Implementation of Real Time Image Processing for a Human Eye Computer Interaction System

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***Abstract*—**People with physical disabilities cannot fully enjoy the benefits provided by computer System. This is because the conventional mouse and keyboard were designed to be used by those who are able bodied. A number of barriers have stood in the way of the integration of eye tracking into everyday applications, including the intrusiveness, robustness, availability, and price of eye-tracking systems. Due to reducing the communication barriers between man and machine human eye computer interaction is important. The goal of this thesis is to lower these barriers so that eye tracking can be used to enhance current human computer interfaces.The main aim of this proposed system is to design and implement a human computer interaction system that tracks the direction of the human gaze. The pupil detection and tracking is an important step for developing a human-computer interaction system. To identify the gaze direction of the user's eye (right, left, up and down).This work can develop a human computer interaction system that is based on iris tracking.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.

Keywords: *Image Processing, Eye detection and tracking, Mouse Activity.*

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I. INTRODUCTION

As the use of computer is increasing day by day, we cannot consider our life without computer. The internet technology plays a very important role to update our knowledge so it is very crucial part of our life. Unfortunately, the use of computer is limited to only those who cannot handle the input devices such as keyboard and mouse. Though the technologies are changing very rapidly the human computer interaction provide a solution for those peoples who are suffering from the motor disability So the physically challenged peoples are away from the use of computers. Therefore it is very necessary to take part in the research in the human computer interaction field and found solution how it would become possible to interact the user with computer in another way. Jacob [3] describes several ways of using eye movements for human-computer interaction. Robust techniques for eye detection in images are of particular importance to eye-gaze tracking systems. The movement of user's eyes can provide a convenient, natural and high bandwidth source of input. By tracking the direction of gaze of the user, the bandwidth of communication from the user to the computer can be increased by using the information about what the user is looking at, and even designing objects specially intended for the user to look at.

In an environmental control system, users always wear some devices. That is, these devices are said to be a contact type. However, if a user uses a contact type device for a long time, the user must work hard to endure pain. The contactless type device is expected to reduce a user's pain. By the development of a human-computer interaction system[1].In a human eye-computer interaction system, we need to understand eye movement to detect an eye. To detect an eye accurately, we focus a pupil of an eye. The pupil detection and tracking is an important step for developing a human-computer interaction system [5]. To develop a human eye-computer interaction system, we examine pupil detection and tracking by image processing techniques. In the image processing techniques, the illumination directly influences the image quality in general [2]. If influence of the illumination is little, we can obtain an image of good image quality. The subsequent image processing techniques are expected almost to succeed.

A vision-based system for detection of eye and face movements is presented, together with its implementation as a Human–Computer Interface for people with disabilities. The proposed work includes face detection, eye tracking and eye-blink detection interpretation of a sequence of blinks in real time to control a non-intrusive human–computer interface. To replace the traditional mouse with the human face and eye movements to interact the Computer. It is to assist the physically challenged persons without hands to use the computer efficiently and also easy [4].

II. LITERATURE SURVEY

2.1 Background History

Emile Java (French ophthalmologist, 1839 - 1907) was among the first who describe in 1879 the movements of the eye during text reading. He observes with a the help of a mirror, that the eye movements are not continuously along the phrase but composed from rapid movements named saccadescombined with short stops named fixation. Later, Edmund Huey (the author of The Psychology and Pedagogy of Reading published in 1908) built an eye tracker device using small contact lens provided with a hole for pupil. An aluminium pointer was connected to lens in order to observe the gaze direction during reading (Edmund Huey, 1908). Eye tracking is a technique whereby the position of the eye is used to determine gaze direction of a person at a given time and also the sequence in which there are moved (Poole & Ball, 2006). That is useful for scientists who try to understand movements of the eye while a person is involved in different activities. Different techniques where developed over the years according to technology available at that time [7].The eye has a lot of communicative power. Eye contact and gaze direction are central and very important cues in human communication, for example, in regulating interaction and turn taking, establishing socio-emotional connection, or indicating the target of our visual interest (Kleinke 1986).

