Review on Automatic Cursor Moving and Clicking of PC with Eye Gaze Tracking

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Abstract— Now a days for computer we are using input devices such as keyboard, mouse and joystick. With the advancements in the field of Human Computer Interaction, eye tracking or iris tracking is the most promising field. It will fundamentally change the way we interact with computers. In the last decade, the development of eye tracking (ET) systems represented a challenge for researchers and different companies in the area of IT, medical equipment or multimedia commercial devices. An eye tracking system is based on a device to track the movement of the eyes to know exactly where the person is looking and for how long. It also involves software algorithms for pupil detection, image processing, data filtering and recording eye movement by means of fixation point, fixation duration. The main aim of this proposed work is to develop a low cost application running, to replace the traditional computer mouse with the human iris for cursor movement. The target audience majorly consists of handicapped people or people with physical impairment. The system designed aims at detecting the user's eye movements for navigating the cursor, analyzing the nature and timing of blinks, which in turn is used as an input to the computer as a mouse click. The system should consists of a good resolution webcam.

Keywords: Eye Gaze Tracking, ETM System, PCCR Method

I. INTRODUCTION

People with physical disabilities cannot fully enjoy the benefits provided by computer System .This is because the conventional mouse and keyboard were designed to be used by those who are able bodied. Due to reducing the communication barriers between man and machine human eye computer interaction is important. The main aim of this proposed system is to design and implement a human computer interaction system that tracks the direction of the human gaze. The pupil detection and tracking is an important step for developing a human-computer interaction system. To identify the gaze direction of the user's eye (right, left, up and down). Human eye uses contactless type devices. This work can develop a human computer interaction system that is based on iris tracking. The iris is widely used as the starting point for detection and tracking. It is an important eye feature that is circular in shape and that can be detected easily.

This paper presents review of hands free interface between pc and human. This technology is intended to replace conventional switching devices for the use of disabled. It is a new way to interact with the electrical or electronic devices that we use in our daily life. The paper illustrates how the movement of eye cornea and blinking can be used for controlling pc. The basic Circle Detection algorithm is used to determine the position of eye. Eye blinking is used as triggering action/clicking which produces binary output through the for computer.

Shrunkhala Satish Wankhede Ms. S. A. Chhabria Dr. R. V. Dharaskar present a paper "Controlling Mouse Cursor Using Eye Movement". 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. In this proposed system 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.

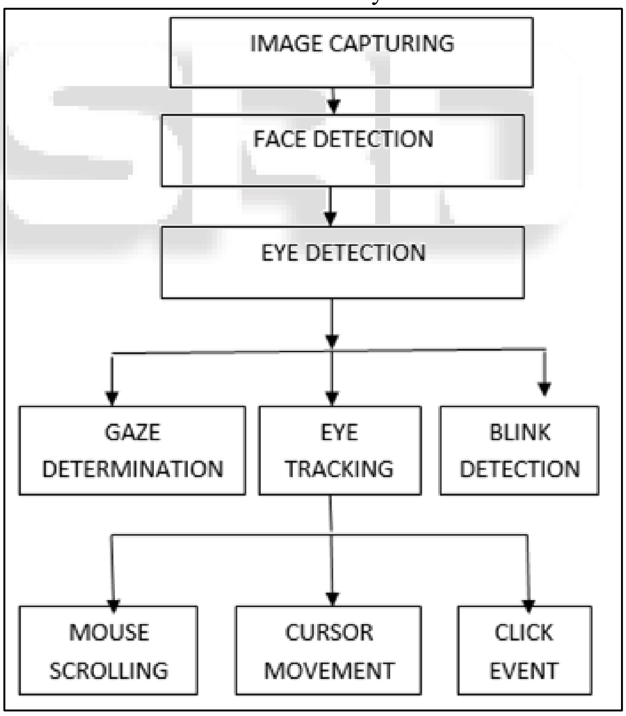

Fig. 1: Implementation of the system

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. Above diagram shows the implementation of the system. 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.

Junghoon Park, Taeyoung Jung and Kangbin Yim publish paper on "Implementation of an Eye Gaze Tracking System for the Disabled People". This paper proposes a modified pupil center corneal reflection(PCCR) hardware method to improve the system accuracy. The modified PCCR eye gaze tracking system, a new version of the PCCR eye gaze tracking system supplemented by the relation between IR LED position and the distance from the eye gaze tracking system to the monitor screen, improves the tracking accuracy within one degree. This paper suggests the adaptive exposure control algorithm for the proposed system which is robust against light.

