IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 3, March 2024

DOI: 10.17148/IARJSET.2024.11325

Eye-Ball Movement Based Cursor Control System Using Deep Learning

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Abstract: Individual Human Machine Interference (HMI) systems are available now to provide improved human-computer communication. People used to use keyboards and mice as input devices back in the day. Individuals experiencing locomotor difficulties are unable to operate computers. For those who are disabled or handicapped, the concept of operating computers with the eyes will be quite helpful. Additionally, having this kind of control will do away with the need for additional assistance from someone to operate the computer. The pupil's center is intimately related to the movement of the cursor. Finding the center of the eye would therefore be our first task. OpenCV and Eye-Tracking are used to carry out this pupil detection technique.

Keywords: eye-ball movement curve, eye-tracking algorithm, deep learning, and webcam.

I. INTRODUCTION

Not everyone can use the user interfaces on our laptops and computers right now. When using these technologies, people with disabilities frequently run across problems, which forces them to ask for assistance from others. Our proposal is a hand-free human-machine interaction (HMI) system that enables users to operate the mouse cursor with only their eye movements, thereby bridging the accessibility gap and empowering those with diverse disabilities.

Furthermore, this technique is advantageous to all users, but it is particularly helpful to individuals with loco-motor difficulties and long mouse sessions, as prolonged mouse use can cause inflammation and wrist strain.

II. BACKGROUND & RELATED WORKS

Deep learning-based eye movement-based cursor control systems have drawn a lot of interest recently because of its potential uses in assistive technology and human-computer interaction. Here is a quick synopsis of the relevant literature and background in this area:

- Context: - Conventional techniques for controlling cursors depend on tangible input devices like touchpads or mice, which may not be available to people with motor disabilities.

- Cursor control systems that rely on eye movements to operate the pointer are designed to give a broader range of users an alternate way to move the cursor.

- The effective detection and interpretation of eye movements for cursor control has been demonstrated by deep learning approaches, specifically convolutional neural networks (CNNs) and recurrent neural networks (RNNs).

Related Works:

- Deep Eye: MIT researchers have suggested Deep Eye, an eye tracking system based on deep learning. It follows the movements of the eyes and manipulates the mouse on a computer screen using a convolutional neural network (CNN). The device can identify eye movements with great precision and lets users interact with the computer only by looking at it.

- Another eye-tracking device that uses deep learning methods to control the cursor is called Eye Gesture. Eye Gesture is a technology developed by a group of academics at Stanford University that translates unique eye movements into cursor actions by combining convolutional and recurrent neural networks. Over time, the system can adjust to the distinct eye movements of each individual user.

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• Assistive Technologies: To improve accessibility for people with disabilities, assistive technologies have incorporated deep learning-based eye tracking systems in addition to cursor control. These technologies give users the ability to communicate, interact with digital devices, and navigate user interfaces with just their gaze, allowing them to participate more completely in a variety of activities.

III. LITERATURE SURVEY

The G. Norris and E. Wilson system focuses on eye movement using electroencephalograms (EEGs). It is configured with an instrumentation amplifier and an inverting op amp. The EEG is attached to the system's designated locations on the head, and the system is worn on the wearer. The EYE Mouse records the change in EOG from gazing up, down, right, and left since there is a fluctuation in potential that is recorded in accordance with the eye movement. This then has the ability The EEG system is utilized with the eye mouse in Bullying, J. A. Ward's suggested system, which simulates brain activity and maps the cursor movement to the EEG system.

Using a microprocessor to record real-time video, V. Khare et al.'s planned work focuses on tracking eye movements. Use of a webcam to record live video that has been divided up into frames is part of the experiment. A specified threshold is set for a specific eye movement, and the cursor moves in sync with the eye movement by comparing it to the threshold.

The Iris detecting system's MATLAB operation is the subject of a publication by Mohamed Nasor et al. Firstly, a webcam is used to detect the face. Next, the iris is extracted and detected using the MATLAB library, which allows for eye tracking. Next, the iris shift is calculated. The shift is then mapped using a graphical user interface, which allows the mouse cursor to move in accordance with the detected eye.

In their conceptual work, S. Mathew et al. offer a method for impaired individuals to operate household equipment. To further follow a basic circuitry, the method here uses an eye tracking mechanism for individual eye movement. This is a nontraining based algorithm that uses image processing for all its functions. HOG is used to find the image's histogram, and SVM is added to allow for face detection and cropping of the iris portion. Targeted points in the eye are then used to map cursor movements.

In a paper by S. R. Fahim et al., the use of the HOG system and motion vector with Python programming and the training-based algorithm HaarCascade is discussed. This algorithm is primarily used with machine learning programming. Multiple eye datasets are provided in the paper, and after the eye data is collected, the system responds to the eye movement and clicks using the eye blinking.