2.2 Related Work

Zhiwei Zhu,Qiang Ji proposed a real-time robust method for eye tracking under variable lighting conditions and face orientations, based on combining the appearance-based methods and the active IR illumination approach. the proposed method uses an active infrared illumination to brighten subject's faces to produce the bright pupil effect. The bright pupil effect and the appearance of eyes are utilized simultaneously for eyes detection and tracking. The latest technologies in pattern classification recognition (the Support Vector Machine) and in object tracking (the mean-shift) are employed for pupil detection and tracking based on eyes appearance [6].

Kyung-Nam Kim and R.S.Ramakrishna proposed an Exact eye movements can be measured by special techniques. This investigation concentrates on tracking eye movement itself. The primary goal is to detect the exact eye position. Two algorithms have been proposed for iris center detection: the Longest Line Scanning and Occluded Circular EdgeMatching algorithms. Rough eye position is not sufficient for tracking eye gaze accurately. Measuring the direction of visual attention of the eyes requires more precise data from eye image. A distinctive feature of the eye image should be measured in any arrangement. The pupil of people having dark or dark-brown eyes can hardly be differentiated from the iris in the captured images. If the image is captured from close range, then it can be used to detect the pupil even under ordinary lighting conditions. It was decided to track the iris for this reason, Due to the fact that the sclera is light and the iris is dark, this boundary can easily be optically detected and tracked. It can be quite appropriate for people with darker iris color [11].

Nixon proposed an approach for accurate measurement of eye spacing using Hough transform. The eye is modeled by a circle for the iris and a “tailored" ellipse for the sclera boundary. Their method, however, is time-consuming, needs a high contrast eye image, and only works with frontal faces [9]. The combination of real-time eye movement data with other, more conventional modes of user–computer communication was also pioneered during the 1980s Eye contact and gaze direction are central and very important cues in human communication, for example, in regulating interaction and turn taking, establishing socio-emotional connection, or indicating the target of our visual interest (Kleinke 1986). The eye has also been said to be a mirror to the soul or window into the brain (Brigham et al. 2001; Ellis et al. 1998)[10].

Jianzhang Wang,Guangyue Zhang and Jiadong Shi proposed a novel pupil and glint detection method for gaze tracking system using a wearable camera sensor and near-infrared LED array. A novel circular ring rays location(CRRL) method is proposed for pupil boundary points detection. Firstly, improved Otsu optimal threshold binarization, opening-and-closing operation and projection of gray-level histogram are utilized to estimate rough pupil center and radius. Secondly, a circular ring area including pupil edge inside is determined according to rough pupil center and radius. Thirdly, a series of rays are shot from inner to outer ring to collect pupil boundary points. Interference points are eliminated by calculating gradient amplitude. At last, an improved total least squares is proposed to fit collected pupil boundary points. In addition, the improved total least squares developed is utilized for the solution of Gaussian function deformation to calculate glint center. The experimental results show that the proposed method is more robust and accurate than conventional detection methods. When interference factors such as glints and natural light reflection are located on pupil contour, pupil boundary points and center can be detected accurately. The proposed method contributes to enhance stability, accuracy and real-time quality of gaze tracking system [8].

Bacivarov, Ionita M and Corcoran proposed statistical models of appearance for eye tracking and eye blink detection and measurement. Active Appearance Model (AAM) a proof-of-concept model for the eye region is created to determine the parameters that measure the degree of eye blinks. After developing an eye model, a blink detector is projected. The main advantage of using AAM technique is that the detailed description of the eye is obtained and not just its rough location. The main drawback of AAM technique is that it is designed to work for a single individual and additionally the blink parameters have to be identified in advance[12].

2.3 Summary & Discussion

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Sr. No.	Paper Name	Author Name	Techniques
1.	Robust Real-Time Eye Detection and Tracking Under Lighting Conditions and Various Face Orientation	Zhiwei Zhu,Qiang Ji	Pupil tracking based on kalman filter
2.	Vision-Based Eye –Gaze Tracking for Human Computer Interface	Kyung-Nam Kim and R.S. Ramakrishna	The Longest Line Scanning and Occluded Circular Edge Matching algorithms
3.	Eye Spacing measurement of facial Recognition	Nixon	Approach for accurate measurement of eye spacing using hough transform
4.	Pupil and Glint Detection Using Wearable Camera Sensor and Near-Infrared LED Array	Jianzhang Wang,Guangyue Zhang and Jiadong Shi	Pupil and Glint detection tracking
5.	Statistical models of appearance for eye tracking and eye-blink detection and measurement	Bacivarov,Ionita M and Corcoran	Active Appearance Model

