Open access Journal International Journal of Emerging Trends in Science and Technology

A Review on Device Controlled Using Eye Movement

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Abstract
This Paper is Introduced an eye controlled system. Traditionally, human computer interface uses keyboard, mouse as an input devices but this paper presents hand free interface between computer and human. Here providing a novel idea to control computer mouse cursor using human eyes movement. It controls mouse-moving by automatically affecting the position where eyesight focuses on and simultaneously mouse- click by affecting blinking action. In this paper we describe Face detection and Eye tracking technology with Algorithm of proposed system. This technology is very helpful for solving the HMI problems of the disabled and providing them a way to communicate with the outside world, improve their ability of living and help them regain confidence.

Key Words: *Eye tracking, Mouse movement, Eye-blinking detection, Image processing.*

1. INTRODUCTION

Disabled people who cannot move anything except their eyes would need a system where they will be able to use their eyes to move the mouse to the position where the eyes is gazing. However people who have no disabilities would also want such a system. The ultimate goal of scientific visualization, virtual reality for people and multimedia technology is to find a best way for people to communicate with computer system [1]. Human–machine interface is the study, planning and design of the interaction between users and machine. Membrane switches, rubber keypads and touch screens are examples of that part of the Human Machine Interface. Typical human–machine interface design consists of the following stages- interaction specification, interface software specification and prototyping:

Common practices for interaction specification include user-centered design, persona, activity-oriented design, scenario-based design, design. Common practices for interface software specification include use cases, constrain enforcement by interaction protocols (intended to avoid use errors). Common practices for proto-typeing are based on interactive design based on libraries of interface elements (controls, deco-ration, etc.). Generally Sight-tracking technology use in Human Machine Interface because of its directness, naturalness and bidirectional. Here Eyes as an input channel can control the peripheral equipment by sight-tracking and achieve multitasking operation, and it has a broad development prospects in industrial control, robotics and clinical medicine. It also has a great application prospects in the Human Machine Interface, for example, the disabled assistant tools, clinical medicine, intelligent computers and robots that can understand human's intentions, household appliances that have mutual functions, virtual reality and games.

In the background of current hot sight-tracking technology , this topic aims at designing an eye controlled system and solving the HMI problems of the disabled so that it can provide a way for them to communicate with the outside world,

improve their ability of living and help them regain confidence. Firstly, the system captures images by using a low illumination and analogic CCD camera. The first task is to compensate for natural head movements to ensure that the user's eye is always in the field of view of the camera tracking the eye [2]. LEDs (LED I) is mounted in front of the camera lens to acquire the bright pupil image [3]. The developed gaze tracking system, Free Gaze, detects gaze position by the two processes. First, the pupil and the Purkinje image are detected from the captured image. Then, the gaze position is computed from these two images by using the eyeball model. Finally, due to the personal calibration, accurate gaze direction is estimated [4]. After developing such system this will be works in office environment, the distance is 50 to 100 cm from the human eye to computer screen, which has a 17-inch 1440*900pixels resolution. Place an infrared light and infrared camera in the front of computer screen, which can be used to capture the face image. When the system works, the face image captured by the simulating camera after a series of digital image processing, the system can superimpose the gaze position calculated on a computer screen, and used it to select the operation control object. The proposed method is successful in detecting eyes of varying scale; within a certain allowable image plane orientation [5]. Users can easily control the object selections and the system through eye gaze. The user can use the eye gazes and blinks to achieve human-computer interaction without hands. However, it is usually not possible to isolate the eye blob only by picking the right threshold value, since pupils are often small and not bright enough compared with other noise blobs[6].''Communication via eye blinks-Detection and duration analysis in real-time'' [7] Initial eye blink is employed to find the eyes. The algorithm detects the eye-blinks. The ''Blink link'' prototype can be used in order to get in touch with the device. Simply by considering the motion information among two consecutive frames and determining that if this motion is caused by blink, eyes are tracked and monitored constantly. This system is a real-time system. The disadvantage of this system is that it can only handle long blinks and is not able to handle short blinks. In case of short blinks it just simply avoids the blinks.

2. OBJECTIVE OF THE SYSTEM

1. Hands - free computing.
2. Easy interaction with computer without using mouse.
3. Pointer of the mouse will move on screen where the user will be looking & the clicks will be performed by blinking.

3. FACE DETECTION

Face detection is a very important part of the developed eye-blink detection algorithm.

They can be divided into:

3.1 Knowledge based methods -

Employing simple rules to describe the properties of the face symmetry and the geometrical relationships between face features [8]

3.2. Feature based methods –

This method based on the detection of mouth, eyes, nose or skin colour. The first involves finding facial features (e.g. noses, eye brows, lips, eye pupils) and in order to verify their authenticity performs by geometrical analysis of their locations, areas and distances from each other. This analysis will eventually lead to localization of the face and the features that it contains. The feature based analysis is known for its pixel-accuracy, features localization and speed, on the other hand its lack of robustness.[9]

3.3 Template matching methods-

This method based on computing the correlation between the input image and stored patterns of the face.[10]

3.4 Model based methods-

Where algorithms are trained on models using neural networks, Support Vector Machines (SVM) or Hidden Markov Models (HMM).

