CHAPTER – 1

INTRODUCTION

Fundamentally paralyzing diseases like paraplegia, which renders a person unable to move from the neck down, are becoming more common in today's society. In the majority of OECD (Organization for Economic Co- operation and Development) nations, women are more likely than men to experience disability. Their eyes are the only organ that can produce various actions. 518 million persons out of a population of 7 billion reported having a disability in the 2011 Census. Around 10% (or 650 million) of the world's population, as of February 7, 2018, has a disability. Many people with Amyotrophic lateral sclerosis (ALS) or those who are paralyzed are unable to perform routine daily tasks on computers. Even when it comes to eating, they require assistance from someone else to feed them. For their daily tasks, these people require assistance. At the moment, people with impairments frequently type on keyboards by holding long sticks in their mouths. The method we offer will enable people with disabilities to lead independent lives. They will have the opportunity to amuse themselves, mingle with others, and live their lives.

The development of innovative and cutting-edge HCI techniques is accelerating. Human eyes contain a wealth of information that can be collected and applied in a variety of ways (i.e. interacting with Computers). Eye movement exhibits a person's area of interest. The goal of tracking eye motions is to monitor human eye movements. By recording eye movements and using them as control signals, direct interaction with interfaces can be made possible without the need for a mouse.

Digital instruments have been interacted with using existing computer input devices such a mouse, keyboard, and other types of input devices. These computer input devices cannot be used independently by people with impairments. In this project, a computer input device that can only be operated with the eyes is created for wearable computers and those with disabilities. Additionally, such data might be utilized to generate the appropriate outputs for operating a

computer, such as moving wheelchairs or commercially available robotic equipment like the robotic arm, to enable these patients to feed themselves. They will become physically capable as a result, and they will become valuable contributors to society. The goal of this project is to investigate and enhance potential uses for the eye gesture tracking technology.

Especially those fields that can aid physically handicapped people in using computers and programmable controlled equipment. As a result, these people could still handle their obligations, enhance the quality of their lives, and carry on with their daily activities—often without the need for assistance. The majority of eye tracking technologies used today track the pupil in real time using video. We used the same methodology and technologies and enhanced them to create a system that is more reliable and precise. Laptop with python 3.9 is used and the sensor used is laptops camera for taking input, tracking pupil of eye, and eye movements. The python modules or packages helped us a lot and the work done is simple when these are used.

OVERVIEW

Personal computers were initially used for solving mathematical problems and word processing. In recent years, however, computers have become necessary for every aspect of our daily activities. These activities range from professional applications to personal uses such as internet browsing, shopping, socializing and entertainment. 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, contact lens method, corneal, pupil

reflection relationship and head movement measurement. These methods require the use of attachments and electrodes to the head, which makes them impractical.

PROBLEM STATEMENT

Eye tracking technology has become one of the most popular techniques within the human and computer interaction (HCI) this is very important for the people who have difficulty with speech and movement disabilities, especially for the paralyzed and amputees person. 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 and facial movements.

SOLUTION

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.

OBJECTIVES

- Easy interaction with computer without using mouse.
- Limitation of stationary head is eliminated.
- Pointer of the mouse will move on screen where the user will be looking & the clicks will be performed by blinking.
- To develop a system which will only use Webcam, and to use human eyes as a pointing device for computer device.

- To provide user friendly human-computer interaction. Designing a System for tracking Face and Eye using Camera.
- Using Facial landmark's technique to detecting the movement of the face, eyes and calculating it cursor position and mouse clicks.

PROJECT SCOPE

- By implementing this process it is cleared that the cursor can be controlled by the eyeball movement i.e., without using hands on the computers.
- This will be helpful for the people having disability in using the physical parts of the computers to control the cursor points.
- Hands – free computing.
- Facilitating the handicapped in using the computer.
- Controlling the mouse pointer through eye movement. Eye based human computer interaction provides real time eye tracking and eye-gaze estimation.

EXISTING SYSTEM

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). The camera mouse was proposed by Margrit Betke for people who are quadriplegic and nonverbal. The movements of the user are tracked using a camera and these can be mapped to the movements of the mouse pointer which is visible on the screen. Yet another method was proposed by Robert Gabriel Lupu, for human computer interaction that made use of head mounted device to track eye movement and to translate it on screen. Another technique by Prof. Prashant salunke presents a techniques of eye tracking using Hough transform.

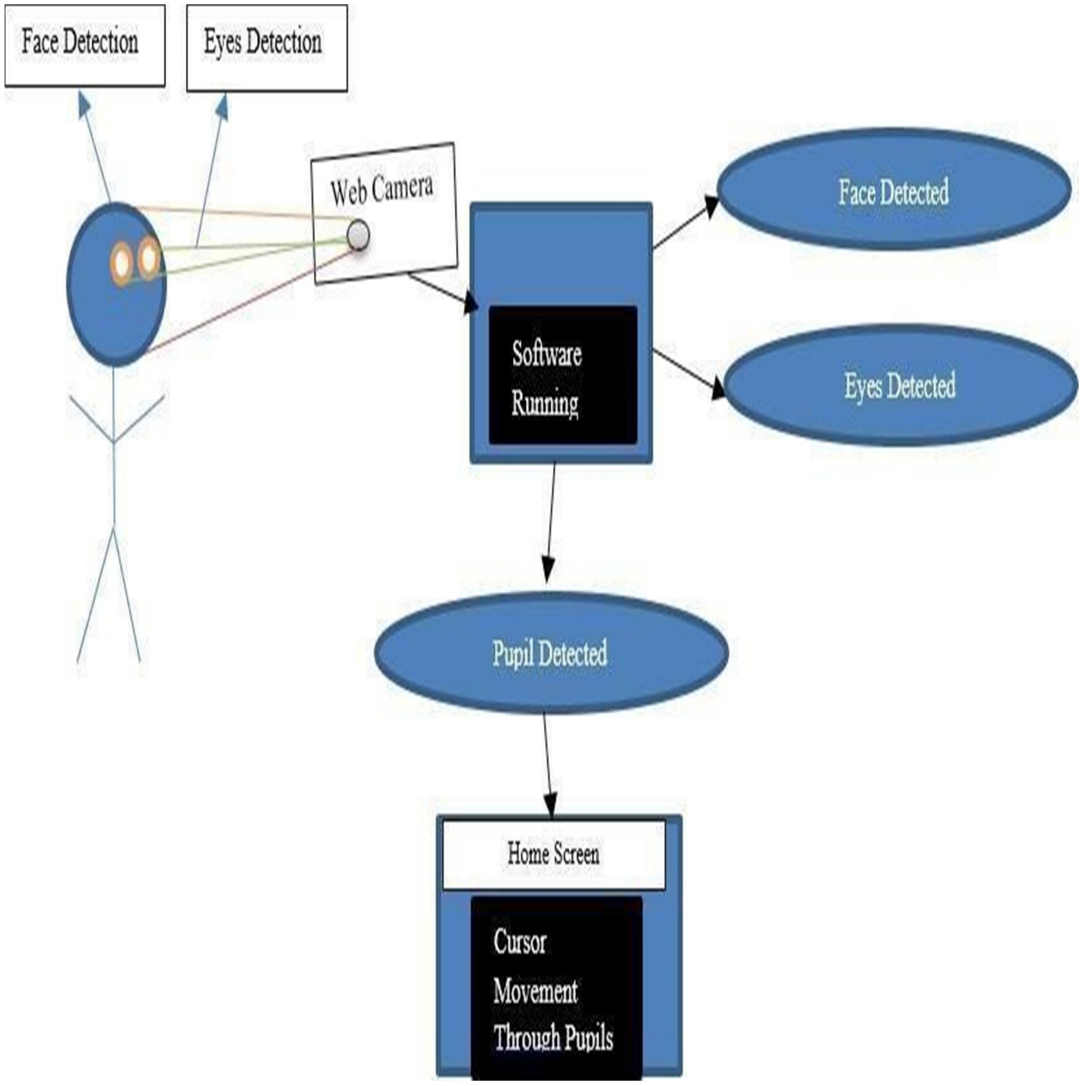
LIMITATIONS:

i. Other methods include limbus, pupil and eye/eyelid tracking, contact lens method, corneal, pupil reflection relationship and head movement measurement.

ii. These methods require the use of attachments and electrodes to the head, which makes them impractical. Other high end techniques 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.

PROPOSED SYSTEM

In the proposed system, we have included the face detection, face tracking, eye detection and interpretation of a sequence of eye blinks in real time for controlling a nonintrusive human computer interface. Conventional method of interaction with the computer with the mouse is replaced with the human eye movements.



