Arduino Based Eye-Writer Using PS3 Eye Camera

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Abstract- *Eye-Writer is an Eye Tracking device and a custom software. It is an application which will help them to draw or write and it is an application of eye tracking. Eye Tracking is a sensor technology to know where your eyes are focused. Individuals suffering from paralysis cannot move their body but they can still move their eyes. So Eye-Writer is without using the rest of the body. The original Eye-Writer was meant for a motionless head. The Eye-Writer which we have designed has a LED and camera mounted away from the head which allows slight motion.*

Keywords: PCCR pupil center corneal reflection

I. INTRODUCTION

The Eye-Writer is an ongoing, open source, collaborative research project that is an attempt to provide people with a neuromuscular disorder and injuries with creative technology. The Eye-Writer is an advantageous eye-tracking glasses and custom software that allows artists and graffiti writers to draw with their eyes alone, suffering from paralysis by Amyotrophic Lateral Sclerosis, as well as other neuromuscular disorders and injuries

The original design contained glasses, but we have a new design, which we have called "eyewriter 2.0", which improves the accuracy of the device and allows people with a slight head movement to use an eye successor. The original eye machine, designed for a paralyzed Graffiti artist TEMPT1, is designed to be worn on a completely immobile head. The 2.0 design, where a camera and a LED system are mounted remotely from the head, can be used by people whose head moves slightly, such as MS patients and people wearing glasses, etc.

Eye tracking is the process of measuring either the gaze direction (what one looks at) or the movement of an eye with respect to the head. An eye-tracker is a device for measuring eye positions and eye movements. Most modern eye-trackers use near-infrared technology together with a high-resolution camera (or other optical sensor) to follow the direction of the gaze. The underlying concept, usually referred to as PCCR, means that the camera follows the pupil center and that it reflects light from the cornea.

II. LITERATURE SURVEY

Edmund Huey built an early eye tracker, using a sort of contact lens with a hole for the pupil. The lens was connected to an aluminium pointer that moved in response to the movement of the eye. Huey studied and quantified regressions (only a small proportion of saccades are regressions), and show that some words in a sentence are not fixated. [1]

The first non-intrusive eye trackers were built by Guy Thomas Buswell in Chicago, using beams of light that were reflected on the eye and then recording them on film. Buswell made systematic studies into reading and picture viewing. [3]

In the 1950s, Alfred L. Yarbus did important eye tracking research and his 1967 book is very highly quoted. He showed the task given to a subject has a very large influence on the subject's eye movement. He also wrote about the relation between fixations and interest. [5]

In the 1970s, eye tracking research expanded rapidly, particularly reading research. A good overview of the research in this period is given by Rayner. [1]

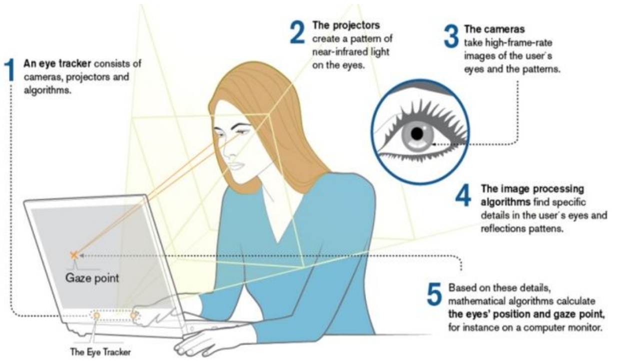
In 1980, Just and Carpenter formulated the influential *Strong eye-mind Hypothesis*, the hypothesis that "there is no appreciable lag between what is fixated and what is processed". If this hypothesis is correct, then when a subject looks at a word or object, he or she also thinks about (process cognitively), and for exactly as long as the recorded fixation. The hypothesis is often taken for granted by beginning eye tracker researchers. [2]

During the 1980s, the eye-mind hypothesis was often questioned in light of *covert attention*, the attention to something that one is not looking at, which people often do. If covert attention is common during eye tracking recordings, the resulting scan path and fixation patterns would often show not where our attention has been, but only where the eye has been looking, and so eye tracking would not indicate cognitive processing.

