

Human Computer Interaction and Eye Tracking

Eye Mouse

Engr. Usman Waheed, Engr. Muhammad Umair, Engr. Muhammad Ibrahim

Abstract— this paper intends to use eye gazing techniques to allow a user to move the mouse pointer using his/her eyes. This objective was achieved using a trained Haar classifier for the face and eyes Detection. The final system is able to detect successfully where the user is looking and to track the eye's gaze. Results illustrating this functionality are well documented in this paper. Although that, some limitations in the movement scaling to fit to the screen dimensions - must be eliminated in future.

Index Terms: Eye Tracking, Human Computer Interaction, Eye Mouse, Cursor Movement.

1 INTRODUCTION

Tracking of Eye has been fundamentally utilized as a part of examination frameworks to examine the visual conduct of people performing an assortment of errands. Be that as it may, for some time now, research has additionally been in progress to inspect the utilization of eye developments in human PC interfaces. Just to some little degree has eye-following examination been coordinated into purchaser items. This absence of a more across the board mix of eye tracking into buyer grade human PC interfaces can be ascribed to the significant rudeness, absence of heartiness, low accessibility, and high cost of eye-following innovation. It is imperative that these obstructions be overcome on the grounds that HCI examine plainly shows the capability of eye tracking to improve the quality of ordinary human-PC interfaces. [4] [3] [1].

Clients with development incapacities take a gander at keys on a virtual console with a specific end goal to connect with a PC that they would somehow be not able to utilize physically [4].

- *Muhammad Ibrahim is currently doing a job In Pakistan telecommunication company Limited, Pakistan, PH +923157103991. Muhammadibrahim707@hotmail.com*
- *Usman Waheed is currently pursuing masters degree program in electric power engineering in University, Pakistan, PH+923336697791.Usmanpasha.220@gmail.com*
- *Muhammad Umair is currently doing job in Cofely Besix Facilities Management LLC., Dubai, UAE, PH+971527391399 umair.muhammad1@yahoo.com*

2 LITERATURE REVIEW

For the reasons of this review, an eye tracking framework will

allude to any arrangement of observing apparatuses that can determine look course, obsession length of time, pupil dilation, or a blend of those.

The essential advantage of an eye-tracking framework is that it gives a steady stream of data about the client continuously that can be utilized to survey the client's mental state (changes in gauge mental usefulness) and/or where they are centring their consideration (Liu and Chuang 2010). To show the client's mental state, the positions and the quantity of obsessions, the obsession term, and the saccade length (the separation a look heading crosses between obsessions) are the most widely recognized variables (Liu and Chuang 2010). To gauge consideration distribution, the term of eye obsessions, the quantity of obsessions, and the measure of fixations (focusing on a region or item various times) uncover examples depicting how a client's consideration is coordinated to a given area or visual region of the PC screen (Liu what's more, Chuang 2010). In the late writing, obsessions have been utilized effectively to gage the level of picture many-sided quality (Crosby et al. 2001) and issue many-sided quality (Jazbec et al. 2006) and also to distinguish the piece of a screen or slide that is seen along with direction (Guan 2002; Liu and Chuang 2010; Pierce 2009; Schrammel et al. 2009).

3-EXPERIMENTAL SETUP AND RESULTS

3.1 Image Analysis

Image analysis is defined in following steps.

3.1.1 Camera Input

The camera data is a feature stream which comprises of a gathering of progressive edges. The framework treats every edge independently and checks it for the unique elements that characterize a face based on the capacities that will be characterized in the accompanying areas. The data from the camera will require some separating procedures to get an exact

position from it. The stages are portrayed in the following subsections:

3.1.2 Read the Image

A picture is chosen so it has impressive diverge from its experience so that the items can be distinguished. The capacity "imread" peruses the picture from a given area and stores it in the structure. The "imshow" limit demonstrates the photo (see fig. 1, 2 & 3). This stride uproots any shading data in the picture to make it simpler to recognize objects. The "rgb2gray" changes over the shading picture into a grayscale picture and stores it into the grid image (see fig. 4).

