Retina Controlled Computing

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Abstract---Retina controlled computing deals with controlling our computers with human retina which basically aims at replacing the function of the mouse of PCs with our retina. Retina controlled computing deals with developing such a system in which the actions performed on the monitor will be completely governed by the movement of the retina of human eye This includes the scrolling up and down of the screen, opening up of any folder just with the help of our eyes and many such functions. This project will not only prove to be a further advancement in the computer technology but will also be a beneficial way of handling the computers for disabled persons.

I. INTRODUCTION

In this modern world there have been a drastic change in the computer technologies, for instance, earlier there were big and bulky computers which are now being replaced by compact and much advanced laptops and notebooks. Now we have decided to take a step further in this field of technology and we attempt to make a computer which can be controlled by the motion of retina of human eye only.

Physically challenged people(having disability especially related to hand movements) may have difficulties when controlling a PC by conventional peripheries. Interaction with computer using eye movement is alternative computer control method. The precise mapping for image co-ordinate to computer monitor screen co-ordinates in real time is necessary for efficient computer control. The objective of this study is to find best mapping for pupil/eye corner gaze tracking system.

Eye tracking data is collected using either a remote or head-mounted 'eye tracker' connected to a computer.While there are many different types of non-intrusive eye trackers, they generally include two common components: a clight source and a camera.The light source (usually infrared) is directed toward the eye.The camera tracks the reflection of the light source along with visible ocular features such as the pupil. This data is used to extrapolate the rotation of the eye and ultimately the direction of gaze. Additional information such as blink frequency and changes in pupil diameter are also detected by the eye tracker.

The aim of this paper is to develop a prototype of retina controlled computing system. Our whole focus and concentration will be placed on designing the system that will accurately monitor the operations performed on the monitor in accordance with eye movement.

This detection can be done using a sequence of images of eyes as well as face and head movement. The observation of eye movements and its edges for the detection will be used. In this paper the algorithms for face detection and eye tracking have been developed on frontal faces with no restrictions on the background .The proposed method for eye tracking is built into five stages. These include coarse and fine face detection, finding the eye region of maximum probability. Using frontal images obtained from a database, the probability maps for the eyes region are built etc.

II. TECHNIQUES FOR DETECTING EYE MOVEMENT

Techniques can be divided into following categories

Eye trackers measure rotations of the eye in one of several ways, but principally they fall into three categories: (i) measurement of the movement of an object (normally, a special contact lens) attached to the eye, (ii) optical tracking without direct contact to the eye, (iii) measurement of electric potentials using electrodes placed around the eyes, and (iv) using a simple camera and digital image processing techniques.

A. *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.

B. *Optical tracking*

The second broad category uses some non-contact, optical method for measuring eye motion. Light, typically infrared, is reflected from the eye and sensed by a video camera or some other specially designed optical sensor. The information is then analyzed to extract eye rotation from changes in reflections. Video based eye trackers typically use the corneal reflection (the first Purkinje image) and the center of the pupil as features to track over time. A more sensitive type of eye tracker, the dual-Purkinje eye tracker, uses reflections from the front of the cornea (first Purkinje image) and the back of the lens (fourth Purkinje image) as features to track. A still more sensitive method of tracking is to image features from inside the eye, such as the retinal blood vessels, and follow these features as the eye rotates. Optical methods, particularly those based on video recording, are widely used for gaze tracking and are favored for being non-invasive and inexpensive.

C. *Electric potential measurement*

The third category uses electric potentials measured with electrodes placed around the eyes. The eyes are the origin of a steady electric potential field, which can also be detected in total darkness and if the eyes are closed. It can be modelled to be generated by a dipole with its positive pole at the cornea and its negative pole at the retina.