This system is composed of various parts in the camera, and experiments were carried out by configuring the system to match the optimum distance through the experiment on both sides of the reflected light LED. Eye-tracking systems use the difference vector (P-CR) between the pupil position (P) and the corneal reflection (CR) to determine the gaze vector.

To bring the image of the camera which supports the USB video class UVC standard compatible interface, we use a video input library using the bright eye and dark eye depend on calculating region of interest(ROI). After two consecutive images are input, the saved two images are converted to the binary images. In the calculated images, the difference between the two images is converted to pupil. Therefore, only the difference between two images is to be extracted. If the difference between the two images is a circular shape that can be a blob candidate, depending on the situation the candidate of pupil can be extracted depending on the known information about pupil.

As shown in Fig. 2, to produce the image from the camera that supports the USB video class(UVC) standard compatible interface, we use a video input library using the bright eye and dark eye depending on region of interest (ROI) calculation. After two consecutive images are input and saved, they are converted to the binary images. In the calculated images, the difference between the two images is converted to pupil. Therefore, only the difference between two images is extracted. If the difference is a circular shape that can be a blob candidate depending on the situation, the candidate of pupil can be extracted depending on the information known about pupil. IR reflection point is extracted from the dark eye. Then, we must check whether they are bright or dark. If dark eyes are selected for finding glints, the threshold value should be chosen. The threshold value is calculated with Eq. (1) and it predicts glint brightness to extract glint. When the dark eye ROI is extracted, the maximum brightness can be expected with glint brightness. Therefore, the threshold weight (maximum brightness and pupil brightness) is set at 9:1 and slightly lower threshold than the maximum brightness is applied to make easy glint extraction. The weight of 9:1 is given because the value between glint that is the brightest and bright pupil that is next to glint brightness is used so that one value between them becomes the threshold.

$$\text{Threshold} = (\text{Max Bright} * 9 + \text{Pupil Bright})/10 \quad (I)$$

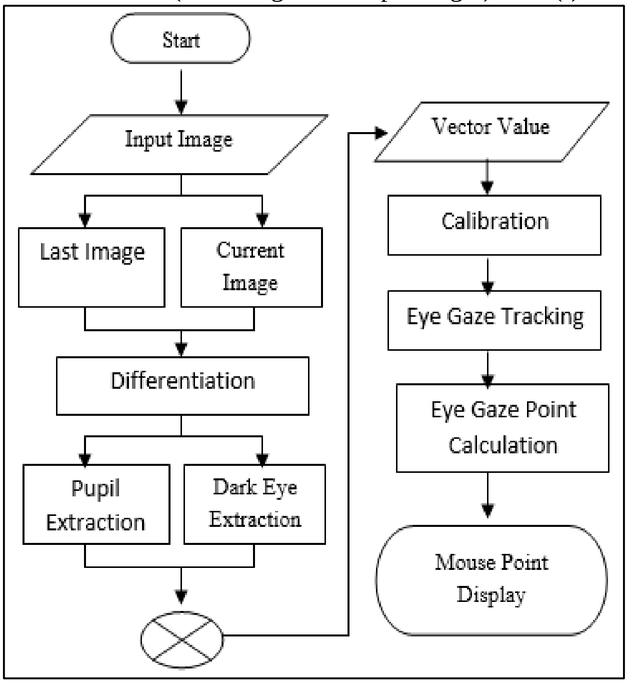

Fig. 2: The flow of the eye gaze tracking algorithm

The proposed system produces the remote eye gaze tracking system optimal to the form factor for the disabled and the eye gaze tracking system of general PCCR method using various image processing technology. Gaze accuracy that is the performance yardstick of the eye gaze tracking system is set at about one degrees and 12 point calibration is used to reflect the gazers eye error.

Robert Gabriel Lupu, Florina Ungureanu, Valentin Siriteanu publish paper "Eye Tracking Mouse for Human Computer Interaction". In this paper a reliable, mobile and low-cost system based on eye tracking mouse is presented. The eye movement is detected by a head mounted device and consequently the mouse cursor is moved on the screen. A click event denoting a pictogram selection is performed if the patient gazes a certain time the corresponding image on the screen.

