Development of Eye-Blink Controlled Application for Physically Handicapped Children

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Abstract. In this paper, we describe a new application operated with eye-blink for physically handicapped children who cannot speak to communicate with others. Process of detecting blinks is performed in the following steps. 1) To detect an eye area 2) To distinguish opening and closing of eyes 3) To add the method using saturation to detect blink 4) To decide by a conscious blink 5) To improve the accuracy of detection of a blink We reduce the error to detect a blink and pursue the high precision of the eye chasing program. The degree of disablement is varied in children. So we develop the system to be able to be customizes depends on the situation of users. And also, we develop the method into a communication application that has the accurate and high-precision blink determination system to detect letters and put them into sound.

Keywords: VOCA (Voice Output Communication Aid), Physically handicapped children, OpenCv, Haar-like eye detection.

1 Introduction

Special support schools in Japan need some communication assistant tools especially for physically handicapped children. In this study, physically handicapped children are defined as children with permanent disablements of their trunks and limbs because of cerebral palsy, muscular dystrophy, spina bifida and so on. Their body movements are very limited and many of them also have mental disorders, so they cannot communicate with their families or caregivers. It prevents helpers from understanding what they really need or think.

Taking the situation into consideration, we develop a communication support tool operated by eye-blink for physically handicapped children. We use front cameras on tablets (iPad, iPad mini of Apple Inc. iOS5.0). After several verifications and examination, we have developed a contactless communication assistant application “Eye Talk”. The application does not malfunction by surroundings, such as brightness or differences of eye shapes.

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2 Purpose of the Study

The most common way to communicate with physically handicapped children is using “Yes=○” or “No=×” cards. (Figure 1) For example, if a caregiver wants to ask a child whether he/she wants to drink water, the caregiver will ask him/her “Do you want to drink water?” and show him/her cards with ○ and × by turns. If the child takes a look at ○ card or put his/her eye on it longer than the other one, the caregiver will know he/she may want to drink water.

But caregivers have to predict what patients need or want to say by their experiences or circumstances in this method. So the questions made by caregivers can be totally different from what patients really want to say. And also, it is difficult to figure out the movement of eyes of patients. Sometimes caregivers have to just guess the answer.

Some communication support tools using movements of eyes for these physically handicapped people have been released already, such as TalkEye[1] or Let’s Chat[2]. Most of them are relatively expensive because they require some special equipment. For example, TalkEye requires the executive head set to measure the movement of eyes.

3 Structure of the System

Process of detecting blinks is performed in the following steps,

1. To detect an eye area (By using OpenCv Haar-like eye-detection)
2. To distinguish opening and closing of eyes (By using the complexity of binarized image)
3. To add the method using saturation to detect blink (Aiming more accurate detection)
4. To decide by a conscious blink (To define what is a “conscious blink”)
5. To improve the accuracy of detection of a blink

3.1 Detection of an Eye Area

There are many methods to detect an object. We choose OpenCv that is a library of programming functions for real time computer vision for image processing in this study. OpenCV's face detector uses a method that Viola, P. [3] developed first and Lienhart, R. [4] improved.