Eye Mouse: Implementation using Eye Detection

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Abstract— Designing the device is dealing with a thought of blending emotions with technology of unbeatable standards. The essence of scientific advancements is purely put through vigorous thought process considering and exploring all possibilities. Manually operated device; helping the physically challenged in their mundane life makes the work dogmatic. Therefore, for an engineer, it becomes a task of elephantine proportions to put forth some of the technological developments which can render flexibility and robustness for the endemics. Hence, the rise of the idea of making an "EYEMOUSE" which can be regulated by EYE-BALL movement. So an individual can control his/her device and can mitigate the dependency. Although, it requires some amount of complex integration of electronics-software components with certain programming skills yet can turn out to be dexterous task for simplifying the movement of device. The objectives of this project is to design and build an "Intelligent" device that must be able to make decisions and respond to situations completely on its own. Navigation and control serves as the major limitation of the overall performance, accuracy and robustness of an intelligent vehicle. This project will address this problem and will provide unique navigation and control scheme for an automatic device using concepts of Image Processing and other guiding technologies. In this research, 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.
Key words: Generic Technology Keywords: Image Processing, Computer Vision, Specific Technology Keyword: Python, Hough Circle Detection, Eye ball detection and localization, Project Type Keyword: USB IR Web camera, Wearable Cap

I. INTRODUCTION

In Manual System, There is no way to operate system for handicapped people. They are out of this newly world of technologies. In current system there are very limited input devices and very less development in field of input devices for handicapped people.

For example if person has prelisted hand he/she cannot operate any personal computer even though he/she has very good knowledge of computer. There must be something for these kind of group of people.

New system will be taking image of an eye through USB webcam. System will monitoring an eye movement and will take decision according to the eye movement.

Eye Mouse: It is like "Mouse", here eye mouse means by using eye, one can operate mouse.

In this research 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.

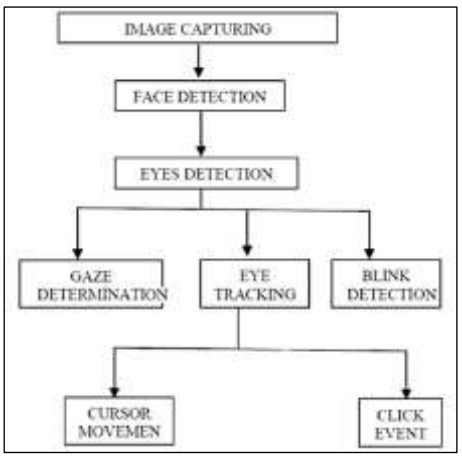
II. GOAL OF THE SYSTEM

- 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

III. OBJECTIVES

- To design a system which provides accurately maneuverability for physically challenged person which is beneficial to society
- Adding extra features on entire system so that it can be commercialized
- Easy interaction with computer without using mouse
- Pointer of the mouse will move on screen where the user will be looking & the clicks will be performed by blinking

IV. PROPOSED ALGORITHM



Input – Eye video input in RGB format.
Output – Detect Eye, Cursor Event
Step 1 – Image Capturing in RGB format
Step 2 – Convert image rgb to gray.
Step 3 – Detecting the face and eye
Step 4 – Cropping eye
Step 5 – Dividing eye into three equal regions
Step 6 – Thresholding each region
Step 7 – Finding the maximum number of black pixels in these regions
Step 8 – Do proper action for mouse cursor event

V. IMPLEMENTATION OF PROPOSED SCHEME

A. Preparation of IR webcam

Normal webcam contained IR filter in front of lens which avoided the psysho visual effect being captured. IR filter had to be removed from the webcam manually. IR LEDs were placed besides the webcam. IR rays had to be absorbed by the eyeball and rest of the IR rays were reflected back to webcam which made it easy to localize an eyeball.

