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# CONTROLLING MOUSE CURSOR USING EYE MOVEMENT

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***Abstract*-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.**

***Keywords- Eye tracking, mouse movement, Eye-blinking detection.***

## 1. INTRODUCTION

Recently there has been a growing interest in developing natural interaction between human and computer. Several studies for human-computer interaction in universal computing are introduced. [1] The vision-based interface technique extracts motion information without any high cost equipments from an input video image. Thus, vision-based approach is taken into account an effective technique to develop human computer interface systems. For vision-based human computer interaction, eye tracking is a hot issue. Eye tracking research is distinguished by the emergency of interactive applications. However, to develop a vision-based multimodal human computer interface system, an eye tracking and their recognition is done. Real-time eye input has been used most frequently for disabled users, who can use only their eyes for input.

## 2. LITERATURE REVIEW

"Design and implementation of human computer interface tracking system based on multiple eye features". For human eye (Iris) detection, batch mode is employed. Iris tracking technique is implemented on static images. This technique simply works when the direction of iris is left, right or center. If the position of iris is up or down, it does not work. The system not works in real time. It is not expert to handle blinks and close eyes. [2]

This paper is aimed for designing and implementing a human computer interface system that tracks the direction of the human eye. The particular motion as well as direction of the iris is employed to drive the interface by positioning the mouse cursor consequently. The location of the iris is completed in batch mode. This means that the frames are stored in a permanent storage device and are retrieved one by one. Each of the frames is processed for finding the location of the iris and thereby placing the mouse cursor consequently. Such a system that detects the iris position from still images provides an alternate input modality to facilitate computer users with severe disabilities.

"Statistical models of appearance for eye tracking and eye blink detection and measurement".[3,4] Active Appearance Model (AAM) a proof-of- concept model for the eye region is created to determine the parameters that measure the degree of eye blinks. After developing an eye model, a blink detector is projected. The main advantage of using AAM technique is that the detailed description of the eye is obtained and not just its rough location. The main drawback of AAM technique is that it is designed to work for a single individual and additionally the blink parameters have to be identified in advance.

"Simultaneous eye tracking and blink detection with interactive particle filters". [5] Eye position is found using eye recognition algorithm. Then these filters are used for eye tracking and blink detection. For describing state transition, auto regression models are used. A statistical active appearance model (AAM) is developed to track and detect eye blinking. The model has been designed for variations of head pose or gaze. During this paper, the model parameters which encode the

variations caused by blinking are analyzed and determine. This international model is further extended using a series of sub-models to enable independent modeling and tracking of the two eye regions. Many techniques to enable measurement and detection of eye-blink are proposed and evaluated. The results of various tests on completely different image databases are presented to validate each model.

**"**Communication via eye blinks- Detection and duration analysis in real-time" [6] 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.

"MouseField: A Simple and Versatile Input Device for Ubiquitous Computing".[7] "MouseField" is a individual personal laptop or human computer interaction system that uses RFID reader and motion sensor. Especially the vision based face and hand motion tracking and gesture recognition is an attractive input mode for better human-computer interaction. Human gesture information has been variously employed in the game, virtual reality and other applications. Such gesture information is classified into the static gesture which uses spatial information only and the dynamic gesture which uses the spatial information and time information together. Since, the dynamic gesture can presents various expressions and it is considered as a natural presenting technique. Such motion information can be acquired by both using device-based interface and vision-based interface. The device-based interface technique gets motion information by motion capture devices and marker. However, the vision-based interface technique extracts motion information from input video image without any high cost equipments. Thus, vision-based approach is considered an effective technique to develop human computer interface systems. For vision-based human computer interaction, eye and hand tracking is hot issue. Eye tracking search is distinguished by the emergence of interactive applications.

Although various interaction technologies for handling information in the present computing atmosphere have been proposed, some techniques are too easy for performing human computer interaction, and others require special expensive equipments to be set up everywhere, and cannot quickly be accessed in our daily environment. In this, a new simple and versatile input device called the MouseField that enables users to control various information appliances easily without large amount of expenses. [7] MouseField consists of an identification recognizer and motion sensors that can detect an object and its movement after the object is placed on it. The system can easily translate the user's actions as a command to control the flow of information. A robust and versatile input device called the MouseField that can be used at almost any place for controlling information appliances. MouseField is a device that combines ID reader and motion sensing devices into one package.

