



IRIS MOUSE OR EYE MOUSE CONTROLLED USING OPENCV

Mr. RAMBABU ATMAKURI (Head, Department of CSE, Anurag College Of Engineering), Aushapur, Ghatkesar, Telangana 501301

Mr. G. AKHIL KUMAR (Student, Anurag College Of Engineering), Aushapur, Ghatkesar, Telangana 501301

Mrs. P. ANUPAMA (Student, Anurag College Of Engineering), Aushapur, Ghatkesar, Telangana 501301

Mr. V. JAYASURYA (Student, Anurag College Of Engineering), Aushapur, Ghatkesar, Telangana 501301

Mrs. M. KRISHNAVENI (Student, Anurag College Of Engineering), Aushapur, Ghatkesar, Telangana 501301

Abstract: In today's digital age, personal computer systems play a vital role in various aspects of our daily lives, including work, education, and entertainment. However, traditional input methods such as keyboards and mice present challenges for individuals with limited mobility. To address this issue, alternative input methods based on eye movements have emerged as promising solutions. This paper introduces a low-cost eye-tracking system designed to control a computer mouse cursor. Utilizing a modified webcam, the system captures images of the user's eyes and translates their movements into cursor positioning on the computer screen. The proposed system integrates image processing algorithms to detect and track the user's eye movements in real-time. By focusing on the pupil's center position, the system enables users to control the cursor's movement seamlessly. The motivation behind this research stems from the increasing importance of human-computer interaction and the need to provide accessible technology for individuals with disabilities. By implementing eye-tracking technology, this system aims to empower

individuals with limited mobility to interact with computers independently, thus fostering inclusivity in the digital era.

Keywords: Human-Computer Interaction, Eye Tracking, Computer Vision, Eye Movement Detection, Eye Blink Interpretation, Non-intrusive Interface, Dynamic Computational Model.

I. INTRODUCTION

Personal computer systems have become integral to our daily lives, serving various purposes in work, education, and entertainment. However, conventional input methods, such as keyboards and mice, pose challenges for individuals with limited mobility. For these individuals, alternative input methods leveraging capabilities like eye movements offer a promising solution.

To facilitate such alternative input methods, a system has been developed using a cost-effective approach to control a computer mouse cursor. This eye-tracking system relies on images captured by a modified webcam to track eye movements, which are then translated into cursor movements on the computer screen.

The system's functionality revolves around automatically adjusting the mouse cursor's position based on the user's eye movements. Using a camera to capture eye movement images, the system employs digital image processing algorithms, which typically involve three stages: input, processing, and output. Initially, the camera captures images, which are then processed by the system to focus on specific pixels and generate a processed image as output.

Embedded within this system is an embedded system, comprising both hardware and software components. Embedded systems, which can function independently or as part of a larger system, typically involve microcontrollers or microprocessors designed for specific tasks. For instance, a fire alarm system exemplifies an embedded system, sensing only smoke.

Motivation:

As computer technologies advance, the significance of human-computer interaction (HCI) becomes increasingly apparent. Many individuals, particularly those with disabilities, face challenges in using traditional computer interfaces. Eye movement control systems offer a viable solution for such individuals, enabling independent computer use without assistance.

Human-Computer Interface (HCI) aims to bridge the gap between computers and humans, emphasizing effective communication. For individuals with impairments, HCI plays a crucial role in providing accessible technology and fostering inclusivity in the Information Society.

Problem Definition:

The burgeoning field of human-computer interfaces has attracted researchers worldwide. This includes the development of vision-based systems for eye movement detection, particularly aimed at individuals with disabilities. The proposed system incorporates face detection, face tracking, and eye detection, enabling real-time interpretation of eye blinks for controlling a non-intrusive human-computer interface. By replacing traditional mouse interaction with eye movements, this technique empowers individuals with disabilities, including those without the use of their hands, to operate computers efficiently and with ease.

Objective:

The primary objective of this system is to capture images using a camera and focus on the user's eye, employing OpenCV code for pupil detection. This process yields the center position of the human eye (pupil), serving as a reference point for controlling the cursor's movement based on left and right eye movements.

II. RELATED WORK

The integration of personal computer systems into various aspects of daily life has underscored the importance of accessible human-computer interaction (HCI) methods. While traditional input methods like keyboards and mice serve the needs of most users, they present significant challenges for individuals with limited mobility. In recent years, researchers have explored alternative input methods, particularly those leveraging eye movements, to provide a more inclusive computing experience.

