A Digital Library of Conversational Expressions: Helping Profoundly Disabled Users Communicate

Hayley Dunlop, Sally Jo Cunningham & Matt Jones

[sallyjo, mattj]@cs.waikato.ac.nz

Department of Computer Science

University of Waikato

Private Bag 3105, Hamilton

New Zealand

ABSTRACT

Digital libraries are for everyone. This paper describes the development of a digital library for a user who has a profound physical disability that means she cannot communicate verbally, and cannot use conventional communication tools.

Keywords

Physical disabilities, communication aids, case study, user centered design, HCI.

INTRODUCTION

Digital libraries have been created for mass audiences as well as for small interest groups. Furthermore, concern over a growing 'digital divide' has prompted research into appropriate interfaces and access methods for individuals and groups on the wrong side of that divide.

This work illustrates a further application of the notion of universal access by considering extra-ordinary users [1]. We describe a DL-based communication tool intended to support conversation for users who experience two types of communication disability: they are incapable of speech, and they are physically unable to use standard writing devices.

THE PROBLEM

Our user, 'Jane', is a fourteen-year old student who has severe cerebral palsy, and as a consequence does not have independent and reliable use of her limbs. Jane is unable to speak. Although she produces non-lingual sounds that can be interpreted by her caregivers, these utterances are of a limited conversational range, and people less familiar with Jane cannot understand them. She is, essentially, non-verbal.

JCDL'02, July 13-17, 2002, Portland, Oregon, USA.

At the time of this study, Jane had several hundred conversational phrases stored on her computer. However, these phrases were not held in a central database; they were scattered across several different programs that Jane cannot open independently. The potential usefulness of these phrases was thus greatly diminished. Further, the phrases were not consistently categorized for access via browsing.

A DIGITAL LIBRARY OF EXPRESSIONS

We based the communication aid on the Open Source Greenstone digital library software [3].We used three techniques to identify expressions for the digital library: an examination of vocabulary recommendations from the Augmentative and Alternative Communication (AAC) research field, advice from Jane's caregivers (using a diary technique), and finally direct input from Jane herself.

Each expression is stored as a document in the digital library, and the set of all documents is treated as a single collection. This organization provides a centralized location for Jane to access. Each expression can have metadata associated with it, such as subject information.

ACCESSING THE DL

Jane's input device is a head switch, which restricts her input events to, effectively, a single left mouse button click. Jane's physical limitations suggest that this is the only input device available to her.

Given this forced choice of input device, the only selection algorithm available for Jane is scanning: onscreen options are successively highlighted until Jane selects one option with a switch action. The Greenstone software includes a flexible macro language that can be used to alter the 'look and feel' of the standard digital library interface. This macro language was used to add a scanning algorithm to the communication aid.

To use browsing to select an expression, Jane first selects 'Browse' mode. Jane is then presented with a list of the eight top-level expression metadata categories, and the scanning algorithm iterates until she either selects one of the categories, or selects the option returning her to the

main screen. This process is repeated until the set of expressions in a category are displayed, and the list is scanned until Jane selects one of the expressions.

In order to search for an expression in the digital library, Jane must be able to enter a keyword into the digital library search interface. The list of expressions containing that term is then displayed in a conventional 'hits' screen, and the hits are successively scanned until Jane selects the desired expression.

To assist Jane in entering characters, we developed and evaluated three onscreen keyboards using Jane's existing assistive software (*Discover Ke:nx*™). Each board employed scanning to iteratively highlight choices until the user makes her selection (in Jane's case, with her head switch).

One of the boards (Figure 1), inspired by [2], resembled a mobile phone keypad – there were just 9 keys each with multiple characters (e.g. "ABC", "DEF"). A theoretical analysis showed that the mean number of head movements and time to enter key terms was statistically significantly lower with this scheme than with the Qwerty and letter-frequency ordered boards. The theoretical benefits of the scheme are because the user can enter ambiguous input (e.g. if a user selects "ABC" what character do they mean?). The ambiguity is later resolved by the software

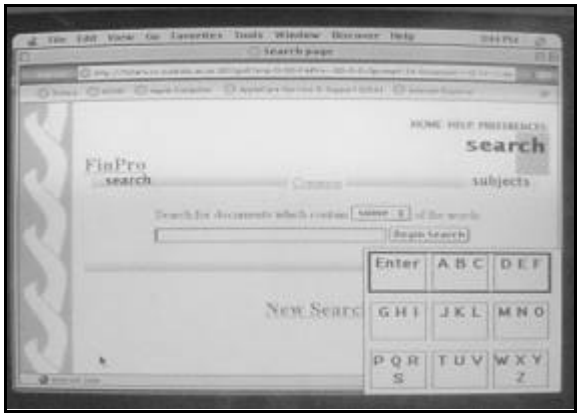

Figure 1: keypad entry of search terms

QUALITATIVE EVALUATION OF THE AID

Jane used to system to carry out some basic browsing and search tasks using full range of interaction methods provided.

For selection, the conventional wisdom is to place the most frequently accessed option as the first item, so that the scanning software highlights this item first. However, Jane had difficulty in focusing on, interpreting, and then selecting the first item before the highlighting moved on to the next item in the sequence. A better design would be to place most frequently accessed elements further down the list.

The telephone keypad approach was seen to have the disadvantage of increasing the user's cognitive load. This was a particular issue for Jane, who has lower than average literacy skills.

Jane felt that the number of phrases (72) in the initial collection was about right, and would be manageable for browsing. Given her dependence on memorization, it appears that browsing would indeed be her preferred interaction mode with the communication aid. However, Jane perceived the searching method, and particularly the telephone-style keypad, as enjoyable; there may be an opportunity to use this sort of interaction method to allow Jane to practice her spelling and to improve her written communication skills.

CONCLUSIONS AND FUTURE WORK

There are many unanswered questions and interesting issues. We focused on one particular user's needs – how can we generalize our findings? The collection at present is static and uses only a limited amount of meta-data: how could the user add to the collection and how could meta-data further enrich the resource?

Jane already enjoys surfing the Web. If the output of the communication aid is piped to an Internet Chat session, then a user could participate in conversations with others in remote locations. The relatively slow conversational speed achieved with this tool would be to some extent obviated by the delays common in Internet Relay Chat—in this case, helping Jane's conversation more closely approach the 'norm'.

Clearly, the access methods can also be applied and extended to enable disabled users to access general collections. Members of the NZDL are also investigating related applications including digital libraries for the illiterate and cross-cultural adaptations.

ACKNOWLEDGMENTS

We would like to express our sincere thanks to Jane, her caregiver, her parents and siblings, and the members of the Physical Assistance Unit at Jane's high school. We would also like to thank the various members of the New Zealand Digital Library group for their technical expertise and creative ideas.

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