

EYE MOUSE FOR PHYSICALLY DISABLED INDIVIDUAL

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering
with specialization in Internet of Things

By

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

**Accredited with Grade “A++” by NAAC | 12B Status by UGC | Approved by AICTE
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **YOGI.B (40111490)** and **SNEHA.K (40732009)** who carried out Project entitled "**EYE MOUSE FOR PHYSICALLY DISABLED INDIVIDUAL**" under my supervision from November 2023 to April 2024.

for 
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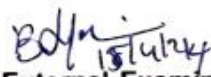


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DECLARATION

I, **SNEHA.K**(Reg.No- 40732009), hereby declare that the Project Report entitled **EYE MOUSE FOR PHYSICALLY DISABLED INDIVIDUAL** done by me under the guidance of **Dr. A. Viji Amutha Mary, B.E., M.Tech., Ph.D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering with Internet of Things**.

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CONFERENCE CERTIFICATE



ABSTRACT

This is an individual Human computer interference system. The mouse and keyboard were used by human computer interference system. Those people who are suffering from certain disease or illness cannot be able to operate computers. The idea of controlling the computers with the eyes will serve a great use for handicapped and disabled person. Also, this type of control will eliminate the help required by other person to handle the computer. This measure will be the most useful for the person who is without hands through which they can operate with the help of their eye movements. The movement of the cursor is directly associated with the center of the pupil. Hence our first step would be detecting the center of point pupil. This process of pupil detection is implemented using OpenCV.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
HCI	Human computer interface
EEG	Electroencephalography
HOG	Histogram of oriented gradients
EAR	Eye aspect ratio
MAR	Mouth aspect ratio
CNN	Convolutional neural network
ETRA	Eye Tracking Research & Application

CHAPTER 1

INTRODUCTION

Computers are designed to be readily accessible for normal individuals. However, for individuals with severe physical disabilities such as cerebral palsy or amyotrophic lateral sclerosis, usage of computers is a very challenging task. There have been many research studies on human computer interface (HCI) to improve the interaction between the user and the computer system. Most of these are applicable only to normal individuals. These interfacing methods include a touch sensitive screens, speech recognition methods and many others.

Despite the success of these techniques, they were not suitable for the physically disabled individuals. Many researchers have tried to develop methods to help the disabled to interact with computers by using signals such as electroencephalography (EEG) from the brain, facial muscles signals (EMG) and electro-oculogram (EOG) .

Other methods include limbus, pupil and eye/eyelid tracking [4-5], contact lens method, corneal, pupil reflection relationship [6] and head movement measurement. These methods require the use of attachments and electrodes to the head, which makes them impractical. Other high end techniques [8] that are based on infrared tracking of the eye movements to control computers were exceptionally expensive and were not affordable for those who need them.

The method described in this paper is distinctive because unlike existing methods we did not use electrodes, infrared, or any other light source to track the eyes. The only hardware that is required is a PC or laptop along with a webcam, which makes it practical and feasible. By taking consecutive snaps of the user from the camera, the program is designed to process these frames individually at very high speed of processing and compare the iris shift in each frame with respect to the initial frame. The frame undergoes several stages of processing before the eyes can be tracked. After obtaining the processed image, the iris shift is calculated and the program prompts the cursor on the screen to move to the respective location.

CHAPTER 2

LITERATURE SURVEY

Thomas Treal et. al [4] complements the existing human-machine interaction literature aiming to disentangle how realism consistency between appearance and behavior of a CG character may affect the way we interact with it. Our results showed, for the first time, that both non-communicative and emotional body motion combined with facial expression made the avatar's pain perception seem more accurate, and in some cases provoked a greater emotional arousal than facial pain expression with a still body.

Deepateep et. al [5] presented a facial based interface as a possible alternative way to control mobile devices applications. The 3D facial movements are obtained using a depth-sensing camera available on many mobile devices. These 3D animation data are analyzed into the form of blend shapes and face direction to determine input actions. These input actions are the conventional touch input actions 3648 such as tap, drag, pinch-in, and pinch-out. For this reason, our proposed facial based input methods can be integrated into the existing mobile applications that used touch interface. Through our user studies, we conducted experiments with several subjects on the practical usability of facial movement interface for mobile applications.

