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Virtual Mouse Using Eye Tracking Technique

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Abstract—

Knowing that user's point of gaze has long held the promise of being a useful methodology for human computer interaction. However, a number of barriers have stood in the way of the integration of eye tracking into everyday applications, including the intrusiveness, robustness, availability, and price of eye-tracking systems. The goal of this thesis is to lower these barriers so that eye tracking can be used to enhance current human computer interfaces. The paper presents the real time system interface between computer and human. —. This technology is able to replace the standard interface which is the computer mouse or we can say traditional mouse with the human eyes, as a new way to interact with computer. Thus, mouse working with the help of human eyes is known as Virtual mouse. The system we described is fast and an affordable technique for tracking facial features. We are trying to detect facial features i.e eyes through Viola Jones algorithm, with the help of Matlab'13. The accuracy of eye tracking was found to be approximately one degree of visual angle. It is expected that the availability of this system will facilitate the development of eye- tracking applications and the eventual integration of eye tracking into the next generation of everyday human computer interfaces.

Key Words— Eye tracking, Virtual Mouse, Viola Jones Algorithm, Matlab'13.

I. INTRODUCTION

It is a fact that the computer has contributed and continues to contribute to the evolution of society as a whole. Using a computer can make life easier for people in several ways, from day to day problem solving to people interaction via communication channels over the internet. "Nowadays it is known that Communication and Information Technologies are increasingly becoming important instruments in our culture, and its use is a real mechanism of inclusion and interaction around the world . Communication and Information Technologies (CIT) are more conspicuous when used for the development of applications aimed at the social inclusion of handicapped people in our contemporary society. However the main limitation of this device is the lack of usability for the people with disabilities including limb paralysis and those who lose their limbs in any accidents or poor development of body due to congenital defects. Such users face problems and inability to hold or moving the mouse as how normal users perform it. The eye tracking systems give them enhanced usability by tracking the eye movements to capture the details of relative position of the eye of the disabled users and use the information to move the mouse on the screen and help them use computers easily in spite of their disabilities. Thus, we think that a device capable of identifying deliberate movements of the eye area (pupils, eyelids and eyebrows), we can provide a new means of interaction that could replace or complement more standard interfaces.

Human eye structure

A human eye is an organ that senses light. An image of eye anatomy is shown in Figures. Several important parts of human eye related to eye tracking are described here. The cornea is a transparent coat in front of eyeball. The iris is the muscle that controls the size of pupil, which is like the aperture in a camera to let light goes inside. The iris has color and is different from person to person, thus can be used in biometrics. The sclera is the tough outer surface of the eyeball and appears white in the eye image. The limbus is the boundary between the sclera and the iris. An image of eye captured by digital camera is shown in Figure below.

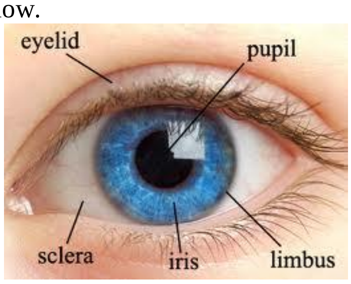


Fig : Eye Structure

EYE TRACKING TECHNIQUES

There is no universal technique to track the movement of the eyes. In any study, the selection of the technique rests with the actual demands of the application. During the analysis phase of this research, three major techniques were analyzed. Every technique has its own robust points and disadvantages. [1]

1. Electro-oculography

Electrooculography is based on electrodes attached to the human skin. Due to the higher metabolic rate at the retina compared to the cornea, the eye maintains a constant voltage with respect to the retina. This can be approximately aligned with the optical axis. Voltage rotates with the direction of gaze and can be measured by surface electrodes placed on the skin around the eyes. This technique is easily mounted elsewhere other than directly in front of the person as compared to other techniques. Electrical skin potential tracking is often used in medicine and practice to diagnose certain conditions. For example, EOG is employed to diagnose sixth nerve palsy. From their analysis it can be seen that while a clinical orthotic examination is still the best technique of diagnosis. Electrooculography provides a suitable replacement within the follow-up stage of treatment programs. While these uses are beneficial, the utilization of electrodes makes this technique of gaze tracking unsuitable for use in everyday applications.