3.2 Histogram

A histogram is a basic table that gives the quantity of pixels that have a given value in a picture (or at some point an arrangement of pictures). The histogram of a dark level picture will thusly have 256 bins (or containers) [9]. Bin 0 gives the quantity of pixels having value 0, bin 1 the quantity of pixels having value 1, etc. Clearly, in the event that you aggregate the majority of the sections of a histogram, you should get the total number of pixels. Histograms can likewise be standardized such that aggregate of the canisters of meets 1[17]. Things being what they are, each compartment gives the rate of pixels having this particular value in the picture. By and large, the visual lack of a picture is that some force qualities are utilized more regularly than others. The centre dark intensities are without a doubt intensely spoken to, while darker and brighter pixel qualities are fairly uncommon. Truth be told, one can feel that a decent quality picture should make equivalent utilization of all accessible pixel intensities. This is the way to go behind the idea of histogram evening out; that is making the picture histogram as level as could be allowed [17] [18].

The Histogram Equalization calculation improves the complexity of pictures by changing the qualities in a power picture so that the histogram of the yield picture is more or less level.

3.3 Image Processing

Utilizing the data accumulated from dissecting the image, there may need to upgrade the way of image examination. Image can be enhance by evacuating upheaval, importance highlights in which you are dazzled, and parcelling the object of vitality from the establishment. Gadgets you can use to improve your photo join lookup tables, spatial channels, dark scale-morphology, and rehash extent dealing with [16] [19].

3.3.1 Lookup Tables

A lookup table (LUT) change changes over grayscale values in the source picture into other grayscale values in the changed image. Use LUT changes to upgrade the unpredictability and shine of a picture by changing the element power of areas with poor differentiation. Normally LUT changes apply to highlight

picture points of interest in ranges containing huge data to the detriment of different regions [19].

3.3.2 Spatial Filters

Spatial channels enhance the picture quality by uprooting commotion and smoothing, honing, and changing the photo. IMAQ tool in MATLAB allows user to configure any imaging device like USB camera into LabVIEW. IMAQ Vision goes hand in hand with various formally portrayed channels, for instance, Gaussian channels for smoothing pictures; Laplacian channels for highlighting picture points of interest; Median and Nth Order channels for clamour evacuation; and Prewitt, Roberts, and Sobel channels for edge recognition. You can likewise characterize your own particular custom channel by indicating your own channel coefficients [19].

3.3.3 Frequency Domain Processing

In hardware, control frameworks building, and insights, the recurrence area alludes to the investigation of numerical capacities or signs regarding recurrence, instead of time [1]. It is essential to place period space chart after some time that indicates how a sign changes, though a recurrence space diagram demonstrates how a significant part of the sign exists in every given recurrence band more than a scope of frequencies.

3.4 BLOB Analysis

Blob Analysis is a major method of machine vision in view of examination of steady picture districts. In that capacity it is an apparatus of decision for applications in which the articles being investigated are unmistakably perceivable from the foundation. [7] [18] [19]. This stride finds the limits of every article that it discovers and stores it in B. The content capacity prints the quantity of articles that are found by "bw" boundaries (see fig. 5)

3.5 THRESHOLDING

Thresholding empowers you to choose scopes of pixel values in grayscale and shading pictures that altered the items under thought from the establishment. Thresholding changes over a photo into a double picture, with pixel estimations of 0 or 1. This procedure lives up to expectations by setting to 1 all pixels whose worth falls inside a certain extent, called the edge interim, and setting all other pixel values in the picture to 0. [21].

This stride limits the picture by changing over the grayscale picture into a picture that contains just two hues. The capacity "im2bw" appoints dark shading to all the pixels that have glow than an edge level and the others as white. The limit "graythresh" pretty much processes the limit of the picture (see fig. 6).

3.6 Partical Measurement

After making a paired picture and enhancing, it can make up to 50 molecule estimations. With these estimations area of blobs and their shape highlights can be focused. By utilizing these highlights to order or channel the particles taking into account one or numerous estimations. For instance, particles whose zones are not as much as x pixels can be channel out [7].

3.7 HAAR FACE CLASSIFIER

The Haar face classifier is a capacity that uses Haar-like highlights for recognizing the face [14]. Haar-Face classifier utilized the histogram balanced picture for recognizing the appearances in the photo (see fig. 7).

