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Eyeball Movement based Cursor and Keyboard Control for Physically Challenged

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Abstract--- *An Individual Human Computer Interface system using eye movement is introduced. Traditionally, human computer interface uses mouse or keyboard as a input device. The proposed system presents hands free interface between computer and user for physically challenged. The main objective is to control the Mouse & Keypad using Eye ball. It also verify the user's authentication using Face Recognition. For Face recognition, Viola Jones Algorithm is used. Camera is connected with the system & mat lab is used for User Authentication. After successful authentication, camera is continued to scan User's Eye ball movement. During this state of action, Our Physical Keypad & Mouse are frozen in order to stop user's Key inputs. On-screen Keyboard& Mouse control is initiated so as to control those through Eye Ball movements. Mat lab software plays a vital role in controlling the on-screen Keyboard& Mouse. We will be using Java for freezing the physical keypad & mouse functionalities. Camera scans the Eye ball of the authenticated user and control of the mouse is achieved through the Eye ball movement. Alphabets are selected by Eye ball clicking for effective communication. The Physical keyboard control is released by Control, Alt & Delete keys. Mat lab is used for Face recognition & Eye ball control. On-screen Keyboard is initiated& freezing of Physical Mouse & Keypad is achieved by Java software.*

Keywords--- *On-Screen Keyboard, Face Recognition and Eye Detection, Web Camera, MAT Lab, Computer, Java, Viola Jones Algorithm.*

I. INTRODUCTION

In today's world technology gets upgraded to the newest level, majority computers rely on mouse and keyboard as the major input devices which could not be used by physically challenged people. The proposed system describes a new method for the physically challenged people to interact using computers with the help of human eye. Most of the devices such as computers and laptop prefer touch screen technology, but still the preferred technology is not cheap enough to be used on desktop systems. The main aim is to develop an interactive virtual human computer interface. In our system, we prefer the usage of Mat lab to detect the web camera which is used for taking images continuously to focus the eye pupil. With the help of various image processing techniques, face recognition and eye tracking are done. For Face recognition, Viola Jones Algorithm is used. After eye tracking is done, the Virtual Keyboard gets displayed automatically and then the cursor is also controlled using the eye movements. By controlling cursor using the eye movements, the letters are selected and typed in any order by eyeball movements, mouse functions are also performed. Meanwhile the physical keyboard and mouse are in frozen state. The physical keyboard and mouse can be released from their frozen state with the help of three combination keys Control +Alt+ Delete. When this method is used, the system is made in user-friendly way such that it provides guidelines for user

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to perform the required action he/she is willing to do.

Existing System

Now a days, people use computer by their hands and touch pad. Traditionally, human computer interface uses mouse and keyboard as an input device. An idea to control computer mouse cursor movement with human eyes is introduced [1]. Blink actions are introduced to replace the mouse clicks [2].Eye position is found using eye recognition algorithm. Then these filters are used for eye tracking and blink detection [3]. Generally for opening a file, one must click on the file by using physical mouse or touch pad. Instead a new system is introduced to replace the physical mouse. One can open a file using the eye movement and blink actions. Both the left and right click is done by blinking the left eye and right eye.

II. PROPOSED SYSTEM

The main objective is to control the Mouse & Keyboard using Eye ball for handicapped people. On-screen keyboard is displayed on the desktop to replace the physical keyboard. Camera is mounted on the top of the desktop and the user image in front of the computer is captured. The image is compared and verified with the database for user's authentication. After successful authentication,

On-screen keyboard is displayed on the desktop automatically. Once the On-screen keyboard is displayed, the physical keyboard and mouse is freezed. The Physical keyboard and mouse freeze is released by pressing Control, Alt & Delete keys. Camera is continued to scan for face recognition using Violo Jones Algorithm. Then the eye is detected successfully to control the mouse and on-screen keyboard. Based on the blink action, the letter is typed and displayed for effective communication.

Human Eye Structure

The human eye is an important organ that senses light. The important parts of human eye related to eye tracking are described. The transparent coat in front of eyeball is cornea. The muscle that controls the size of pupil is called iris, which is like the aperture in a camera to let light goes inside. The iris has colour and is different from person to person, thus can be used in biometrics. The tough outer surface of the eyeball is sclera and appears white in the eye image. The boundary between the sclera and the iris is called limbus. The captured eye image by digital camera is shown in Figure 1.

