A Review on 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. Due to reducing the communication barriers between man and machine human eye computer interaction is important. 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). Human eye uses contactless type devices. This work can develop a human computer interaction system that is based on iris tracking. The iris is widely used as the starting point for detection and tracking. It is an important eye feature that is circular in shape and that can be detected easily.

Keywords: *Image Processing, Pupil detection, Iris and Gaze Tracking.*

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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 can 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 [1] 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. The "Dark Pupil/Light Pupil" technique using infrared light. Under infrared illumination, the pupil becomes very white, almost the exact opposite of its visual

spectrum appearance. By capturing both the dark and light pupil images, the high contrast can be used via image subtraction to evaluate the pupil location with very high accuracy.[2]

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 [3]. 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 [4]. 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 [5]. 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.

1.1 Motivation

Some people are so severely paralyzed that they only have the ability to control the muscles in their eyes. For these people, eye movements or blinks are the only way to communicate. To develop a system that can aid the physically challenged by allowing them to interact with a computer system using only their eyes. The task of reducing or eliminating the communication barriers between man and machine is an arduous task. There is little motivation in providing an alternative communication tool for those whose physical abilities are extremely limited. Human eye movements have the potential to be a convenient, natural, high bandwidth and fast input mode of computers due to their communication power.[6]

1.2 Objectives

- To develop a human-computer interaction system for the detection and tracking of eye pupil.
- To develop a human eye-computer interaction, we examine pupil detection and tracking by image processing techniques.
- To identify the gaze direction of the user's eyes (right, left, up and down).
- A device using a human eye is one of contactless type devices. This work to develop a human computer interface system that is based on iris tracking. The iris is widely used as the starting point for detection and tracking. It is an important eye feature that is circular in shape and that can be detected easily.
- By tracking the position of the irises, useful interfaces can be developed that allow the user to control and manipulate functions on the screen.

1.3 Scope

Eye tracking and gaze detection is becoming an increasingly interesting option even in traditional computing. Major technology companies and the gaming industry are starting to show growing interest in embedding eye tracking in their future products. The system that would be available at low cost, easy to use, and more accurate than the previous one.

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 saccades combined 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). The jittery movement of the cursor may distract concentration as the user's attention is drawn by the movement. If the user tries to look at the cursor, he may end up chasing it as the cursor is always is a few pixels away from the point they are looking at (Jacob 1995) 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).The Starburst algorithm(Parkhurst,2005) relies on black or white pupil detection but can also be used for iries detection if eye receive enough ambient light[8].

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 [9].

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 Edge Matching 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 [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 [11].

2.3 Summary & Discussion

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.	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

2.4 Limitations

- It is purely hardware dependant.
- User must have practice for interacting the software.
- By using MATLAB software system performance is very slow.

III. SYSTEM DESIGN AND IMPLEMENTATION

3.1 Basic idea

The pupil detection and tracking is an important step for developing a human-computer interaction system. To develop a human eye-computer interaction system, to examine pupil detection and tracking by image processing techniques. In the image processing techniques, the illumination directly influences the image quality in general. If influences of illumination is little, we can obtain an image of good image quality. The subsequent image processing techniques are expected almost to succeed. In order to avoid the influences of illumination, we have tried to combine the hardware constitution of an infrared light-emitting diode (LED) light, a sensitive infrared camera, and an infrared (IR) filter.

Traditional human-computer interfaces demand manual dexterity. Unfortunately, people with physical disabilities cannot fully enjoy the benefits provided by computer systems. This is because the conventional mouse and keyboard were designed to be used by those who are able bodied. The task of reducing or eliminating the communication barriers between man and machine is an arduous task. There is little motivation in providing an alternative communication tool for those whose physical abilities are extremely limited. Human eye movements have the potential to be a convenient, natural, high bandwidth and fast input mode of computers due to their communication power.

3.2 System Implementation

Modules of Proposed System:

Proposed system can be divided into the following modules,

1. Getting Image from Device

The first steps of the eye-tracking algorithm is first to locate the eyes of the user from an image and then use the location information to perform certain functions.

2. Image Enhancement

The next step after retrieving the input image is to enhance it. This increases the image definition by improving contrast..

3. Boundary Tracing

Tracing the boundaries of the eyes is important as finding the outline of the eyes makes it easier (computationally) to localize the position of the irises.

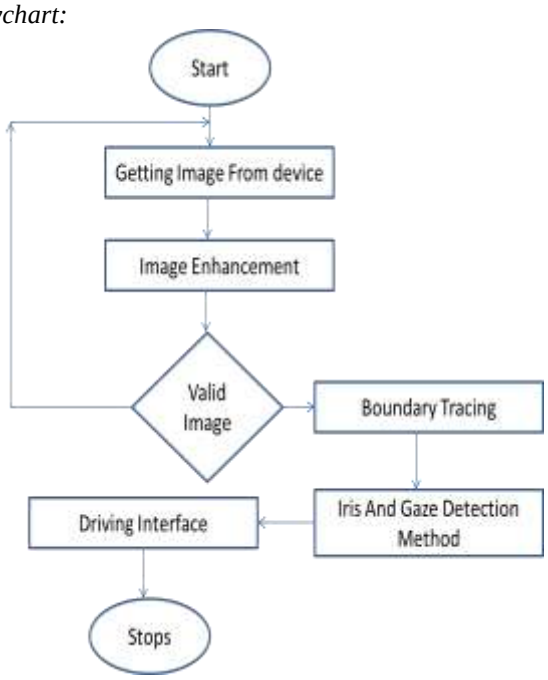
4. Iris and Gaze position detection

Several calculations were performed on images in order to detect the actual position of the iris.

5. Driving the Interface

Mouse events were triggered based on the calculated values of the variable. All mouse events were generated.

Flowchart:



IV. CONCLUSION AND FUTURE SCOPE

4.1 Conclusion

Day to day the lifestyle of people get 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(not the eye location but iris centre

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. It will be more useful for paralyzed people they can easily interact with the computer.

4.2 Future Scope

This work can be use in market for commercial purpose. In automobile Industry eye tracking can be used for observation and safety of the driver. The eye tracking is very useful in the field of the medical sciences.

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