

Department of Computer Engineering



Human computer interaction for disabled using eye motion tracking

Sanika Kulkarni
Roll No:-323037

Guided By:
Dr.A.K.Barve
15 February 2017

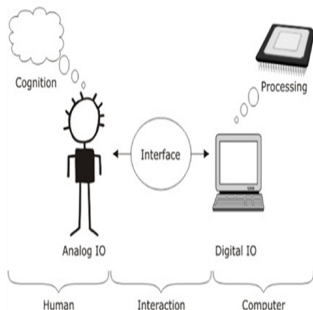
- Introduction
- Objectives
- Social Impact
- Literature Survey
- Implementation
- Output For Face Detection
- Output For Eye Detection
- Conclusion
- References



Human Computer Interaction

- Human computer interaction also known as HCI, refers to the interaction between humans and computers. The interaction can be of many forms like:

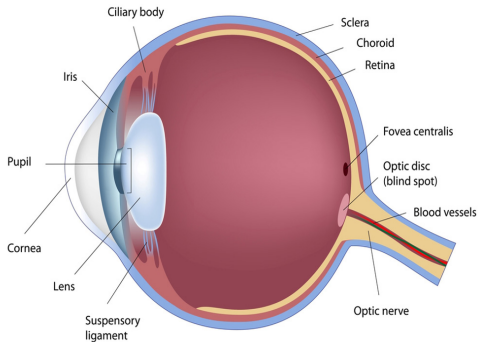
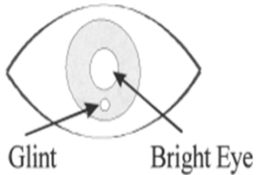
- SIGHT
- SOUND
- TOUCH



TYPES OF HCI

- AUDIO BASED HCI
 - Depends on information gathered from audio signals.
- SENSOR BASED HCI
 - Various sensors gather information like motion sensors, pressure sensors, etc.
- VISUAL HCI
 - Based on visual input.
 - We are going to use this kind of HCI in this seminar.

THE HUMAN EYE



The parts which will be mentioned later are:

- Pupil
- Cornea
- Glint

Objectives

- To create awareness about HCI and its applications.
- To show how HCI can help to solve real life problems like helping the limb disabled in this case.
- To show how computer can be accessed by using just eye movements and how this can help not only the disabled but the whole society and thus make technology “hands free”.

- This seminar's topic, when implemented, will help the limb disabled to access computer by using just their eye which is not possible normally.
- Accessing computer can make their lives easier. They can communicate using internet and video calls which will help them to stay connected with people across the globe.
- It will also help them get employment which in turn can help them become independent and at the same time enrich the society by their valuable inputs.

ALGORITHMS USED IN THIS PAPER:

- The first step performed on each input frame is the face detection, which is achieved using **Viola-Jones algorithm**.
- **Circular Hough Transform** is used to locate the pupil in eye image.
- Glint (a small and intense dot inside the pupil image) is detected by the **blob analysis method**.
- **Pupil Corneal Reflection (PCR) method** to estimate gaze of user by determining the relationship between pupil center and glint.
- **Template matching method** is used for blink detection.

Disadvantages Of Existing Techniques

- The technique mentioned in the first paper needs more storage space in database and it is a time consuming process as in it various iris center location information is stored and matched.
- In the second paper, the technique allows natural head movement but the set up becomes costly and complex due to use of more number of cameras.
- The third technique involves more computational time.
- Due to these reasons , a new technique is developed which is cost efficient, with simple hardware needs and good accuracy.

<u>LITERATURE SURVEY</u>			
PAPER	Novel Eye Gaze Tracking Techniques Under Natural Head Movement	Eyeball Model-based Iris Center Localization method for Visible Image-based Eye-Gaze Tracking Systems	Estimation of gaze for human computer interaction
ALGORITHMS OR METHODS	The cornea of the eyeball is modeled as a convex mirror. Via the properties of convex mirror, a simple method is proposed to estimate the 3-D optic axis of the eye.	Iris centre locations are found out by making spherical models of eyeball to form elliptical shape by rotation and stored in a database.	Daugman's algorithm.
CONS	Because of the requirement of more no. of cameras and IR illuminators, the set-up becomes complex and also costly.	It affects the performance of gaze tracking because of the direct mapping of iris center on the target plane.	More computational time.

