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EYE CONTROLLED VIRTUAL MOUSE

K.Sanjeevaiah[1], B.Monika Lakshmi[2], B.Rohini[3], D.Swetha[4] , T.Praveen[5]
[1]Associate Professor, Department of CSE, HITAM, T.S
[2]B. Tech Student, Department of CSE, HITAM, T.S
[3]B. Tech Student, Department of CSE, HITAM, T.S
[4] B. Tech Student, Department of CSE, HITAM, T.S
[5] B. Tech Student, Department of CSE, HITAM, T.S

***Abstract*—** In recent years, the development of assistive technologies has significantly enhanced the quality of life for individuals with physical disabilities. One such innovation is the eye controlled virtual mouse, a system designed to enable hands-free computer interaction using eye-tracking technology. This paper presents a comprehensive overview of the design, implementation, and performance of an eye-controlled virtual mouse. The system leverages advanced eye-tracking hardware to capture and interpret eye movements, translating them into cursor movements and click commands on a computer screen. Key features include calibration routines to accommodate individual differences in eye movement, algorithms for precise gaze estimation, and user-friendly software interfaces that ensure accessibility and ease of use. Our evaluation, conducted with a diverse group of participants, demonstrates the system's high accuracy and responsiveness, making it a viable alternative for users with limited motor abilities. This innovation not only broadens the scope of assistive technology but also paves the way for further advancements in human-computer interaction.

Keywords—**Eye-tracking , Gaze tracking , Virtual mouse , Human-computer interaction (HCI) , Gaze-based interaction**

INTRODUCTION

The evolution of human-computer interaction has paved the way for the development of innovative technologies aimed at enhancing accessibility and usability for all users, particularly those with physical disabilities. The eye-controlled virtual mouse represents a significant advancement in assistive technology, allowing users to control a computer using only their eye movements. This introduction outlines the motivation behind the development of an eye-controlled virtual mouse, the key components of the system, and its potential impact on users.

Motivation

Individuals with severe physical disabilities often face substantial barriers when interacting with traditional computer interfaces. Conventional input devices like keyboards and mice require fine motor skills, which may not be feasible for all users. Eye-tracking technology offers a handsfree alternative, enabling these individuals to regain independence and access digital resources with greater ease. The development of an eyecontrolled virtual mouse is driven by the need to create inclusive and adaptable computer interfaces that cater to a wider range of abilities.

Eye-Tracking

Technology Eye-tracking technology forms the cornerstone of the eye-controlled virtual mouse system. It involves the use of specialized hardware to detect and record eye movements and software algorithms to interpret these movements as cursor actions on a computer screen. This section delves into the technical aspects of eye-tracking technology, including: Hardware Components: Cameras, infrared sensors, and other equipment used to capture eye movements. Software Algorithms: Methods for processing eye movement data and translating it into cursor movements. Calibration Techniques: Procedures to ensure accuracy and reliability in eye-tracking across different users.

System Design

The design of an eye-controlled virtual mouse involves integrating eye tracking technology with user interface elements to create a seamless and intuitive experience. This section covers: User Interface Design: Approaches to designing user-friendly interfaces that accommodate eye control. Gaze Estimation: Techniques for accurately determining the user's point of gaze on the screen. Click Mechanisms: Methods for executing click commands using eye gestures or prolonged gaze.

User Experience and Accessibility

The success of an eye-controlled virtual mouse hinges on its usability and accessibility. This section discusses: User Testing: Evaluations conducted with diverse user groups to assess system performance and user satisfaction. Accessibility Features: Customizations and features designed to enhance accessibility for users with varying needs. Feedback and Iteration: The role of user feedback in refining and improving the system.

LITERATURE SURVEY

Vantukala VishnuTeja Reddy, Thumma Dhyanchand, Galla Vamsi krishna , Satish Maheshwaram (2022) determined that in human-computer interaction, virtual mouse implemented with fingertip recognition and hand gesture tracking based on image in a live video is one of the stud ies. In this paper, virtual mouse control using fingertip identification and hand gesture recognition is proposed.

Rares Pogoreanu and Radu Gabriel Bozomitu (2022) determined that, a gyroscopic pointing device that allows a user to type text by using a specialized virtual keyboard.