3.8 HAAR EYE CLASSIFIER

The Haar eye classifier is a function that uses Haar-like highlights for distinguishing the eye. The classifier uses constructed in guidelines for distinguishing the eye and begins following it the length of it stays inside the scope of the cam [13] [14]:

After a face was distinguished utilizing the Haar-Face classifier, the picture was then gone through another classifier to perceive the eye (see fig. 8).

3.9 REGION OF INTEREST (ROI)

Locale of Interest is a rectangular range in a photo, to part question for further changing. In the wake of identifying the face and eye by the Haar classifier the ROI is then connected keeping in mind the end goal to get the inside of the eye [8] [19].

3.10 Object Tracking

Article following is done consequently in the wake of distinguishing the item the length of it stays inside scope of the cam. The position of the pixels in the past casing is spared into an area in a cluster and indicated in a screen-sized white picture then contrasted with the current edge. This methodology is rehashed until the cam can no more distinguish the client [11] [6] [10].

3.11 KNN

K-closest neighbor calculation is a technique for grouping items taking into account nearest preparing samples in the element space. K-closest neighbor calculation is among the least difficult of all machine learning calculations. Typically the object is classified based on the labels of its k nearest neighbors by majority vote. In the event that $k=1$, the article is just named the class of the item closest to it. At the point when there are just two classes, k must be an odd integer [20] [22] (see fig. 9).

3.12 Actual Position Calculations

The point in which the middle of the eyes was identified is thought to be the real position of the eye for the initially recognized edge and is put away in a cluster in which the first

component is the directions of the current position. The X-direction of the fact of the matter is thought to be the X-position of the student while the Y-direction is thought to be the Y-position of the understudy [11] [15].

3.13 Screen Coordinates Determination

For every recognized position, the new position is to be contrasted and the past one put away in the cluster. On the off chance that any distinction happens, it's then subtracted from the past position, and then the distinction is scaled to the screen measurements and added to the past put away position to get the genuine mapping on the screen [19].

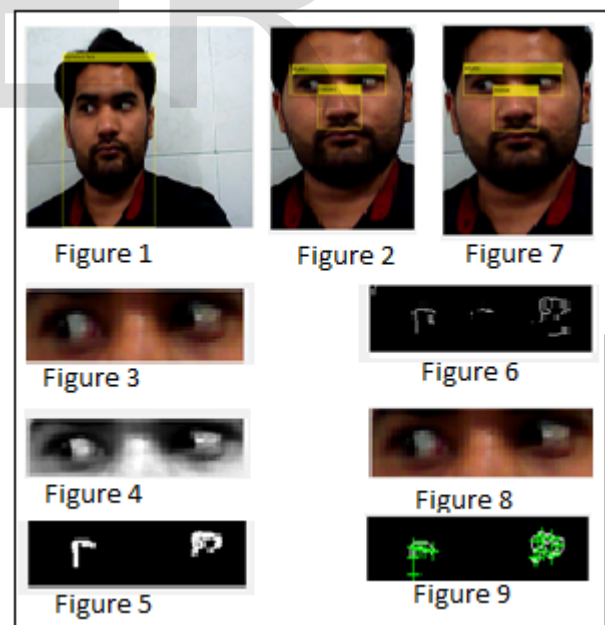
3.14 Scaling

Scaling is obliged to guide the distinguished position as per the screen measurements.

3.15 Cursor Movement

Cursor development is attained to utilizing the position got from the scaled point (scaled focus of the eye) decided in the ROI. In the figure beneath the key parts of the framework are barely clarified. It exhibits a strange state viewpoint of how the eyes are followed in the framework utilizing PC vision techniques.

3.15 Figures and Tables



4 RESULTS EVALUATION

- The framework had the capacity recognize and find the position of the eye's effectively and thus, consequently moving the cursor on the screen in the region of interest.
- The scaling of the coordinates to fit into the screen's dimensions was to be achieved by Storing the coordinates of the current detected position then for the future detected one the difference is calculated and then scaled to the screen dimensions.
- Another significant explanation behind the constrained exactness is that the following of the understudy position is in view of doing the recognition over and again.
- The framework lives up to expectations in a legitimate manner just if the client is sufficiently close (a large portion of a meter far from the screen) to the PC such that the iris of the eye is clear in the casing taken by the cam.