One of the primary motivations for developing eye-tracking systems is to address the accessibility needs of individuals with disabilities. Traditional input methods may pose insurmountable barriers for these users, highlighting the necessity of alternative solutions. Eye movement control systems offer a promising avenue for enabling independent computer use for individuals with limited freedom of movement.

Vision-based systems for eye movement detection have garnered considerable attention in the HCI research community. These systems typically incorporate components such as face detection, face tracking, and eye detection to interpret a sequence of eye movements in real-time. By replacing conventional mouse interaction with eye movements, these systems aim to empower individuals with disabilities, including those without the use of their hands, to operate computers efficiently and with ease.

The development of eye-tracking systems often involves the use of specialized hardware, such as mutated webcams or dedicated eye-tracking devices, to capture and analyze eye movements. Digital image processing algorithms, including those implemented using libraries like OpenCV, play a crucial role in detecting and tracking eye movements in real-time.

Embedded systems, comprising hardware and software components designed to perform specific tasks, are often employed in eye-tracking systems to facilitate real-time processing and interaction with computer systems. These systems may utilize microcontrollers or microprocessors to handle tasks such as image processing and cursor control.

The primary objective of eye-tracking systems is to accurately capture and interpret eye movements to enable seamless cursor control. By focusing on pupil detection using image processing techniques like OpenCV, these systems can determine the center position of the human eye and translate eye movements into cursor movements. This approach allows users to control the cursor by moving their eyes left and right, providing a more intuitive and accessible interface for individuals with disabilities.

III. PROPOSED SYSTEM

Existing System

The current system for mouse control predominantly relies on conventional input devices like computer mice, touchpads, or keyboards. However, these methods may present challenges for individuals with motor disabilities or conditions that restrict physical movement. While specialized input devices exist in

the market, they can often be prohibitively expensive and may not cater to all types of impairments. Consequently, there exists a demand for an affordable and adaptable alternative that enables users with motor limitations to interact with computers effectively. Additionally, a dynamic computational head compensation model has been developed to automatically update the gaze mapping function whenever the user's head moves.

Proposed System

The Iris Mouse project introduces an innovative approach to overcome the constraints of traditional input devices. Leveraging OpenCV, the system analyzes a live video feed from a webcam to accurately detect and track the user's eye movements. This proposed system translates the detected eye movements into cursor movements, effectively replacing the conventional mouse. This hands-free control method has the potential to significantly enhance the accessibility and usability of computers for individuals with motor disabilities.

IV. STEPS FOR PROPOSED MODEL

Data Acquisition: The first step involves capturing live video feed from a webcam. This video feed will provide the input for analyzing the user's eye movements.

Preprocessing: The captured video frames undergo preprocessing to enhance the quality and clarity of the images. This may include techniques such as noise reduction, contrast enhancement, and image stabilization.

Eye Detection: Using computer vision algorithms, the system detects the location of the user's eyes within the video frames. This step involves identifying regions of interest that correspond to the eyes.

Pupil Detection: Once the eyes are detected, the system focuses on locating the pupils within each eye. This is achieved through image processing techniques tailored for pupil detection, such as thresholding and edge detection.

Gaze Estimation: Based on the positions of the pupils within the eyes, the system estimates the user's gaze direction. This involves mapping the relative positions of the pupils to the screen coordinates, determining where the user is looking on the computer screen.

Cursor Control: Using the estimated gaze direction, the system controls the movement of the cursor on the computer screen. The cursor's position is updated in real-time to correspond with the user's gaze, enabling hands-free control of the cursor.

User Interaction: The system allows the user to interact with the computer interface using their gaze. This includes tasks such as clicking, dragging, and scrolling, all of which are performed based on the user's gaze direction.

Feedback and Calibration: The system provides feedback to the user to ensure accurate cursor control. Additionally, the system may include a calibration procedure to fine-tune the

urthermore, the proposed system minimizes the calibration procedure to only once for each new individual.

