An Interactive System for People Suffering from Cerebral Palsy

Bruno Patrão, Department of Electrical and Computer Engineering, Institute of Systems and Robotics, University of Coimbra, Coimbra, Portugal

Paulo Menezes, Department of Electrical and Computer Engineering, Institute of Systems and Robotics, University of Coimbra, Coimbra, Portugal

ABSTRACT

In this paper the authors present the development of an augmentative system for people with movement disabilities (mostly cerebral palsy people) to communicate with people that surround them, through a human-computer interaction mechanism. The authors developed an assistive technology application based on gaze tracking in order to select symbols in communication boards, which represent words or ideas so that they could easily create phrases for the patient’s daily needs. Cerebral palsy people already use this kind of communication boards, so the authors intend to extend their use for people with absolute no motor coordination. An important improvement of the proposed system with respect to the existing solutions is the ability to work in the presence of voluntary or involuntary head movements. An evaluation of the usability was performed, which showed that it can be easily used by any non-trained person.

Keywords: Board Communication, Cerebral Palsy, Communication, Eye Tracker, Gaze Tracking, Human-Computer Interaction, Physical Disabilities, Usability Evaluation

INTRODUCTION

Cerebral palsy is a disease that affects many people in all over the world. A large number of persons affected by cerebral palsy (CP) do not have the ability to communicate in the same way as healthy people do. Only in Europe, there are about 1,140,000 people who suffer of cerebral palsy (Bates, Donegan, Istance, Hansen, & Räihä, 2007). People suffering from cerebral palsy have frequently extreme difficulty in communicating and interacting with other people. This occurs because the disease affects parts of the brain that control muscle movements, leading to activity limitations. The motor disorders of cerebral palsy are often accompanied by disturbances in senses, cognition, communication, perception, behaviour, and/or seizure. These disorders give rise to different handicap levels affecting mobility, senses, language, reasoning, attention, and so forth (Mauri, Granollers, Lorés, & García, 2006). When CP

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results in strong mobility impairment the solution is to use electric wheelchairs controlled by adapted joysticks.

As already stated speech capabilities are frequently affected, even for people with full cognitive faculties. Although they can understand perfectly spoken language, they have extreme difficulty in using, or cannot use at all, vocal communication. For them, the existing solution is to use communication boards. These boards consist in a grid with symbols representing verbs, actions, objects, places, etc. (CPS, 2012), and are customized for each user, depending on their cognitive and/or pointing capabilities (Figure 1). These boards are generally printed in paper, and are used by pointing the symbols in sequence using a finger, a hand or head attached pointer. Although requiring a special training in the use of these communication means, users can reach a good communication level with the help of special education teachers, technicians and speech therapists.

Speech therapists, who take care of children with CP, argue that people that use this kind of communication walk through a learning process that starts with very simple communication boards, going progressively toward more complex ones.

There are indeed people that have very little or no control at all of the limbs movements. For them, the traditional communication boards are absolutely useless, as they cannot point the board symbols. If the disease does not affect the eye movements then gaze direction can be used to know where the person is looking at. This can be applied to the communication boards as long as it is possible to know on any instant to which symbol the person is looking at. Naturally, the use of this gaze-based communication principle requires an adaptation period so that the CP patient can fully understand its functioning and gain the required ability to take full advantage of it.

According to interaction design experts, any user action must produce the adequate

Figure 1. Example of a paper printed communication board used by cerebral palsy people
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