The work flow of the proposed system includes the following steps:

- The architecture of the proposed system design and the detail workflow of the system functionalities will be described developed a prototype of eye control system that is based on low- cost eye trackers and the released Application Program Interface (API).
- This system was composed of all of the functions of mouse and keyboard, and user should choose the desired function first and then do the real interaction with computer.
- The accuracy of the eye tracking control system will depend on the eye tracker employed. However, the usage flow of this system goes against user's intuition and it is not natural for user to communicate with computer smoothly.
- Therefore, in this paper we present an eye tracking based control system that not only supports the commercial low-cost eye trackers but also provides more natural and more convenient communication mechanisms for user-computer dialogue.

ADVANTAGES:

i. This technique will help the paralyzed person, physically challenged people especially person without hands to compute efficiently and with the ease of use.

ii. Firstly, camera captures the image and focuses on the eye in the image using OpenCV code for face and eye detection.

iii. This results the center position of the human face. Then the center position of the face is taken as a reference and based on that the human or the user will control the cursor by moving left and right.

CHAPTER - 2

LITERATURE SURVEY

The literature was examined in order to address the objectives, comprehend the study topic, concentrate on the research questions, organize the data collection strategy, define the words, and correctly identify the framework. Understanding the study field that involves eye detection and mouse cursor movement was the most crucial challenge.

As we read through the literature, we noticed that the emphasis was on how to create a system that can satisfy the demands of people who are physically challenged and that system should be very simple to grasp.

The "sixth sense" technology, developed by a team at MIT, promises to improve human-computer interaction by utilizing hand and eye gestures. The entire system can be mounted on the user's helmet so that it can be used anywhere in the world and projected onto flat surfaces (like walls). The issue is that it doesn't generate a system that can communicate with other compatible devices or offer improved aid and accessibility to the impaired.

An eye tracking algorithm based on the Hough transform was created in 2018. This method can identify a person's face and eyes. It recognizes the user's face and eyes using a webcam. Matlab is the system's foundation. The real-time tracking and time- speed problems in this system are the problem. The system is relatively sluggish and requires an expensive, high-quality computer system to function effectively.

A pupil center coordinate detection method was first introduced in 2015. The webcam in this system use Hough Transform Techniques to identify a person's pupil. The problem with this approach is that it is not real-time and takes a long time. It takes a long time to capture the body first, then the face, the eyes, and ultimately the pupil. A face and eye-controlled system based on MATLAB was created in 2014. The mouse is moved by moving the eyes and face on a webcam. The problem with this technology is that it only functions within a few centimeters of the source. A method based on pictogram selection was created in 2013 and used an eye tracking

technology. It makes the system dependable by utilizing a variety of eye- tracking approaches. The problem with this technology is that it won't function if any liquid is found in the eyes. When women apply eyeliner or mascara to their eyes, for example, the system malfunctions. Human eyes use a two-lens system housed in a liquid called vitreous humour to project light waves from various objects in the outside world onto the retina.

In order to accommodate very precise color vision, the fovea is densely packed with cones, with around 161,900 per square millimeter. We can see from the structure of a retinal exterior that just a small region of our visual field can be resolved in high resolution.

[1] "Design and Development of Hand Gesture Based Virtual Mouse," Author name: K. H Shibly, S. Kumar Dey, M .A Islam and S.Iftekhar Showrav. Published in: 2019.

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.

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.

MERITS:

- With eye mouse we can implement WSN which can detect any event at a desired position in sensing field without human interaction directly.
- By this project we can implement low cost based surveillance system which in user friendly and easily recognized places in any real world system

DEMERITS:

- Real time limitations.
- Camera resolution

[2] "Eye-controlled mouse cursor for physically disabled individual" Author's name: Mohamed Nasor, K KMujeeb Rahman, Maryam, Mohamed Zubair Published in: 2018.

This paper presents a novel algorithm for controlling the movement of a computer screen cursor using the iris movement. By accurately detecting the position of the iris in the eye and mapping that to a specific position on the computer screen, the algorithm enables physically disabled individuals to control the computer cursor movement to the left, right, up and down. The algorithm also enables the person to open and close folders or files or applications through a clicking mechanism.

MERITS:

- Eye mouse is a very helpful tool which can replace a normal mouse device.
- A gift for physical challenged people.

DEMERITS:

- It is difficult to control eye position accurately all the times unlike mouse. Eye tracker provides instable output when it does not get appropriate image of the eye in consecutive frames.

[3] "An image-based eye controlled assistive system for paralytic patients" Author's name: Neil Castellino and Michelle Alva Published in: 2017.

Communication is an essential part of human life which paralytic patients with locked-in syndrome are deprived of. In locked-in syndrome, the patient cannot move any of his voluntary muscles except the eyes. Taking this into consideration, the proposed system is designed to detect the face and pupil of the patient through a standard webcam using Haar cascade classifiers and Circular Hough Transform algorithm respectively. The proposed system displays different images of daily activities. The patient will have to look at an image for a period above a pre-decided threshold time in order to select it. Subsequently, the system will track the point of gaze of the patient and will select the image accordingly after a confirmation from the patient. Based on this confirmation, the aide will be notified via text or audio. Successful implementation of the system will help the paralytic patient to easily communicate his needs to the aide.

MERITS:

- It helps to communicate with machines in order to automate manual tasks.
- It increases user experience and performance in playing games.

DEMERITS:

- It does not work with few users who wear contact lenses or have long eye lashes.
- Improper usage may lead to eye problems.

[4] "Eye Tracking Based Control System for Natural Human-Computer Interaction" Author's name: Shu-Fan Lin, Xuebai Zhang, Shyan-Ming Yuan Published in: 2017.

Eye movement can be regarded as a pivotal real-time input medium for human-computer communication, which is especially important for people with physical disability. In order to improve the reliability, mobility, and usability of eye tracking technique in user-computer dialogue, a novel eye control system with integrating both mouse and keyboard functions is proposed in this paper. The proposed system focuses on providing a simple and convenient interactive mode by only using user's eye. The usage flow of the proposed system is designed to perfectly follow human natural habits. Additionally, a magnifier module is proposed to allow the accurate operation. In the experiment, two interactive tasks with different difficulty (searching article and browsing multimedia web) were done to compare the proposed eye control tool with an existing system. The Technology Acceptance Model (TAM) measures are used to evaluate the perceived effectiveness of our system.

MERITS:

- It helps to learn from experts delivering skills.
- It makes technology more intuitive.

DEMERITS:

- It does not work with few users who wear contact lenses or have long eye lashes.
- Eye movements of some users are often un-intentional. This results into unwanted responses by the system.

[5] "Hardware and software implementation of real time electrooculogram (EOG) acquisition system to control computer cursor with eyeball movement". Author's name: Hossain, Zakir, MdMaruf Hossain Shuvo, and Prionjit Sarker Published in: 2017.

Human computer interface (HCI) is an emerging technology of neuroscience and artificial intelligence. Development of HCI system using bio signal e.g. Electrooculogram (EOG), Electromyogram (EMG), Electroencephalogram (EEG), Functional near-infrared spectroscopy (fNIRS) etc. are attracted more and more attention of researchers all over the world in recent years because through this it is possible to get acquainted with advanced technologies of artificial intelligence. This paper presents the design and implementation of a fully functional

Electrooculogram(EOG) based human computer interface. In this work we have designed and implemented necessary hardware and software for EOG signal acquisition along with controlling hardware such as wheelchair, robotic arm, mobile robot etc., and move computer mouse cursor simultaneously using EOG signal.

MERITS:

- This interface has three portion: EOG signal acquisition and amplification, analog to digital conversion, and real time hardware and mouse cursor movement. Eye movement is detected by measuring potential difference between cornea and retina using five Ag-Agcl disposable electrodes .
- EOG is much more reliable, cost efficient and non-invasive to implement.

DEMERITS:

- It reduces the number of potential users of the system and its applications since it increases the cost of the system and reduces its flexibility, portability, and autonomy.

[6] "Hand Gesture Recognition System Using Image Processing" Author's name: Sagar P. More and Abdul Sattar, Published in: 2016.

A gesture is a form of nonverbal communication or non-vocal communication in which visible bodily actions communicate particular messages, either in place of, or in conjunction with, speech. Gestures include movement of the hands, face, or other parts of the body. Gestures differ from physical non-verbal communication that does not communicate specific messages, such as purely expressive displays, proxemics, or displays of joint attention. Gestures allow individuals to communicate a variety of feelings and thoughts, from contempt and hostility to approval and affection, often together with body language in addition to words when they speak.