In this proposed eye tracking method is oriented towards the possibility to be used by patients for email, messenger and social sites. In this paper he propose an eye tracking mouse (ETM) system using video glasses and a new robust eye tracking algorithm based on the adaptive binary segmentation threshold of the acquired images. The proposed system allows the patient to communicate his needs, to browse a graphical user interface and to select an image or a word, using only his eyes.

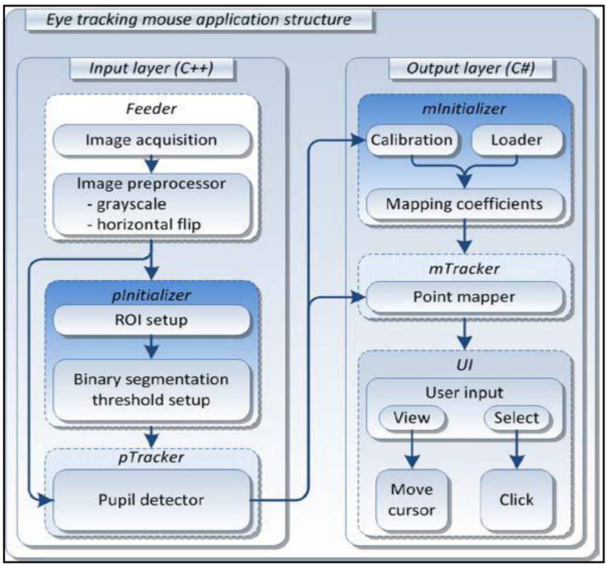

Fig. 3: Eye-tracking mouse software application

The proposed ETM system consists of two hardware devices, webcam and video glasses and the software application running the eye tracking algorithm. The webcam, mounted on a video glasses frame with the help of an aluminum bar, has a modified system lens in order to be used at a short suitable distance (less than ten centimeters) from user's eyes. It captures images only in infrared light by using an infrared filter on top of the lens. Six infrared LEDs provide constant illumination of the eye so that the natural light has an insignificant influence on pupil detection.

The video glasses display copies of the computer screen for both eyes so that the patient sees a 16:9 widescreen 1.9 m display, as seen from 3 m [4]. The software application detects the pupil and maps its webcam position on computer screen in concordance with patient's gaze direction. Therefore, the mouse cursor is moved in the point of screen coordinates. By gazing at that point for one to two seconds, the software generates left click event. In this way the patient can point and click.

Unlike the previous approach, video glasses were used instead of computer monitor so that the head position of the patient does not affect the eye tracking algorithm after calibration. The software application was written in C++ and C# using Visual Studio 2010 and OpenCV library for image processing. The software application is organized on two layers, as it is presented in Fig. 2.

The input layer is written in C++ and consists in three modules: Feeder, pInitializer and pTracker. The Feeder module provides for pInitializer continually acquired and pre-processed images until ROI (Region of Interest), binary segmentation threshold and mapping coefficients are obtained. After these values are validated, the pTracker module detects eye pupil and mTracker determines the mouse coordinates. The output layer written in C# defines how information provided by the input layer are processed. So, the Point mapper calculates the new cursor coordinates based on webcam pupil coordinates. The mapping coefficients can be loaded from a local file or can be also updated when the mTracker is not running.

The output layer written in C# defines how information provided by the input layer are processed. So, the Point mapper calculates the new cursor coordinates based on webcam pupil coordinates. The mapping coefficients can be loaded from a local file or can be also updated when the mTracker is not running. The Calibration component of mInitializer module displays nine points on screen, one at a time. The patient has to look straight to each of them for one or two seconds and the corresponding positions of the pupil are recorded. Then, using the Sheena and Borah equations, the mapping coefficients are determined.

The User Interface (UI) module moves the cursor in the position provided by Point mapper. The click event is generated if the cursor stays in a certain position for one second.

The social impact of the proposed ETM system may be significant allowing the social reinsertion of the disabled persons and increasing their self-respect. For many disabled people, such a communication system could help them to continue their intellectual and social life or to pass easier the difficult period of medical recuperation. In addition, taking into account that many people with disabilities do not afford a suitable communication system, this low-cost system could successfully replace the more expensive ones. The proposed mobile device should be also useful for people with limited hand functions or should be integrated in different virtual and augmented reality systems for recovering and rehabilitation process targeting persons suffering from neuromotor paralysis in the spirit of the new paradigm of Cyber-Physical Systems.

