

# Eye Movement Tracking for Angle Prediction: A Systematic Review

Lakshita<sup>1</sup> Prof. Dolley Shukla<sup>2</sup>

<sup>1,2</sup>Department of Information & Technology

<sup>1,2</sup>Shri Shankaracharya Group of Institution, Bhilai, Chhattisgarh, India

**Abstract**— The term Eye gaze communication refers to working computer framework by tracking the eye gaze of the human. Eye tracking is the way toward tracking the snapshot of eye and determining where the user is looking on the screen. Eye gaze innovation is hand free or voice free innovation i.e. without utilizing hand or voice we can work the computer. People with cerebral palsy, spinal cord injury, brain injury, brainstem stroke, muscular dystrophy and so forth can utilize this framework. This framework is additionally called as vision-controlled communication framework. In this kind of communication framework control keys are shown on the screen. By taking a gander at the control keys user can work computer, type, get to web, send email and so forth. The framework is valuable to improve the life of incapacitated individual. Right off the bat we are showing what in reality the eye gaze communication framework is and the key components. We are assessing the conduct of user when they are utilizing the eye gaze interfacing. Utilized distinctive strategies for eye tracking, for example, electro-oculography, scleral seek loop, infrared oculography, video oculography, and diverse methodologies i.e. highlight based approach and appearance based approach and so forth. We have tried to analyse surveys based on few parameters.

**Key words:** Eye Tracking, Eye Detection, Eye Gaze-Tracking

## I. INTRODUCTION

Normal computer user invest the vast majority of their energy taking a gander at the computer screen. Various scientist found that detection of eye gaze is productive for working the computer framework. For human computer cooperation characteristic user handles the computer framework or play out their day by day work with regular conduct. Be that as it may, the crippled individual can't play out their day by day work normally. So eye gaze communication framework encourages them carry on with their life freely. It is additionally called as hand free communication. Eye gaze communication depends on the eye gaze of the human. User can work this framework by looking at computer screen and the eye tracker gadget presume that where the user is looking. Eye tracking is the procedure of estimating either the purpose of gaze or the movement of the eye in respect to the head.

Eyes are ordinarily utilized for perception not for control. Eye moments are common and phenomenally quick. Course of the gaze verifiably show primary focus of consideration. Eye gaze attaching in eye gaze communication framework empowers the users through movement of eye to control a framework. There are number of techniques for estimating eye movement. The eye gaze framework is a communication control framework that you can keep running with your eyes. The eye gaze framework is a direct-select vision controlled communication and control framework. To work eye gaze communication framework user ought to have one eye with great vision and capacity to keep head genuinely steady. The fundamental point of the paper unmistakably

manages the different parts of eye gaze communication and unique approach, for example, electro-oculography, video oculography and so forth utilized for the eye gaze communication.

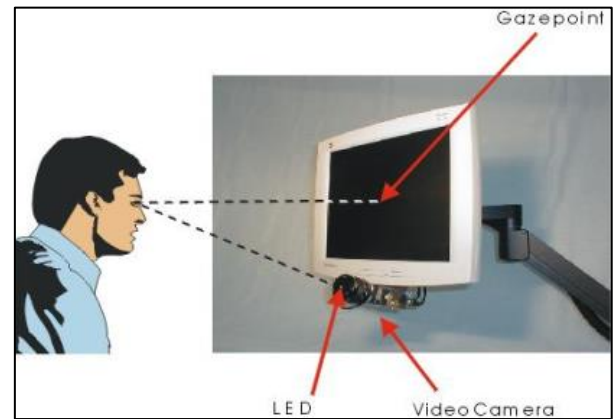


Fig. 1: Basic Concept of Eye Gaze Communication

### A. Electro-Oculography

In this technique, sensors are joined at the skin close to the eye to quantify an electric field exist when eyes turn. By recording the little contrasts in the skin potential around the eye, the situation of eye can calculated. By putting anodes painstakingly, it is conceivable to record even and vertical movements. This system isn't so proper for day by day life, since it require close contact of terminals. It is a shabby, simple and intrusive technique.

### B. Scleral Search Coils

In this technique, small coils of wire are installed in an altered contact focal point. At the point when a loop of wire moves in an attractive field, voltage is generated in curl. On the off chance that this curl is attached to the eye, at that point a flag of eye position will created. A coordinated mirror is settled in the focal point permits estimating of reflected light. An incorporated curl in a focal point permits recognizing the curl's introduction in attractive field. This focal points can be connected after nearby analgesics has been presented. It is profoundly exact strategy for eye tracking.