Gesture processing takes place in areas of the brain such as Broca's and Wernicke's areas, which are used by speech and sign language. In fact, language is thought to have evolved from manual gestures. The theory that language evolved from manual gestures, termed Gestural Theory.

MERITS:

- Helpful in commercial interactive game and advertisement.
- Easier computer control.
- Ideal for use with desktop computers.

DEMERITS:

- Improper usage may lead to eye problems.
- Frames captured per second.

[7] "Real-Time Eye Blink Detection using Facial Landmarks" Author's name: Čech and Soukupová Published in: 2016.

A real-time algorithm to detect eye blinks in a video sequence from a standard camera is proposed. Recent landmark detectors, trained on in-the-wild datasets exhibit excellent robustness against face resolution, varying illumination and facial expressions. We show that the landmarks are detected precisely enough to reliably estimate the level of the eye openness. The proposed algorithm therefore estimates the facial landmark positions, extracts a single scalar quantity eye aspect ratio (EAR) – characterizing the eye openness in each frame. Finally, blinks are detected either by an SVM classifier detecting eye blinks as a pattern of EAR values in a short temporal window or by hidden Markov model that estimates the eye states followed by a simple state machine recognizing the blinks according to the eye closure lengths. The proposed algorithm has comparable results with the state-of- the-art methods on three standard datasets.

MERITS:

- It increases computing and resource efficiency.
- It helps to assess human conditions and behaviors.

DEMERITS:

- It requires some calibration time before it gives satisfactory results. Hence few users deviate themselves from using it.
- It is expensive technology due to costly hardware requirements.

[8] "Using for a video based mouse-Kernels replacement interface". Author's name: Samuel Epstein-Eric Missimer Margrit Betke Published in: 2012.

Some people cannot use their hands to control a computer mouse due to conditions such as cerebral palsy or multiple sclerosis. For these individuals, there are various mouse-replacement solutions. One approach is to enable them to control the mouse pointer using head motions captured with a web camera. One such system, the Camera Mouse, uses an optical flow approach to track a manually selected small patch of the subject's face, such as the nostril or the edge of the eyebrow. The optical flow tracker may lose the facial feature when the tracked image patch drifts away from the initially-selected feature or when a user makes a rapid head movement.

MERITS:

- Ideal for use with desktop computers.
- Usually supplied as part of a new computer system

DEMERITS:

- They need a flat space close to the computer.
- Older style mice which have roller balls can become clogged with grease and grime and lose their accuracy until cleaned.

[9] "Real-time eye-gaze estimation using a low-resolution webcam" Author's name: Yu-Tzu Lin Ruei-Yan Lin Yu-Chih Lin Greg C Lee Published in: 2012.

Eye detection and gaze estimation play an important role in many applications, e.g., the eye- controlled mouse in the assisting system for disabled or elderly persons, eye fixation and saccade in psychological analysis, or iris recognition in the security system. Traditional research usually achieves eye tracking by employing intrusive infrared-based techniques or expensive eye trackers. Nowadays, there are more and more needs to analyze user behaviors from tracking eye attention in general applications, in which users usually use a consumer-grade computer or even laptop with an inexpensive webcam.

MERITS:

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- Nowadays, there are more and more needs to analyze user behaviors from tracking eye attention in general applications, in which users usually use a consumer-grade computer or even laptop with an inexpensive webcam.

DEMERITS:

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- It is expensive technology due to costly hardware requirements

[10] "Facial Feature Based Method For Real Time Face Detection and Tracking I-CURSOR" Author's name: International Journal of Engg Researchand App., Vol. 2, pp Published : 2012.

In the proposed system, we have included the face detection, face tracking, eye detection and interpretation of a sequence of eye blinks in real time for controlling a nonintrusive human computer interface. Conventional method of interaction with the computer

with the mouse is replaced with the human eye movements. This technique will help the paralyzed person, physically challenged people especially person without hands to compute efficiently and with the ease of use. Firstly, camera captures the image and focuses on the eye in the image using OpenCV code for pupil detection. This results the center position of the human eye (pupil). Then the center position of the pupil is taken as a reference and based on that the human or the user will control the cursor by moving left and right.

MERITS:

- Facial features (nose tip and eyes) are detected and tracked in real-time to use their actions as mouse events. In our work we were trying to compensate people who have hands disabilities that prevent them from using the mouse by designing an application that uses facial features (nose tip and eyes) to interact with the computer.
- It can be applied to a wide range of face scales. Our basic strategy for detection is fast extraction of face candidates with a Six-Segmented Rectangular (SSR) filter and face verification by a support vector machine.

DEMERITS:

- Real time limitations.
- Camera resolution.

CHAPTER - 3

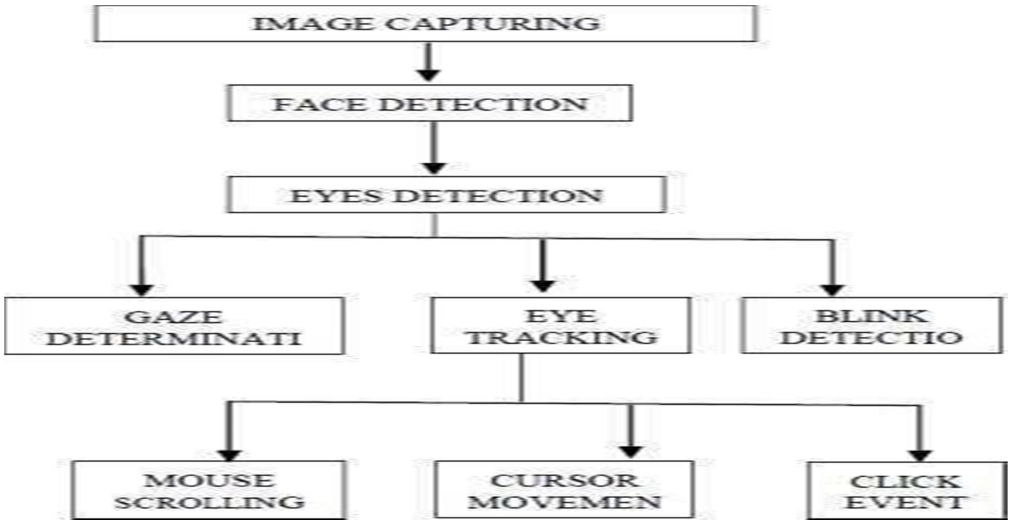
SOFTWARE REQUIREMENT SPECIFICATIONS

FUNCTIONAL REQUIREMENTS

- *FACE DETECTION METHODS :* Face Detection Methods Face detection is the step stone for all facial analytical algorithms, including facial orientation, facial mapping, face recognition, facial recognition / authentication, facial expression tracking / recognition, gender recognition.
- *FEATURE BASED METHODS :* The characteristic-based approach is to identify faces by extracting facial structural features. It is first classifier and then used to distinguish between facial and non-facial regions. The aim is to transcend the limitations of our instructive awareness of faces. This method is divided into many phases and also images of several faces.
- *EYE DETECTION APPROACHES :* There are some detection methods that undergo various stages, such as the positioning of the face and eyes from different locations.
- *EYE TRACKING TECHNIQUE :* Pupil Tracking- Pupil tracking is a gaze-detection technique that is often used in combination with other methods. The eye is much more than a tool for moving the cursor at high speeds. Input of eye movement is obviously faster than input of any factors. Until any mechanical pointing system is controlled, the user typically looks at the destination to which he or she wants to travel.
- *CONTROLLING THE MOUSE POINTER :* The input of eye movement is taken from the individual's pupil. If a person looks at a center mouse pointer, that point would be taken as the input point and it sets that location as the basis for gaze tracking and it begins moving in the direction of the person's eye movement and the cursor stops moving when the person's eye hits its initial place.
- *LEFT AND RIGHT MOVEMENT OF THE PUPIL :* Horizontal eye pupil movement can be achieved using circular artifacts. If the pupil moves in the left direction, the mouse

pointer moves in the left direction as well, and the same happens in the right direction as well.

- *UP AND DOWN MOVEMENT OF THE PUPIL :* Vertical eye pupil movement can be achieved by using pupil scale. The eyes are in slightly half-closed state when gazing downwards. This phenomenon can be used to guide the step from top to bottom of the mouse pointer.
- *CONTROLLING THE MOUSE CLICK EVENTS :* A blink of an eye can be done to the mouse click case. As the mouse pointer begins to shift the eye pupil's path if a person decides to perform a chosen event then the person blinks the eye mouse pointer executes the click event.