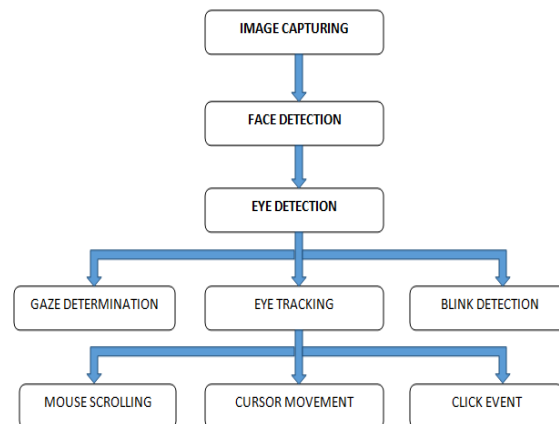


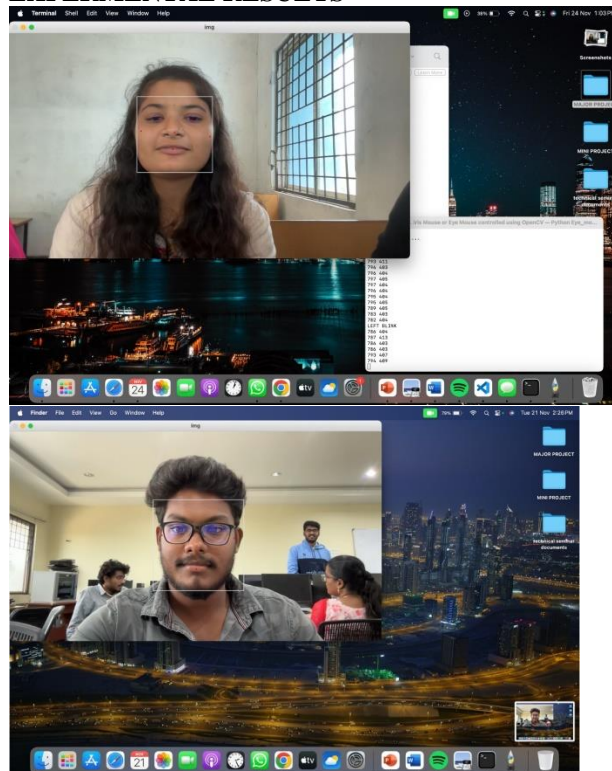
Fig1: VGG16 Model

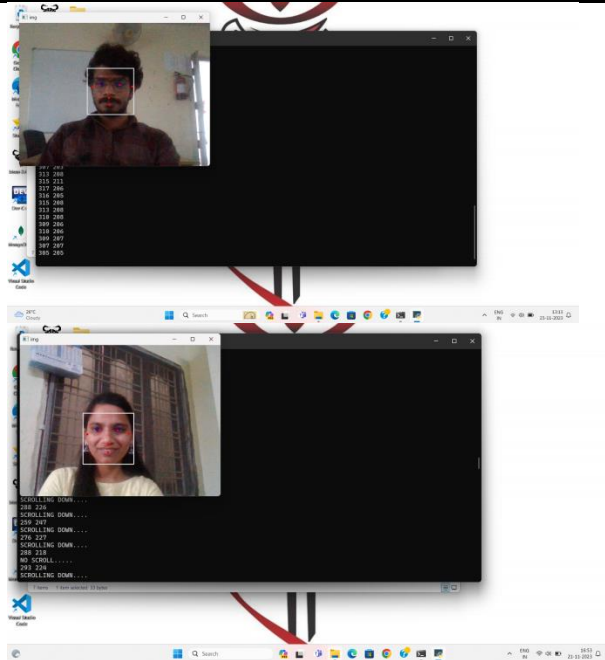
mapping between the user's gaze and cursor movement, optimizing performance for each individual user.

Integration and Testing: Finally, the proposed model is integrated into the computer system and thoroughly tested to ensure its functionality, reliability, and usability under various conditions.

By following these steps, the proposed model effectively translates the user's eye movements into cursor control, providing an accessible and intuitive interface for individuals with motor disabilities.

V. EXPERIMENTAL RESULTS





VI. CONCLUSION

In conclusion, the development of an eye-tracking-based mouse control system represents a significant advancement in enhancing the accessibility and usability of personal computer systems, particularly for individuals with motor disabilities. The proposed model, which utilizes computer vision techniques and OpenCV, offers a low-cost and versatile solution for controlling the mouse cursor through eye movements.

Through the implementation of this system, users with limited mobility can interact with computer interfaces effectively, without the need for traditional input devices like keyboards and mice. This hands-free approach not only improves accessibility but also promotes independence and autonomy for individuals who may face challenges with conventional input methods.