Table 2.3: Summary of Literature Survey

III. SYSTEM ARCHITECTURE

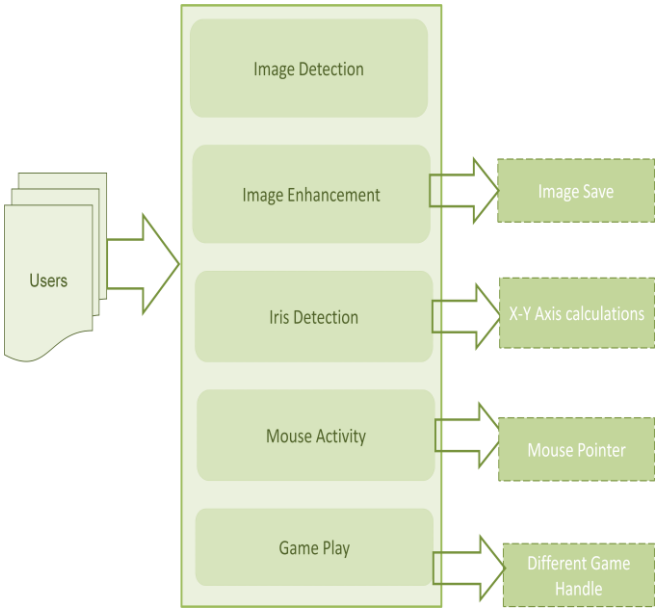

Fig 3.1: System architecture

As a user sits in front of the computer, a video camera mounted above the monitor observes one of the user's eyes. Advanced image processing implemented in the software continually analyzes the video image of the eye and determine the user is looking on the screen. Nothing is attached to the user's head and body. There is absolutely no need for additional hardware apart from the video camera. In image detection take input from camera to get the image from webcam i.e. the image can be detected in image detection then image enhancement after retrieving the input image is to enhance it and it can be save in any drive or folder. In iris detection several calculations were performed on images in order to detect the actual position of the iris. This in turn indicates which direction the user is looking in. There were 8 parameters calculated, namely: (min_x, y_min_x, max_x, y_max_x, min_y, x_min_y, max_y, x_max_y).In mouse activity, mouse cursor will move from one position to another on the screen and user will perform clicking by blinking their eyes for 1 or 2 seconds and that we can choose the clicking time option. The system is to efficiently track the head movement or eye movement of a person from web-cam or from external web-cam and move mouse cursor according to that, eye blink then click event will perform. This blink is used to control computer and do some specific task and games can also play with the help of mouse cursor, different games can be handle.

IV. PROPOSED DESIGN

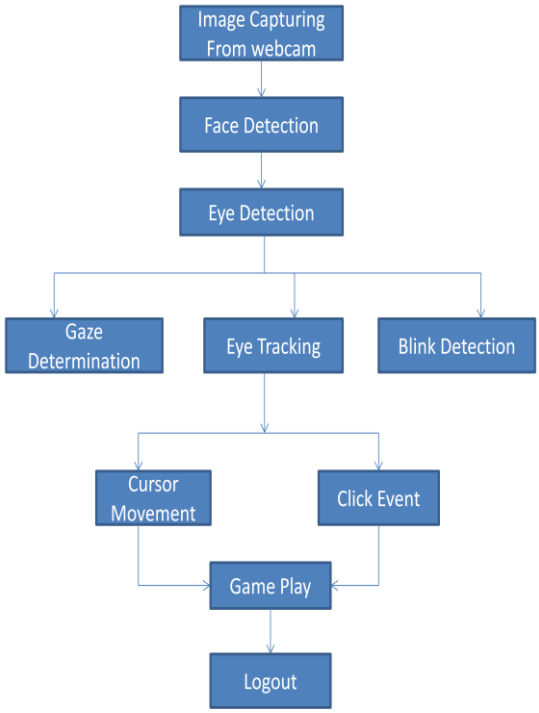

Fig.4.1: Proposed Design

The system is real time which captures a movement of mouse cursor through eye movement. It overcomes the existing system by avoiding the use of external hardware that caused serious eye damages. In this system the hard blink is only used for selecting particular file or folder with eye detection its first aim is to captured face for the movement of mouse cursor. Then it reacts as the mouse does. In this user first of all creates a registration then login to the system. If user already creates a registration they can directly login to the system. In this image captured from webcam and this image is detected in image

