1 Title

Human Computer Interfaces for People with Physical Disabilities.

2 Introduction

The uptake of electronic and computing devices within society has grown massively in recent years. Most of these devices require interaction by people through button presses and other movement. The Personal Computer, for example, requires precise movement of hand muscles by the user through a keyboard and mouse. This method of interaction causes obvious issues for people lacking full control of these muscles, but who are otherwise quite capable of using the devices.

Health Technology Consultancy, in collaboration with 2004 studentship award recipient Steven Webb, have produced the *expand* system (Webb, 2005) to provide a user with full control of a PC and other devices through actuation of a single on/off type interface, such as a blowtube. This allows people with physical disabilities access to computing devices through use of a single muscle which they are most capable of using.

While much of the groundwork for the project has been completed, further development is required to generate a system suitable for release to the general public.

3 Nature of Project

3.1 Background

Human Computer Interface (HCI) design is a large research field within computer science, containing aspects of psychology, social sciences (Carroll, 1997), design and art. A subset of HCI focuses on people with physical disabilities (Bergman and Johnson, 1997; The GNOME Accessibility Project, 2004). More recent research takes a closer look at input devices and how lack of mobility affects usage of existing systems (Lopes, 2001). Steriadis and Constantinou (2003) present results of studies into single button interfaces, describing the effectiveness of different scanning methods to cycle between "clickable" areas on a screen. The concepts used are similar to the *expand* system.

The aim of *expand* is to make computing technology available to people who cannot use traditional methods of input. While commercial solutions exist, the costs involved can be high. The *expand* system aims to be free, or at least inexpensive. This applies to all aspects of the system including hardware, software, and support.

Hardware for the *expand* system comprises of a PC, an Infrared (IR) transceiver and a single button input device. The PC should be inexpensive, hence the *expand* system must operate on older PCs, lacking some features of current models. An IR transceiver is used to control electronic devices in the patients environment such as a TV. This has been produced using readily available off-the-shelf components from electronics retailers (Altronics, 2005; Dick Smith Electronics, 2005) and is simple to build for people with minimal electronics knowledge. Further research is required for input devices to specific to patients' needs.

Software for the *expand* system is broken into three main sub-systems:

- Parallel Port Universal Infrared Controller (PPUIRC) - Interface to hardware
- Icon Commands (IC) - Generate commands using "clickable" icons
- Uno - Single button control interface to computer

These software components operate together to allow access to underlying applications, such as web browsers and email programs in addition to giving a user ability to control items within their environment through the PC software. All software is released under the GNU General Public License (2005) allowing use of other similarly licensed software within the system.

Distribution and support of the *expand* system is the final important aspect. Currently the system is unavailable to users. Releasing the system, and documentation is the next step of the project.

3.2 Aim

The aim of this project is to release *expand* as a complete system, enabling people with a physical disability a higher level of accessibility to computing devices. This must be at little or no cost to the user.

3.3 Objectives

The specific objectives of the project to obtain the overall aim are listed in order of importance:

1. Create development documentation and Sourceforge development web site (SourceForge.net, 2005)

2. Uno - Develop configuration dialogs to allow customisation
3. Icon Commands - Develop configuration dialogs to allow customisation
4. Create modular install packages
5. Create user documentation and web site
6. Uno - Reset function
7. Uno - Resizing of keyboard text
8. Uno - Improve user interaction
9. Uno - Internationalisation of keyboard layout
10. Uno - Predictive text input using dictionary of common words
11. Uno - Provide different scanning methods selectable for user preference.
12. Uno - Simplify input device access to capture key press from any device known to the system.
13. Perform testing with users from Shenton Park Rehabilitation Center and modify system as a result of outcomes.
14. PPUIRC - investigate alternate input methods, such as USB

3.4 Methodology

Completion of each phase within the project will mark specific milestones met and allow the next phase to begin.