- *WORKING OF CONTROLLING THE MOUSE CLICK EVENTS* : The user will sit in front of the personal computer or laptop screen, a small video camera positioned above the panel to monitor the eyes of the user. The computer analyzes the eye's video image on an ongoing basis and decides where the user views the device. There is nothing connected to the head or body of the customer. The user stares at the key for a given time span in order to "pick" any key, and to "press" any key, the user only blinks his eye. Calibration procedure isn't needed in this framework. Data for this method is eye-only. There is neither external hardware attached nor needed.

NON-FUNCTIONAL REQUIREMENTS

- *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. The face detection method can be organized in two categories:
- *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.
- *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.

SYSTEM REQUIREMENTS

- *SOFTWARE REQUIREMENTS :*
  - OS : Windows 10
  - Language : Python
  - IDLE : Python 3.9, Pycharm
  - Packages : OpenCV, PyautoGUI, MediaPipe

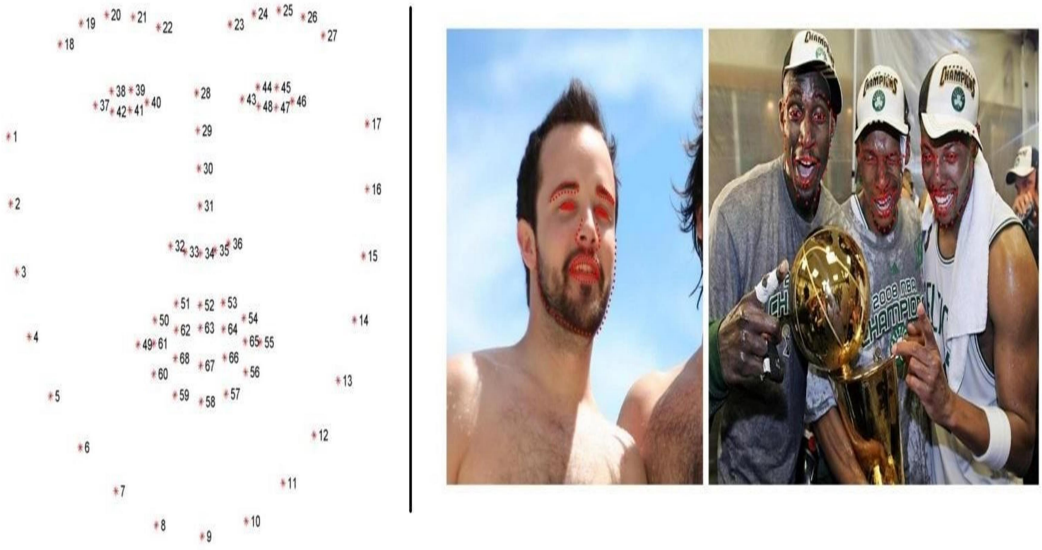
- *HARDWARE REQUIREMENTS :*
  - System : Laptop or Desktop with camera
  - Hard Disk : 10 GB
  - RAM : 2 GB (Onwards)

CHAPTER - 4

SYSTEM ANALYSIS AND DESIGN

- *SYSTEM ANALYSIS :* 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.

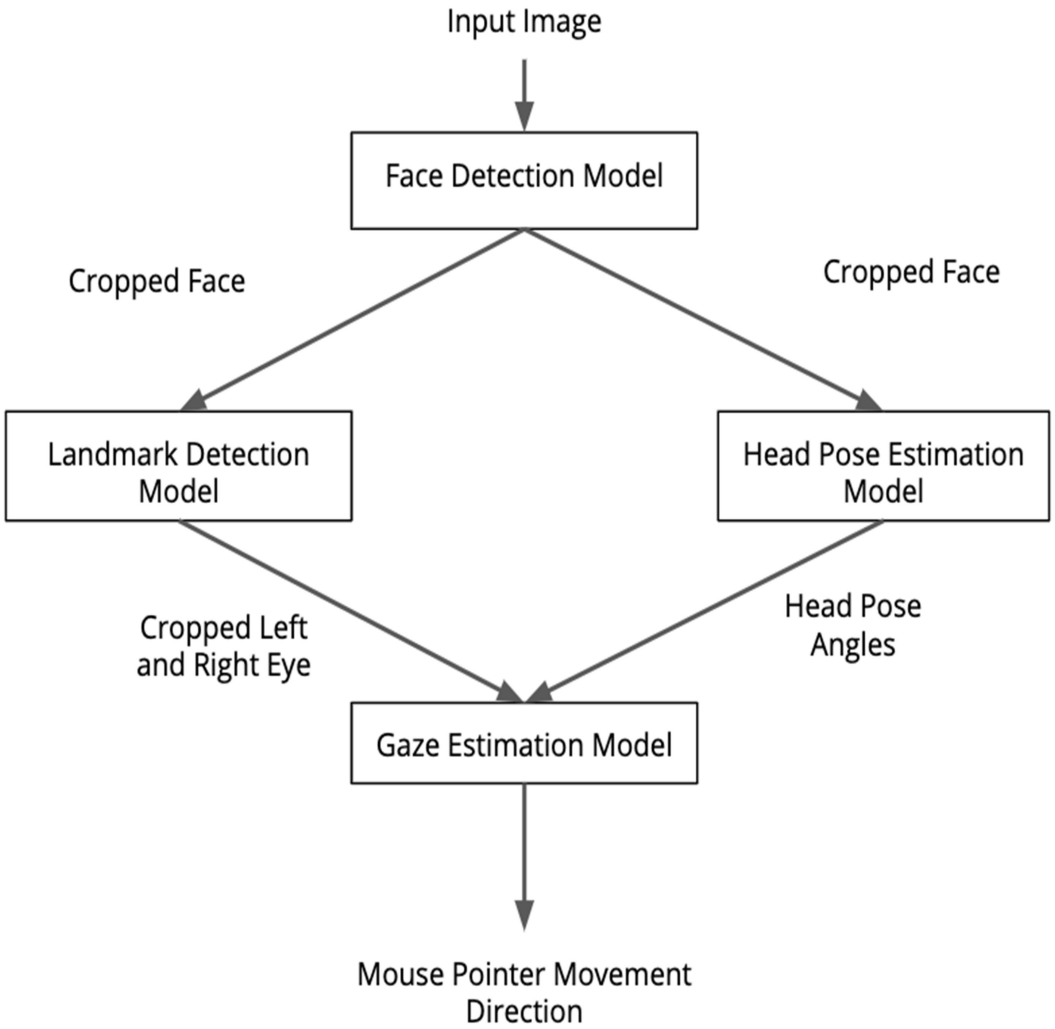
- *HIGH LEVEL DESIGN* : This project is deeply centered around predicting the facial landmarks of a given face. We can accomplish a lot of things using these landmarks. From detecting eye-blinks in a video to predicting emotions of the subject. The applications, outcomes, and possibilities of facial landmarks are immense and intriguing.



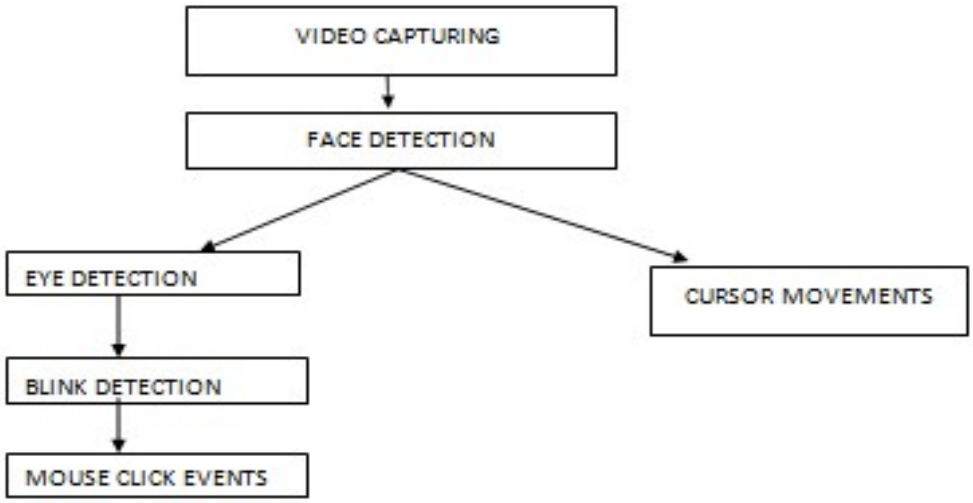
Using these predicted landmarks of the face, we can build appropriate features that will further allow us to detect certain actions, like using the eye-aspect-ratio (more on this below) to detect a blink or a wink, using the mouth-aspect-ratio to detect a yawn etc or

maybe even a pout. In this project, these actions are programmed as triggers to control the mouse cursor. PyAutoGUI library was used to move the cursor around.