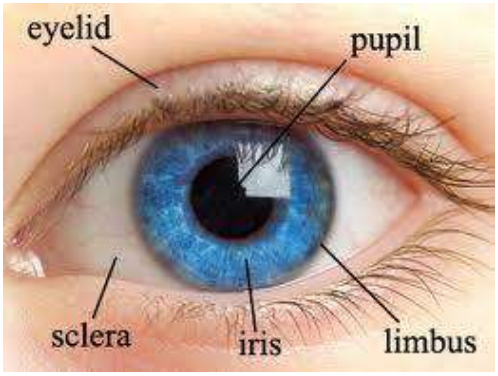

Fig. 1: Structure of Eye

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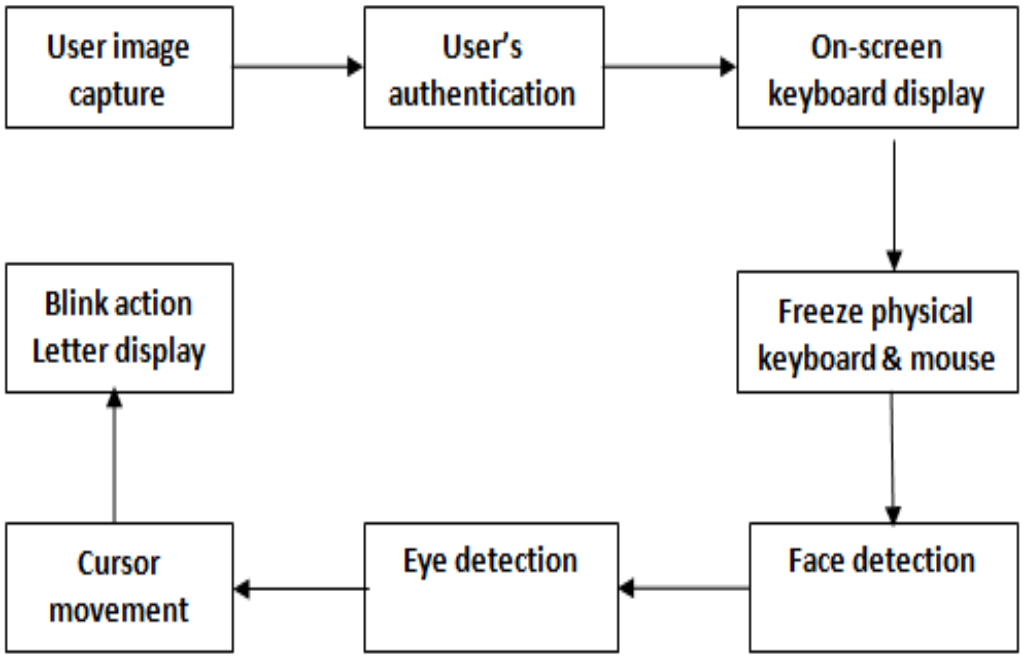

Fig. 2: System Workflow

System Working

The system starts with capturing an image of human face and detects an eye from the face and converts to gray level, remove noises, converts to binary image, calculate pixel value, detects sclera, divides eye and screen quadrants and finally performs mouse functions such as mouse move, left click, right click, double click, selection, drag & drop, and typing using on-screen keyboard according the pixel value as shown in figure 2. If sum of white pixel value is zero, mouse click operation is performed, and if sum of white pixel value of both eyes is one or more, mouse movement is performed.

III. ARCHITECTURE DIAGRAM

User is seated in-front of the desktop and the Logitech camera starts capturing the user's image. Initially its scan the user's face and checks for Authentication. If the user is authenticated person its starts capturing the user's eye. Based on the truth table the letters are typed by eye blink actions as shown in figure 3.

Algorithm

The processing steps is presented in figure 4.

