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AI Virtual Mouse

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Abstract: The method for creating a process of human-computer interaction has changed since the advancement of computer technology. The mouse is a great tool for the human-computer interaction. This study offers a way to move the pointer without using any technological devices. On the other hand, other hand moves can be applied for operations like drag and click objects. The suggested system will just need a camera as an input device. Along with additional tools, the system will need to be used with OpenCV and Python. The output from the camera shall be shown on a display that is connected so that the user may adjust it further. The Python tools that will be used to build this system are NumPy and Mediapipe a very effective framework that offers quick fixes for AI tasks. It allows users to move the computer cursor around using hand movements while holding dvds like markers of color. Certain finger movements can be used to carry out actions like pulling and left- clicking. A hand gesture detection system for controlling a virtual mouse is presented in this research, enabling more organic human-computer interaction.

Keywords: Hand Tracing, Finger counter, AI Virtual Mouse.

I. INTRODUCTION

As the rapidly developing field or interaction with computers (HCI), physical gestures are essential for improving this connection. Using hand gestures to understand different facets of human-computer interaction along with employing him to create creative solutions is the main objective. Projects like Hand Tracking, Finger Counting, Gesture-Based Volume Control, and, eventually, an AI-powered Virtual Mouse and Virtual Keyboard are among the suggested solutions. These projects evolve from basic to complex features and are integrated. The basis for ensuring adaptability and fostering efficiency is the development of these systems as modular mini- projects.

Technologies for human-computer interaction have advanced hugely as the outcome of tech breakthroughs. It is still one of those most utilized devices of overcoming the interfaces. This study suggests a brand-new technique for directing the cursor's movement without the need for further technological devices. Certain grips might be carried out deeds with utilizing and tugging. All that will be essential to the computer to function is a regular webcam.

Python, OpenCV, and associated libraries will be used in the implementation. The feed through webcams will end up shown on the system screen so that users may adjust it as necessary. Important Python modules, such as the mouse module and NumPy, will serve as the system's cornerstone. The creation of an electronic interactive keyboard will be the main goal of the initial stage of development. employing the digit examining the component as its primary element, this action involves creation of One Finger This for detecting and rest your fingertips as and Hand Logging to track hand movement and assess the frame rate.

A technique for managing cursor movement without the need for further electrical devices is presented in this paper. Rather, a variety of hand motions will allow for activities like dragging and clicking. The system is implemented using OpenCV, Python, as well as relevant technologies but just needs a camera as an input device. The algorithm's displayed incorporates the camera stream, enabling users to adjust the interface as necessary. The scrolling components and It have a pair integral Libraries for Python in which have been used in the system's development. Implementing a virtual mouse when integrating hand tracking with the ability to track hand movements, measure frame rates, and count fingers using your hand documenting module as the basis is the main goal of the project's first phase.

The computer mouse has long been a necessary input tool for using graphical user interfaces. The need for effective and flexible human-computer interaction (HCI) systems has increased as computers have become more and more ingrained in daily life. Despite their accuracy, contemporary laser mice are nevertheless constrained by their physical design. The goal of this project is to create a virtual mouse that tracks fingers using a regular camera. The project intends to provide a versatile and affordable substitute for traditional mice thru using tracking of items techniques in mixed form with it in a Python environment, hence increasing the flexibility and intuitiveness of interaction.

II. LITERATURE SURVEY

According to research and studies on sign language, hand gestures are among the most basic and effective natural forms of communication. Recent advances in AI and pattern recognition have made it more possible to recognize hand gestures in real time during human-computer interaction. Numerous fields, including effective watchfulness, fraud detection, industrial robot control, sign language translation, environmental manipulation, and rehabilitation for individuals with upper-body difficulties can benefit from virtual hand gesture recognition. Because they offer a distinct and user-friendly method of interacting with technology, virtual hand gesture recognition systems are a suitable input arrangement. However, one of the challenges is precisely recognizing motions from different perspectives and angles. By enabling computers or cameras to recognize hand gestures, our research aims to address this issue and provide users with control over the mouse.

A laptop-based "Zero Cost" hand identification system that uses basic algorithms to identify the hand while participating its movements and assign an action to each movement is the finished product. Python is a simple language that is platform independent, flexible, and portable—all of which are desirable attributes in a program meant to create that Virtual Mouse and Running An awareness system. As a result, the apparatus we're building—written in Python—is significantly quicker to respond and easier to implement. Examining some of the most current developments in hand gesture detection technology and identifying virtual mice for computer-human interaction are the goals of this project.