## 3. GOAL OF THE SYSTEM:

1. Hands - free computing
2. Facilitating the handicapped in using the computer
3. Controlling the mouse pointer through eye movement
4. Eye based human computer interaction provides real time eye tracking and eye-gaze estimation

## 4. OBJECTIVES OF THE SYSTEM:

1. Easy interaction with computer without using mouse
2. Limitation of stationary head is eliminated.
3. Pointer of the mouse will move on screen where the user will be looking & the clicks will be performed by blinking.

## 5. FACE DETECTION

Face detection has always been a vast research field in the computer vision world. Considering that it is the back bone of any application that deals with the human face. [8]

The face detection method can be organized in two categories:

### 5.1 Feature-based method:

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.

**5.2 Image-based method:**

The second method is based on scanning the image of interest with a window that looks for faces at all scales and locations.

This category of face detection implies pattern recognition, and achieves it with simple methods such as template matching or with more advanced techniques such as neural networks and support vector machines. Before over viewing the face detection algorithm we applied in this work here is an explanation of some of the idioms that are related to it.

## 6. EYE DETECTION APPROACHES

Following are the various eye detection approaches:

**6.1. Regression approach**

Tries to minimize the distance between the predicted and actual eye positions. Simply by understanding the functional mapping from the input image to eye positions.

**6.2. Bayesian approach**

Learns model of eye appearance and non-eye appearance. Use Baye's principle to build a "probability of eye". Produces output for patches around each pixel of the input image, from which a prediction will be extracted.

**6.3. Discriminative approach**

Treats the problem as one of classification. A classifier is trained to produce positive output for patches around the eye and negative elsewhere.

From the above approaches, Bayesian approach is been taken into consideration. [8]

## 7. 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 techniques were analyzed; the Limbus tracking, Pupil tracking, and Electrooculography. Every technique has its own robust points and disadvantages. [9]

**7.1. Limbus Tracking**

Limbus Tracking explains a way of tracking the eye using the limbus. The limbus is the boundary between the white sclera of the eye and the darker iris. As the sclera is white and the iris is darker, this boundary can easily be visually detected as well as tracked. This technique is based on the position and shape of the limbus relative to the head, therefore the head must be kept quite still or the apparatus must be fixed to the user's head. This technique is negatively affected by the eyelid often concealing all or part of the limbus. This makes its uses limited to horizontal tracking. Usually this technique does not involve the use of infra red light.

**7.2. 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, a higher resolution is achievable. 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.

**7.3. Electrooculography**

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.

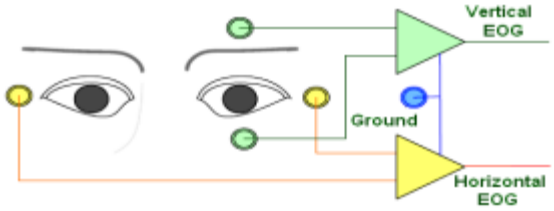


Figure 1: Correct positions of five electrodes [10]

### 7.4. Saccade

A saccade is a fast/rapid movement of an eye. Especially as it jumps from one fixation point to another (as in reading).When something attracts our attention, we position our gaze on it, thus performing a *fixation. A fixation* usually has duration of at least 100 to 150 milliseconds (ms).The fast eye movements that occur between fixations are known as SACCADES.

## 8. INPUT FROM THE EYE

Now input medium turns to eye movements as a real time. Eye movement input is distinctly faster than other current input. Before the user operates any mechanical pointing device, he or she usually looks at the destination to which he or she wishes to move. Thus the eye movement is available as an indication of the user's goal before he or she could actuate any other input device. The eye is, of course, much more than a high-speed cursor positioning tool. Because of the upper and lower eyelid, etc., it is difficult to find the complete circular shape of the pupil

### 8.1. Mouse pointer control

Figure 2: Left and right movement of the pupil

In order to use the pupil to control the mouse pointer (cursor) on the screen, the central coordinate of the screen is set as a start point. This position is used as the base for gaze tracing, and the initial position of the mouse pointer is set as the center of the screen. The moving position of the cursor takes the initial position as the base. As the pupil move to some direction, the coordinate of the mouse pointer on screen change according to the movement of the pupil. When the pupils return to the original position, the cursor stops moving.