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1. The camera takes the image of the user who sits in front of the computer.
2. The image is compared and verified with the database for user's authentication.
3. After successful user's authentication, on-screen keyboard is displayed automatically on the desktop.
4. Once on-screen keyboard is displayed, the physical keyboard and mouse are frozen by using java code.
5. Freezing can be released by pressing control, alt and delete keys on same time.
6. Once on-screen keyboard is displayed, Camera starts scanning the user eye by taking video.
7. After receiving these streaming videos from the camera, it then breaks into frames.
8. After receiving frames, it checks for lighting conditions because the camera requires sufficient lights from external sources otherwise an error message will display on the screen.
9. The captured frames that are already in RGB mode are converted into Black 'n' White in order find the edge movement.
10. Images (frames) from the input source focusing the eye are analyzed for Iris detection (center of eye) using Viola Jones Algorithm.
11. After that, a mid point is calculated by taking the mean of left and right eye centre point.
12. Then, the mouse will move from one point to another on the screen and user will perform clicking action by blinking their eyes.
13. Based on the blink action, the letter is typed and displayed for effective communication.

Fig. 4: Proposed Algorithm

Face Detection

The camera is attached with the computer to capture images of the person using the system. From the captured image, human face is detected and cropped in order to detect the eyes. Face detection has been researched with a different methods that often is motivated by a technique of face detector. Such techniques can use colors, textures, features and templates. The following two techniques are tried in this proposed system to select the best one.

Skin Color Analysis Method

Skin color analysis is often used as part of a face detection technique. Various techniques and colorspaces can be used to divide pixels that belongs to skin from pixels that are likely to the background. This technique faces with a big problem as skin colors are usually different over different people. In addition, in some cases skin colors may be

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similar to background colors with some measures. For example, having a red floor covering or a red wooden door in the human image can cause to fail the system.

Viola Jones Algorithm Method

This method performs set of features at a number ofscales and at different locations and uses them toidentify whether an image is a face or not. A simple, yet competent, classifier is built by identifying a few efficient features out of the whole set of the Haar-like features which can be generated using the AdaBoost[3] technique. To provide a real time processing, a number of classifiers that containing set of features are combined together in a cascaded structure.According to Viola Jones algorithm [4], face detection is performed using the facts that human eye is darker than upper cheeks and forehead as presented in Fig.5 , and there is a brighter part in between the two eyes that separates the left eye from the right eye as presented in Fig.5 . The features required by the detection framework generally performs the sum of image pixels in a rectangular area as presented in Fig.5. The features used by Viola and Jones algorithm are rely on more than one rectangular areas. Fig.5 presented the four types of features used in viola Jones algorithm. Fig.5 presented features that looks similar as bridge of the nose. Fig.5 presented feature looks similar to the eye is darker than upper cheeks.

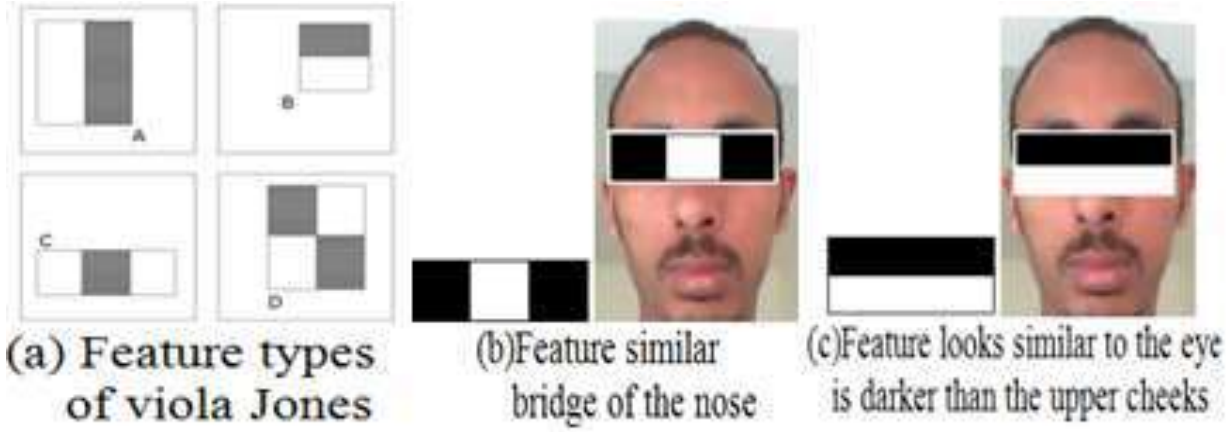

Fig. 5: Viola Jones Algorithm Features

The value of a given feature is the sum of the pixels of the un-shaded rectangle subtracted from the sum of the pixels within shaded rectangle [3].These rectangular filters are very fast at any scale and location to capture characteristics of the face. As it is must, the collection of all likely features of the four types which can be produced on an image window is probably big; applying all of them could be something intensive and could generate redundant activities. So, only a small subset of features from the large set of features are used. The advantage of Viola Jones algorithm is, its robustness with very high detection rate and real time processing.