- *SYSTEM ARCHITECHTURE* : The camera mouse was proposed by Margrit Betke for people who are quadriplegic and nonverbal. The movements of the user are tracked using a camera and these can be mapped to the movements of the mouse pointer which is visible on the screen. Yet another method was proposed by Robert Gabriel Lupu, for human computer interaction that made use of head mounted device to track eye movement and to translate it on screen. Fig Procedure of gesture-based mouse and keyboard. Another technique by Prof. Prashant salunke presents a techniques of eye tracking using Hough transform.



- *LOW LEVEL DESIGN :* Low-level design (LLD) is a component-level design process that follows a step-by- step refinement process. This process can be used for designing data structures, required software architecture, source code and ultimately, performance algorithms.



- *MODELING :* Python was used to design the mouse system, and the following Python modules were imported to make the system operate.

- MediaPipe offers cross - platform, customizable ML solutions for live media.
- OpenCV is a collection of programming tools with a real-time computer vision major focus.
- PyautoGUI is a cross-platform GUI automation module allows you to automate computer by controlling the mouse as well as performing simple picture recognition.

A. USE CASE DIAGRAM : Use case diagram indicates that the system completes the subsequent stages.

1) Software is active.
2) Turn on the laptop's webcam and display a picture of a person.
3) Face detection is carried out.
4) The system recognizes a person by their eyes.
5) After performing the aforementioned action, perform the subsequent procedure.
6) The system then uses a laptop's webcam to recognize eyes and a face.

B. ACTIVITY DIAGRAM :

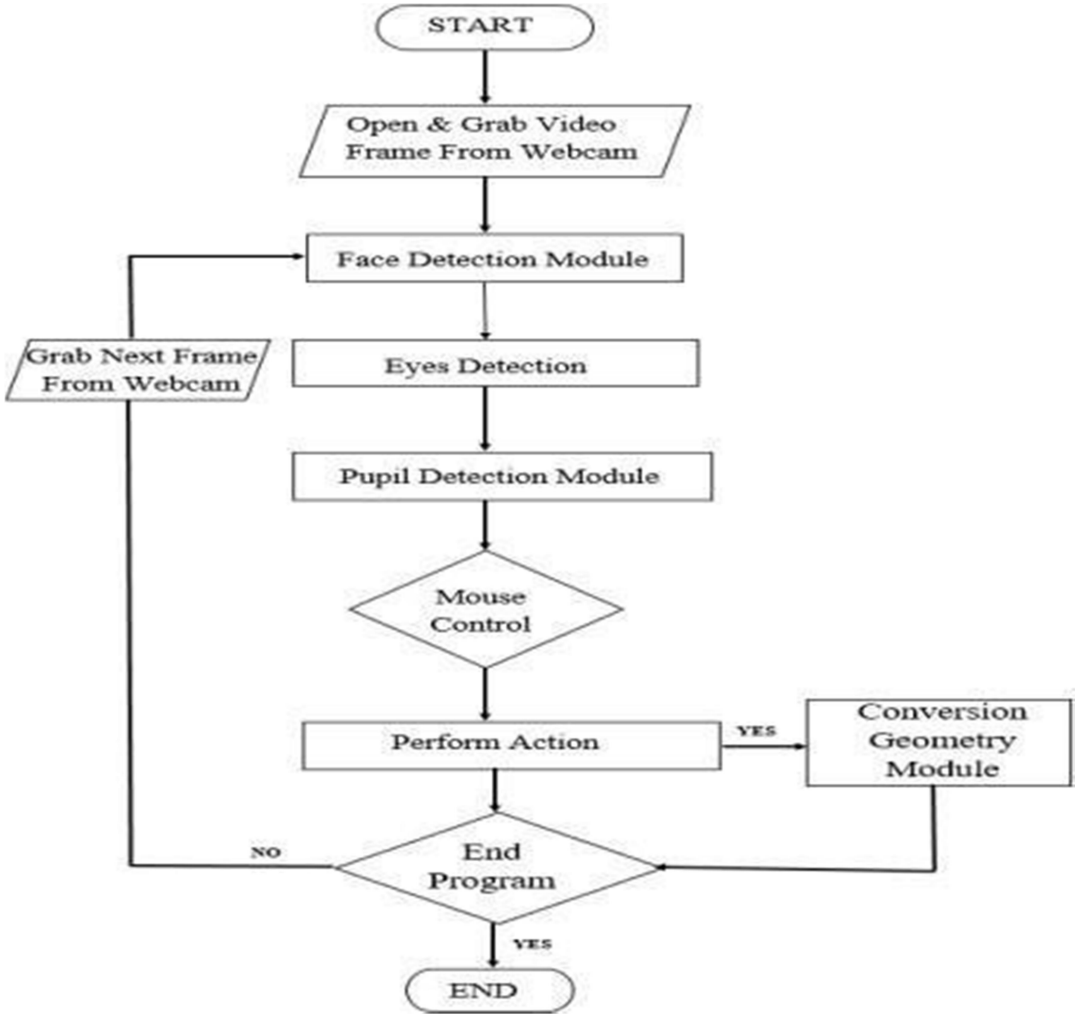


Figure depicts the system's operation. The Eye Mouse software has the following phases from beginning to end.

1) Switch on the webcam and record some footage.
2) The system takes a step and finds the face.
3) The system detects the presence of eyes.
4) The mechanism locates the pupil of the eye.
5) The system will find the eyes and carry out geometric translations using only the image of the user's face from the webcam.
6) The mouse control function recognizes a gesture, moves the mouse cursor, and translates the coordinates to the user's screen.

C. SYSTEM SEQUENCE DIAGRAM

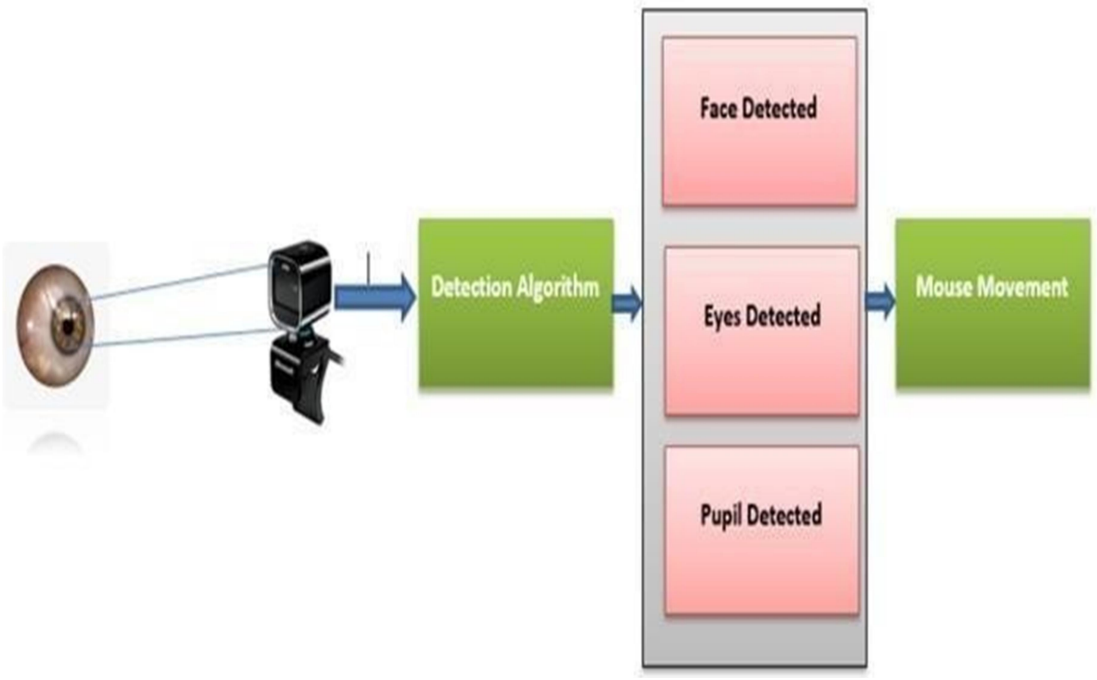


Fig : Sequence Diagram

The user's interactions with the system are depicted in Fig. in order. The six fundamental modules of our system are elaborated in Fig.'s system sequence diagram. Using detection techniques, the system uses the webcam to identify a person's pupil in the first module. The machine then finds the face. The mechanism then finds and seizes the eyes. The machine then finds the pupils. The system begins moving the mouse cursor in the last module by monitoring pupil movement.