2. "Dark Pupil/Light Pupil" technique

"Dark Pupil/Light Pupil" technique using infrared. Under infrared illumination, the pupil becomes very white, almost the exact opposite of its visual-spectrum appearance. By capturing both the dark and light pupil images, the high contrast (which is mostly localized to the pupil) can be used via image subtraction to evaluate the pupil location with very high accuracy. Because we wanted to leverage more eye data than just pupil location, and because we wanted to use widely available equipment as much as possible, we chose not to use this method.

3. Visible-light cameras and Computer-vision techniques

The final method uses plain visible-light cameras and computer-vision techniques to extract details about the position of various interesting features. The growth of the computer vision field in the last ten to fifteen years has led to a multitude of techniques that are capable of performing such analysis. For examples, see the USB Webcam Blink Detector by Chau and Betke, the Starburst Algorithm by Li and Parkhurst, and Savas' Track Eye software[2]. One benefit of this method is that it doesn't rely on characteristics that are extremely specific to the eye (e.g. retinal charge gradients or infrared pupil reflection), and can be tailored to other features of more complex interactions. Because of the variety of options, the ability to use ordinary cameras, and some group member experience in computer vision, we decided to use these techniques for our project.

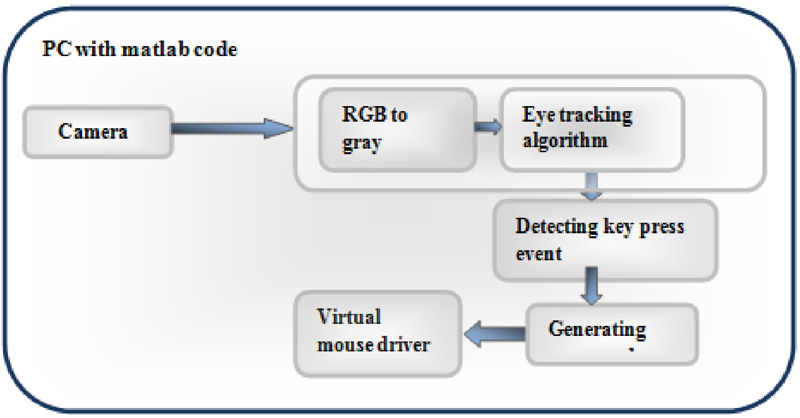
II. LITERATURE INNTERVIEW

"Controlling Mouse Cursor Using Eye Movement" In this paper, an individual human computer interface system using eye motion is introduced. Traditionally, human computer interface uses mouse, keyboard as an input device. This paper presents hands free interface between computer and human. This technology is intended to replace the conventional computer screen pointing devices for the use of disabled. The paper presents a novel idea to control computer mouse cursor movement with human eyes It controls mouse-moving by automatically affecting the position where eyesight focuses on, and simulates mouse-click by affecting blinking action. However, the proposed vision-based virtual interface controls system work on various eye movements such as eye blinking.[7]

"Robust Real-Time Face Detection" [8] This paper describes a face detection framework that is capable of processing images extremely rapidly while achieving high detection rates. There are three key contributions. The first is the introduction of a new

image representation called the "Integral Image" which allows the features used by our detector to be computed very quickly. The second is a simple and efficient classifier which is built using the AdaBoost learning algorithm (Freund and Schapire, 1995) to select a small number of critical visual features from a very large set of potential features. The third contribution is a method for combining classifiers in a "cascade" which allows background regions of the image to be quickly discarded while spending more computation on promising face-like regions. A set of experiments in the domain of face detection is presented. The system yields face detection performance comparable to the best previous systems (Sung and Poggio, 1998; Rowley et al., 1998; Schneiderman and Kanade, 2000; Roth et al., 2000). Implemented on a conventional desktop, face detection proceeds at 15 frames per second.

III. BLOCK DIAGRAM



Face detection is first and foremost step in tracking[3], later the detection of eyes which is done with the help of viola jones algorithm [4] .Later the tracking system is the step in the eye-tracking device and is the most directly in contact with the user. Tracking processes all of the data from the camera input(s), presents the calibration and parameter-tweaking interfaces to the user, and performs computer vision-related algorithms to determine the location of the user's pupils and eyebrows. From a user-interface perspective, the operation of the device is as follows:

• When the program begins, the user is prompted to position the camera and headgear properly so that the full regions of both eyes are clearly visible and unobstructed in the video.

• Then the user is prompted to select the appropriate eye regions from a video snapshot. The selection of the eye region is very important because it allows us to significantly narrow our search space, ensure that only eye-related features appear on the image, and cut down on external interference with the tracking process.

