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Survey on Empowering Human-Computer Interaction with Multi Modal Virtual Mouse

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ABSTRACT: The virtual mouse offers users a more comfortable and intuitive way to interact with their computers, especially for individuals who have injuries or disabilities that prevent them from using a traditional mouse. It is more accessible to a wider range of people thanks to the implementation of several modules, such as the hand gesture, eye movement, and voice recognition modules, which give users a variety of alternatives for manipulating the virtual mouse. The virtual mouse's potential advantages go beyond accessibility, as it can also be utilized to boost output and lessen physical fatigue brought on by continuous use of a real mouse.

KEYWORDS: Virtual Mouse, Hand Gestures, Iris Movement, Voice Recognition, Interface, Python.

I.INTRODUCTION

An innovative technique that has made great strides in recent years is virtual mouse control using hand gestures, eye movement, and voice recognition. Without the use of a mouse or keyboard, this technology provides a more natural and intuitive approach to handle computer systems.

Using hand motions to move the cursor on the screen is known as virtual mouse control by hand gestures. This method employs a camera to record the hand movement and translate it into a cursor movement. Similar to eye movement, iris movement entails controlling the cursor on the screen with eye movement. An eye-tracking camera is needed for this method in order to track user eye movement and convert it to cursor movement. Another method for controlling the virtual mouse is voice recognition, which enables the user to speak commands to control the cursor motions.

Many advantages come with the usage of virtual mouse control via hand gestures, eye movement, and voice recognition, including improved user experience, increased productivity, and increased accessibility for those with disabilities. This technology, for instance, can help those with physical limitations who might not be able to use conventional mouse and keyboard commands. Also, to offer a more realistic and natural experience, this technology has been widely applied in gaming, virtual reality, and augmented reality applications.

In addition, the operation of a virtual mouse using hand gestures, iris movement, and voice recognition has potential uses in augmented reality, home automation, and the medical and educational domains. In contrast to how students can engage with educational materials using hand gestures or speech recognition, doctors and other medical professionals can swiftly and readily access patient information and medical records using this technology.

Overall, the utilization of speech recognition, eye movement, and hand gestures to control a virtual mouse has the potential to change how we interact with computers and make it feel more intuitive and natural. We may anticipate even more cutting-edge applications that will improve our daily lives as this technology advances.

II.BACKGROUND

The current virtual mouse control technology allows us to do standard mouse operations like mouse pointer control, left click, right click, drag, etc. utilizing a hand recognition algorithm. The hand recognition technology is not being used any further.

There are currently virtual mice that use voice recognition, eye movement, and hand gestures. Here are a fewexamples:

1. Myo Armband: The Myo armband is a wearable gadget that uses electromyography (EMG) sensors to

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capture hand and arm gestures. It enables users to manage their computers with hand gestures by detecting hand movements and translating them into cursor movements on a computer screen.
2.Eye Sight Technologies: A business called Eyesight Technologies has created a device called Eyesight that tracks head and eye motions to control a computer cursor. The program tracks the user's iris movements using infrared cameras and converts them into cursor movements on the screen.
3.Dragon Naturally Speaking: Using speech commands and voice recognition software, users of Dragon NaturallySpeaking may operate computers. It enables users to operate their computer without a keyboard or mouse and to dictate documents since it can recognize and respond to spoken words and phrases.
4.Leap Motion: Leap Motion is a gesture recognition system that can monitor hand motions in three dimensions. Users are able to manage their computer by making hand gestures since it can recognize finger movements and translate them into cursor movements on a computer screen.
These systems are continuously evolving, and new technologies are being developed to improve their accuracy and usability.

III. STUDIES ON RELATED WORK

The Summary of Related works is presented in Table 1 below.