Biele et. al [6] focuses on face movement in the context of human–computer interaction. Although face movement is discussed mainly in the context of expressing emotions, it can also be analyzed independently from emotional processes. The first section of this chapter outlines the brain processes responsible for the processing of emotions and generating facial expressions, and offers general information on surface electromyography. Later sections focus on computer based facial movement recognition and explain the differences between two main approaches to this problem—one based on video signals, and the other on measurement of muscle activity. Additionally, the two methods are analyzed with regard to their potential applications.

Kubacki et. al [7] describes design process of a controlling an electric DC motor based on Electrooculography (EOG). In first paragraph authors presented information about Electroencephalography (EEG) and Electrooculography (EOG).

Authors performed a literature overview concerning on those two techniques. In the next step, authors implemented simplified mathematical model of DC motor and PID controller. The system was built with used of the bioactive sensors mounted on the head, which was triggered by the signal from eyes movement and facial expressions. The built interface has been tested. Three experiments were created. In all three experiments, three people aged 25–35 was involved. Each of them conducted from 5 to 10 attempts each scenario. Between attempts respondent had a 1-min break. Each scenario was more difficult than before. The investigators attempted to enter a virtual red dot into the green square using only eyes movement and blinking.

Bisen et. al [8] addressed on the idea of building up a model to control computer systems by utilizing facial landmarks like eyes, nose and head gestures. The face recognition systems mainly detect and recognize eyes, nose and head gestures to control the movement of the mouse cursor in order to operate computer system in real time. This paper proposes the facial landmarks-based human computer interaction model in which histogram of oriented gradients (HOG) has been taken for global facial feature identification and extraction that is considered as HOG descriptors. Furthermore, pre trained linear SVM classifier gets extracted features to detect whether it is a human face or not, including use of pyramid-based images and sliding window algorithm. Moreover, pre-trained ensemble of Regression Trees algorithm is applied to recognize facial landmarks such as eyes, eyebrows, nose, mouth, and jawline. The main purpose is to effectively utilize facial landmarks and allow the user to perform activities mapped to explicit eye blinks, nose and head motions using PC webcam. In this model, eye blinks have been detected through estimated value of eye aspect ratio (EAR) and newly proposed β parameter. Accordingly, classification report has generated for both estimation and analysed best results for β parameter in terms of accuracy with 98.33%, precision with 100%, recall with 98.33% and F1 score with 99.16% under good lighting conditions.

MARIN et. al [9] proposes a work on how drones could be controlled using brainwaves without any of those devices. The drone control system of the current research was developed using electroencephalogram signals took by an Emotiv Insight headset. The electroencephalogram signals are collected from the user's brain. The processed signal is then sent to the computer via Bluetooth. The headset employs Bluetooth Low Energy for wireless transmission. The brain of the

user is trained in order to use the generated electroencephalogram data. The final signal is transmitted to Raspberry Pi zero via the MQTT messaging protocol. The Raspberry Pi controls the movement of the drone through the incoming signal from the headset. After years, brain control can replace many normal 3649 input sources like keyboards, touch screens or other traditional ways, so it enhances interactive experiences and provides new ways for disabled people to engage with their surroundings.

Gupta et. al [10] developed a digital personal assistant for handicapped people which recognizes continuous Bangla voice commands. We employed the cross-correlation technique which compares the energy of Bangla voice commands with pre-recorded reference signals. After recognizing a Bangla command, it executes a task specified by that command. Mouse cursor can also be controlled using the facial movement of a user. We validated our model in three different environments (noisy, moderate and noiseless) so that the model can act naturally. We also compared our proposed model with a combined model of MFCC & DTW, and another model which combines cross correlation with LPC. Results indicate that the proposed model achieves a huge accuracy and smaller response time comparing to the other two techniques.

Gawande et. al [11] consider all the techniques of face recognition and also Human Computer Interaction. Detecting and normalizing human faces from live video streams is the first crucial step in a face verification/recognition system. The contributing disciplines include computer science, cognitive science, human factors, software engineering, management science, psychology, sociology, and anthropology. Early research and development in human-computer interaction focused on issues directly related to the user interface.

