IntelliVision

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ABSTRACT

IntelliVision is an interactive multi-sensory environment intended for cognitively impaired children in a hospital setting. The system detects and responds to a child's movement, with the goal of engaging the child's visual attention more effectively than traditional stimuli and entertainment.

Our primary focus was on the needs of children with Cortical Visual Impairment (CVI). In the absence of appropriate stimuli, some cognitively impaired children, including those with CVI, will engage in repetitive, self-destructive, or other injurious behavior. With this problem in mind, we tested various types of interactive visual and sonic input with the children, and observed the impact on their visual attention, focus, and overall behavior. We found that the rate of visual and sonic changes, size and clarity of the visuals, as well as vibration input were all key attributes in capturing children's attention more effectively than existing methods.

Keywords

Children, Cortical Visual Impairment, multi sensory stimuli, sensory integration, interactive sound and video, vibration therapy

INTRODUCTION

Cortical Visual Impairment (CVI)

CVI is a condition that causes difficulty in processing and interpreting visual information in the visual cortex. It can be caused by a number of conditions (including brain damage from lack of oxygen, trauma, epilepsy, infections, metabolic diseases). Although often referred to as a blindness, some vision is often present in children with CVI. Peripheral vision is often used, rather than direct, to track a visual stimulus. These children bring objects very close to their eyes – which fills the existing visual field and reduces non-essential visual stimuli, and allows them to better process the visual information. Over time, children with CVI will show improvement in visual responsiveness. Modification of the visual environment is critical to encouraging this growth. [1]

Concept Development

The need for innovative and interactive stimuli was identified via a collaboration between NYU's Occupational Therapy and Interactive Telecommunications Programs, and the Pediatric Center of the NY Foundling Hospital.

Within the Foundling Hospital, existing methods of stimulus and entertainment for patients are passive and non responsive to a child's presence. These methods (including snoezelen[1] and regular television) were occasionally effective in capturing and maintaining the attention of children with cognitive impairments. For some children, particularly those with multiple sensory deficits, this lack of engaging activity results in self-injurious behavior. Consequently, the staff at Foundling identified the need for more effective stimuli.

Overview

IntelliVision consists of a large screen display that is mounted over a bed or wheelchair. The screen displays video and sound content generated by a computer running MAX/MSP/Jitter[2]. There are currently three content modules, which share an infrastructure and basic interaction model. A digital video camera captures the patient's image and surrounding environment, and translates his/her motion into changes in the imagery and sound. The change of visual effects resulting from this motion varies based on which module is selected.

There is also a tactile module that vibrates in response to bass frequencies in the audio. This device can be positioned at different points on a bed or wheelchair tray to provide appropriate tactile stimulation.

Because this system is intended for a hospital setting, we anticipated that a therapist or other staff would be running the program. Therefore we created a simple screen interface allows therapist to easily access, select and adjust the

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[1] Snoezlen is a sensory integration therapy practice that incorporates light and sound stimuli.

[2] Max/MSP/Jitter is an interactive software program available through http://www.Cycling74.com

content experiences based on a patients particular condition, without having to make any adjustments directly to the software patches.

Once a module is selected, the therapist can then select from a variety of additional settings, including: motion sensitivity, color palettes, music genre and overall volume.

USER SCENARIO

A patient with cerebral palsy is recovering from surgery at Foundling. This patient has CVI and sensory deficits, which require different visual stimuli than a typical environment provides, to capture her attention. A therapist places IntelliVision over the patient's bed, in lieu of turning on the TV, to keep the patient engaged. The therapist turns on the attached computer, selects the appropriate content program, and adjusts the sensitivity settings for the patient.

Because this patient has physical mobility, and some recognition of cause and effect, the therapist selects the MusicMoves program (pictured right), which shows the patient image with a vertical bar scrolling across the screen. A vibrant color scheme is chosen since children with CVI respond better to saturated, high contrast colors [1]. Any movement is translated into musical notes, which appear on screen as well as in the soundtrack. When the bar moves across the notes location on screen, those notes are played along with the background sound. If the patient continues moving, new notes appear and the older ones expire over time. If the patient rests for an extended period of time, the background sound and image continue in an aesthetically pleasing mode until the patient moves and triggers additional sounds.

PROCESS AND PROTOTYPE

This project began in February 2004 as part of a cross departmental collaboration at NYU, and is still in the early stages of prototyping. The objective is to test and develop a version to install at Foundling within the next few months.