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detection. Then image enhancement after retrieving the input image is to enhance it and it can be saving in any drive or folder. In iris detection first of all to detect the face and eyes of the user then show the calculations of x, y, width and height of the user's eye movement. Then in mouse activity, mouse cursor will move from one position to another on the screen and user will perform clicking by blinking their eyes for 1 or 2 seconds and those we can choose the clicking time option. The system is to efficiently track the head movement or eye movement of a person from web-cam or from external web-cam and move mouse cursor according to that, eye blink then click event will perform. This blink is used to control computer and do some specific task and games can also play with the help of mouse cursor, different games can be handle. Controlling the mouse pointer through eye movement. The eye-gaze system is a direct-select vision-controlled communication and control system. Only requirements to operate the Eye gaze are control of at least one eye with good vision & ability to keep head fairly still. Its primary users can be adults and children with cerebral palsy, spinal cord injuries, brain injuries, multiple sclerosis, Brainstem strokes, etc. Eye gaze can be used in homes, offices, schools, hospitals, and long term care facilities.

Algorithm

Step1: Take a input from webcam.

Step2: After receiving this image or streaming videos from the cameras, it will break into frames.

Step3: After receiving frames, it will check for lighting conditions because cameras require sufficient lights from external sources.

Step4: Images (frames) from the input source focusing the eye are analyzed for Iris detection (canter of eye).

Step5: After this, a mid point is calculated by taking the mean of left and right eye centre point.

Step6: Finally the mouse will move from one position to another on the screen and user will perform clicking by blinking their eyes.

V. RESULT ANALYSIS

After the simulation of the different types of existing system, proposed system generates some result. The system's aim is to control the mouse motions and events hands-free by using head and eye movement and our system is able to give the output as expected**.** According to head movement mouse cursor will move. After that eye blinks will observed and from that mouse click events will work. During the analysis phase of this research, three techniques were analysed: the limbus tracking, Pupil tracking, and Electrooculography. With the help of this technique analyzes three parameter Iris Detection, Image Enhancement and Mouse movement. All this parameter is analyze with millisecond as compared to eye movement.

Movement	Iris Detection (ms)	Image Enhancement(	Mouse Movement(ms)
1	4.7	5.9	8.5
2	3.5	6.3	8.9
3	4.2	6.1	9.1
4	4.9	6.9	8.1
5	5.1	5.6	8.7

Table 5.1: Parameter

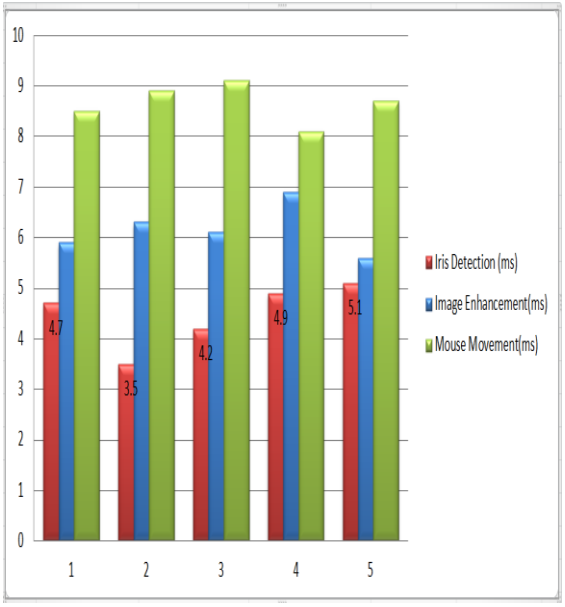

Figure 5.1: Graph showing Time (ms) required for Iris Detection, Image Enhancement and Mouse Activity

Parameter	Existing System (ms)	Proposed System (ms)
Face Detection	5.9	4.7
Eye Detection	6.3	5.1
Gaze Detection	5.8	6.1
Eye Tracking	6.5	6.3
Blink Detection	5.7	5.2
Play Game	6.4	6.2

