HCI: Helping Southland Children with Special Needs

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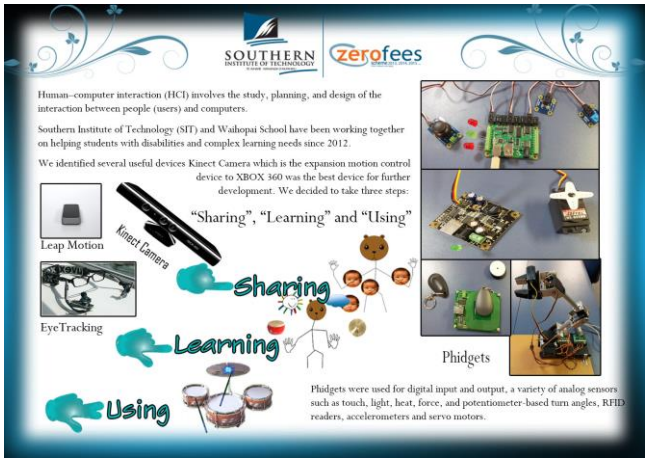
ABSTRACT
In this paper, we describe a student project from 2012 where physical interfaces were developed to aid communication with a group of severely physically challenged children.

Categories and Subject Descriptor
K.3.1 [**Computers and Education]**: Computer Uses in Education *–computer-assisted instruction (CAI).*

General Terms
Performance, Design, Human Factors.

Keywords
Interaction



1. INTRODUCTION
The Southern Institute of Technology was approached by a local teacher to develop computer devices to improve the communication experiences of a small group of severely physically challenged children. The children, aged between 11 and 18, had limited motor movement, were confined to assistant propelled wheelchairs, and had little or no means of verbal communication. The main interaction to date had been using buttons mounted on a mouse, and on toys. There was little knowledge of the extent of the world-view of the children.

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The children had been in a relatively isolated environment and there were concerns over their acceptance of a small group of strangers intruding in their environment, let alone intruding in their personal space. Ethical approval was given by SIT, all interaction was sanctioned by the children's parents/guardians and was closely supervised by their teacher. The project had the risk that it was quite possible to spend the eight months with no positive outcomes.

The project follows a growing movement to use sensors and computer controlled devices to assist children with special needs. Alper, Hourcade, and Gilutz [1] discuss using HCI techniques and specifically mentions projects helping children with hearing problems and projects assisting children with autism.

Our project was a capstone project for final year students in the Bachelor of Information Technology at the Southern Institute of Technology. The students had just started a Human Computer Interaction paper where they investigated ways to physically interact with computers using more than the traditional methods such as keyboards and screens. The main technologies used were the Phidget Kits from a Canadian company - Phidgets Inc (http://www.phidgets.com). Phidgets were used for digital input and output, a variety of analog sensors such as touch, light, heat, force, and potentiometer based turn angles, RFID readers, accelerometers and servo motors. Saul Greenberg and Michael Boyle pioneered these devices and have published a number of papers showing their applications [2]. Since then they have been used in a variety of both educational and industrial applications. Deligiannidis [3] describes how a virtual reality gaming environment using Phidgets was used with children with cerebral palsy to help boost self-esteem through social interaction.

For our project the students also investigated basic operations using the Microsoft Kinect for recognition of body movement and ultimately this became the most productive part of the project.

2. RESULTS AND FINDINGS
Initially the group simply extended the switch based devices in order to learn more about the children and the limitations on their capabilities. Small programs were developed to stimulate them visually, and involved picture recognition. One design point that quickly became apparent was the need for all software to have minimal decorative features and plain coloured backgrounds in order to avoid distracting the children. The next stage of development was to create simple stick figure applications that the students could control using the Microsoft Kinect device. The Kinect uses a series of cameras to body detect movement. This was highly advantageous to our children as it meant they could communicate with the computers without having to attach sensors to their heads and limbs – a situation that would have been intrusive. Because of the limited and mobility of the children and their lack of control over their movement, any detected motion had to have a wide tolerance range.

The group first extended the picture recognition games to use the Kinect for input and then worked on a simple music program where the children controlled, via the Kinect, a virtual drum set with cymbals.

3. FUTURE DEVELOPMENT

There are a rapidly increasing number of HCI devices coming on the consumer market which may help improve life experience for people with severe challenges such as our children had. The group researched eye-tracking technology initially but found the technology was not appropriate for this project both cost-wise and time-wise; however it should be revisited in the future. Some work has been done on the Leap Motion sensor as an alternative to the Kinect; however the features of the Leap Motion are higher accuracy of movement detection, a very narrow dept range for movement and detection of hands, not the entire body. While the Leap Motion is an exciting development, the limitations that the children have with movement make the Kinect a more useful communication device at this stage. Another device we have looked at but which is not yet available is the MYO armband from Thalmic Labs (http://www.thalmic.com). Until we have such a device we cannot compare its suitability but movement detection without cameras promises to offer potential.

4. CONCLUSION

While this project has only touched the surface of what can be done, it has been satisfying and successful in that we have shown that it is possible to increase the level of interaction with these children. While the projects were quite simple the project has shown that there are new possibilities available for such children not simply in education but in their general lives where computer control can be extended to controlling their environment with less reliance on caregivers.

The project was appreciated by the teacher, and this year another group of final year students have been invited to continue where the original project left off.

REFERENCES

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