Chapter 9
A Facial Expression Mediated Natural User Interface Communication Model for Children with Motor Impairments

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ABSTRACT

This work was motivated by the limitations of the existing Assistive and Augmentative Communication tools to help children with Cerebral Palsy who have Motor Impairments (CP-MI). A novel model was designed, developed, and evaluated in order to help CP-MI children. The proposed model monitors and detects in real time the critical expressions on the CP-MI children's faces. Subsequently, the critical expression is sent to the caretaker either by an audio alarm or as an SMS message through the mobile phone. Multiple pilot tests on the developed prototype were performed with normal human prior to the evaluation with the CP-MI children. Later, 21 CP-MI children from a special education school were being invited to participate in the evaluation. The evaluation results and findings showed that the idea of adopting the facial expression as an alternate communication medium is workable for the CP-MI children.

INTRODUCTION

Cerebral Palsy (CP) is a term used for people who experience disability caused by brain damage during or before birth or in the first years of their lives, resulting in a loss of voluntary muscular control and coordination (Badawi et al., 1998; Columbia Electronic Encyclopedia, 2008; Hurley et al., 2011; Chen et al., 2012). Hyperbaric Service of the Palm Beaches (2009) uses the term "Cerebral Palsy" to describe a multitude of chronic disorder which affect body movements. This disorder is not caused by the functional problems of the muscles or nerves, but rather of the brain's ability to adequately control the body.

DOI: 10.4018/978-1-4666-4438-0.ch009

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Morris (2009), in his historical studies on Cerebral Palsy, stated that previous researchers have struggles in coming to terms with the definition and classification of Cerebral Palsy for over 150 years. He finally quotes Rosenbaum et al.'s (2006) definition of Cerebral Palsy as "*Cerebral Palsy describes a group of permanent disorder of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication behavior, by epilepsy and by secondary musculoskeletal problem.*"

Generally, a child diagnosed with Cerebral Palsy cannot be cured or recovered from the disability, but some treatment can improve the child's capabilities and accessibility. Some medical research reported many patients could enjoy near normal lives if their neurological problems were properly managed (4MyChild, 2009). There is no single standard therapy that works for all patients, but their capabilities to perform some tasks can be improved by identifying their unique needs and impairments. An individual treatment plan can be created based on the identified needs.

Due to motor impairment, these children also experience other disabilities relates to daily human communication. For instance, children with Athetoid or Dyskinetic cannot communicate properly with other due to problem in speaking and the speech produced was incomprehensible (4MyChild, 2009).

AUGMENTATIVE AND ALTERNATIVE COMMUNICATION

Speech therapists and pathologies suggested children with Cerebral Palsy to adopt assistive communication tools to overcome communication difficulties (Davis, Moore, & Storey, 2003; Pennington, Goldbart, & Marshall, 2004; Chapman, 2009; Rummel-Hudson, 2011). Assistive communication tools i.e. Augmentative and Alternative Communication tools are devices that seek to "*increase, maintain, or improve the functional capabilities of individuals with disabilities*" (Davis, Moore, & Storey, 2003). Novita (2006) defined Augmentative and Alternative Communication as a term used for all communication that is not speech, but is used to enhance or to replace speech. An AAC system means the whole combination of methods used for communication, for example, gestures, eye pointing, vocalizations and pointing to symbols. It is also a communication that attempts to compensate for the motor impairment and disability of children with severe expressive communication disabilities through the use of symbols, signing and devices (Millar, Light, & Schlosser, 2006).

Hodge (2007) and Hourcade et al. (2004) claims the AAC system is very effective and useful for children with physical and speech disabilities. It helps these children to improve their communication and socialization skills not only with their caretakers, parents and people around them. Hodge adds that the AAC system can train them in developing language, knowledge and in encouraging the subject to participate in any activities that are involved.

Overall, the advantage of using the AAC system is to be able to monitor children with Cerebral Palsy and to have control over what happens to them from time to time. Some of the examples and stories of children who may need the AAC system have been documented by Novita Children's Services (2006) and it shows that the AAC system does help them to communicate well with the public.

There are many types of AAC tools available in the market and recommended by speech pathologists (Novita Children's Services, 2006; 4MyChild, 2009). These tools are also available in Michigan's Assistive Technology Resource (2002) and AbleData (2010) while American Speech-Language-Hearing Association (ASHA, 2010) and the International Society for Augmentative and

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