Table: Survey

The following steps are implemented in the system:

- Video Processing
- Face And Eye Detection
- Pupil Localization
- Glint Detection
- Gaze Estimation
- Blink Detection

- The video is given as an input. The USB port of camera is connected to the computer and the camera is mounted on the top of the computer screen.
- A limited size keyboard is created with 4 keys. Whenever the user looks at particular key, eye images are captured and transmitted to computer through USB cable.
- The image processing software will then access each frame and performs some processing operations to estimate the gaze of the user.
- The first process performed on each frame is face detection.

Face And Eye Detection

- A non-touch user interface approach is used here.
- Face detection is carried out and then eye detection is done.
- To detect the face and eye, the algorithm used is Viola-Jones algorithm.
- The library called Computer Vision System Toolbox is used to implement it in MATLAB.

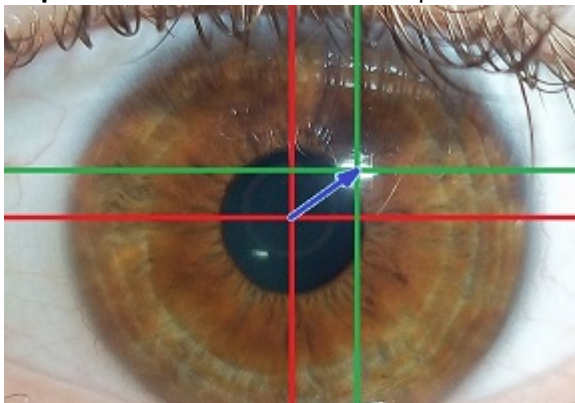
Pupil Localization

- To estimate the gaze of user Pupil Corneal Reflection method is used.
- The method consists of pupil detection and glint detection.
- When the fraction of light enters into the eye, it gets reflected from the retinal surface and forms pupil image.
- If a fraction of the light gets reflected from the corneal surface, it produces a small and intense dot in the pupil image called glint.
- The relationship between this glint and Pupil is found out to estimate the gaze.

- This is done by Blob Analysis method.
- A blob is a connected region of white pixels in a binary image.
- A Cropped eye image is given as an input to this step.
- Firstly, a white pixel is found out. Once that is done, Pixels around it are analyzed by 8 connectivity method.
- If neighbouring pixels are white, then it is considered as a glint.

Gaze Estimation

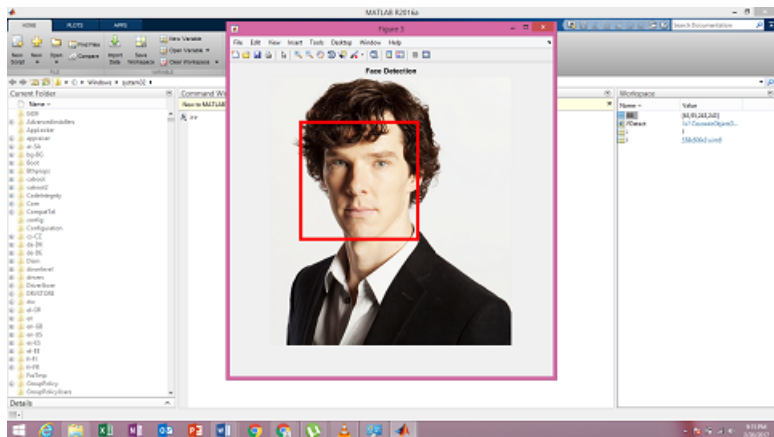
- Once these both are detected, we can estimate gaze by joining the center point of pupil and glint image.
- Since glint is reflection of cornea, the method is called **Pupil Corneal Reflection** technique.