4. EYE TRACKING TECHNIQUES

Eye tracking is the process of determining where someone is looking. It can also measure the characteristics of eye movements and the eye itself, such as the size of the pupil. To conduct eye

tracking, we need special equipment called an eye tracker, three techniques were analyzed;

4.1 Pupil tracking

Pupil tracking is a technique of gaze detection that is commonly used often in conjunction with different forms of tracking. There are several reasons for this; however the main advantage is the notion of the "bright spot". Like the situation associated with red eye when taking flash photographs at night, infrared can used in pupil detection to form a high intensity bright spot that is easy to find with image processing. This bright spot occurs when infrared is reflected off the back of the pupil and magnified by the lens. The main advantage of pupil tracking is that as the border of the pupil is sharper than the limbus, the limbus is the boundary between the white sclera of the eye and the darker iris. Also, as the pupil is never really covered by the eyelid, x-y tracking is more feasible as compared to Limbus tracking. The disadvantage is that the difference in contrast is lower between the pupil and iris than between the iris and sclera-thus making the border detection more difficult.

4.2 Eye-attached tracking

The first type uses an attachment to the eye, such as a special contact lens with an embedded mirror or magnetic field sensor, and the movement of the attachment is measured with the assumption that it does not slip significantly as the eye rotates. Measurements with tight fitting contact lenses have provided extremely sensitive recordings of eye movement, and magnetic search coils are the method of choice for researchers studying the dynamics and underlying physiology of eye movement. It allows the measurement of eye movement in horizontal, vertical and torsion directions.

4.3 Electrooculography

The third category Electrooculography (EOG) is a technology that consists of placing electrodes on the person's forehead around the eyes to record eye movements. The voltage that exists between the eyes is a very small electrical potential that can be detected using electrodes. People with certain disabilities may use these systems in order to have certain communication. The human eye is polarized, with the front of the eye being positive and the back of the eye being negative. This is caused by a concentration of negatively charged nerves in the retina on the back of the eye. As the eye moves the negative pole moves relative to the face and this change in the dipole potential can be measured on the skin in micro volts. To translate this voltage into a position, two sets of electrodes are used to measure the differential voltage in the vertical and horizontal direction. The figure below indicates how the electrodes are placed on the face. The orange leads measure movement in the horizontal direction and the green leads measure movement in the vertical direction. The blue sensor is placed behind the ear or on the ear lobe to provide a ground reference. EOG is a very robust technique for measuring saccadic eye movement associated with gaze shifts and detecting blinks. Contrary to video-based eye-trackers, EOG allows recording of eye movements even with eyes closed, and can thus be used in sleep research. It is a very light-weight approach that, in contrast to current video-based eye trackers, only requires very low computational power, works under different lighting conditions and can be implemented as an embedded, self-contained wearable system. The major disadvantage of EOG is its relatively poor gaze direction accuracy compared to a video tracker. That is, it is difficult using EOG to determine with good accuracy exactly where a subject is looking, though the time of eye movements can be determined.

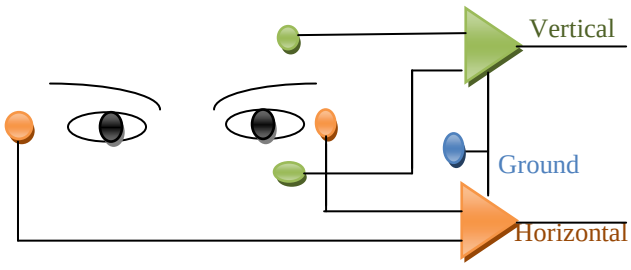

Figure 1: Correct positions of five electrodes [11]

5. SYSTEM WORKING

In this system, Input medium turns to eye movement. Eye movement input is faster than

other current input. Aim of this system is user can control the mouse movements and buttons only by the eyes movement and eyes blinks.

5.1 Left and Right movement

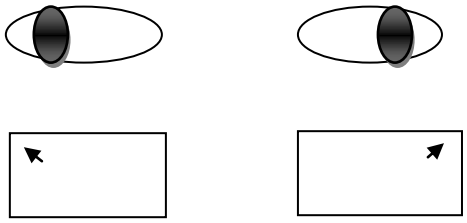

Figure 2: Left and Right movement of pupil and Mouse pointer

Here, pupil is used to control the mouse pointer (cursor) on the screen, the central coordinate of the screen is set as a start point. As the pupil move to some direction, the coordinate of the mouse pointer on screen change according to the movement of the pupil. [12]

5.2 Up and Down movement

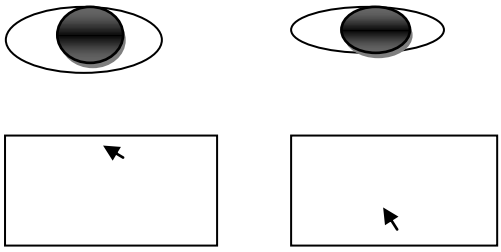

Figure 3: Up and down movement of pupil and mouse pointer

When people look upwards, the eyes are getting bigger. When looking downwards, the eyes are in slightly half-closed state. This phenomenon can be used for controlling the mouse pointer to move from top to bottom.