CHAPTER - 5

IMPLEMENTATION

METHODOLOGY AND TECHNIQUES

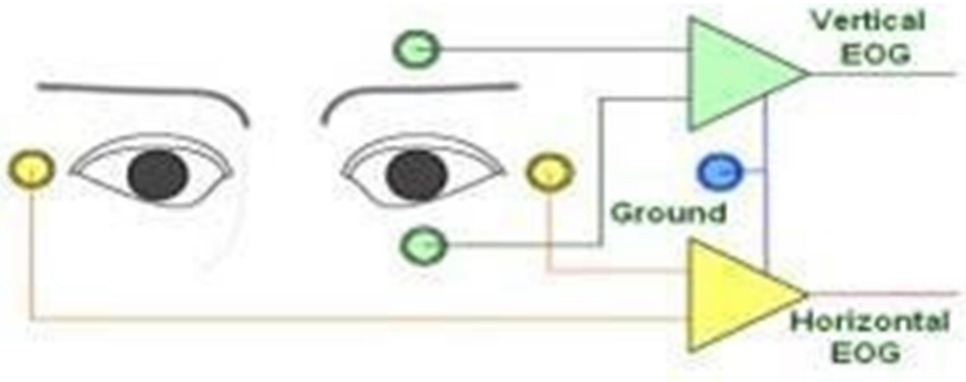
- *METHODOLOGY :* The first step was to use a face detection algorithm locate the face on an image frame captured by an ordinary webcam. The next step was to detect only the eyes from this frame. We consider tracking only one eye movement for faster processing time. Then the iris movement was tracked. Since the color of the iris is black, its image has a significantly lower intensity compared to the rest of the eye. This helps us in easy detection of the iris region. Taking the left and right corners of the eye as reference points, the shift of the iris as the person changed his eyes focus was determined. The shift was then used to map cursor location on the test graphical user interface (GUI).

- *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.

- *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 allor part of the limbus. This makes its uses limited to horizontal tracking. Usually this technique does not involve the use of infra red light.

- *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.

- *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 directionof gaze and can be measured by surface electrodes placed on the skin around the eyes. This techniqueis 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 arebeneficial, the utilization of electrodes makes this technique of gaze tracking unsuitable for use in everyday applications.



Using Python, an image is created. First, it opens the camera and starts taking video. It then selects a frame and changes it to a gray scale image because it converts images to binary form, making it easy to find things. The face is detected using Haar-cascade. Haar-cascade detects items from other photos after training on many positive and negative images. It will crop the frame and pass it on for additional processing after detecting the face. The Haar-cascade algorithm will detect eyeballs and trim the frame.

Eye-cascade : The Haar cascade recognizes eyes. A numpy-supported four-variable array gives us x, y, w, and h all at once. The camera detects eyeballs from x and y; w is the width, and h is the height. These variables construct a rectangle around the eye and crop the image, as seen in Fig. The rectangle begins at x and finishes at x+w horizontally and y and y+h vertically.

Fig: Output of The System

Fig. shows output. For further processing, the application will blur the little image. It then finds, then draw a circle around the pupil. Sometimes the camera sees black rings around the eyes as pupils.

The technology detects circular dark patches in the rectangle's center to fix this. The camera will only track the eye's pupil this way. Define x and y using PyAutoGUI for cursor movement. y moves the mouse vertically, x horizontally. Both of them start with a random value, so when the code runs, the mouse starts moving. Check the gap between two frames to detect eye movement. Human eyes move somewhat. To fix this, the eye is considered motionless if its position difference is less than 5 pixels. If the eye's horizontal location is larger than5 pixels and its vertical position is less than 5 pixels, it's travelling horizontally. The eye moves diagonally if its horizontal and vertical positions differ by more than 5 pixels. The mouse cursor moves vertically, horizontally, and diagonally when we move our eyes.

Harr-cascade Algorithm : The system performs two tasks in this algorithm. Determine the person's face and eyes the face-cascade function is shown in Fig.

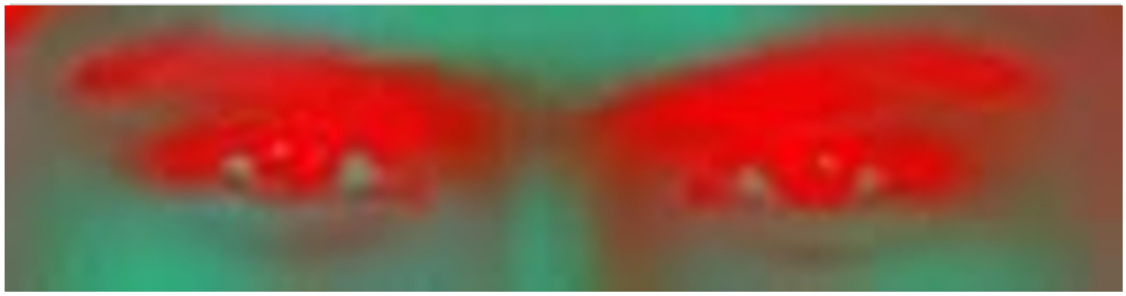


Fig: Face-Cascade

Face-cascade is used to initially identify the user's face in an image. It crops the image and run scan around the face for later processing. The user's eyes are picked up from the image once the face has been extracted as depicted in Fig. below

Fig: Eye-Cascade

Because both eyes move simultaneously, tracking can be done by looking at just one eye's motions. This program selects the user's left eye for clicking anything and right eye for moving the mouse cursor. It crops this picture by drawing a box/ellipse shape around eye.

❖ PSEUDO CODE OR ALGORITHM

```
# Eye Contolled Mouse

This program uses OpenCV, Mediapipe, and Pyautogui libraries to control the mouse cursor using eye movements.

## Imports Packages

import cv2

import mediapipe as mp

import pyautogui

## Initialize Video Capture

cam = cv2.VideoCapture(0)

## Initialize Face Mesh Detection

face_mesh = mp.solutions.face_mesh.FaceMesh(refine_landmarks=True)

## Get Screen Width and Height

screen_w, screen_h = pyautogui.size()

## Set Camera Resolution to 480p

def make_480p():

    cam.set(3, 854)
```

```
    cam.set(4, 480)
make_480p()
## Main Loop
while True:
    _, frame = cam.read()
    frame = cv2.flip(frame, 1)
    rgb_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
    output = face_mesh.process(rgb_frame)
    landmark_points = output.multi_face_landmarks
    frame_h, frame_w, _ = frame.shape
## Eye Tracking
    if landmark_points:
        landmarks = landmark_points[0].landmark
        for id, landmark in enumerate(landmarks[474:478]):
            x = int(landmark.x * frame_w)
            y = int(landmark.y * frame_h)
            cv2.circle(frame, (x, y), 3, (0, 255, 0))
            if id == 1:
                screen_x = screen_w * landmark.x
                screen_y = screen_h * landmark.y
                pyautogui.moveTo(screen_x, screen_y)
        left = [landmarks[145], landmarks[159]]
        right=[landmarks[145], landmarks[159]]
### Left Eye
```

```
        for landmark in left:
            x = int(landmark.x * frame_w)
            y = int(landmark.y * frame_h)
            cv2.circle(frame, (x, y), 3, (0, 255, 255))
        if (left[0].y - left[1].y) < 0.004:
            pyautogui.click()
### Right Eye
        for landmark in right:
            x = int(landmark.x * frame_w)
            y = int(landmark.y * frame_h)
            cv2.circle(frame, (x, y), 3, (0, 255, 255))
        if (right[0].y - right[1].y) < 0.004:
            pyautogui.click()
## Display Frame
    cv2.imshow('Eye Controlled Mouse', frame)
    cv2.waitKey(1)
```

CHAPTER - 6

TESTING

Testing is a dynamic technique of verification and validation. It involves executing an implementation of the software with test data and examining the outputs of the software and its operational behavior to check that it performing as required.

The following statement serve as the objectives for testing :

- Testing is a process of executing a program with the intent of finding error.
- A good test case is one that has a high probability of finding an as-yet undiscovered error.
- A successful test is one that uncovers as-yet undiscovered error.

SOFTWARE DEVELOPMENT LIFE CYCLE(SDLC)

The software development life cycle(SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project from an initial feasibility study through maintenance of the completed application. Software development life cycle is a process used by the software industry to design, develop and test the software.

- PHASES IN SOFTWARE DEVELOPMENT :
  - Requirement Analysis
  - Software Design
  - Development or coding
  - Testing
  - Maintenance

1. Requirement Analysis : The requirements of a desired software product are excited. Based on the business scenario the SRS(Software Requirement Specification) document is prepared in this phase. It is the process of determining user expectations for a system under consideration. These should be quantifiable and detailed. Such requirements are also called functional specifications. It serves as a foundation for test plans and also an agreement

between developer and customer. It is the process to make stated and unstated requirements clear and to validate requirement for completeness, unambiguity and feasibility.