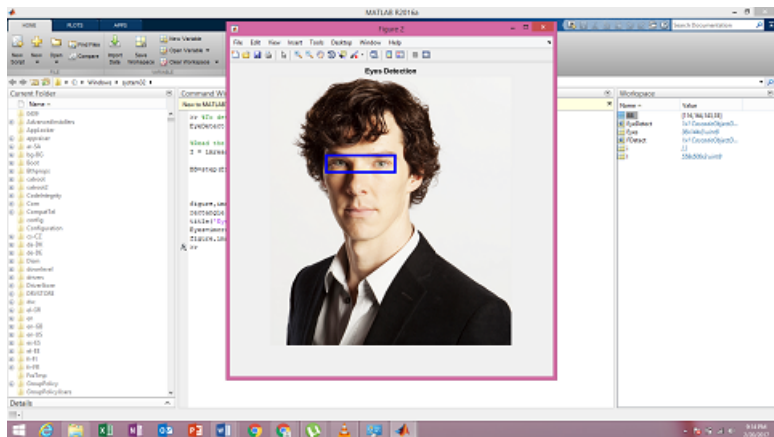
Blink Detection

- There is a track pointer on screen which moves as the gaze moves and thus enables us to know which key the user is looking at.
- The typing process is carried out by blinking.
- For this, two templates are formed:
 - 1) Closed Eye Template.
 - 2) Open Eye Template.
- The incoming frame is matched with the template.
- If the frame matches with closed eye template, then it is considered as a blink.

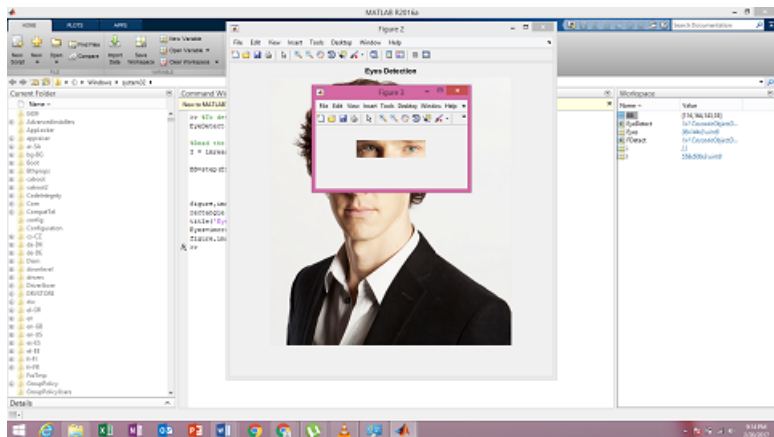
Output Of Face Detection



Output Of Eye Detection



Output Of Eye Detection



Conclusion

- We can implement face and eye recognition to improve HCI for disabled.
- This can be used by everyone to easily access the computer without using hands.
- It can allow interaction with computer from a distance.

References

- Zhiwei Zhu and Qiang Ji, “Novel Eye Gaze Tracking Under Natural Head Movement”, Biomedical Engineering, IEEE Transaction on, Volume 54, Issue 12, Page(s): 2246-2260, Year 2007.
- Seung-Jin Baek, Kang-A Choi, Chunfei Ma, Young-Hyun Kim, and Sung-Jea Ko, “Eyeball Model-based Iris Center Localization for Visible Image-based Eye-Gaze Tracking Systems”, IEEE Transactions, Volume: 22, Issue: 10, Page(s): 415-421, Year: 2010.
- Uma Sambrekar, Dipali Ramdasi “Estimation of Gaze For Human Computer Interaction”, International Conference on Industrial Instrumentation and Control (ICIC), Page(s): 1236-1239, Year: 2015.
- Paul Viola, Michael J. Jones, “Robust Real-Time Face Detection”, International Journal of Computer Vision, Volume: 57, Issue: 2, Page(s): 137-154, Year: 2004.

Any Questions?

THANK YOU!