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Eye Controlled Devices and Techniques

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Abstract: ***This review paper suggests a method for people with severe physical disabilities wherein the traditional method of using a mouse and keyboard is substituted by the eye movement. This provides an innovative idea of controlling the movement of computer mouse cursor by using eye movement. The project mainly consists of image capturing, processing and controlling the mouse cursor. This system is very useful to solve the problems of disabled so that they can communicate and interact with their surroundings.***

Keywords: Eye tracking; Electrooculography; Eye movement control; Hough transform; Canon edge detection.

I. INTRODUCTION

With the growth in computer technology the importance of human interactive environment is increasing rapidly. Most of the mobile phones and laptops are using touch screen technology which is still not cheap enough to be used on desktop systems. Thus in such conditions an eye tracker device can work as a way of interacting with the computer and many more devices.

Eye tracking is a process of measuring the motion of the eye with respect to head or the point where one is looking at. To locate the eye positions eye tracker can be used. Disabled people who are be unable to make any movements except their eyes can make a good use of this technology. In this review paper we discuss the various methodologies that can used both in aspects of hardware and software along with their applications and future scope.

II. TECHNIQUES

A. Hardware Approaches

a) Electrooculography: This is a technique of measuring the corneal retinal standing potential that exists between front and back of the eye. A pair of electrodes is placed either below and above or to the left and right of the eye to measure the eye movement (Fig 1). If the eye moves from center position towards one of the two electrodes, one of the electrodes sees the positive side of the retina and the other electrode sees the negative side of the retina. Thus a potential difference occurs between the electrodes. Here the eye acts as a dipole. The cornea approaches the electrode near the outer corner of the left eye, resulting in a negative change in the potential difference and if it approaches the electrode near the inner corner of the left eye then there will be a positive change in the obtained potential difference.

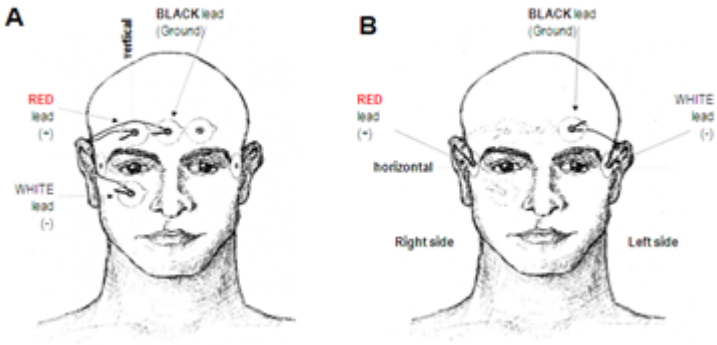

Fig 1. An arrangement of EOG electrodes

b) Infrared: In this method corneal reflectors are created using center of the pupil and infrared light. The vector between the pupil center and the corneal reflections can be used to find the point of attention on surface. There are two methods of eye tracking techniques using infrared light. They are bright-pupil (Fig 2) and dark-pupil (Fig 3) tracking [6]. Bright pupil tracking creates a greater iris/pupil contrast while a dark-pupil tracking creates a darker color of the pupil than the original pupil. Thus the transformed brighter or darker pupil can be located by the sensor.

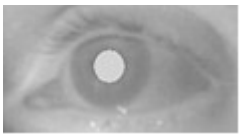

Fig 2. Bright pupil

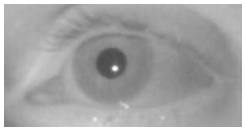

Fig 3. Dark pupil

c) Corneal reflection: The corneal reflection approximates to one of the brightest regions in the eye image, and the round shape and size of the corneal reflection is fixed when the distance between cornea and the camera is established. Thus the corneal reflection can be obtained through pixel intensity threshold and

geometrical character (Fig 4). This threshold is used to produce a binary image and the values only above the threshold are taken as corneal reflection.

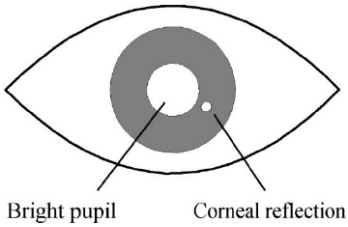

Fig 4. Corneal reflection

B. Software Approaches

a) Hough transforms: The Hough transform is a technique used to separate features of a particular shape within an image [4]. It is commonly used for the detection of regular curves such as lines, circles, ellipses, etc. here hough transform is used for detecting the pupil's center position and find the ee gaze direction. The horizontal and vertical angle of the eyeball rotation is found and the eye gaze direction is deduced.

b) Canny edge detection: Canny edge detection is algorithm that can detect edges with less noise involved. Process of canny edge detection [5] is done as follows:

1. Apply Gaussian filter to smooth the image and remove noise.
2. Find intensity gradients of the image.
3. The non-maxima pixels of the threshold are suppressed to thin edge ridges.
4. Determine potential edges by applying double threshold.
5. Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

An illustration of the transformation of an image to its edges using edge detection techniques is shown in Fig 4 and Fig 5.

Fig 5. Original image

Fig 6. Canny edge detected output

III. APPLICATIONS

Eye tracking for market research has become very important nowadays. Eye tracking has also been introduced to the human computer interaction and gaming industry enables for instance game designers to get a better understanding of the game experience. Automotive research has also embraced head mounted eye tracking for a long time to gauge driver's visual attention with respect to navigation and layout of dashboards. The academic and scientific research fields are currently making the most use of eye tracking for cognitive, developmental, and experimental and media applications in psychology and neuroscience.

IV. FUTURE SCOPE

This paper is mainly focused on the device controlled using eye movement, which provides computer access for the disabled. Here the eye tracking techniques have a wide range of applications such as it provides disabled people to control their wheel chairs, video games are built using this technology where using a pair of glasses the movement is recognized for the game. This system has helped the disabled to communicate with their neighboring people by using the eye movement. The MRC's video cameras are being developed for the use in MRI scanners. This technology will also control the future mobile devices where this feature will allow the users to scroll down a page without having to touch the screen, it can be mainly used for the security purposes and it would be difficult to hack an individual pattern.

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