5.3. Mouse click events control

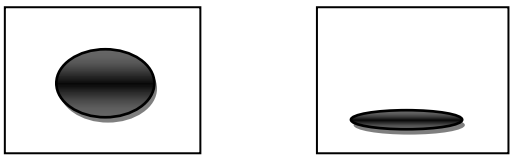

Figure 4: Eye blinks motion detection

The mouse click is depending upon the blink of eye. Namely, when one person's eyes are recognized in closed state, we click the position of the current mouse pointer. Figure 4 shows closed state of eyes. When the left eye blinks, we click the left key of the mouse. When the right eye blinks, we click the right key of the mouse. Normally, when the errors of the human blinks occur, both eyes are closed together. At this time, we do not perform any actions. The action is only carried out with the closure of a single eye.

6. BLOCK DIAGRAM OF PROPOSED SYSTEM

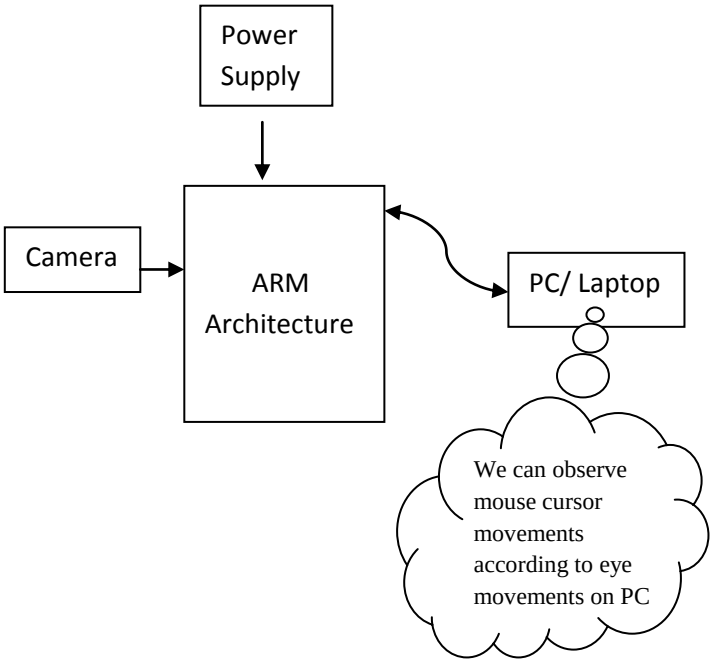

Figure 5: Block diagram of Proposed System

In This system, the framework consists of ARM processor, camera and personal computer. Here the camera is connected to ARM board through USB port and PC is connected through Ethernet cable to the controller. The camera captures the eye movements and those images will be sent to arm controller through USB port. After receiving the input from camera, the controller processes those images by using Open CV library also we can used MATLAB. And then controller sends signals to PC through Ethernet to operate mouse cursor movements according to eye movements. Here, pupil is used to control the mouse pointer (cursor) on the screen; the central coordinate of the screen is set as a start point. As the pupil move to some direction, the coordinate of the mouse

pointer on screen change according to the movement of the pupil.

7. WORK-FLOW

A complete procedure is presented that moves the mouse from one place to another on desktop through user's eyes movement. Detailed processing steps are presented below:

1. By using USB type camera that is interfaced to the embedded board we can capture the live video of the eye movements.
2. To detect the motion first Open the video device, and capture the video from video device and grap the frame from video.
3. Then read the image from the grap frame and store that image in particular memory location.
4. After we will read already stored image, then the current image and already stored we will convert to gray image.
5. Then compare the both images and differentiate them. Again we will convert that image to black and white image.
6. After that the controller will send the video through Ethernet technology frame by frame. If any motion is detected, it will capture that image and stores into the internal memory of the micro controller.
7. After that image processing, the controller controls the mouse according to eye movements.

8. CONCLUSION

This paper focused on the analysis of the development of the ‘’Device controlled using eyes movement’’. Advantage of this system is providing computer access for people with server disabilities. In this paper we describe Face detection and Eye tracking technology. The most unique aspect of this system is that it does not require any complicated wearable attachments. This makes the interaction more efficient and enjoyable. The interface includes hardware and software components. This system also used in industrial control, robotics, medical, advertising, Psychology and so on.

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BIOGRAPHIES

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