Yuliang Zhao (2022) determined that the traditional mouse has been used as a main tool for human-computer interaction for more than 50 years. However, it has become unable to cater to people's need for mobile of ficing and all-weather use due to its reliance on the support of a two dimensional plane, poor portability, wearisomeness, and other problems. In this paper, they proposed a portable ringtype wireless mouse scheme based on IMU sensors and a multi-level decision algorithm.

Nowadays computer vision has reached its pinnacle, where a computer can identify its owner using a simple program of image processing. In this stage of development, people are using this vision in many aspects of day to day life, like Face Recognition, Colour detection, Automatic car, etc. In this project, computer vision is used in creating an Optical mouse and keyboard using hand gestures. The camera of the computer will read the image of different gestures performed by a person's hand and according to the movement of the gestures the Mouse or the cur sor of the computer will move, even perform right and left clicks using different gestures. Similarly, the keyboard functions may be used with some different gestures, like using one finger gesture for alphabet select and four-figure gesture to swipe left and right.

METHODOLOGY

It pertains to the realm of Human-Computer Interaction (HCI) and illustrates the enhancement of existing open-source frameworks in Computer Vision and HCI to develop an affordable eye-tracking solution tailored for individuals with disabilities. The system model and overview are depicted in

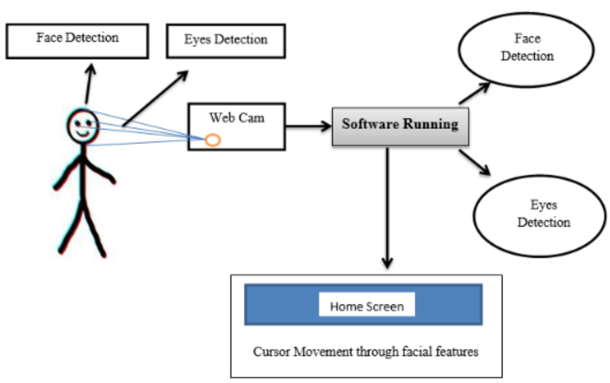

Fig : Use case diagram

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The prototype system utilizes camera input for real-time identification and tracking of the user's pupil [25]. The information obtained from this "tracking" can be utilized by computers or microcontrollers to execute various tasks. One such task involves monitoring pupil movement [26] and storing the tracked eye movement to control a computer's mouse pointer, enabling individuals with disabilities, such as Amyotrophic Lateral Sclerosis, to communicate with others. Equipped with a high-resolution web camera strategically positioned, along with user-friendly open-platform software, the system is easy to install and compatible with all current laptops and desktop computers. This system seamlessly transitions through the concept, design, and proof-of concept phases, involving the implementation of research paper segments and collaboration with the opensource community to design and develop a prototype. Importantly, it ensures the use of open-source, affordable, readily accessible, and commercially off-the-shelf (COTS) components.

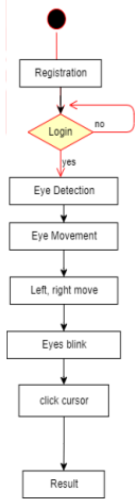

Fig : Flow chart

The sequence of the user's interactions with the system is illustrated in the figure in a sequential order. The system sequence diagram in the figure details the six core modules of our system. In the initial module, the system employs detection techniques to utilize the webcam for pupil identification. Subsequently, the machine proceeds to locate the face, followed by identifying and capturing the eyes. The next step involves pinpointing the pupils. In the final module, the system initiates the movement of the mouse cursor by monitoring the movement of the pupils.The development of a virtual mouse control system utilizing eye movement tracking entails a comprehensive methodology encompassing both hardware and software components. This section delineates the sequential process employed in crafting and implementing this innovative system, elucidating calibration procedures, tracking algorithms, and usability testing. The cornerstone of the virtual mouse control system lies in the selection of an appropriate eye movement tracking technology. Commonly employed are high-resolution and low-latency eye trackers, such as infraredbased systems or video-based systems. The choice of technology is pivotal for ensuring precise and real-time tracking of eye movements. Modern eye trackers possess the advantage of capturing subtle nuances, including saccades, fixations, and smooth pursuits, providing a rich dataset for accurate virtual mouse control.The hardware setup involves the installation and calibration of the eye tracking device. This typically includes placing sensors or cameras strategically to capture the user's eye movements with optimal accuracy. Calibration entails instructing the user to follow a set of on-screen points or targets, allowing the system to map the relationship between the user's gaze and on-screen cursor movement. This step ensures the virtual mouse control system is tailored to the individual's unique eye movement patterns. Attaining high calibration precision is paramount for the accuracy of the virtual mouse control system. The calibration process must be designed to accommodate variations in individual eye movement patterns while minimizing errors. Iterative calibration methods, wherein the system refines its