According to Hoffman, current consensus is that visual attention is always slightly (100 to 250 ms) ahead of the eye. But as soon as attention moves to a new position, the eyes will want to follow. [3]

We still cannot infer specific cognitive processes directly from a fixation on a particular object in a scene. For instance, a fixation on a face in a picture may indicate recognition, liking, dislike, puzzlement etc. Therefore eye tracking is often coupled with other methodologies, such as introspective verbal protocols. [5]

III. EYE TRACKING



The term 'eye tracking' as used here means an estimation of the direction of the user. In most cases, estimating the direction of the can means identifying the object on which the can falls.

The accuracy of eye movement measurement is strongly dependent on a clear differentiation of the pupil and detection of corneal reflection. The visible spectrum probably generates uncontrolled mirror reflection, while illuminating the eye with infrared light that is not perceptible by the human eye, the delineation of the pupil and the iris makes an easy task while the light enters the pupil directly, it simply reflects from the iris. This means that a clear reflection is generated (with little noise) and can therefore be monitored with ease.

Near infrared light is directed towards the middle of the eyes (the pupils) causing visible reflections in the cornea (the most optical element of the eye), which are followed by a camera.

IV. PARAMETERS

i) Size and dilation of the student

An increase in pupil size is called pupil dilation and a decrease in size is called pupillary constriction. The tablet size primarily responds to changes in light (ambient light) or stimulus material (for example, videostimulus).

ii) Distance to the screen

Together with the pupil size, eye-trackers also measure the distance to the screen and the relative position of the respondent. Leaning forward or backward for a remote device is tracked immediately and avoids any approach.

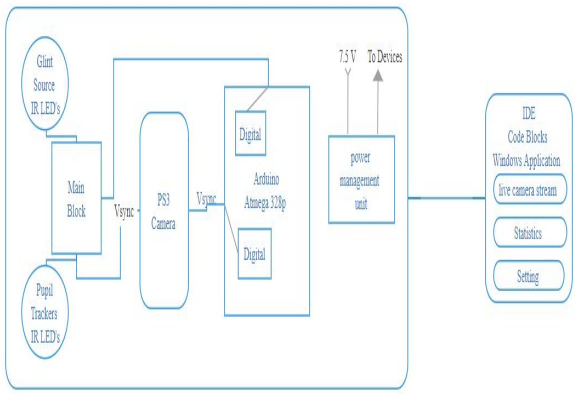
iii) Ocular deformation

Most eye-trackers measure the positions of the left and right eyes independently of each other. This allows for the extraction of vergence, i.e. whether left and right eyes move together or apart. This phenomenon is only a natural consequence of focusing close and far away. Divergence often occurs when our mind drifts, if we lose our focus or concentration.

iv) Flashes

Eye-tracking also provides essential information about cognitive workload by monitoring flashing. Cognitive demanding tasks can be associated with delays in flashing, the so-called attention flashing. However, many other insights can be derived from blinking. For example, a very low frequency of flashes is usually associated with higher levels of concentration. A fairly high frequency is indicative of drowsiness and a lower focus and concentration.

V. LEARNING AN END-TO-END MODEL



The working of the model is divided into three basic steps. First of all, create LED lighting devices for the sides of the screen and the center. From a technical point of view, the system works by having 3 IR illuminators blink every frame. On even frames it uses the central illuminator (placed around the camera lens) and on odd frames it uses the 2 side illuminators. On even frames, the pupil appears clear, because the IR light actually bounces against the back of your eye, such as the red-eye effect. Our pupil looks dark on odd frames.