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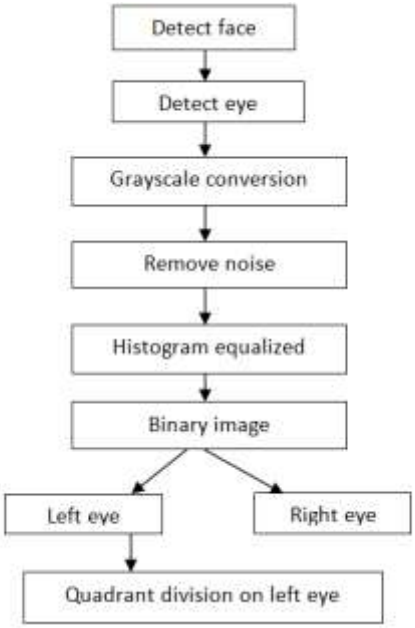

Fig. 6: Processing Structure of the Proposed Method

IV. EYE DETECTION

Eye movement analysis [5], can be used to analyze performance of eye to cursor integration. Eye pair is detected and cropped from the cropped face by eliminating other face parts such as mouth, nose and ears. The resultant image is divided into two parts: left eye and right eye. The left and right eye images are converted from RGB to gray scale and then noise is removed using image enhancement techniques (median filter and wiener filter). After this, image is converted into binary image(black and white) using threshold value. The processing structure of the proposed method is shown in Fig. 6.

Gray Scale Conversion

Grayscale images can be the result of measuring the intensity of light at each pixel according to a particular weighted combination of frequencies (or wavelengths). Gray scale conversion is done for edge detection.

Fig. 7: Gray Scale Image of Eye

Image Enhancement

Removing noises and improving image quality is used for better accuracy on computer vision. Noises could be Gaussian noise, balanced noise and the impulse noise [6]. Impulse noise distributed on the image as light and dark noise pixels and corrupts the correct information of the image. Therefore, reducing impulse noises are key important in computer vision. In this paper, two methods of image enhancement (median filter and wiener filter) are used. Those methods are used to remove noises.

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Image Binarization Using Threshold Value

In most of vision systems, it is helpful to be separate out the parts of the image that is corresponding to which the image we are interested with, and the parts of the image that corresponds to the background. Thresholding usually gives an easy and suitable way to carry out this segmentation based on different gray level intensities of an image.

A single or multiple threshold levels could decide for the image to be segmented; for a single value threshold level every pixel in the image should compare with a given threshold value and if the pixel of the image intensity value is higher than the assigned threshold value, the pixel is represented with white in the output; on the contrary if the pixel of the image intensity value is less than the assigned threshold value, the pixel is represented with black. For the multiple threshold level there are groups of intensities to be represented to white while the image intensities that have out of these groups are represented to black. Generally thresholding is useful for rapid evaluation on image segmentation due to its simplicity and fast processing speed [7]. Image binarization is the process of converting a gray level into black and white image by using some threshold value.

Fig. 8: Binary Image after Using Single and Multiple Thresholding

Eye and Mouse-Cursor Integration

When both eyes are opened, the left eye is divided into four quadrants to integrate with mouse-cursor movement. To divide the eye into four quadrants, center of the eye is a reference point. Eye corner location is used to find widths and heights of an eye which are used to calculate center of eye. Using x and y-coordinates that created at the corner of eye, center of eye is calculated[8]. Fig.9 (a) presented eye quadrants labeled with 1, 2, 3, and 4, and Fig.9 (b) presented quadrants of computer screen that is labeled with 1, 2, 3, and 4.

a) Eye quadrant b) Screen quadrant

Fig. 9: Eye and Screen Quadrants

V. CONCLUSION

This paper is fully focused on the development of hands-free PC control- Eyeball movement based cursor and keyboard control. This system does not require any wearable attachment is the most unique aspect. The mouse pointer is operated using the user eye movement. This system has been implemented in Windows 8.1 with 4GB RAM in Mat lab environment using Mat lab Image Acquisition Processing Toolbox. Image Processing Toolbox is sufficient for the sensitivity of the system and to work in real time as how normal mouse perform movement task.