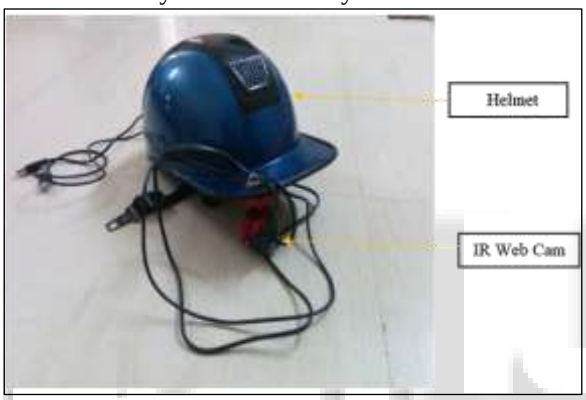


Fig. 1: IR Web Cam Attached with Helmet

1) Converting Web Cam to IR Web Cam & Why Need OF IR?

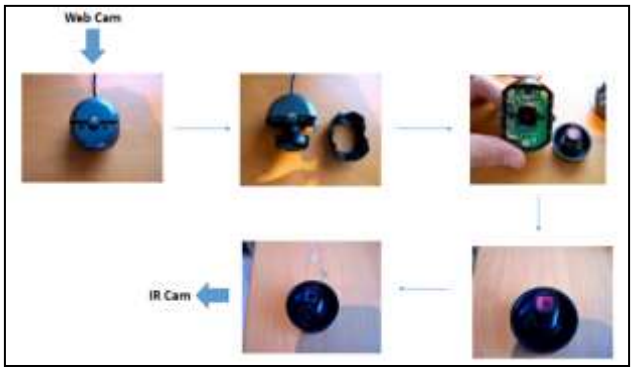


Fig. 1: Converting Web Cam to IR Web Cam

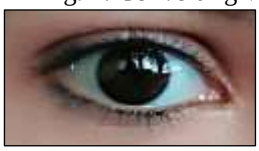


Image with Normal Web Camera

Image with IR Web Camera

Fig. 3: Significance of IR image

From the above figures it is clearly visible to detect eye from IR cam then from normal web cam. We have used IR light of 950nm which lies in Class B IR rays which is less harmful to eye and skin.

B. Platform Selection

A system had to be reliable and economical. Therefore use of an open source platform for coding was mandatory. Platform used for development of this system were Python: a widely used general-purpose and high-level programming language for mathematical analysis and Open CV: an open source library for real time image processing

C. Eye ball localization and Result

1) Initial Approach for Eye Detection:

Initial approach was based on harr casacade face and eye classifier which can take the coordinates of face in a moment then also the coordinates of eyes in colour image.

a) Steps of Harr Cascade Method:

1) Step 1: Grab an Image from a camera in Python
2) Step 2: Convert the image to gray scale
3) Step 3: Detecting the face and eye using harr Cascade_frontalface_default.xml and harrcasacde_eye. xml from the loaded image

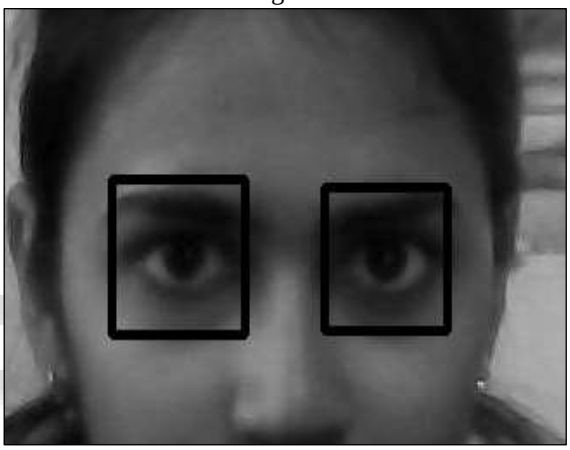


Fig. 4: Eye detected Image

4) Step 4: Cropping and dividing eye into three equal regions

Fig. 5: Cropped Image

5) Step 5: Thresholding and inverting each region

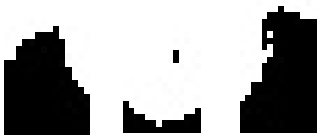


Fig. 6: Three equal regions

6) Step 6: Finding the maximum number of white pixels in these regions
7) Step 7: Region which has the highest number of white pixels is the location of eyeball and tacking necessary action based on it.