Table 5.2:Analysis of Existing and Proposed System

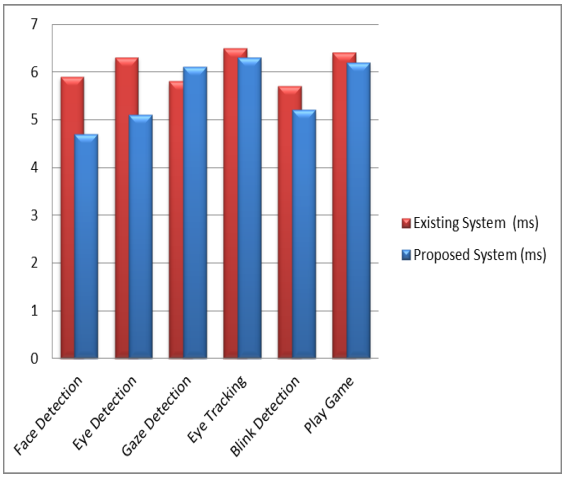

Figure 5.2 Graph shows the parameter execution time required for the existing system and proposed system

The above table and graph shows the parameter execution time required for the previous and proposed system. Face detection, Eye detection, Gaze detection, Eye tracking and Blink

detection are the parameter of human computer interaction. In this previous system required more time for executing the parameter but in the proposed system parameter requires less time for execution and main approach is that user plays the game hands free with the help of eye movement.

VI. CONCLUSION

Day to day the lifestyle of people gets changes and the use of computer is increasing; we cannot consider our life without computer. The internet technology plays a very important role to update our knowledge. This work provides an alternative communication method for people with severe disabilities. Eye gaze tracking method involving eye movement tracking and in eye movement include (left and right movement).This will lead to a more functional and robust as for each new gaze there will be a new command. 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. It will be more useful for paralyzed people they can easily interact with the computer.

REFERENCES

[1] V. I. Pavlovic, R. Sharma, and T. S. Huang, "*Visual interpretation of hand gestures for human-computer interaction: a review*," IEEE PAMI,Vol. 19, No. 7, 1997, pp. 677-695.

[2] S. Z. Li, R. Chu, S. Liao, and L. Zhang, "*Illumination invariant face recognition using near-infrared images*," IEEE PAMI, Vol. 29, No. 4, 2007, pp. 627-639.

[3] R.J.K.Jacob"*The use of eye movements in human-computer interaction techniques: What you look at is what you get",* ACM Transactions on Information Systems, 9(3):152–169, April.

[4] Vaibhav Nangare, Utkarsha Samant, Sonit Rabha," *Controlling Mouse Motions Using Eye Blinks, Head Movements and Voice Recognition*," International Journal of Scientific and Research Publications, Volume 6, Issue 3, March 2016 329 ISSN 2250-3153

[5] D. W. Hansen and Q. Ji, "*In the eye of the beholder: a survey of models for eyes and gaze*," IEEE PAMI, Vol. 32, No. 3, 2010, pp. 478-500.

[6] Zhiwei Zhu,Qiang Ji,"*Robust Real Time Eye Detection and Tracking Under Variable Lighting Conditions & Various Face Orientation*."

[7] Robert Gabriel Lupu and Florina Ungureanu"*A Survey of Eye Tracking Methods and Application."*

[8] Jianzhang Wang,Guangyue Zhang and Jiadong,"*Pupil and Glint Detection Using Wearable Camera Sensor and Near-Infrared LED Array*" Sensors 2015, 15, 30126–30141; doi:10.3390/s151229792.

[9] M. Nixon," *Eye spacing measurement for facial recognition, in: Proceedings of the Society of Photo-Optical Instrument Engineers*."

[10] Robert Gabriel Lupu and Florina Unguruanu,"*A Survey of Eye Tracking Method and Application*".

[11] Kyung-Nam Kim and R.S.Ramakrishna,"*Vision-Based Eye Gaze Tracking for Human Computer Interface."* 0-7803-5731-O/99/$10.00 01999 IEEE

[12] Bacivarov, Ionita M., Corcoran,P. , "*Statistical models of appearance for eye tracking and eye-blink detection and measurement*", IEEE Transactions, August 2010