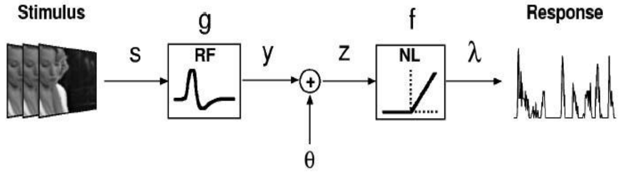

Fig. 1:

The electric signal that can be derived using two pairs of contact electrodes placed on the skin around one eye is called Electrooculogram (EOG). If the eyes move from the centre position towards the periphery, the retina approaches one electrode while the cornea approaches the opposing one. This change in the orientation of the dipole and consequently the electric potential field results in a change in the measured EOG signal. Inversely, by analysing these changes in eye movement can be tracked. Due to the discretisation given by the common electrode setup two separate movement components – a horizontal and a vertical – can be identified. A third EOG component is the radial EOG channel, which is the average of the EOG channels referenced to some posterior scalp electrode. This radial EOG channel is sensitive to the saccadic spike potentials stemming from the extra-ocular muscles at the onset of saccades, and allows reliable detection of even miniature saccades.

D. Digital Image Processing

The final and most efficient of all the four techniques is using a simple camera or webcam to sense the motion of the retina and capture its image and further performing some digital image processing techniques on the captured image to govern the operation on the monitor.

From the above mentioned 4 techniques ,we have decided to work with the fourth technique i.e. using digital image processing.

In this technique there is no requirement of external expensive electrode as used in EOG technique, neither special contact lens with an embedded mirror nor magnetic field sensor as used in eye attached tracking which is the biggest disadvantage of the rest three techniques.

In the digital image processing technique we simply require a camera or a webcam (in-built in laptops) as an input device and image processing i.e. MATLAB as the main processing tool.

III. METHODS

The proposed method is built in five stages and these are the sequence of steps which are going to be executed in MATLAB tool.

1) Localization of the eyes
2) Tracking the eyes in the subsequent frames.
3) Detection of eye movement.
4) To process the image of detected eye using MATLAB.
5) Relating the movement of cursor on the computer screen with detected eye movement.

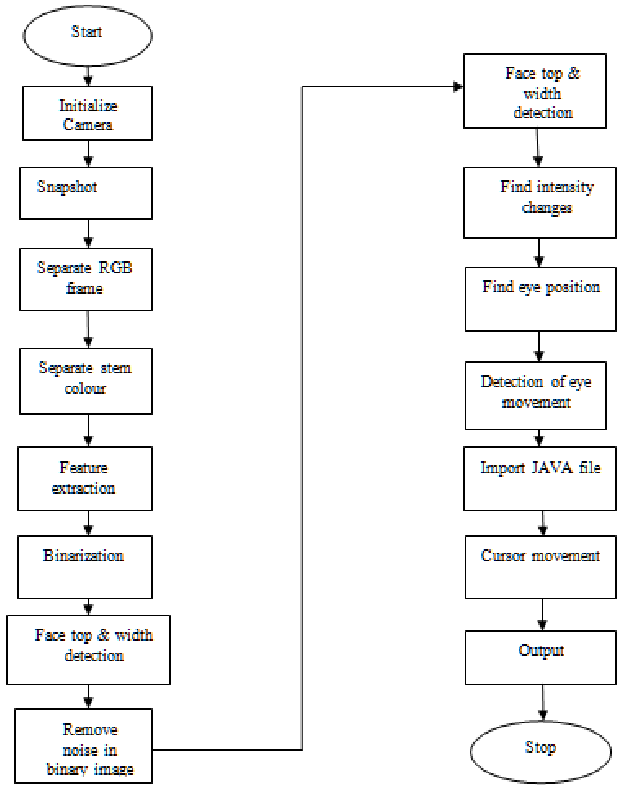

Fig. 2: Flowchart Of The Project

IV. CONCLUSION

We have decided to develope a system that controls the computer with the help of human retina. Doing this will replace the function of the mouse with our retina .In this system the actions performed on the monitor will be completely governed by the movement of the retina of human eye This includes the scrolling up and down of the screen, opening up of any folder just with the help of our eyes and many such functions. We are doing it with the help of image processing technique using MATLAB and the advantage of this method being that it does not require any external hardware

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