3.4.1 Phase One - Development environment

An initial period of exploring the system will also involve completing objective one. This will allow existing and new developers to interact and assist with the project as needed. This facility is provided at no charge by SourceForge.net (2005) for "open source" projects such as *expand*.

3.4.2 Phase Two - Software development

Phase two involves modification of the Uno and Icon Command sub-systems to bring them to a level suitable for release. This requires meeting objectives two and three, and six to twelve. Phase two also requires determining the most suitable initial configurations and testing the system as a whole.

3.4.3 Phase Three - Distribution

Phase three involves generating installation packages ready to release. This involves meeting objective four.

3.4.4 Phase Four - Documentation and testing

The final phase is the generation of user documentation and a web site for release of *expand*. This meets objective five. Modifications to the system may now be made by developers through the SourceForge website following feedback from users. This phase will also hold generation of a final report on outcomes of the project.

3.5 People

People involved in this project are as follows:

- Wilson Waters, Curtin University: Student
- Brett McLoughlin, Health Technology Consultancy: Host supervisor
- Geoff West, Curtin University: Academic supervisor
- Steven Webb, Human Technology Consultancy, Curtin University: Expand system development

4 Timetable

4.1 Timeline

See Table 1.

4.2 Resources

The following resources will be required for successful completion of the project:

- PC to develop and test software
- Hardware for testing

Table 1: Timeline

Phase	Description	Milestone	Weeks	Start
1	Development environment	Sourceforge development site available	2	1
2	Software development	Uno and IC ready for release	5	2
3	Distribution	Packages released	1	7
4	Documentation and testing	User documentation released on web site	2	9

  - Environmental items: Air conditioner or TV to test IR functionality
  - Single button input devices such as a blow tube

- Sourceforge development site
- Web site hosting - Information, documentation and downloads
- Patients from Shenton Park Rehabilitation centre for testing and feedback
- Supervisors time

5 Potential of the Project

The potential of the *expand* system can be broken into three main areas: social advantages through increased independence, savings to the West Australian government through reduced disability support costs, and the marketing of commercial products for interaction with the system.

Providing a solution for people with disabilities to interact with their environment gives independence which is otherwise lost. This allows people to control their environment, improving self-worth and quality-of-life. Employment could be sought in occupations such as research, support, and data entry where access to a computer is the main requirement.

This independence will also reduce costs to governments through numerous channels. If people with disabilities can generate their own income, they will reduce their dependence on social welfare, allowing this funding to be spent elsewhere. By giving people control over their environment, some people with disabilities may live in their own homes rather than government funded health care facilities. Full time support from nurses and health professionals may also be reduced.

Development of electronic input devices may also provide a worthy commercial application. While the *expand* system includes details to inexpensively produce effective hardware, commercial entities may develop devices for specific patients, providing growth for engineering and production facilities.

6 Key Objectives for Host Organisation

While Health Technology Consultancy will not directly profit through release of the *expand* system, the indirect benefits have potential to assist all organisations involved in public health. By taking strain off government spending in disability support, funding may be redirected to other important areas within public health, such as medical imaging. Health Technology Consultancy is a supplier of medical imaging equipment and would directly benefit from an increase in funding.

7 Benefits to Western Australia

As discussed in section five, people with disabilities living in Western Australia will directly benefit from this project through improved quality-of-life. With the West Australian government spending over $244 million on disability services (Kucera, 2005) over the 2005/06 period. The increased independence of people with disabilities would reduce the funding required. Less dependence on health professionals would also benefit the West Australian public health system.

8 Conclusion

Completion of the *expand* project through the Studentship Award has the potential to benefit many people throughout Western Australia and the world. The technological advances of this system will allow people with physical disabilities the use of computers where it was previously difficult, or impossible. Reduced reliance on government welfare schemes will benefit society as a whole, as funding is spent in other areas. Most important are the social advantages of such a project, giving people with disabilities an improved quality-of-life through independence.

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