5 CONCLUSIONS

In this paper we generally depict some illustrative studies in the field of eye tracking, covering a few perspectives in regards to distinctive sorts of gadgets, calculations for understudy identifications, picture preparing or information sifting and likewise some no doubt understood applications in assistive innovation, human PC cooperation, virtual reality, brain research or e-learning. As a general inclination we can presume that later on eye tracking methodologies will be a hot subject for analysts.

6 REFERENCES

- [1] Tobii 1750 Eye-tracker, Tobii Technology AB, Stockholm, Sweden.
- [2] Yarbus A. L. Eye Movements and Vision. Plenum Press, New York, 1967.
- [3] Bernd Jähne and Horst Haußecker (2000). Computer Vision and Applications, A Guide for Students and Practitioners. Academic Press. ISBN 0-13-085198-1.
- [4] "Computer Vision Introduction," http://www.ecse.rpi.edu/Homepages/qji/CV/3dvision_intro.pdf, May 5, 2013.
- [5] "Haar-Like Features," http://en.wikipedia.org/wiki/Haar-like_features, June 23, 2013.
- [6] Paul Viola and Michael Jones, "Rapid Object Detection using a Boosted Cascade of Simple Features," in ACCEPTED CONFERENCE ON COMPUTER VISION AND PATTERN RECOGNITION, 2001.
- [7] Chow and C. Liu. Approximating discrete probability distributions with dependence trees. IEEE TIT, 1968.
- [8] D. Cristinacce and T. Cootes. Feature detection and tracking with constrained local models. In BMVC 2006.
- [9] N. Dalal and B. Triggs. Histograms of oriented gradients for human detection. In CVPR 2005.

- [10] P. Felzenszwalb, R. Girshick, D. McAllester, and D. Ramanan. Object detection with discriminatively trained partbased models. IEEE TPAMI, 2009.
- [11] P. F. Felzenszwalb and D. P. Huttenlocher. Pictorial structures for object recognition. IJCV, 2005.
- [12] R. Gross, I. Matthews, J. Cohn, T. Kanade, and S. Baker. Multi-pie. Image and Vision Computing, 2010.
- [13] Heisele, T. Serre, and T. Poggio. A Component-based Framework for Face Detection and Identification. IJCV, 2007.
- [14] M. Jones and P. Viola. Fast multi-view faces detection. In CVPR 2003.
- [15] P. Phillips, H. Moon, S. Rizvi, and P. Rauss. The feret evaluation methodology for face-recognition algorithms. IEEE TPAMI, 2000.
- [16] G.de Haan, "Video Processing for Multimedia Systems", Eindhoven, The Netherlands, 2000.
- [17] Y. Kim, L.-S Kim, and S.-H. Hwang, "An advanced contrast enhancement using partially overlapped sub-block histogram equalization", IEEE Trans. Circuits Syst. Video Technol, vol. 11, no. 4, pp. 475-484, Apr. 2001.
- [18] N.R.Mokhtar, Nor Hazlyna Harun, M.Y. Mashor, H.Roseline, Nazahaha Mustafa, R.Adollah, H. Adilah, N.F.Modh Nasir, "Image Enhancement Techniques Using Local, Global, Bright, Dark and Partial Contrast Stretching", Proceedings of the world Congress on Engineering 2009 vol. I, WCE 2209, July 1-3, 2009, London U.K.
- [19] Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing Using MATLAB".
- [20] Cover, T., Hart, P., Nearest-neighbor pattern classification, *Information Theory, IEEE Transactions on*, Jan. 1967, pp. 21-27.
- [21] <http://www.mathworks.com/discovery/image-thresholding.html>
- [22] Bremner D, Demaine E, Erickson J, Iacono J, Langerman S, Morin P, Toussaint G, Outputsensitive algorithms for computing nearestneighbor decision boundaries, *Discrete and Computational Geometry*, 2005, pp. 593-604.

7 ACKNOWLEDGMENT

First and foremost all praise to Allah. I would like to extend my greatest gratitude and deepest thanks to our supervisor Engr.Shoaib Rabbani for his endless support, understanding, patience and motivation. Many thanks to my parents for always being there for me.