III. PROPOSED SYSTEM

The technique uses hand color recognition to make dynamic cursor location adjustments. The suggested approach is made to work well in a range of lighting venues while matching every hue of skin, protecting dependability and accessibility. As a groundbreaking contribution to its area and a starting point for further developments in gesture- based control systems, this work has a lot of promise. The goal is to create a free hand recognition program that works with laptops and PCs that have webcams. The technology will allow users to manipulate the mouse cursor and carry out necessary operations which might include clue venture and fundamentally mouse branches like left and right clicks by deciphering hand gestures. This method seeks to streamline interaction and offer a user-friendly, hardware-free cursor control substitute.

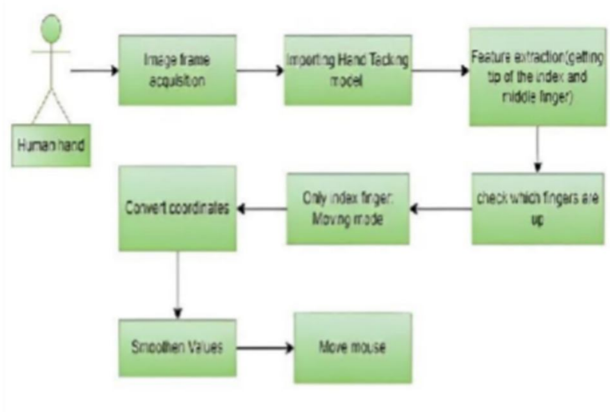
The idea is that this particular use that happens gets identified by finger motions. If only the tip of the index finger is detected, for example, the cursor will move in time with the finger, simulating mouse operation. The basic and clear gestures needed guarantee that the system will always be simple to use. Other capabilities like hand tracking, finger counting, and gesture-based controls for volume will further be built right into it in addition to the AI-powered virtual mouse. These new features are intended to increase the system's adaptability and optimize the results obtained in a particular project.

A. *Hand Tracking*

Each of the main parts of the Hand Tracking model are their hands landmark appreciation and palm-side detection. The palm detecting module trims extraneous portions of the picture to isolate the palm-containing region. After that, the hand landmark module locates 21 distinct landmarks on the identified palm to allow for accurate tracking and analysis.

B. *Finger Counter*

The Finger Counter is based on the Hand Tracking concept, which has adaptable as well as reusable components that provide easy and effective integration. It also makes use of an existing dataset with six photos, one for each hand posture, ranging from a closed fist to four fingers spread. The model predicts the number of nails show by the processing the 21 hand landmarks in real time and analyzing where they are placed. This method efficiently counts fingers and illustrates the finger.

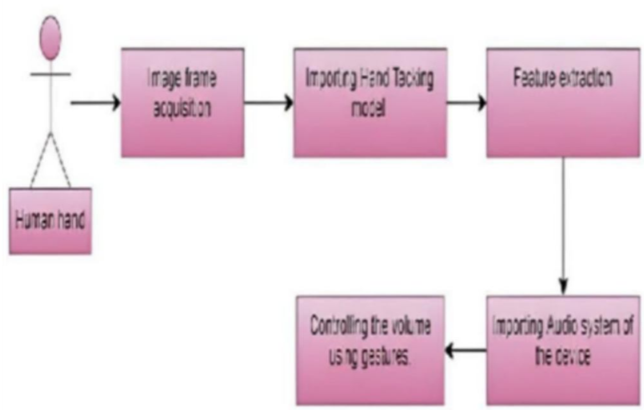


C. Gesture Volume Control

Additionally, this model uses the Hand Tracking modules to change the volume in response to finger motions. The volume may be controlled by detecting the locations of both fingers, and it can be locked with an appropriate rate utilising the pinky finger. The software creates the intended function by removing the necessary sights by the 21-hands image information with creating code their doors right away.

D. Virtual AI Mouse

The AI-powered virtual mouse is made to mimic mouse movements with webcam-captured finger movements. The hands Tracker model can be utilized by the algorithm in order to recognize and monitor 21 premises landmarks. The functionality is set up so that, during focus navigation, entirely the actions of the middle index finger can be captured & defined, thereby providing precise regulation devoid of using a mouse.