### C. Infrared Oculography

The infrared oculography measures the power of reflected infrared light. In this strategy, eye is lit up by the reflected infrared light. The contrast between the occurrence infrared light and reflected infrared light from the surface of eye conveys the data about the situation of eye. It can quantify eye movement in darkness.

### D. Video Oculography

In video oculography, to decide the movement of, eye single or different cameras are utilized by utilizing the data acquire from the images caught. Video oculography is generally utilize eye tracking system. Video oculography assembled into single-camera eye tracker and multi-camera eye tracker. Diverse methodologies utilized are included based gaze

estimation approach appearance based gaze estimation approach. The primary point of highlighted based gaze estimation is to recognize instructive nearby features of eye. In highlight based approach the attributes of human eye are investigated to recognize set of various element of eye like forms, eye corners and corneal reflection (most usually utilized element for gaze estimation). In appearance based strategy image contains are utilized to assess course of gaze by mapping image data to screen facilitates. Appearance based gaze estimation approach distinguish and track eyes specifically in view of photometric impact.

## II. LITERATURE SURVEY

Antoine Picot et al. [1], detection in light of visual signs that can be removed from the analysis of a high casing rate video is exhibited. An investigation of distinctive visual features on a steady database is proposed to assess their pertinence to recognize drowsiness by data-mining. At that point, an algorithm that consolidations the most pertinent blinking features (span, level of eye conclusion, frequency of the squints and abundancy speed proportion) utilizing fuzzy logic is proposed. This algorithm has been tried on a colossal dataset speaking to 60 hours of driving from 20 unique drivers. The principle advantage of this algorithm is that it is autonomous from the driver and it doesn't should be tuned. Besides, it gives great outcomes with over 80% of good detections of languid states.

Ali Bulent Usak et al. [2], the point of this paper is to introduce the outline and use of an electrooculogram (EOG) in view of a proficient human-computer interface (HCI). Setting up an option channel without talking and hand movements is imperative in expanding the personal satisfaction for the handicapped. EOG-based frameworks are more effective than electroencephalogram (EEG)-based frameworks now and again. By utilizing an acknowledged virtual console, it is conceivable to advice in composing the requirements of the patient in a moderately brief time. Considering the bio potential estimation traps, the novel EOG-based HCI framework enables individuals to effectively speak with their condition by utilizing just eye movements. Grouping even and vertical EOG channel signals in a productive interface is acknowledged in this examination. The new framework is microcontroller based, with a typical mode dismissal proportion of 88 dB, an electronic clamor of 0.6  $\mu\text{V}$  (p-p), and a testing rate of 176 Hz. The closest neighborhood algorithm is utilized to characterize the signs, and the order execution is 95%. The novel EOG-based HCI framework enables individuals to effectively and financially speak with their condition by utilizing as it were eye movements.

Zhao Lv et al. [3], Bio-based human computer interface (HCI) has pulled in more consideration of inquires about everywhere throughout the world lately. In this paper, an EOG-based HCI framework is presented. It is made out of three sections: EOG intensifying and obtaining, EOG design acknowledgment and control summon yield. Three plane cathodes are utilized to identify the EOG signals, which contains the data identified with the eye blinking and vertical (or flat) eye movements alluded to pre-outlined summon table. An online flag handling algorithm is assigned to get the

charge data contained in EOG signals, and these orders could be utilized to control the computer or different instruments. In light of this HCI framework, the remote control tests driven by EOG are figured it out.

Feng Lu et al. [4], in this paper, author address the issue of free head movement in appearance-based gaze estimation. This issue stays testing since head movement changes eye appearance fundamentally, and along these lines preparing images caught for a unique head posture can't deal with test images caught for other head postures. To beat this trouble, we propose a novel gaze estimation technique that handles free head movement by means of eye image blend in view of a single camera. Contrasted with regular settled head posture strategies with unique preparing images, our strategy as it were catches four extra eye images under four reference head stances, and afterward unequivocally orchestrates new preparing images for other inconspicuous head postures in estimation. To this end, we propose a single-directional (SD) stream model to proficiently deal with eye image varieties because of head movement. We demonstrate to evaluate SD streams for reference head postures to start with, and afterward utilize them to deliver new SD streams for preparing image amalgamation. At last, with engineered preparing images, joint advancement is connected that at the same time comprehends eye image arrangement and gaze estimation. Assessment of the strategy was led through tests to survey its execution and show its viability.