2. Design : Plans are laid out concerning the physical construction, hardware, operating systems, programming, communications and security issues for the software design. Design phase is concerned with making sure the software system will meet the requirements of the product.

   There are 2 stages in design:

   - High Level Design(HLD): It gives the architecture of the software product to be developed and is done by architects and senior developers.
   - Low Level design(LLD): It is done by senior developers. It describes how each and every feature in the product should work and how every component should work. Here, only the design will be there and not the code.

3. Testing : Testing is evaluating the software to check for the user requirements. Here the software is evaluated with intent of finding effects. It involves executing an implementation of the software with test data and examining the outputs of the software and its operational behavior to check that it performing as required. It is the process of evaluating a system or it components with the intent to find whether it satisfies the specified requirements or not.
4. Maintenance : Once the new system is up and running for a while, it should be exhaustively evaluated. Maintenance must be kept up rigorously at all times. Users of the system should be kept up-to- date concerning the latest modifications and procedures. It is the process of repairing tests so they stay up to date with code changes. It is also important to update your automation framework infrastructure if there are any changes to the tools or third-party libraries that you use. Code changes can happen often in agile companies, even several times a day.

SOFTWARE TESTING LIFE CYCLE(STLC)

Testing itself has many phases i.e is called as STLC. It includes

- Test Plan: It is a document which describes the testing environment, purpose, scope, objectives, test strategy, schedules, mile stones, testing tool, roles and responsibilities, risks, training, staffing and who is going to test the application, what type of tests should be performed and how it will tracks the attacks.
- Test Development: Preparing test cases, test data, preparing test procedure, preparing test scenario, writing test script.
- Test Execution: In this stage, we execute the documents those are prepared I test development phase.
- Analyze Result: Once executed documents will get results either pass or fail. We need to analyze the result during the phase.
- Defect Tracking: Whenever we get defect on the application, we need to report the bug report file and forwards to test lead team and Dev team. Dev team will fix the bug.

LEVEL OF TESTING USED IN PROJECT

1. Unit Testing : Initialization testing is the first level of dynamic testing and is the first responsibility of developers and then that that of the test engineers. Unit testing is performed after the expected test results are met or differences are explainable/acceptable.
2. Integration Testing: All module which make application are tested. Integration testing is to make sure that the interaction of two or more components produces results that satisfy functional requirements.
3. System Testing: To test the complete system in terms of functionality and non-functionality. It is black box-testing performed by test team, and at the start of the system testing the complete system is configured in a controlled environment.
4. Functional Testing: The outgoing links from all the pages from specific domain under test. Test all internal links. Test links jumping on the same pages. Check for the default values of fields. Wrong inputs to the fields in the forms.

TEST CASES

Testing is evaluating the software to check for the user requirements. Here the software is evaluated with intent of finding effects. It involves executing an implementation of the software with test data and examining the outputs of the software and its operational behavior to check that it performing as required.

Test case Number	TC_01
Module Under Test	Face Detection
Description	The method is based on scanning the image of interest with a window that looks for faces at all scales and locations.
Output	Face detection implies pattern recognition, and achieves it with simple methods such as template matching.
Remarks	Test Successful

The above table represents the Test case 01. The module under test case is 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. 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. The expected output is, Face detection implies pattern recognition, and achieves it with simple methods such as template matching, and the actual output is Test is successful.

Test case Number	TC_03
Module Under Test	Input From the Eye
Description	Mouse Pointer Control and Mouse Click Events Control are Use to detect the input from the eyes
Output	Left and right movement of the pupil, Eye blink motion detection will be detected
Remarks	Test Successful

The above table represents the Test case 02. The module under test case is 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 expected output is, Left and right movement of the pupil, Eye blink motion detection will be detected and the actual output in the Test is successful and we got required output as expected before testing.

❖ *Libraries Used*

- OpenCV
- PyAutoGUI
- MediaPipe

➢ OPENCV : OpenCV is the huge open-source library for the computer vision, machine learning, and image processing and now it plays a major role in real-time operation which is very important in today's systems. By using it, one can process images and videos to identify objects, faces, or even handwriting of a human. When it integrated with various libraries, such as Numpy, python is capable of processing the OpenCV array structure for analysis. To Identify image pattern and its various features we use vector space and perform mathematical operations on these features.

The first OpenCV version was 1.0. OpenCV is released under a BSD license and hence it's free for both academic and commercial use. It has C++, C, Python and Java interfaces and supports Windows,Linux, Mac OS, iOS and Android. When OpenCV was designed the main focus was real-timeapplications for computational efficiency. All things are written in optimized C/C++ to take advantage of multi-core processing.

★ APPLICATIONS OF OPENCV : There are lots of applications which are solved using OpenCV, some of them are listed below

- Face recognition
- Automated inspection and surveillance number of people – count (foot traffic in a mall, etc)
- Vehicle counting on highways along with their speeds
- Interactive art installations
- Anamoly (defect) detection in the manufacturing process (the odd defective products)
- Street view image stitching
- Video/image search and retrieval
- Robot and driver-less car navigation and control object recognition.
- Medical image analysis
- Movies – 3D structure from motion

★ OPENCV FUNCTIONALITY :

- Image/video I/O, processing, display (core, imgproc, highgui)
- Object/feature detection (objdetect, features2d, nonfree)
- Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)
- Computational photography (photo, video, superres)
- Machine learning & clustering (ml, flann)
- CUDA acceleration (gpu)

★ IMAGE-PROCESSING : Image processing is a method to perform some operations on an image, in order to get an enhanced image. If we talk about the basic definition of image processing then “Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality”.

★ DIGITAL-IMAGE : An image may be defined as a two-dimensional function f(x, y), where x and y are spatial(plane) coordinates, and the amplitude of fat any pair of coordinates (x, y) is called the intensity .In another word An image is nothing more than a two-dimensional matrix (3-D in case of coloured images) which is defined by the mathematical function f(x, y) at any point is giving the pixel value at that point of an image, the pixel value describes how bright that pixel is, and what colour it should be. Image processing is basically signal processing in which input is an image and output is image or characteristics according to requirement associated with that image. Image processing basically includes the following three steps:

1. Importing the image.
2. Analyzing and manipulating the image.
3. Output in which result can be altered image or report that is based on image analysis.

➢ PYAUTOGUI : PyAutoGUI is a Python library that enables you to automate tasks by controlling the mouse and keyboard. It provides functions for simulating mouse movements, clicks, and keystrokes, which can be useful for automating repetitive tasks, creating GUI automation scripts, or even testing graphical user interfaces.

★ KEY FEATURES OF THE PYAUTOGUI LIBRARY INCLUDE :

1. CROSS-PLATFORM COMPATIBILITY: PyAutoGUI works on Windows, macOS, and Linux, making it suitable for automating tasks across different operating systems.
2. MOUSE CONTROL: It allows you to move the mouse cursor to specific coordinates on the screen, click mouse buttons, drag and drop items, and scroll the mouse wheel programmatically.
3. KEYBOARD CONTROL: PyAutoGUI can simulate keystrokes, key combinations (e.g., Ctrl+C, Ctrl+V), and special keys (e.g., Enter, Tab, Shift).

4. SCREEN CAPTURING: You can capture screenshots of the entire screen or specific regions of the screen using PyAutoGUI.
5. PIXEL DETECTION: PyAutoGUI includes functions for detecting the color of pixels on the screen, which can be useful for creating automation scripts that respond to changes in the graphical user interface.
6. MULTI-MONITOR SUPPORT: It supports multiple monitors, allowing you to control the mouse and interact with applications across different screens.
7. CUSTOMIZABLE SETTINGS: PyAutoGUI provides options to customize the mouse movement speed, click duration, and other parameters to suit your automation needs.

To get started with PyAutoGUI, you can install it using pip:

```
pip install pyautogui
```

After installing the library, you can start writing automation scripts using the provided functions to control the mouse and keyboard. PyAutoGUI's documentation includes detailed explanations of each function and examples to help you get started with automating tasks efficiently.

- MEDIAPIPE : Mediapipe is a popular library in Python developed by Google that offers a framework for building multimodal (audio, video, etc.) machine learning models. It provides ready-to-use, high-quality implementations of various perception tasks, such as hand tracking, face detection, pose estimation, object detection, and more. The library is built on top of TensorFlow, which makes it efficient and flexible for real-time processing and inference on CPUs and GPUs.

★ KEY FEATURES OF THE MEDIAPIPE LIBRARY INCLUDE :

1. CROSS-PLATFORM COMPATIBILITY: It supports various platforms such as Windows, Linux, macOS, Android, and iOS, making it versatile for different development environments.