IV. RESULTS

The AI Virtual Mouse uses a camera to identify hand motions and use them to control mouse operations. The use of computer vision algorithms allows for the smooth execution of tasks such as drag-and-drop and clicking. The project makes use of OpenCV's video capture capabilities, which allow for real-time gesture tracking and detection. Direct data collection from live streaming becomes viable the OpenCV's video capture module, which allows for constant system engagement. This method might be used in a number of real-time situations, including manipulating desktop cursors as well as steering Android-powered smart TVs. Because of its simple architecture, the system depends far less on external hardware. The needed actions over the screen can frequently be made with uncomplicated finger motions in front of the camera, providing an alternative to more conventional tools like laser beam removes or mouse.

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A. Abbreviations and Acronyms

- AI (artificial intelligence)
- HCI (human-computer interaction)
- CNN (convolutional neural network)
- TP (true positive)
- TN (true negative)
- FP (false positive)
- FN (false negative)
- FPS (frames per second)
- GUI (graphical user interface)
- ID (identifier: used for finger ID in gesture recognition)
- PX (pixels)
- Open-CV (open-source computer vision)
- YOLO (you only look once: object detection model)

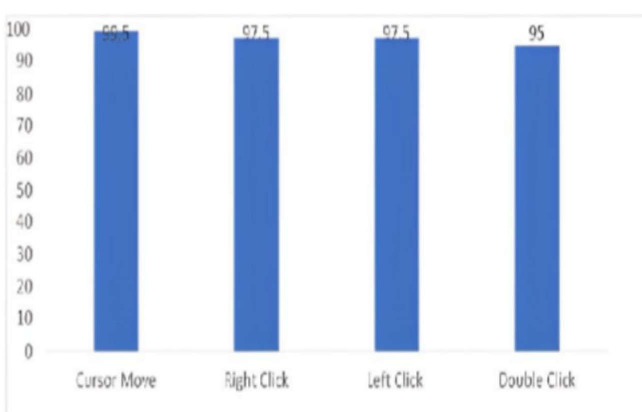
B. Units

- Accuracy: Measured as the percentage of correct predictions.
- Pixels (px): Unit for measuring distances between points on the screen or finger positions (e.g., gap between thumb and index finger).
- Frames Per Second (FPS): Measure of the processing speed and responsiveness of the virtual mouse in realtime. Higher FPS indicates smoother cursor movement.
- Milliseconds (ms): Measure of latency or delay between detecting a gesture and the corresponding action on-screen. Lower ms means faster response time.
- Degrees (°): If using angle-based gestures (e.g., finger rotation), this would be the unit of measurement for rotation.

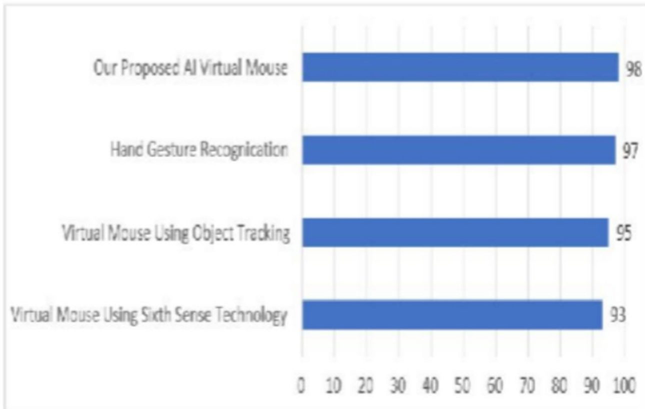
C. Equations

When evaluating the effectiveness of an AI- powered virtual mouse system, accuracy is crucial. It displays how well the system can decipher gestures and carry out matching actions on the screen. The percentage of gestures that are successfully recognized and executed as the expected computer motions such as instructions is known as preciseness in this context. A system with 95% accuracy, for instance, may correctly identify 95 out of 100 gestures; the other movements are either misclassified or ignored. The ratio of properly detected gestures to total gestures executed is commonly used to define the accuracy formula for gesture recognition:

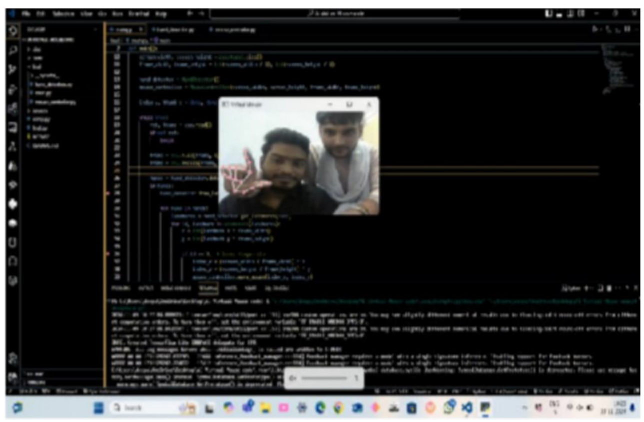
$$\text{Accuracy} = \frac{TP + TN}{TP+FP+TN+FN} \times 100$$