2.1 INFERENCES FROM LITREATURE SURVEY

The above papers focuses on providing the overview about the various eye based cursor movement techniques developed or proposed. Hence, we discuss & study the above Literature survey for developing low-cost based system aims to handle & also affordable for the majority of the physically challenge subjects.

Thus, we concluded these paper which shows how we can access our computer machine with respect to human iris. Different types of eye tracking systems have been reported in the literature survey. Among these, head-mounted and remote eye

tracking devices are used in real-time applications. One of the most commonly used applications of gaze-controlled interfaces is text entry using a virtual keyboard

2.2 OPEN PROBLEMS IN EXISTING SYSTEM

In the existing system, the detection of the Iris of the eye is done using Matlab and controls the cursor. An eye movement-controlled wheelchair is an existing one that controls the wheelchair by monitoring eye movement. In Matlab, it is difficult to predict the Centroid of the eye so we go for OpenCV.

Matlab delete the iris and control cursor. Eye movement-controlled wheel chair is existing one that controls the wheel chair by monitoring eye movement. In matlab the difficulty is to predict the centroid of eye so we go for open cv.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

The project involved analyzing the design of few applications so as to make the application more user's friendly. To do so, it was really important to keep the navigations from one screen to the other well ordered and at the same time reducing the amount of typing the user needs to do. In order to make the application more accessible, the browser version had to be chosen so that it is compatible with most of the browsers.

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

Following modules need to be installed:

OpenCV: OpenCV is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects, faces, or even the handwriting of a human. It can be installed using "pip install opencv-python"

MediaPipe: MediaPipe is a framework for building multimodal (eg. video, audio, any time series data), cross platform (i.e Android, iOS, web, edge devices) applied ML pipelines. It can be installed using "pip install mediapipe".

Autopy: AutoPy is a simple, cross-platform GUI automation library for Python. It includes functions for controlling the keyboard and mouse, finding colors and bitmaps on-screen, and displaying alerts. It can be installed using "pip install autopy"

CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

Looking at the disadvantages of all the above methodologies used in previous systems, The system comprises of various phases including face detection, eye localization, iris detection, midpoint focus and mouse pointer control. The eye region is darker compared to the nose bridge region. This will be used as a distinguishing feature in the detection of the eyes from the face. The mouse left click event will occur if the eye is closed for at least five seconds. The system will display an error if no input is detected or the eye is closed for longer period of time which comprises of more than a minute of no activity. Eye Ball Tracking with OpenCV refers to a computer vision project that involves using the OpenCV library to track the movement of a person's eye. This technology can be used in a variety of applications, such as eye-controlled interfaces for disabled individuals, marketing research studies to track user attention, and improving driver safety systems. By analyzing the movement of the eye, the project can provide valuable insights into human behavior and interaction with technology.

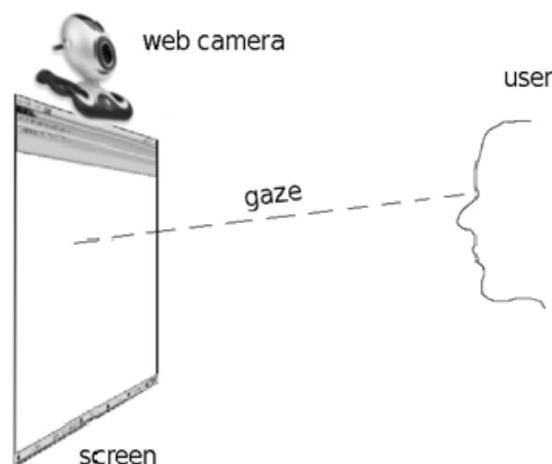


Fig: 4.0 outlook of gaze detection

In our proposed system the cursor movement of computer is controlled by eye movement using Open CV. Camera detects the Eye ball movement which can be processed in Open CV. By this the cursor can be controlled.

4.1 SELECTED METHODOLOGY OR PROCESS MODEL

Nowadays, computer systems have become a vast part in our day to day survival since they are used in various areas such as at workplace etc. Personal Computers mostly use input method as mouse. But in case of disability or physically handicapped they cannot able to operate computers. In such cases, it might be preferable to use input methods such as eye movements. To enable such input method , a system is designed to control cursor on a computer system without the use of mouse . In the new system, the cursor movement is controlled by the eyeball movement using OpenCV. It has camera which detects the Eyeball movements and based on these eyeball movements the cursor is controlled using OPENCV.