2. PRE-TRAINED MODELS: Mediapipe comes with pre-trained models for a range of tasks, allowing developers to quickly integrate complex functionalities into their applications without the need for extensive training data or model development.
3. REAL-TIME PERFORMANCE: The library is optimized for real-time performance, making it suitable for applications that require low latency, such as augmented reality, virtual try-on experiences, interactive games, and more.
4. MODULAR DESIGN: Mediapipe's modular design allows developers to easily combine different components to create custom pipelines for specific use cases. This modularity also enables easy experimentation and customization.
5. PYTHON API: It provides a Python API for ease of use, allowing developers to access and manipulate the functionality of the library using familiar Python programming paradigms.
6. INTEGRATION WITH TENSORFLOW ECOSYSTEM: Since Mediapipe is built on top of TensorFlow, it seamlessly integrates with the TensorFlow ecosystem, including tools for training, serving, and optimizing machine learning models.

To get started with Mediapipe, you can install it using pip:

```
pip install mediapipe
```

Once installed, we can start using Mediapipe for various computer vision tasks. The library is highly flexible and can be adapted to various other computer vision and machine learning tasks. Its modular design allows developers to combine different components to create custom pipelines tailored to specific use cases.

CHAPTER - 7

RESULT

Individuals facing disabilities often encounter challenges when attempting to perform basic computer tasks. In such scenarios, the system is designed to automatically recognize the individual's condition. Once it detects the person's pupil, it initiates the correlation between mouse and eye movements. The mouse pointer starts to follow the movement of the pupil, and mouse clicks are triggered based on the blinking of the eye. Our system undergoes testing involving changes in eye position and the introduction of fluids to the eyes. Short- and long-distance tests are also conducted on the system, yielding varied results in terms of distance. The efforts to create a virtual mouse control system through eye movement tracking have yielded promising results, as explored in this section, which provides a detailed analysis of the system's performance during usability testing. The study involved participants with diverse eye movement characteristics and varying levels of computer proficiency, aiming to assess the accuracy, efficiency, and user satisfaction of the virtual mouse control system.

Usability testing was conducted in a controlled environment with a diverse pool of participants, ensuring a comprehensive evaluation. The testing scenarios covered standard desktop computing tasks, gaming simulations, and virtual reality interactions. Participants were tasked with performing activities commonly associated with traditional mouse control, such as navigating through menus, selecting icons, and interacting with graphical interfaces. To evaluate the effectiveness of the virtual mouse control system, key metrics were employed: The system's precision in translating eye movements into on-screen cursor control was evaluated by measuring the alignment between the user's gaze and the selected on-screen targets. Task completion time and the number of errors during usability test scenarios were analyzed to determine the system's efficiency compared to conventional mouse control methods.

Participants provided subjective feedback through surveys and interviews, expressing their overall satisfaction with the virtual mouse control system in terms of ease of use, comfort, and

perceived effectiveness. The outcomes of the evaluation revealed commendable accuracy across various tasks. Participants consistently achieved precise cursor control, effectively selecting targets with their gaze. The system demonstrated the ability to capture subtle nuances in eye movements, including rapid saccades and smooth pursuits, translating them into accurate on-screen actions. In terms of efficiency, the virtual mouse control system exhibited competitive performance compared to traditional mouse control methods. Although participants initially experienced a learning curve while adapting to the new modality, task completion times showed significant improvement over the usability testing session. The reduction in errors indicated users' growing proficiency in controlling the virtual mouse with their eye movements.

User satisfaction emerged as a pivotal aspect of the evaluation, with participants expressing a high degree of contentment with the natural and intuitive nature of the virtual mouse control system. The majority reported a positive experience, highlighting the system's adaptability to their individual eye movement patterns. Notably, participants with limited motor skills appreciated the hands-free aspect of the system, emphasizing its potential as an accessible alternative. The initial learning curve observed during usability testing is a common phenomenon when introducing a novel interaction modality. Participants unfamiliar with eye movement-based control systems required a brief adjustment period. However, their adaptability became evident as they progressively acclimated to the system, showcasing improved efficiency and accuracy over time.Task-specific performance varied, with certain tasks showing higher efficiency with the virtual mouse control system. For activities heavily relying on precise cursor control, like graphic design or drawing, participants found the system advantageous. However, tasks involving rapid and extensive cursor movement, such as scrolling through lengthy documents, presented challenges that warrant further optimization.

The positive correlation between user adaptation and improved performance underscores the importance of familiarity and practice. As users became more accustomed to the virtual mouse

control system, their ability to navigate interfaces and complete tasks efficiently increased. This suggests that with prolonged use, the system has the potential to become a seamless and instinctive means of interaction. The positive impact on accessibility was notable, particularly for participants with motor impairments, who found the virtual mouse control system liberating as a hands-free alternative to traditional input devices. This aligns with the system's objective of enhancing accessibility for individuals facing physical challenges, opening up new possibilities for computer interaction. Feedback regarding privacy and security measures implemented in the system was generally positive. Participants appreciated the emphasis on data encryption, user consent mechanisms, and adherence to privacy regulations, instilling confidence in the system's responsible handling of sensitive eye movement data.

The results and analysis of the virtual mouse control system through eye movement tracking provide a solid foundation for future developments. Several avenues merit exploration, including further optimization for tasks requiring rapid cursor movement, extended user training sessions, enhanced integration with specialized software, and continuous iterative development based on user feedback and technological advancements. the results and analysis indicate a promising trajectory towards a more natural, accessible, and efficient means of computer interaction with the virtual mouse control system through eye movement tracking. The positive user satisfaction and impact on accessibility underscore its potential to redefine the landscape of human-computer interaction. As advancements continue, the ongoing refinement and development of such systems hold the promise of shaping a future where eye movement tracking becomes a standard and intuitive modality for navigating digital interfaces.

CHAPTER – 8

CONCLUSION AND FUTURE WORK

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.

This system helps the paralyzed people to communicate their ideas and thoughts and needs for them. To differentiate voluntary and normal eye blinks, the eye blink frame rate is used. This algorithm helps the paralyzed people to communicate efficiently. This system doesn't require a person to operate and maintenance is very less. This complete project consists of proposed system, pc or laptop and web cam. The system can be used in many places like hospitals, homes, nursing homes etc. This system provides a new possibility in the life of paralyzed people with eye movement. It helps the paralyzed people to communicate their thoughts through the given phrases in the system. The aim of this system is to reduce the efforts of paralyzed people to communicate their thoughts by using eye movement algorithm. Surely this system will provide a solution for people with severe paralysis.

This device seeks to provide a low-cost eye-mouse that will enable the user to control a computer system's mouse cursor. The system is simple to use and cost-effective, relying just on a laptop camera and Python programming language software modules. With the help of this project the desire of any person, whether he is normally abled or not doesn't matter. This system is easy and can be used in any system or laptops. Finally, we point out that the project can be used in a variety of environmental settings with just minor adjustments to the brightness and contrast needed to retain its durability. This is a remarkable accomplishment for such a cheap eye-tracking technology.

FUTURE WORK

Keyboard and mouse actually form an integral part of the computer system. Our system architecture can facilitate the use of computer for the paralyzed people. We have developed a virtual system where people can communicate with the computer without using any physical keyboard and mouse. This could lead to a new age of Human Computer Interaction in which physical contact with the computer would not be necessary at all. The use of object detection and image processing in OpenCV for the implementation of our work has proved to be practically successful and the task of keyboard and mouse is achieved with good precision. This system can be beneficial to certain people who have no control over their limbs. Most of the applications require additional hardware which are often very expensive. The motive of this work is to create this technology as cheaply as possible and to create it under a standardized operating system as well. Though, our system can be used as an alternative for physical keyboard and mouse, it still may perform less accurately in a low light condition. This is a concern for further research. Moreover, the work can be extended for a wide variety of environments and can be tested using the sophisticated existing models. We have tested out system in real time for several times and analyzed the results. Our system is not 100% accurate though clicking the phrases with eye blinks are more accurate, Sometimes normal blink also gets detected instead of voluntary blink. However these limitations can be minimized by using high resolution camera.

As technology continues to advance, the continuous refinement and development of such systems promise to shape a future where eye movement tracking becomes a standard and intuitive modality for navigating digital interfaces. The positive trajectory identified in this study opens avenues for innovation, emphasizing the importance of user-centric design, accessibility, and ongoing collaboration between researchers, developers, and end-users. In this evolving landscape, the virtual mouse controlled by eye movement tracking stands as a testament to the transformative potential of human-computer interaction technologies.

CHAPTER – 9

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