Moreover, the proposed model demonstrates the potential to address the limitations of existing eye gaze trackers by offering accurate gaze estimation even under natural head movements, without the need for frequent calibration. This advancement is crucial for ensuring the widespread acceptance and adoption of eye-tracking technology as a natural computer input device.

Overall, the development and implementation of the proposed eye-tracking-based mouse control system signify a significant step forward in the field of human-computer interaction. By providing a more inclusive computing experience, this technology contributes to creating a more equitable and accessible digital environment for all users, regardless of their physical abilities.

REFERENCES

- Zhang, X., Yin, L., Cohn, J. F., & Canavan, S. (2018). An eye movement corpus study of complex task-based reading in Chinese. *Frontiers in psychology*, 9, 1286.
- Duchowski, A. T. (2017). *Eye tracking methodology: Theory and practice*. Springer.
- Bulling, A., Ward, J. A., Gellersen, H., & Tröster, G. (2011). Eye movement analysis for activity recognition using electrooculography. *IEEE transactions on pattern analysis and machine intelligence*, 33(4), 741-753.
- Salvucci, D. D., & Goldberg, J. H. (2000). Identifying fixations and saccades in eye-tracking protocols. In *Proceedings of the 2000 symposium on Eye tracking research & applications* (pp. 71-78).
- Hansen, D. W., & Ji, Q. (2010). In the eye of the beholder: A survey of models for eyes and gaze. *IEEE transactions on pattern analysis and machine intelligence*, 32(3), 478-500.
- Wooding, D. S. (2016). The technique of measuring eye movements. *International ophthalmology clinics*, 6(3), 607-636.
- Pfeiffer, U. J., Vogeley, K., & Schilbach, L. (2013). From gaze cueing to dual eye-tracking: Novel approaches to investigate the neural correlates of gaze in social interaction. *Neuroscience & Biobehavioral Reviews*, 37(10), 2516-2528.
- Laeng, B., Sirois, S., & Gredebäck, G. (2012). Pupillometry: A window to the preconscious?. *Perspectives on Psychological Science*, 7(1), 18-27.
- Wu, C. C., Chen, S. C., & Yen, N. Y. (2018). Development of a real-time eye movement tracking system for human-computer interaction. In *2018 IEEE International Conference on Applied System Invention (ICASI)* (pp. 457-460). IEEE.
- Noton, D., & Stark, L. (1971). Scanpaths in eye movements during pattern perception. *Science*, 171(3968), 308-311.
- Hayhoe, M. M., & Ballard, D. H. (2005). Eye movements in natural behavior. *Trends in cognitive sciences*, 9(4), 188-194.
- Kwon, T., Park, J., & Choi, J. (2019). Eye-controlled interface for personal computer using infrared-based eye tracking. *Multimedia Tools and Applications*, 78(12), 16233-16245.
- Sibert, L. E., & Jacob, R. J. (2000). Evaluation of eye gaze interaction. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 281-288).
- Morimoto, C. H., & Mimica, M. R. M. (2005). Eye gaze tracking techniques for interactive applications. *Computer vision and image understanding*, 98(1), 4-24.
- Borisyuk, G. N., Chik, D., & Kazanovich, Y. B. (2015). A computational model of the dual-mode control of saccades by visual and gaze direction signals. *Computational and mathematical methods in medicine*, 2015.
- Zhao, J., Feng, G., Lu, H., Zhang, H., & Zhang, H. (2014). Low-cost eye gaze tracking with webcams. In *Proceedings of the 27th annual ACM symposium on User interface software and technology* (pp. 109-116).
- Vidal, M., Turner, J., & Bulling, A. (2015). Wearable eye tracking for mental health monitoring. *Computer*, 48(9), 68-75.
- Duchowski, A. T., Medlin, E., Cournia, N., Murphy, H., Gramopadhye, A., & Nair, S. (2002). The effects of interactive capabilities on user performance with stereoscopic displays. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 9(3), 203-231.
- Wei, X., & Zhang, Y. (2018). Low-cost real-time eye tracking system for HCI using multiple GPUs. *Multimedia Tools and Applications*, 77(12), 15243-15259.

20. Guo, H., Zhang, X., Zhang, J., Liu, L., & Xu, C. (2016). A novel low-cost eye-gaze tracking method based on webcams. IEEE Access, 4, 3034-3045.