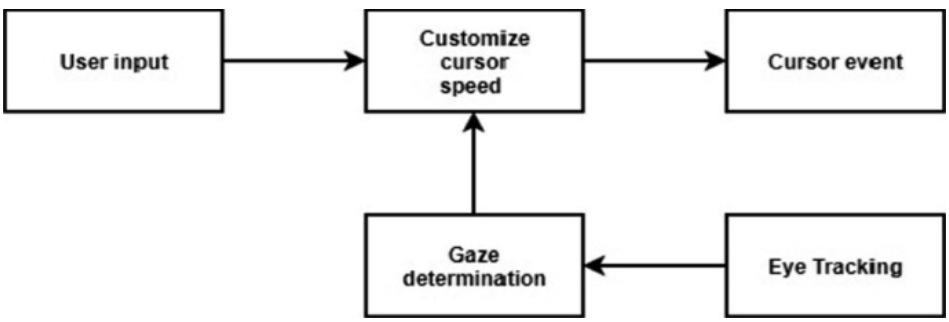
IV. METHODOLOGY

THE PROPOSED SYSTEM CAPTURES EYEBALL MOVEMENTS USING A SIMPLE WEBCAM. HERE ARE THE KEY STEPS:

• Eyeball Detection: After taking pictures with the laptop camera, face indexing is used to determine the user's eye locations.

• Deep Learning Approach: We make use of both deep learning and machine learning methodologies. Precise control over cursor movement is ensured by using an inbuilt dataset to classify individual eyes with high accuracy

• Noise Reduction: By applying filters, noise is eliminated, enabling precise and fluid cursor movement.



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V. RESULTS

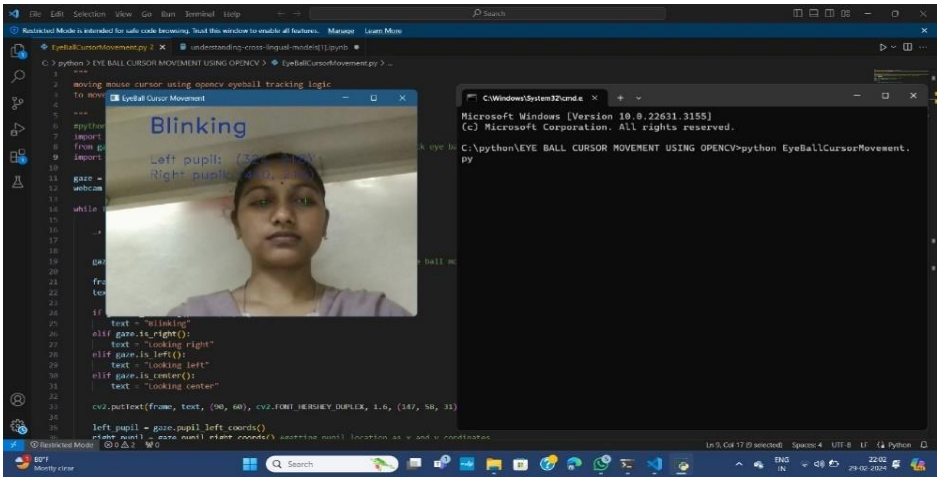

FIG- 1: Blinking

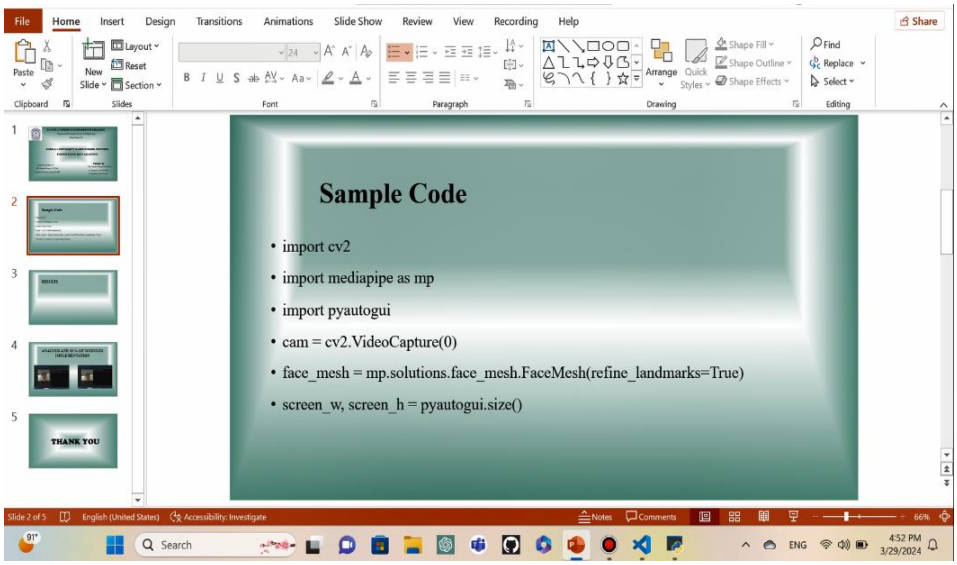

FIG-2: Blinking on Scroll Down Button

VI. CONCLUSION

A human-computer interface that allows people with disabilities to manipulate a computer's cursor using their eye movements has been successfully implemented by the pilot project. Accessibility of computers for people with disabilities has been greatly improved by the system's use of OpenCV. By helping impaired people interact with the digital world more successfully, the project's solution has the potential to significantly enhance their quality of life. Ultimately aiming to create an Information Society that is more inclusive and accessible, this effort closes the gap between technology and disability.

FUTURE SCOPE

Deep learning has the potential to revolutionize computer interaction, especially for those with special needs related to accessibility. It is possible to develop an eyeball movement-based cursor control system that uses blinking and icon closure while typing. This vision can only be realized and its societal impact can only be maximized by sustained research, development, and collaboration across diverse fields.

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BIOGRAPHY

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