Graphic Chart of AI Virtual Mouse Accuracy



Graph for Compression between The Models



V. DISCUSSIONS

There are a number of obstacles to overcome while creating an AI-based virtual mouse system, but obtaining great precision and responsiveness is one of the main ones. Continuous video feeds must be processed in real-time to guarantee accurate gesture identification and reduce latency for fluid cursor movement. An additional obstacle is creating a basic gesture mapping system, which requires careful balancing of different actions, like this clicking as well scrolling, and motions like moving a mouse pointer from an open hand. Ergonomic usability is also essential for avoiding user fatigue from prolonged use. Making a device compatible with a variety of operating systems is also crucial to its viability for broad use.

VI. CONCLUSION

This system uses real-time camera input in conjunction with hand tracking and recognition to carry out mouse operations including gesture- based volume control and right-click. It is made to employ methods of computer vision for executing all common mouse functions. However, the variety of human skin tones and the fluctuating lighting circumstances might make it difficult to achieve consistent performance. The accuracy of many vision algorithms is impacted by illumination irregularities. The findings imply that making these algorithms more dependable in any setting will greatly increase the system's effectiveness. merely erasing requiring to provide hand-held devices, this approach tends to conserve premises especially is especially helpful for presentations.

Since the proposed model has greater accuracy, the AI virtual mouse can be used for real-world applications, and also, it can be used to reduce the spread of COVID-19, since the proposed mouse system can be used virtually using hand gestures without using the traditional physical mouse. The model has some limitations such as small decrease

in accuracy in right click mouse function and some difficulties in clicking and dragging to select the text. Hence, we will work next to overcome these limitations by improving the fingertip detection algorithm to produce more accurate results.

VII. LIMITATION

Numerous unresolved problems in this study may hinder the results of color recognition. One of the obstacles encountered at the acknowledgment phase is the surroundings.

Because high intensity or blackness may make it hard to see the targeted colors in the captured frames, the recognition process is extremely sensitive to brightness levels. Furthermore, another factor that could affect color identification results is distance. Because the existing detecting zone can only let see colors within a certain radius. Any color displays that go beyond this threshold will be filtered out because they are considered noise.

Long-term adoption can be challenging as extended use of AI virtual mice can cause user boredom & distress, specifically when using gesture-based input modalities. Additionally, users can find it difficult to adjust to different input techniques like hand signals or eyeball gestures, thus might end in an extended learning period. Certain AI systems' inability to soak up surroundings might cause misunderstandings, particularly when a user moves erratically and too quickly, making task completion more difficult.

VIII. FUTURE WORK

The systemrequires little setup and is completely self-sufficient and intuitive. In order to achieve more accuracy and the ability to adapt, future developments will concentrate on improving the models by including sophisticated procedures for segmentation until inquiry into computer tracking based on the pace.

An adjustable zoom-in/out function is needed to increase the covered range because the existing recognition mechanism can only detect objects within a 25 cm radius. This function can automatically modify the focus rate dependent on the proximity between both the operator and the video camera.

The hardware of the device, which comprises the processor's processing speed and the amount of the memory space, has a significant impact on the download speed. RAM and the webcam's capabilities. As a result, the program might run more effectively when it's installed on a good computer with a webcam that works well in various lighting conditions.

IX. ACKNOWLEDGEMENT

We convey our profound appreciation to all those who helped us during this study. First of all, we would like to express our sincere gratitude to Mr. Jagbeer Singh, our supervisor, for his unwavering leadership, insightful counsel, and considerate criticism during this project. Their knowledge has been extremely important in determining the course and outcome of our effort. We also want to send deep thanks to our buddies and coworkers at Meerut Institute of Engineering & Technology (MIET), whose encouragement, support, and helpful criticism were essential in helping us improve our study. Our team members deserve particular recognition for their cooperation in gathering and analyzing everything which made the project possible. We also want to acknowledge how the challenges presented have inspired people all throughout the world due to the COVID-19 epidemic, which inspired the creation of this virtual mouse project in an effort to increase user accessibility.

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