital satellite (D-Sat) and digital cable (D-Cab) services also requires the installation of an STB. This adds a significant element of complexity in operation as gross manipulation of the TV set (switching on and off, adjusting picture quality, etc) requires use of the TV's remote control in addition to that of the STB's. Service providers have introduced facilities for 'training' the STB handset to replace the TV's for most, but not all, functions. Often owners are not aware of this possibility.

Don Norman's 'Seven Stages of Interaction' are used to analyse the task model with respect to the issues that each level of the task presents (Norman and Draper 1986). The seven stage concepts are applied at each level, so that in a super-task, a sub-task analysed as being an 'action', when expanded, may represent a 'goal' at the sub-task level.
Steps in individual tasks may simultaneously be composed of a number of Norman's stages. For example; the task of picking something up may simultaneously represent:

- the implied goal of having possession of the object (G),
- an implied intention of achieving that goal by the action of picking the object up with the hand (I),
- the specification of an action sequence of operating the hand and arm (A) that could if necessary be analysed in increasingly fine-granularity,
- the execution of the action (X),

- the perception of the state of the world composed of sight, touch and proprioception received during execution (P),
- interpretation of the identity of the object picked up, together with the information that it is being successfully held (T),
- evaluation of the success of possessing (securely) the (identified) object (E).

Figure 1 below shows an example of the task of managing broadcast viewing, specifically the selection of channels.

Task Number	
2.2	Manage broadcast viewing
2.2.1	G^1 Select channel
2.2.1.1	I^1 *Method:* Use 'channel number' to select channel
2.2.1.1.1	A^1 G^2 Enter 'channel number' into STB
2.2.1.1.1.1	I^2 Enter digits into STB using remote
2.2.1.1.1.1.1	A^2 Obtain (STB) remote*
2.2.1.1.1.1.2	A^2 *While digit to enter:* Enter digit
2.2.1.1.1.1.2.1	Press (digit) button*
2.2.1.1.1.1.2.2	E^2 *Option:* Confirm digit entered
2.2.1.1.1.1.2.2.1	P^2 Locate (channel display) on (STB)*
2.2.1.1.1.1.2.2.2	T^2 Read (channel display) on (STB)*
2.2.1.1.1.2	E^1 *Option:* Confirm channel selected
2.2.1.1.1.2.1	P^1 Locate (channel display) on (TV screen)*
2.2.1.1.1.2.2	T^1 Read (channel display) on (TV screen)*

Figure 1. Digital Television Task Model Fragment

2. Utility of the model

The model can be used to assess the assumptions about user capabilities that are implicit in a design, either as a tool for user-based evaluations or a Claims Analysis evaluation using scenarios and personae (Rosson and Carroll 2001). In the former case subjects are set tasks including subtasks indentified in the model format. Difficulties that occur are pinpointed to specific sub-tasks that they are trying to perform at points where problems occur, isolating parts of the task where there are significant gulfs of execution and evaluation. In the scenario-based Claims Analysis the dialogue and artefact are examined, so that designers can assess the demands that the design makes on the viewer. A 'claim' would for example, be that the viewer locate and read the channel display, and enter the appropriate numbers. The way that this is design carries assumptions about the viewer being able to perform a visual scan (perceive the information, given its size, colour, etc) interpret the information, and recognize the cue to confirm a channel selection. Implicit in this is the assumption that viewers will be able to read characters of the size offered and be able to cope with the level of foreground and background colour offered. Our previous work (Springett and Griffiths 2007) suggests that viewers with low vision have significant difficulty with such tasks. Cross-referencing the 'claims' with the personae description (e.g. a viewer with low central vision) pinpoints weakness in the design and areas where the space of alternatives requires exploration.

3. Conclusion and future work

The aim of this work is to proceed from the start-point of exposes gulfs in the 'system model of the viewer' embodies in the design and actual models of the user derived through user-based or contrived evaluation studies. The model requires a further extension that formally describes the cognitive and physical demands of existing designs. The linkage of this approach to more creative innovative design exercises is also a goal in the next phase of this work.

References

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