Matej Cerny et al. [5], this article manages at present utilized gaze tracking frameworks, their order also, application potential outcomes. Additionally are introduced chosen gaze tracking frameworks reasonable for human-computer interface. At long last are proposed upgrades of these frameworks in light of analysis of their feeble and quality focuses.

Cheng-Lung Jen et al. [6], this paper proposes another wearable eye-gaze tracking framework with a single webcam mounted on the glasses. To start with, the locale of intrigue (ROI) of eye is extricated by skin detection and eyelid evacuating. At that point Hough circle detection is used to look through the competitor of circles in the eye's ROI and connected to decide the status of opening or shutting of eye. In view of the circle detection, the eye focus and sweep are identified by utilizing slightest square based starburst algorithm. To upgrade the heartiness of eye focus estimation, we utilize molecule channel to manage the aggravation of eye focus position incited by various lighting condition and clamor. Moreover, the gaze position on the screen is anticipated polynomial insertion. The exploratory outcomes checked the precision and viability of the proposed framework.

Yiu-ming Cheung et al. [7], This paper tends to the eye gaze tracking issue utilizing an ease and more advantageous web camera in a work area condition, instead of gaze tracking methods requiring particular equipment, e.g., infrared high-determination camera and infrared light sources, and in addition an awkward adjustment process. In the proposed technique, author first track the human face in an ongoing video grouping to separate the eye districts. At that point, author join force vitality and edge quality to acquire the iris focus and use the piecewise eye corner locator to distinguish the eye corner. Author receive a sinusoidal

make a beeline for reenact the 3-D head shape, and propose a versatile weighted facial features installed in the stance from the orthography and scaling with cycles algorithm, whereby the head posture can be assessed. At long last, the eye gaze tracking is achieved by joining of the eye vector and the head movement data. Investigations are performed to assess the eye movement and head posture on the BioID dataset and posture dataset, separately. Likewise, tests for gaze tracking are performed progressively video arrangements under a work area condition. The proposed strategy isn't touchy to the light conditions. Trial comes about demonstrate that our technique accomplishes a normal exactness of around 1.28° without head movement and 2.27° with minor movement of the head.

Sajjad Samiee et al. [8], this examination proposes a drowsiness detection approach in light of the mix of a few distinctive detection techniques, with vigor to the information flag misfortune. Subsequently, on the off chance that one of the strategies comes up short for any reason, the entire framework keeps on working legitimately. To pick rectify blend of the accessible techniques and to use the advantages of strategies for distinctive classifications, an image preparing based procedure and a strategy in view of driver-vehicle association is utilized. Keeping in mind the end goal to abstain from driving diversion, any utilization of a meddlesome technique is forestalled. A driving test system is utilized to accumulate genuine data and after that manufactured neural systems are utilized as a part of the structure of the composed framework. A few tests were led on twelve volunteers while their resting circumstances amid one day before the tests, were completely under control. In spite of the fact that the effect of the proposed framework on the change of the detection exactness isn't amazing, the outcomes demonstrate the principle points of interest of the framework are the unwavering quality of the detections and

strength to the loss of the information signals. The high unwavering quality of the drowsiness detection frameworks assumes an essential part to diminish drowsiness related street mischances and their related expenses.

Sushil Chandra et al. [9], With the advancement of Eye Tracking from an idea to reality, it is being investigated experimentally nowadays in Human Computer Interaction with a specific end goal to record the eye movements to decide the gaze course, position of a user on the screen at a given time and the arrangement of their movement. The triple goal of this paper incorporate acquainting the per user with the key perspectives and issues of eye-movement innovation, useful direction for building up an Eye tracking application, and different openings and basic difficulties to create (Man and Machine Interfacing) MAMI frameworks utilizing Eye tracking. Author have remarkably incorporated The Eye Tribe with Unity5.1.1 and through an examination, we have additionally surmised that a subject with what's more, without bifocal glasses indicate moderately comparable obsession comes about on the off chance that they have adjust vision yet the outcomes vary with little mistake in the event that the eye is remedied utilizing focal points. Another investigation utilizing Eye Clan demonstrates that gaze input requires less time when contrasted with the mouse input.

Giancarlo Iannizzotto et al. [10], Reliable detection and tracking of eyes is a vital prerequisite for mindful UIs. In this paper, author exhibit an imaginative way to deal with the issue of eye tracking. A number of conventional eye finders, decided for their own properties, are joined by two distinctive aggressive plans with intend to get a higher level of strength and unwavering quality. To outline our work and approve our aggressive mix approach, Author present a proof-of-idea single-camera remote eye tracker and talk about its execution and the created test comes about.