SI.No.	Authors	Technology	Advantages	Limitations
1	Hritik Josi,Nitin Waybhase [1]	Informative algorithmic rule	Hand detection is transformed to binary image.	The system gets slow.
2	Anadi Mishra,Sultan Faiji,Pragati Verma,Shyam Dwivedi,Rita Pal [5]	CV2.VideoCapture, OpenCV And Mediapipe.	Able to control our screen by moving our fingers which will work as cursor.	Uses only the proper hand to perform gesture.
3	Mohamed Nasol,Mujeeb Rahman,Haya Ansari [7]	MATLAB	Eye detection movement.	Small decrease in accuracy.
4	Sunil Kumar Beemanapally,Chetan Kumar,Diksha Kumari [8]	Image Processing,Eye tracking,Hough transform.	It provides a clear and consise.	Deforms non-elastically as pupil changes size
5	Khushi Patel,Snehal Solaunde,Shivani Bhong [11]	Mediapipe,OpenCV	Hands free control.	Privacy Concerns
6	Likitha R,Kmaraswamy S,Revathi B [12]	Voice Assistant, Sapi 5.	Improved accessibility.	Environment factors.

Table 1: *Comparison of related work.*

IV. PROPOSED SYSTEM

The technologies stated above could be combined in a virtual mouse system that uses voice recognition, iris movement, and hand gestures to provide a more smooth and simple user experience. The following are some probable characteristics of such a system:
1. Hand gesture recognition: The system might capture hand movements and translate them into cursor movements on a computer screen using a can involve using your hands to point, click, or scroll.

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2. Iris movement recognition: The system might also track the user's iris movements and convert them into cursor movements using an infrared camera or other technology. This would make it possible to manipulate the cursor more precisely and could be especially helpful for those who have trouble moving around or using theirhandsdeftly.
3. Voice recognition: The system might come with voice recognition software that enables users to speak commands to their computer. This might involve instructions for starting applications, utilizing menus, and even dictating text.
4. Software integration: The system may be made to work with current programs like media players, productivity programs, and web browsers. In the context of the program they are using, this would enable users to operate their computer using a combination of hand gestures, iris movements
5. User-adjustable settings: The system may have user-adjustable settings that let users modify the sensitivity of the software that recognizes hand gestures, eye movements, and vocalizations. Users might then modify the system to suit their unique requirements and tastes.
Overall, a system that integrates speech recognition, iris movement identification, and hand gesture recognition could give users a more flexible and natural way to operate their computer, especially for people with limited dexterity or mobility.

V. USE OF PROPOSED WORK

There are a number of potential use cases for the suggested development of virtual mouse employing hand gesture, eye movement, and speech recognition, including:
1. Accessibility: Those with disabilities that restrict their ability to utilize standard input devices like a keyboard or mouse may find the system to be very helpful. The system might offer a more user-friendly and accessible way for users to manage their computer by combining hand gesture detection, iris movement recognition, and voice recognition.
2. Productivity: By minimizing the time and effort needed to browse their computer, the system may also be advantageous for people who want to increase their productivity. Users may swiftly and easily interact with the system by combining hand motions, eye movements, and vocal commands easily perform tasks such as openingprograms,navigatingmenus,andtyping.
3. Gaming: The technology might also be used in games, allowing players to control game characters with hand gestures or the camera using iris movements. Vocal instructions could potentially be utilized to interact with other players or carry out in-game tasks.
4.Virtual reality: The technology could be employed in apps for virtual reality to give consumers a more realistic and natural manner to interact with virtual settings. Users might direct their movements and interact with virtual objects using hand gestures and eye movements, while vocal commands could be utilized to carry out tasks or traverse menus.
5.Medical applications: The system may also be used in the medical area to operate medical hardware or software during operations or other procedures. Surgeons might control the movement of surgical equipment or the zooming in and out of images with hand gestures and iris movements, while voice instructions could be used for other duties.
The proposed work of virtual mouse employing hand gesture, iris movement, and speech recognition has a wide range of possible applications in many industries, making it a versatile and profitable technology.