On-screen keyboard is introduced to perform all keyboard actions for effective communication. Our motive is to create this technology in the lowest cost possible way and also to create it under a standardized operating system in

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moreuser friendly manner.

REFERENCES

[1] Craig Hennessey, Jacob Fiset "Long Range Eye Tracking: Bringing Eye Tracking into the Living Room", *IEEE Transactions on consumer Electronics,* vol.50, no.5, pp.77-85, Sept 2016.

[2] Shyam Narayan Patel, V. Prakash " Autonomous Camera based Eye Controlled Wheelchair system using Raspberry-Pi", *in proc. of 2nd IEEE International Conference on Innovations in Information Embedded and Communication Systems,* vol.33, no.4,pp.111-118, Aug 2015.

[3] M. Mangaiyarkarasi and A.Geetha, "Cursor Control System Using Facial Exoressions for Human-Computer Interaction", *IEEE transactions on computer development technology,*vol.8, no.1, April 2014.

[4] Ziho Kang and Steven J. Landry, "An Eye Movement Analysis Algorithm for a Multielement Target Tracking Task: Maximum Transition-Based Agglomerative Hierarchical Clustering", *IEEE transactions on human-machine systems,* vol. 45, no. 1,pp.192-199, feb 2015.

[5] Youlian Zhu, Cheng Huang, "An Improved MedianFiltering Algorithm for Image Noise Reduction", Sciverse Science Direct, Elsevier, *Physics Procedia* 25, vol.22,no.3,pp. 609-616,Aug 2015.

[6] Moe Win, A. R. Bushroa, M. A. Hassan, N. M.Hilman, AriIde-Ektessabi, "A Contrast Adjustment Thresholding Method for Surface Defect Detection Based on Mesoscopy", *IEEE transactions on industrial informatics,* vol. 11, no. 3,pp.329-337, june 2015.

[7] Muhammad Usman Ghani, Sarah Chaudhry, Maryam Sohail and Muhammad Nafees Geelani, "GazePointer: A RealTime Mouse Pointer Control Implementation Based On Eye Gaze Tracking", *IEEE transcations on consumer electronics,* vol. 4,no. 1,pp.424-431, jan 2013.

[8] Shrunkhala Satish Wankhede, Mrs. S.A.Chhabria, Dr.R.V. Dharaska " Controlling Mouse Cursor Using Eye Movement", *Special Issue for National Conference On Recent Advances in Technology and Management for Integrated Growth* 2013.

[9] Akhil Gupta, Akash Rathi, Dr. Y. Radhika, "Hands- free pc control" controlling of mouse cursor using eye movement, *International Journal of Scientific and Research Publications,* vol. 9, no. 4, pp. 92-99,April 2012.

[10] Sidra Naveed, Bushra Sikander, and Malik Sikander Hayat Khiyal "Eye Tracking System with Blink Detection", *International Journal of Engineering and Technology(UAE),* vol. 32, no. 11,pp.121-129,Aug 2012.

[11] Jixu Chen, Yan Tong, Wayne Grayy, QiangJiz, "A Robust 3D Eye Gaze Tracking System", *IEEE Transactions on scientific and research development,* vol. 21, pp.189-196, march 2008.

[12] Ioana Bacivarov, Mircea Ionita, Peter Corcoran, "Statistical models of appearance for eye tracking and eye blink detection and measurement", *IEEE transactions on consumer electronics,* vol.54 , no.3, pp. 1312-1320, Aug 2009.

[13] S.S. Deepika and G. Murugesan, "A Novel Approach forHuman Computer Interface Based on Eye Movements for Disabled People" *International Journal of Innovation in Engineering Research & Management,* vol. 6, no. 9, pp.1001-1009, march 2015.

[14] Ryo Shimata, Yoshihiro Mitani and Tsumoru Ochiai, "AStudy of Pupil Detection and Tracking by Image Processing Techniques for a Human Eye–Computer Interaction System", *IEEE transactions on research and development,* vol.15, no.2, pp.200-208 ,June 2015.

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