The difference between the two allows us to isolate and follow the student in real time. In addition, the glare (reflections of the IR illuminators) of the dark frame is maintained and this, plus the information about the pupil, is calibrated to screen the position using a least-squares fit process for a comparison that shows an image of shimmering / pupil offers a position to screen position.

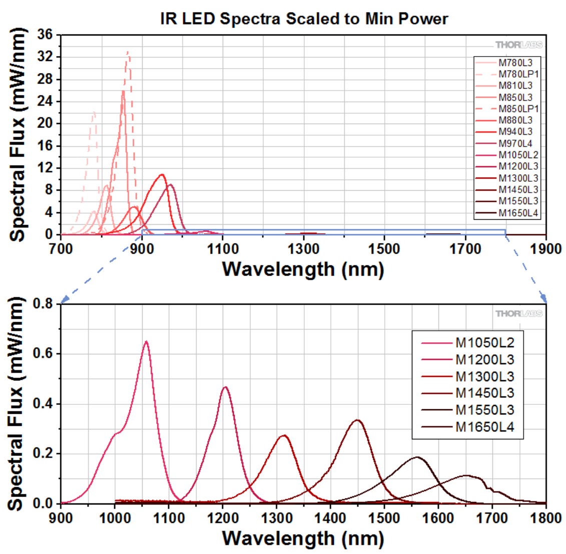
In particular, an infrared light source illuminating the eye of a wearer can generate reflections of the wearer's cornea with a relatively high intensity, also called 'glints'. The glints can be displayed with an infrared camera. When the infrared light sources are illuminated at a relatively lower intensity, it is possible to determine the pupil location. Glints, in combination with the pupillary location, can be used to accurately determine the viewing direction and eye rotation. The particular gaze direction could be used in different eye tracking applications. By controlling the light sources to change the intensity levels and by combining multiple images of the eye to record multiple glistening locations with the pupillary location, eye-tracking can be performed with better accuracy and with fewer light sources.

Second, hacking the PS3 eye camera to get the vertical synchronization (when the video frame is taken) and to make it sensitive to IR.

Third, programming and building the arduino / circuit to control the blinking. Finally, setting the basis for the system and going through the basic principles of the softwar

VI. RESULT

A] IR LED



B] Software Results

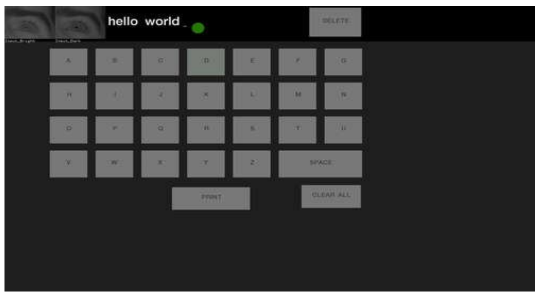
i) Using EyeWriter software - Catch Me

Look at the Catch box. As you tail, the color of the box turns green.

When the box is completely green, it is caught and appears somewhere else. Continue to capture the boxes to test your eye tracking calibration

ii) Using Eye-writer software – Typing

Look at which key you want to press. As you watch, the color of the keys turns green and blue. When the button flashes blue, it is pressed. You can see what you have typed at the top of the screen.



VII. FUTURE SCOPE

i. The project will inspire the formation of social networks, broadening the scope of research into its potency not only as a tool for expression by drawing, but also in the fields of medicine and welfare.

ii. Anyone can build and use the Eye-Writer by utilizing a combination of computers and other familiar instruments, and installing software that is available for free. It is probably the most versatile device for drawing with the eyes.

VIII. CONCLUSION

Thus Eye-Writer is a boon to the disabled people suffering from neuromuscular diseases. It's cost is low which is affordable even to the common man. It improves the accuracy of the device and allows people whose heads are moving even slightly to use an Eye-Writer, unlike the previous version where eye tracking glasses were used. It is not a bulky setup as the person using Eye-Writer will not have to wear the glasses.

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