VI. STUDIES ON RELATED WORK

A virtual mouse using different types of input modalities such as hand gestures, iris, and voice. In terms of related work, there have been several studies and research efforts in the area of gesture-based interfaces and input modalities. Some notable studies and research in this area include below:
1. Gesture-based interfaces for virtual reality:Several studies have explored the use of gesture-based interfaces

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for virtual reality applications. These interfaces typically use hand gestures or body movements to interact with virtual objects and environments.
2.Eye-tracking interfaces: Eye-tracking technology has been used to develop interfaces that allow users to interact with computers using their eyes. These interfaces can be particularly useful for individuals with motor impairments.
3.Voice-based interfaces: Voice-based interfaces, such as voice assistants like Siri and Alexa, have become increasingly popular in recent years. These interfaces allow users to interact with computers using natural language commands.
4. Multimodal interfaces: Many research efforts have focused on developing interfaces that combine multiple input modalities, such as gesture, voice, and touch, to create more natural and intuitive interaction experiences. User experience design for gesture-based interfaces: There is also a growing body of research focused on designing effective user experiences for gesture-based interfaces. This research explores issues such as gesture recognition accuracy, gesture design, and user feedback.

VII. THE PROBLEMS

Based on the study, the following Problems are found in the existing systems:
1.Accuracy: If the hand gesture, iris, or speech recognition software is not accurate enough, the virtual mouse's accuracy could become a problem. The user may become frustrated as a result because they may find it challenging to move the pointer or choose items on the screen.
2.Compatibility: The virtual mouse may not work with all operating systems or gadgets, which could limit its applicability. For instance, if the virtual mouse is limited to a certain version of Windows, Mac users might not find it useful.
3.Learning curve: Using the virtual mouse efficiently may require users to pick up new movements or vocal instructions, which can be difficult for certain people.
4.Accessibility: Some users may struggle to utilize the virtual mouse because of physical impairments such restricted hand movement or poor vision. This may prevent a sizeable section of the population from using the virtual mouse.
5.Processing power: The virtual mouse could use a lot of processing power, which could make the user's computer or gadget run more slowly. Frustration and decreased productivity may result from this.
6.Privacy: There may be worries about data security and privacy if the virtual mouse uses speech recognition or iris scanning. If users believe that their personal information is not being appropriately protected, they could be reluctant to use the virtual mouse.
7.Cost: Depending on the technology utilized, developing and implementing a virtual mouse may be expensive, which could limit consumers' access to it. This can make it challenging for people or organizations to justify the expense if they don't expect to gain much from utilizing the virtual mouse.

VIII. RESEARCH GAPS

Research is required to determine the virtual mouse's usability, including how simple it is for users to learn and use the various types of interaction and how effective it is when compared to conventional mouse input techniques.
1.Accuracy: Research is required to assess the precision and dependability of the many forms of virtual mouse interaction, including as voice recognition, iris scanning, and hand gesture recognition.
2.Accessibility: Research is required to determine how to make the virtual mouse more usable for those with disabilities, such as those who have poor hand dexterity, eyesight problems, or trouble speaking.
3.Integration: Research is required to determine how well the virtual mouse can be adapted to various operating systems and hardware, as well as how well it can be integrated with currently available software and hardware.
4.Privacy and security: It is important to look at how to make the virtual mouse safer and protect user privacy,

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especially if it uses biometric information like voice or iris scans.
5.Performance: Research is required to assess the virtual mouse's performance in terms of speed and responsiveness, as well as how it may be tailored to work best with various hardware and processing power.
6.Cost-effectiveness: It is necessary to assess the virtual mouse's cost-effectiveness in comparison to conventional mouse input methods and determine whether it adds enough value to justify the development and implementation costs.

IX. CONCLUSION

In conclusion, a virtual mouse that can be operated via hand gestures, eye movement, and voice assistant technologies might make using computers and other devices more natural and effective. For people with impairments who might find it challenging to operate a conventional mouse or keyboard, this kind of technology can be extremely useful.Although this technology is still in its early stages of development, encouraging developments have been made. Virtual mouse technology has the potential to become a commonplace means of human-computer interaction with additional study and development, offering a more smooth and natural user experience.

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