Gaze Tracking

Nityam Dixit
Btech Computer Science
AU2040140
nityam.d@ahduni.edu.in

Devyash Shah
Btech Computer Science
AU2040152
devyash.s@ahduni.edu.in

Kavan Gondalia
Btech Computer Science
AU2040030
kavan.g@ahduni.edu.in

Kush Patel
Btech Computer Science
AU2040137
kush.p3@ahduni.edu.in

***Abstract*—The eye-tracking technology has shown continuous increase in its usage in mobile and its potential applications in various fields. The use of pervasive eye tracking can provide valuable information for a range of applications, such as life logging, user authentication, and mobile communication. We mention the two main types of eye-tracking technology, corneal reflection and pupil tracking, and provide examples of popular open-source eye-tracking libraries, such as WebGazer that utilize machine learning to estimate gaze location.**

***Index Terms*—Eye tracking, corneal reflection, pupil tracking, WebGazer, gaze tracking.**

I. Introduction

Eye tracking technology has evolved significantly in recent years, with attention shifting towards eye-based interaction in mobile and pervasive settings. Gaze behavior is a key indicator of human attention and provides rich information for understanding interactions with real-world environments. Pervasive eye tracking enables continuous monitoring and analysis of eye movements, offering potential applications in fields such as life logging, display interactions, user authentication, and mobile communication. This new paradigm of eye tracking requires an interdisciplinary approach at the intersection of ubiquitous computing, eye-tracking research, ego-centric vision, cognitive psychology, and design to address the implications and challenges of mobile eye-based interaction.

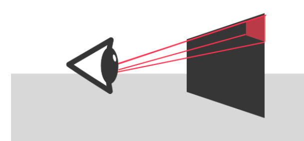
II. Literature Survey

According to Theory, Practice, and Standardization of Eye-tracking Technology (2018), there are two main types of eye-tracking technology: corneal reflection and pupil tracking. The former uses a camera and light source to track the reflection of light on the cornea, while the latter uses a camera to track the movement of the pupil. The latter method is the one you are using in your gaze tracker.

WebGazer is a popular open-source eye-tracking library that utilises machine learning to estimate a user's gaze location on a webpage (Papoutsaki et al., 2016). According to the LearnOpenCV video on Gaze Tracking and Estimation (2021), this library uses a simple algorithm to track the user's gaze by measuring the distance between the pupil and the eye corners. This can be useful for a variety of applications, including website design and marketing research.

III. Implementation

Corneal reflections do not affect the method for recognising pupils in IR-lighted eye-camera pictures. The following is our standard pupil detection algorithm: The eye camera picture is first converted to grayscale. Followed by applying a blur filter, and then the starting area of the pupil is approximated using the most vital response centre-surround characteristic. After getting an image by the threshold, use a method to fit an ellipse.
By performing multiple calibrations, we can get a transformation matrix, which can be helpful in mapping our eye movements to the real-world coordinate system.



IV. Results

Fitting an ellipse to the pupil movements can help to improve the accuracy of the gaze estimation by accounting for the non-circular shape of the pupil and any distortions caused by the camera or other factors. We can easily detect the pupil from the eye with approx 7-8 fps (The camera itself has a low, 10, fps). It requires very low computational power. It can be improved with a better camera system.

V. Conclusion

To sum up, eye tracking technology has come a long way in recent years and has found many applications in mobile and pervasive settings. The ability to monitor and analyze eye movements continuously has opened up many possibilities for research and development. Pupil tracking is a popular method used in eye-tracking technology, and this article discussed an algorithm for detecting pupils in IR-lighted eye-camera pictures. By fitting an ellipse to the pupil movements, the accuracy of gaze estimation can be improved, and multiple calibrations are done to map eye movements to the real-world coordinate system. As this technology becomes more common, there is a need for interdisciplinary approaches to address the challenges and implications of mobile eye-based interaction.

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