Riddhi Chavda,Madhura Barve, Amit Doshi publish a paper with titled "Real Time Eye-Tracking Using Web Camera". This paper describe project.

The main aim of this project is to develop a low cost application running in an open source environment and a widely used operating system Linux, to replace the traditional computer mouse with the human iris for cursor movement. The target audience majorly consists of handicapped people or people with physical impairment. The system designed aims at detecting the user's eye movements for navigating the cursor, analyzing the nature and timing of blinks, which in turn is used as an input to the computer as a mouse click. The system consists of a good resolution Logitech C270 HD webcam, as opposed to the otherwise popular infrared cameras available in the market.

The existing cameras used for tracking are highly expensive but our system is affordable and easy to use. In the project we have used the Fabian Timm image processing algorithm to achieve iris tracking.

This project implemented the Fabian Timm algorithm which locates and tracks the user's eye in consecutive frames of the video stream. The intended input is the region of interest, where the search procedure takes place, i.e. only the eye image. To navigate the mouse pointer on the screen, user will have to move our iris to the desired position and then blink for over threshold number of frames duration to establish a valid click.

They used cameras for video chat applications support high-definition (HD) images with high resolutions up to 1920x1080 pixels. They use Logitech c270HD

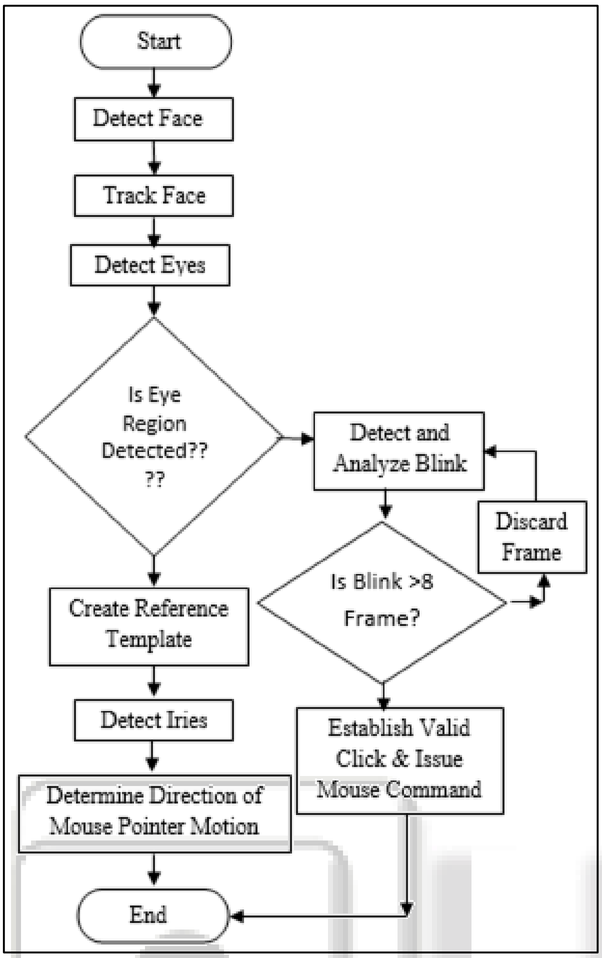

Fig. 4: Flowchart of implemented algorithm.

Older eye tracking algorithms were highly dependent upon the amount of light, resolution and contrast. Hence, the images which suffered from lower resolution and contrast gave sub-standard tracking. Thus the Fabian Timm algorithm was devised. The advantage of this algorithm is that it works in even poor lighting conditions. The algorithm first detects the face, then the eyes and then the center of the iris. It tracks the irises in real time thereby detecting where the user is currently looking. It maps the iris position as the change in cursor location on the screen.

– It works by measuring gradients of the iris.
– It uses segmentation of Image Processing.
– It will keep on measuring the gradient using the gradient function. The value of gradient will be maximum for the iris part and that will be it.
– It takes the screenshot the eyes so as to keep it as a backup making the system more robust.
– The gradient functions are implemented using OpenCV libraries.

The system shows that it has a potential to be used as generalized user interface in many applications such as determining web usability in heat maps. A heat map is a graphical representation of data where the individual values contained in a matrix are represented as colors.

II. CONCLUSION

In this paper we roughly describe some representative studies in the field of eye tracking, covering some aspects regarding different types of devices, algorithms for pupil detections, image processing or data filtering and also some well-known applications in assistive technology, human computer interaction, virtual reality, psychology or e-learning.

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