The horizontal movement of the pupil can be fully grasped by the movement of the circular objects as shown in Figure 2. The vertical movement of the circular object is more subtle than the horizontal movement, so the size of the pupil is used for control as shown in Figure 3. 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.

Figure 3: Up and down movement of the pupil

**8.2. Mouse click events control**

The mouse click is treated by perceiving the blink of an eye. Namely, when one person's eyes are recognized in closed state, we click the position of the current mouse pointer. The Figure 4 shows the calculus of the closed state of the eyes.

Figure 4: Eye blink motion detection

Namely, compared the black pixel with the white pixel on the mask and, when the black pixel is far less than the white pixel, we deem the eyes lying in closed state. 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.

## 9. PROPOSED ALGORITHM

A complete procedure is presented that moves the mouse from one place to another on desktop through user's eyes movement. Before the processing for the movement of mouse begins, detailed processing is presented below:

1. Camera receives the input from the eye.
2. After receiving these streaming videos from the cameras, it will break into frames.
3. After receiving frames, it will check for lighting conditions because cameras require sufficient lights from external sources otherwise error message will display on the screen.
4. The captured frames that are already in RGB mode are converted into Black 'n' White.
5. Images (frames) from the input source focusing the eye are analyzed for Iris detection (center of eye).
6. After this, a mid point is calculated by taking the mean of left and right eye centre point.
7. Finally the mouse will move from one position to another on the screen and user will perform clicking by blinking their eyes for 5 seconds.

**10. WORKING**

The user has to sits in front of the screen of personal computer or laptop, a specialized video camera mounted above the screen to observe the user’s eyes. The computer continually analyzes the video image of the eye and determines where the user is looking on the screen. Nothing is attached to the user’s head or body.

To “select” any key, the user looks at the key for a specified period of time and to “press” any key, the user just blink the eye. In this system, calibration procedure is not required. For this system input is only eye. No external hardware is attached or required.

Figure 5 shows the implementation of the system.

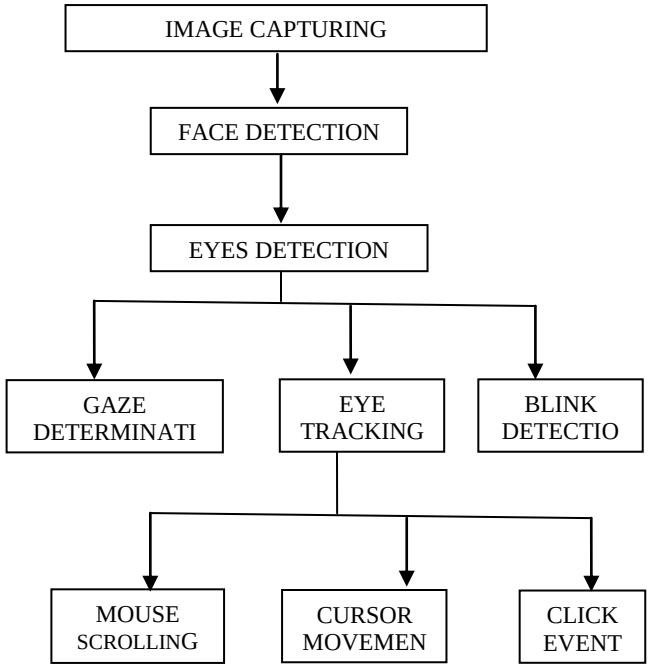


Figure 5: Implementation of the system

## 11. CONCLUSION

This paper focused on the analysis of the development of hands-free PC control - Controlling mouse cursor movements using human eyes. Thus, the comprehensive study of the gaze-based interaction processes is implemented. The mouse pointer is operated using eye. The most unique aspect of this system is that it does not require any wearable attachments. This makes the interaction more efficient and enjoyable. A user interface is the system by which human interact with a computer. The user interface includes hardware and software components. No external hardware is attached or required.

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