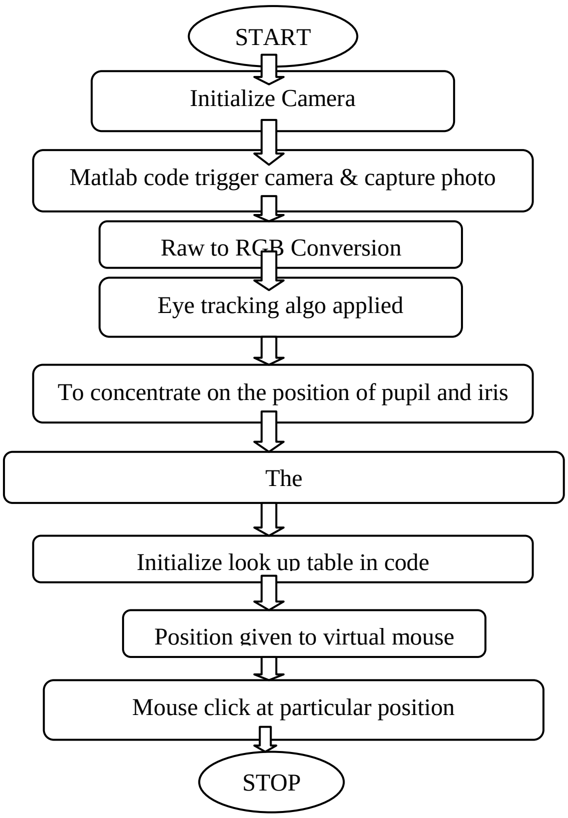
• With the regions selected, detailed tracking windows appear and the user is prompted to configure (via a set of track bars) the parameters that determine tracking. This is certainly the clumpiest part of the system, and the part that would benefit greatly from improvement in a more polished version of the device. Specifically, the track bars control the threshoding level applied to the input images. The user does not need to know any technical details since the best-guess estimate of pupil and eyebrow position are superimposed on the camera input, and the user need only slide the various track bars until the estimates are steady and follow his or her movements.

• After the parameters are set, calibration mode begins. In this stage, the user is prompted conduct a few eye and eyebrow movements while the program trains. The specific required actions are looking left, right, up and down, and raising the eyebrows. Once calibration is complete, the user is ready to begin using the device. The device can be recalibrated or disabled at any time with a simple keystroke.

The tracking algorithms are both based heavily on the contrasts and contours contained in the image of the eye. The pupil recognition algorithm is borrowed from Zafer Savas' Track Eye software . The image is first threshold and then run through a canny edge detector. Then contours are found and the contours are filtered to extract the largest, most circular closed contour available. In a sufficiently controlled image with proper parameters, this contour will be the pupil. The eyebrow recognition follows a similar process, and was custom written by our group. Very few existing eye trackers that we could find dealt at all with eyebrows, and we think eyebrow raise/lower recognition could provide useful control motions. The eyebrow recognition algorithm uses Thresholding and contour finding[5] , and then looks for the contour highest up in the image that is sufficiently large and oval-shaped. For this reason, it is important that the eye region be cropped short enough so that it doesn't contain other long/oval-shaped contours higher up (such as hair or the underside of the hat).[6]

IV. SOFTWARE DESCRIPTION

- ***Flowchart***



- ***Algorithm***

1. Here we are using USB webcam with 640 by 480 resolutions as source of input.
2. Matlab code will trigger the camera and will capture the photo.
3. This photo will be converted from RGB into gray to process it further

4. Now, eye tracking algorithm will be applied
5. In this, we will have to concentrate on the position of pupil and iris
6. So, as per the position detected in the image from the camera, the input is fed to the mouse driver function called in MATLAB
7. MATLAB will decide where to click as per the look up table saved in code
8. This is then fed to the virtual mouse to click at particular position

V. APPLICATION

Virtual mouse is used in the computer world for interact with computer without touching any physical device. It will used to control computer programs and any computer applications like playing games.

VI. FUTURE SCOPE

Future work may include improving the robustness against the lighting conditions. By using the highly qualified camera operate the operation to get more accurate result. Adding the scrolling movement (Using nose) Functionality. Also add the speech module which will operated by users mouse and launch on the start of the PC. Also we can add scrolling functionality by using face movements.

VII. CONCLUSION

"Virtual Mouse" is boon for the disable people who are not able to use physical mouse properly. It will gives them a new way to interact with computer world. It opens a new era.

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