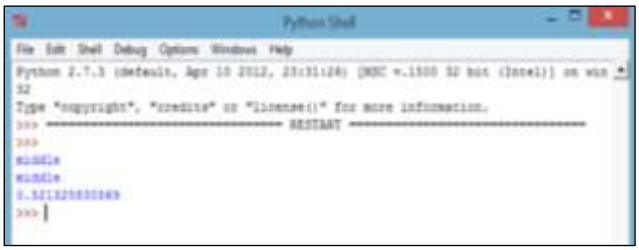


Fig. 7: Final Output of Eye Position

8) Step 8: Mouse pointer movement and click event performed.

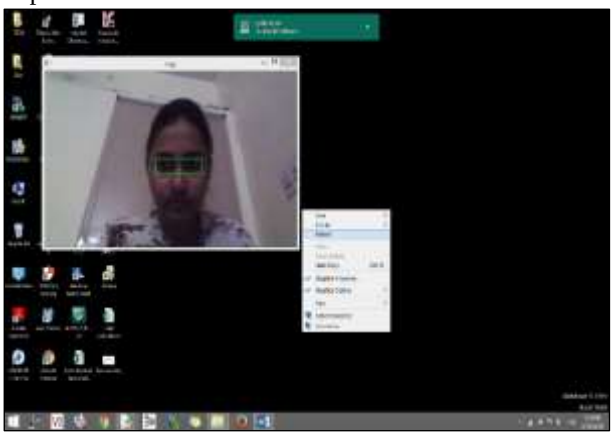


Fig. 8: Final Result

b) Flaws of Method:

- In windows this code runs efficiently with total execution time of 0.69 seconds
- But in raspberry pi same code takes around 2.3 seconds to process a frame which is not reliable in real time environment
- It also requires different value of thresholding during the night so this is not acceptable method
- Due to all this hurdles we to shift for another domain of image processing to achieve faster execution with accuracy and precision.

2) Final Approach for Eyeball Detection:

As not satisfactory results were obtained in earlier method we now were processing another algorithm which can be robust in any real time situation and is independent of subject.

a) Steps of Hough Circle Method:

1) Step 1: Grabbing an image from an IR camera to python

Fig. 9: IR Image

2) Step 2: Convert an image to gray scale and scaling by the factor of 0.38

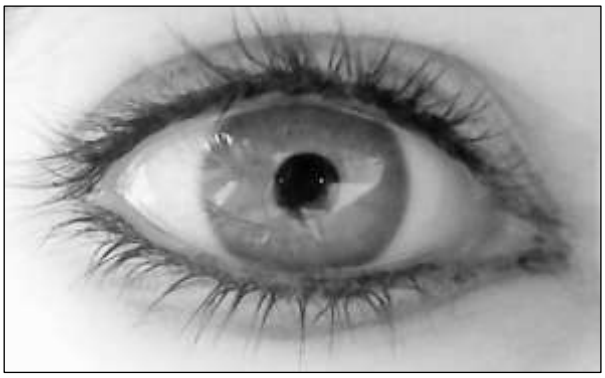


Fig. 10: Cropped Image

3) Step 3: Giving the time of 7 seconds for calibration an eye which basically detects midpoint of an eye using hough circle transform

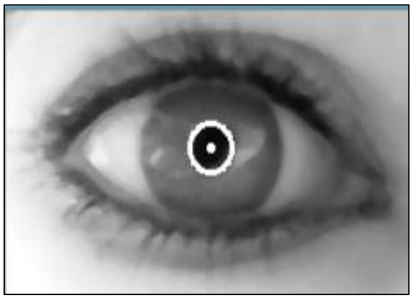


Fig. 11: Eye Detected Image

4) Step 4: Based on detected circle center making a rectangle of fixed coordinates around an eye