Needs Assessment

Therapists at Foundling were looking for multi-sensory experiences for patients in their facility that would:

- Serve some of the more involved patients with CVI who seemed to have more downtime than others
- Help capture children's visual attention and prevent potentially injurious self stimulation
- Teach children cause and effect and encourage independent physical movement as well

User Testing

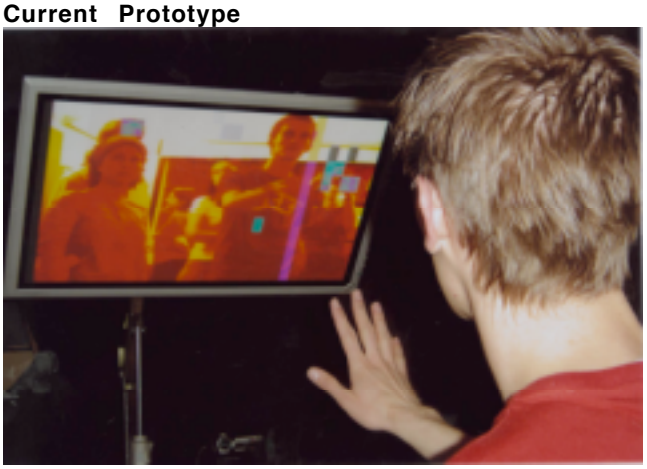
Early observations

In the first phase of observation, a variety of video footage was shown at Foundling, including nature scenes, urban imagery and more abstract visuals. Therapists observed the children's responses and rated them based on whether it captured or focused their attention, as well as the overall effect on their behavior. We expected nature scenes to be more calming and focusing, so were surprised as we observed that the rate of change in the content (motion in the content as well as change between content segments) was more influential in capturing attention than the content itself.

The next phase of testing incorporated the child's image. The patient's image was projected onto the screen and their movement would trigger colorful abstract visual effects to the image. We found some children were more engaged by their own image being projected on screen. We also tested a variety of music and sounds (jazz, rock, hip-hop, reggae), but again found that the change was as, if not more, important that the content itself in capturing attention.

An experience during this observation inspired the inclusion of vibration stimuli. A patient came in to view the content and was visibly agitated, moving around aggressively and engaging in self-stimulating behavior (hitting herself on the forehead). Changes in imagery and sound seemed to have little impact on her, until we moved the speakers on to her wheelchair tray. The closer the speakers (and the resulting vibration from them) were, the more focused and calm she became.

Current Prototype



1. Display: IntelliVision uses a 42-inch plasma screen. It is mounted to a Hoyer lift -- a portable, hydraulic device used in hospitals to lift heavy patients into bed. This lift was adapted with a mounting strap, which holds the plasma screen on the lift and allows for the screen to be raised and lowered above a patient bed or wheelchair. (Although the screen could be mounted to other stationary racks, mobility of the display between patient beds was a requirement for this prototype.)

2. Image capture: We've used both a web cam and a digital video camera- either could be used to capture the patient's image.

3. Image and sound software: Max/MSP/Jitter patches are used to generate the visual and audio content, as well as translate and process patients motion into changes in the content.

4. Vibrating rest: A Bass Shaker is embedded in a wood and foam form and then connected to an amplifier. (Bass Shakers are commonly used as car vibration accessories.)

Bass frequencies from the amplifier create the vibration in the bass shaker, causing vibrations to pass through the rest.

ASSESSMENT AND FUTURE DIRECTION

Further testing with the target population is needed to better understand their needs and refine the interaction.

Foundling test and application

We will be testing the current prototype with patients from the Foundling Hospital in late August 2004. Based on our findings we will revise the interface and content, and then pursue funding to install this in the Foundling Hospital.

Additional user groups: elderly

Through conversations and observations with other care environments, we have identified other potential applications. An extended care facility for elderly patients is one area we're exploring to expand this application as a relaxation and pain management tool.

ACKNOWLEDGMENTS

We thank Marianne Petit and Anita Perr from NYU for their inspired teaching; Luke DuBois and Rob Ryan also from NYU, for their technical guidance and support; Camillo Alvarez from the NY Foundling Hospital for construction time and expertise. Lastly we thank the anonymous UbiComp reviewers for their insightful feedback on this abstract.

REFERENCES

[1] "Understanding Cortical Visual Impairment In Children", Linda Baker-Nobles, Ann Rutherford, *The American Journal of Occupational Therapy,* Oct 1995, volume 49, #9