OpenCV is used with processor pace with 1 GB of RAM and in-built Wi-Fi. Camera (IP Camera) is associated with the OpenCV to understand the vision of the machine. The camera will grab the eye movement and controls the cursor. Likewise, it will also perform the activities like scrolling and moving. It has some steps to follow .They are,

- IP cam captures the eyeball movements which are processed using OpenCV
- Eye Aspect ratio (EAR) technique for pupil detection
- Frames getting started and EAR values being detected based on the eyeball movements.
- cursor activities are performed.

4.2 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM

After capturing the live images, we use the Facial Landmark Detector to map the facial points. We make a black mask of the same size as our webcam frame. We store the coordinates of the facial marks on the left and right eyes respectively and draw them on the mask. After detecting the eyes, we draw the eyes on the black mask that we created. Now we have a mask where the area across the eye is drawn in white, wherein the mask is black. This white area is expanded and morpholized a little using a morphological operation. We now segment out the eyes. Now we convert all the white pixels to black that

are 255 values so that only the eyeball area is the dark part left across the white eyes area. We need to create a binary mask by thresholding. For thresholding, we convert the resultant image to grayscale.

So now we find an appropriate value of threshold against which we segment out the eyeballs from the eye. Now the eyeballs are segmented out. We now find the two largest contours from the mask which should be our eyeballs. This leaves out some errors such as not being able to detect eyes accurately, but it can be measured by taking the midpoints between the eye area and dividing the image accordingly. Then we find the value of contours which is maximum in those frames and those should be our eyeballs.

For the detection of movement of the eyeball, we calculate the ratio of eye landmark points to get the position of eyeball and then connect the movement of eyeball to cursor using a script that controls the mouse to automate interaction with other applications. Now the cursor will move according to the movement of our eyeballs. We now move on to the clicking part where the blinking of eyes is used for clicking events. Firstly, we calculate the eye aspect ratio (EAR). The Eye Aspect Ratio is a constant value when one's eye is open, but rapidly falls to 0 when one's eye is closed. We then take the average EAR of both eyes respectively and calculate the absolute difference between both the EAR's. Now we compare the difference EAR and value of threshold that we have set for the blink. If the difference is greater than the blinking value of threshold, we move further and compare the EAR of right and left eyes respectively. So if the EAR of the right eye is greater than the EAR of the left eye, it implies that the right eye is open but we cannot be sure of the left eye; or the other way round.

To check whether the left eye is open or not, we compare the EAR of the left eye and the value of the threshold for the eyes that we had set previously. So if the value of threshold is greater than the EAR value, it implies that the left eye is closed. Now we link this to the left click of the mouse and therefore, left mouse click is performed. We now use the same procedure for right click using the right eye wink. Now we can move the cursor using our eyes and also perform right click and left click by winking the right eye and left eye respectively.



Fig: 4.2.0.Iris landmark detection

The basic explanation of the above process is given in the following block diagram, the webcam of the pc or laptop will take the input as an image of the eye

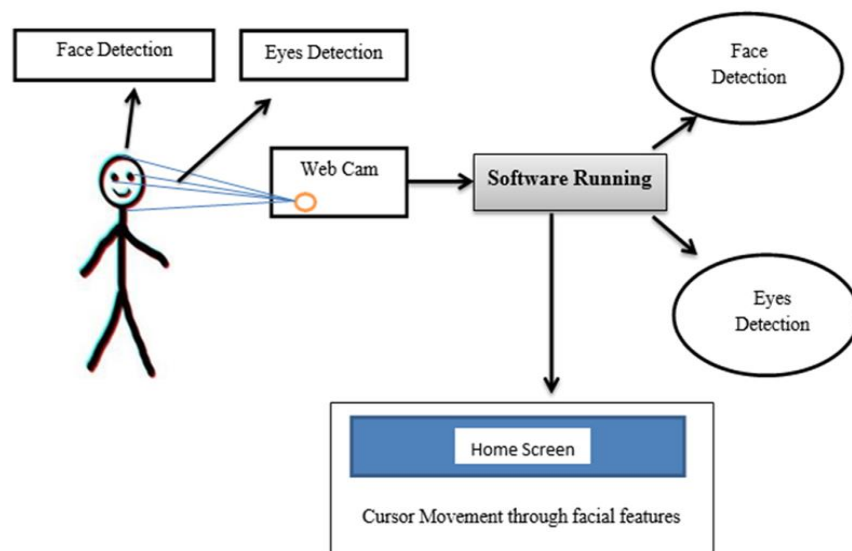


Fig 4.2.1 Architecture of proposed system

Right Eye	Left Eye	Action
True	False	Left Click
False	True	Right Click
True	True	Moving mode
False	False	Blink