Author	Dataset Used	Method	Finding	Advantage	Disadvantage
Antoine Picot et al. [1]	60 hours of driving from 20 different drivers	Fuzzy logic	An algorithm that merges the most relevant blinking features (duration, percentage of eye closure, frequency of the blinks and amplitude-velocity ratio) using fuzzy logic is proposed.	It provides good results with more than 80% of good detections of drowsy states	Need to achieve an acquisition campaign of drowsy data with a high frame rate camera so as to validate the whole method proposed on video data.
Ali Bulent Usak et al. [2]	251 samples of eye movement images	Nearest neighborhood algorithm	Aim of this paper is to present the design and application of an electrooculogram (EOG) based on an efficient human-computer interface (HCI). Establishing an alternative channel without speaking and hand movements is important in increasing the quality of life for the handicapped.	Nearest neighborhood algorithm is used to classify the signals, and the classification performance is 95%.	Need to improve the quality of the graphic interface for better and quick selections of the menu options.

Zhao Lv et al. [3]	EOG signals	Online signal processing algorithm	An online signal processing algorithm is designated to get the command information contained in EOG signals, and these commands could be used to control the computer or other instruments.	Based on this HCI system, the remote control experiments driven by EOG are realized.	Need to generate different commands to execute.
Feng Lu et al. [4]	Eye images	Single-directional (SD) flow model	Propose a novel method to allow head motion in appearance-based gaze estimation. We introduce a SD flow model to handle eye appearance variation effectively and perform accurate synthesis.	The method was conducted through experiments to assess its performance and demonstrate its effectiveness	Consider a user-screen distance of around 60 [cm] which is insufficient
Matej Cerny et al. [5]	Eye Image	Ellipse fitting algorithm	This article deals with currently used gaze tracking systems, their classification and application possibilities. Further are presented selected gaze tracking systems suitable for human-computer interface.	Proposed improvements of these systems based on analysis of their weak and strength points.	Improvements can be done by using multilayer neural networks for eye or face position estimation.
Cheng-Lung Jen et al. [6]	Eye Image	Starburst algorithm	Proposes a new wearable eye-gaze tracking system with a single webcam mounted on the glasses. First, the region of interest (ROI) of eye is extracted by skin detection and eyelid removing.	The experimental results verified the accuracy and effectiveness of the proposed system.	Need to take more eye samples.
Yiu-ming Cheung et al. [7]	Video frames	AWPOSIT algorithm	This paper addresses the eye gaze tracking problem using a low cost and more convenient web camera in a desktop environment, as opposed to gaze tracking techniques requiring specific hardware, e.g., infrared high-resolution camera and infrared light sources, as well as a cumbersome calibration process	The experimental results have shown the efficacy of the proposed method.	Need improvement in the estimation of the head pose
Sajjad Samiee et al. [8]	Eye image	Back propagation learning algorithm	The proposed system on the improvement of the detection accuracy is not remarkable, the results indicate the main advantages of the system are the reliability of the detections and robustness to the loss of the input signals.	The high reliability of the drowsiness detection systems plays an important role to reduce drowsiness related road accidents and their associated costs.	Need to use more accurate system as decision-making unit.



Sushil Chandra et al. [9]	Eye images	Computer-vision algorithms	Human computer interaction allows users to input information in a more natural way into their computers. Eye tracking can be used as a control medium, like moving the Cursor and clicking on icons on the screen, as well as creating adaptive user interfaces, where the computer reacts to the eye gaze of the user and create an interactive environment.	Experiment using Eye Tribe shows that gaze input requires less time as compared to the mouse input.	Need to use Eye tracking to analyze visual movement
Giancarlo Iannizzotto et al. [10]	Eye image	Expectation maximization (EM) algorithm	Present an innovative approach to the problem of eye tracking. A number of traditional eye detectors, chosen for their own properties, are combined by two different competitive schemes with the aim to obtain a higher degree of robustness and reliability.	Results showed significant improvements both with respect to the use of single detectors and to the use of some well-known simple fusion and merging approaches.	Proposed approach is not constrained to the specific application to eye tracking

Table 1: Comparisons of Various Techniques & Method Used in Present System

### III. CONCLUSION

From the research of different paper, to conclude that using eye gaze as directing apparatus toward work framework is exceptionally helpful. This paper contend that it is achievable to utilize eye gaze of computer user inside interface to help management of application. As eye tracking framework enhance in quality and precision and decrease in esteem, it will snatch consideration of the user. Human eye movement is a mix a few willful and automatic psychological process therefore eye movement should utilize carefully.

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