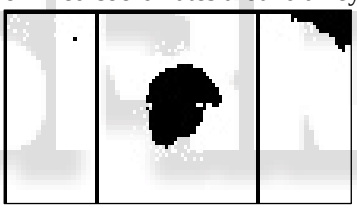


Fig. 12: Three equal region segmented

5) Step 5: Cropping and dividing an image into 3 equal regions

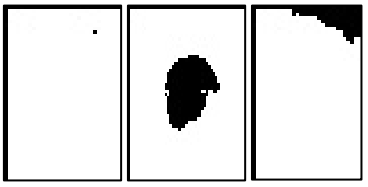


Fig. 13: Cropped region segmented

6) Step 6: Thresholding all the three region and finding the maximum number of black pixels

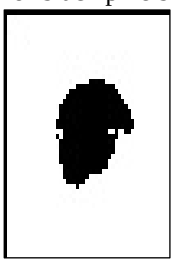


Fig. 14: Eyeball Detected Image

7) Step 7: Mouse pointer movement and click event performed based on eyeball detection

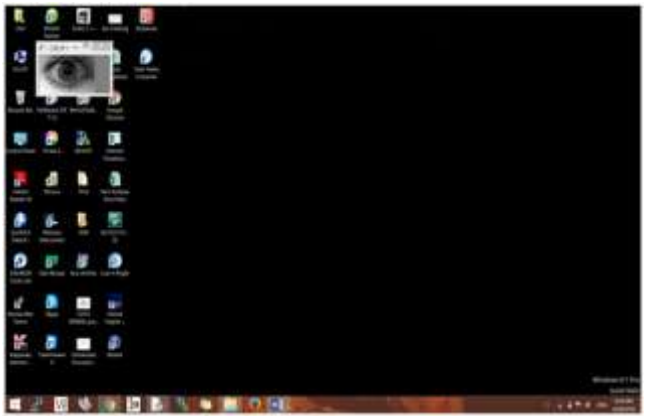
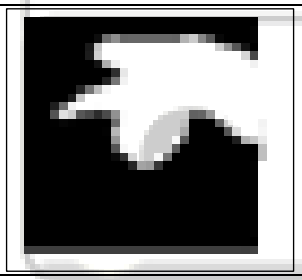
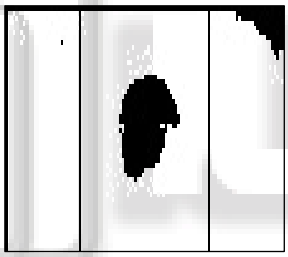


Fig. 15: Final Result

This method proved to be well robust and effective that can operate the device based on eyeball detection. The removing of IR filter from normal camera allows infrared light to pass through camera which makes detection easier.

The bright light emitted from IR led made all areas around eyes bright but eyeball which is black absorbed light rays, turning image in black dot at center and white all around so detection of black dot was easier in the 3 rectangular regions.

VI. DIFFERENCE BETWEEN BOTH METHODS

Harr Cascade Method	Hough Circle Method
	
Execution Time: More	Execution Time: Less
Effect of Background illumination affects the Output	Effect of Background illumination do not affects the Output
Harr cascade itself a predefined data file which has eye feature parameters so there are chances that objects similar to the eye can also be detected.	This method has dynamic characteristics of calibrating an eye so there are rare probability of false object detection

VII. CONCLUSION

Eye Moose serves as the major breakthrough for society which blends the scientific applications with requirements of the society. Being from the engineering domain the prime focus of my knowledge is to implement theoretical background to practical foreground so I took up this challenge which covers the vast domain from different field - Image processing (Open CV, Python).

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. Advantage of this system is providing computer access for people with server disabilities. In this paper we describe Eye tracking technology. This makes the interaction more efficient and enjoyable. The interface includes hardware and software components.

With the help of this research I have relished and furnished my technical and managerial skills whose output can be seen as in my skillfully prepared research.

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