Fig:4.2.2 Eye mouse control

4.3 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

OpenCV: OpenCV is a huge open-source library for computer vision, machine learning and image processing. Open CV supports a wide variety of programming languages like python, c++, java etc. It can process image and videos to identify objects, faces or even the handwriting of a human. It can be installed using “pip install OpenCV-python”.

MediaPipe: MediaPipe is a framework for building multimodel(eg: video, audio, any time series data), cross platform (i.e Android, iOS ,web, edge devices) applied ML pipelines. It can be installed using “pip install mediapipe”.



4.3 Fig: OpenCV and MediaPipe

4.4 PROJECT MANAGEMENT PLAN

Detect Face: This component's primary function is to detect the webcam and the face. If more than one webcam is identified, the system will prompt you to choose one. It recognizes the face and does a geometrical analysis of their relative positions, areas, and distances. The component will recognize face characteristics and apply geometrical analysis to determine their distance. It causes facial features to be localized. Pattern recognition and Template matching are used in the second method, which is image-based.

Track face movement: The nose tip is tracked so that its movement and coordinates can be used as the mouse pointer's movement and coordinates. The eyes are tracked to detect blinks, which are then converted into mouse clicks. The tracking mechanism works by anticipating where the feature will be in the current frame based on its previous location; template matching is then used to find the feature's new coordinates.

Perform mouse operations: In this module, new pixels are compared to previous pixels to determine the threshold value, and to perform mouse click actions on blinks, first test whether the blink is right or left, then click.

4.6 TRANSITION/ SOFTWARE TO OPERATIONS PLAN

Software Specifications:

- Operating system : Windows 10.
- Coding Language : Python
- Tool : OpenCV

Hardware Specifications

- Processor : Intel Core
- Ram : 2GB
- Hard disk : 500GB

REFERENCES:-

- I. Nasor, Mohamed, et al. "Eye-controlled mouse cursor for physically disabled individual." Advances in Science and Engineering Technology International Conferences (ASET), 2018. IEEE, 2018.
- II. Elahi, Hossain Mahbub, et al. "Webcam-based accurate eye-central localization." Robot, Vision and Signal Processing (RVSP), 2013 Second International Conference on. IEEE, 2013
- III. Meng, Chunling, and Xuepeng Zhao. "Webcam-Based Eye Movement Analysis Using CNN." IEEE Access 5 (2017): 19581- 19587.
- IV. Cáceres, Enrique, Miguel Carrasco, and Sebastián Ríos. "Evaluation of an eye-pointer interaction device for human-computer interaction." Heliyon 4.3 (2018): e00574.
- V. Tsai, Jie-Shiou, and Chang-Hong Lin. "Gaze direction estimation using only a depth camera." 2018 3rd International Conference on Intelligent Green Building and Smart Grid (IGBSG). IEEE, 2018.
- VI. Valenti, Roberto, Nicu Sebe, and Theo Gevers. "Combining head pose and eye location information for gaze estimation." IEEE Transactions on Image Processing 21.2 (2012): 802-815.
- VII. Hegde, Veena N., Ramya S. Ullagaddimath, and S. Kumuda. "Low cost eye based human computer interface system (Eye controlled mouse)." India Conference (INDICON), 2016 IEEE Annual. IEEE, 2016.
- VIII. Prof. Prashant Salunkhe, Miss. Ashwini R Patil "A Device Controlled Using Eye Movement", International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) 2016. [9] Haar-like features h https://en.wikipedia.org/wiki/Haar-like_feature
- IX. Tobii Technology h <https://www.tobii.com/>
OPENCV h <https://opencv.org>