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understanding of the user's gaze through multiple calibration points, contribute to enhanced precision.The efficacy of the virtual mouse control system heavily relies on the efficiency of the tracking algorithms. Various algorithms, such as gaze mapping and predictive tracking, are employed to interpret raw eye movement data and translate it into onscreen cursor movements. Gaze mapping involves establishing a direct correspondence between eye movement coordinates and cursor coordinates, while predictive tracking anticipates the user's intended point of focus, reducing cursor lag and enhancing real-time responsiveness. Seamless integration with existing software is crucial for the practical application of the virtual mouse control system. The system should be designed to work alongside standard operating systems and software applications without requiring substantial modifications. Application programming interfaces (APIs) or software development kits (SDKs) facilitate this integration, enabling the virtual mouse control to function as an additional input modality.The virtual mouse control system should be versatile and adaptable to various computing environments. This includes compatibility with different operating systems, applications, and devices. Cross-platform compatibility ensures users can employ the system across a range of scenarios, from standard desktop computing to virtual reality environments.Usability testing is a critical phase to assess the performance and user experience of the virtual mouse control system. Participants with diverse eye movement characteristics and levels of computer proficiency engage with the system in controlled settings. Usability metrics, such as accuracy, efficiency, and user satisfaction, are collected and analyzed to gauge the effectiveness of the system.

RESULTS AND ANALYSIS

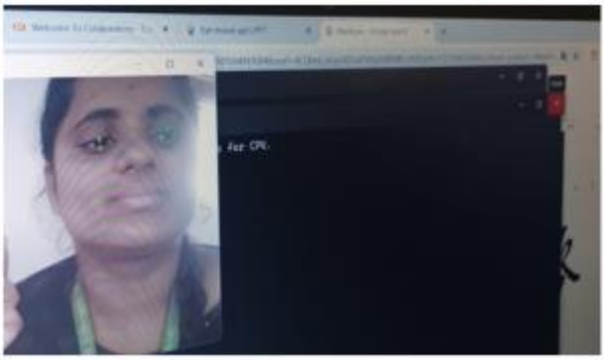

Figure : Representation of Modules in the Proposed Systemt.

We are capturing video of eyes to track the movement of eyes in fig.

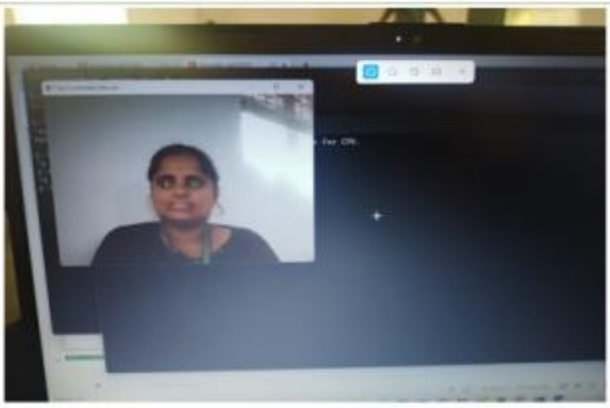

Figure : Tracking of eyes

With the help of eye movements we can use our eyes as mouse with out help of physical mouse fig.

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CONCLUSION

With the help of eye movements we can use our eyes as mouse with out help of physical mouse.In this research, First, it will locate the eye's pupil in the middle. Then, various commands are established for the virtual keyboard depending on the variations in pupil position. The signals pass through the motor driver on their way to the virtual keyboard itself. The motor driver's ability to regulate direction and speed allows the virtual mouse to go forward, left, right, and stop. It provides a control method based on eye tracking that enables people to easily and intuitively interact with computers using only their eyes. The system combines keyboard and mouse functionality such that users may use it to do practically all computer inputs without the need for conventional input devices. The technology not only makes it possible for disabled people to use computers in the same way as able-bodied users, but it also gives sighted persons a fresh option for using computers. In a surfing trial, the suggested method increased browsing effectiveness and enjoyment, and also allowed users to easily engage with multimedia. Finally, it can determined the location of the eyes and do mouse events using this approach.

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