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MOUSE AND KEYBOARD MOTION SENSING USING HAND SIGNS

Mrs. Asha M L
Assistant Professor, Department of Information Science and Engineering
Atria Institute of Technology
Bangalore, Karnataka, India
asha.ml@atria.edu

Priyanka M V
Department of Information Science and Engineering
Atria Institute of Technology
Bangalore, Karnataka, India
mvpriyanka8@gmail.com

Sindhu A
Department of Information Science and Engineering
Atria Institute of Technology
Bangalore, Karnataka, India
sindhuaswathareddy@gmail.com

Supriya Daspalle
Department of Information Science and Engineering
Atria Institute of Technology
Bangalore, Karnataka, India
supriyadaspalle@gmail.com

***Abstract*—The project presents a way for Human-Computer Interaction (HCI) that employs a web camera or an integrated camera to control the movement of the indicator instead to the current methods, which typically involve manually entering buttons or altering the positions of a physical mouse. Instead, it can perform the functions that a physical computer mouse does, and it does it through camera and technology for computer vision to manage different mouse events. The Virtual Mouse color recognition application constantly acquires real-time image data and processes it using several filtering and conversion phases. The application utilizes an image processing technique to obtain the coordinates of the desired colors that have emerged within the frames holding a list of color combinations, each of them correlates to a different mouse function. The program will run the mouse function and transform it to an actual mouse function which will be able to applied on the user's PC if the current color combination passes. The main aim of the project is to virtually interface with the system in virtually every manner imaginable.**

Keywords: Gesture Recognition, Human Computer Interactions, Graphical User Interface, Open-Source Computer Vision.

I. INTRODUCTION

A mouse is a device utilized by computing that can recognize two-dimensional motions on a overhead. This motion is transformed into the motion of a indicator on a display to control the Graphical-User-Interface (GUI) on a system platform. A wide range of mouse have already been created by modern technology, such as wired and wireless mouse, whose movements are managed by a hard rubber ball that rotates as it adapts to the mouse's movements. Several decades later, an LED sensor that could detect movement on the tabletop and send the information to the computer for processing was developed to replace the hard rubber ball in the optical mouse.[1] The wired and wireless mouse still has physical and technical constraints, regardless of how precise it is. Therefore, a virtual Human-Computer device that integrates the traditional mouse and keyboard via a webcam or other image-capturing device might act as a substitute to the touchscreen. The camera device will become frequently employed through software program that records individual actions and interprets them to generate pointer motions that resemble those of a physical mouse. The primary use of a keyboard is to allow users to interact with the computer by inputting characters or symbols.[2]

The program must be quick enough to gather and process each image in state to trail the user's motion appropriately. The project will therefore use OpenCV, an open-source computer vision library, and the most current applications programming methods to make over software application. The introduction of gesture-based interfaces has made human-computer interaction much natural and intuitive.[3]

II. RELATED WORK

This system employ a webcam or built-in camera to detect hand signs and fingertips, processing the captured frames to execute specific mouse functions. Results indicate that the proposed model demonstrates high accuracy, outperforming existing models and overcoming many limitations. The system's accuracy suggests its potential for real-world applications and its potential use in reducing the spread of

COVID-19 by allowing virtual mouse control without physical contact. However, it has some extent, such as a little decrease in accuracy in right-click functions and difficulties in text selection through clicking and dragging. Future work aims to address these limitations by improving the hand sign recognition algorithm for increased accuracy.[1]
The paper introduces a novel virtual-mouse method utilizing RGB-D images and fingertip detection, enabling users to interact with system without conventional mouse devices, gloves, or markers. It offers highly accurate gesture estimates and demonstrates practical applications, overcoming limitations of existing virtual-mouse systems.

Key benefit of the proposed method include its robustness in varying light conditions and complex backgrounds, accurate fingertip tracking over longer distances, and the ability to track fingertips of multiple individuals simultaneously. However, the study acknowledges limitations inherited from the Microsoft Kinect system. Consequently, future work aims to address these limitations and enhance the fingertip tracking algorithm. Additionally, there's a plan to expand the system to support more gestures and interact with diverse smart environments. The authors propose enriching skeletal tracking by integrating machine learning algorithms like OpenPose for multi-person 2D pose detection, encompassing body, hand, and facial keypoints.[2]

The paper proposes a system to recognize hand signs and replace traditional mouse and keyboard functions, encompassing mouse cursor movement, drag-and-click actions, and keyboard features such as typing alphabets and other functions. It utilizes skin segmentation to isolate the hand's color/image from the background, employing a "remove arm" method to address whole-body inclusion in the camera view. The proposed algorithm detects and recognizes hand gestures, enabling operation of mouse and keyboard features and facilitating the creation of real-world user interfaces. The system's potential applications span various fields, including 3D printing, architectural drawings, and medical operations, offering significant contributions to medical science by enhancing human-computer interaction in computational tasks.[3]

The framework described in the content utilizes imagination-based cursor control using hand motion, implemented in C++ with the OpenCV library. It enables cursor movement by tracking the user's hand and performs cursor functions through different hand gestures. While the system shows latent as a practical alternative to the computer mouse, its main limitation is the requirement for a well-lit environment, making it unsuitable for outdoor or poorly lit settings commonly encountered with computer usage. The quality of hand motion recognition could be enhanced by incorporating the Template Matching technique with AI classification.

Additionally, the system can automatically launch a video player by opening a text document and pausing execution for a specified time to load the media player. Once recording is played, the system invokes the necessary tools such as OpenCV, camera, and pyautogui, allowing users to control without conventional methods.[4]

The evolution of a new system aimed at enhancing human-computer interaction for 3D modeling tasks. Standardized input devices similar to mouse and keyboard are deemed insufficient for such interactions. The proposed system allows users to import 3D models and collaborate with them using hand signs, enabling operations such as rotation, zooming, highlighting, moving, and capturing of the models. The primary focus is on improving human-computer interaction by providing a more precise and intuitive method of interaction without the need for physical devices similar to mouse and keyboard.[5]

The paper presents a proposed methodology focused on estimating fingertip positions from RGB images containing hand signs in visual sense. The experiment uses a dataset with analyzable aspect moment and varying illuminations. The methodology combines regression techniques with multi-label classification to turn up seeable prolonged fingers in the video framing. The proposed Deep Neural Network (DNN) architecture robustly estimates fingertip positions given a detected hand region. Results demonstrate improved performance compared to existing methods for aggregate fingertip perception in videos, with an ordinary forward time of 9.072 ms for fingertip detection on a 640 × 480 image. Future work aims to develop a more buirdly fingertip detection system which is focusing on reducing detection errors.[6]

The presented method offers on-screen cursor control without physical connection to a sensor, utilizing identification and tracking of colored caps on fingertips. Hand signs or colored caps can regenerate each other for the same purpose. Various mouse operations such as single left click, right click, and scrolling are controlled using different combinations of colored caps. The program allows adjustment of skin color range supported on the individual and lighting conditions. Additionally, it analyzes the unused area within the hand's convex hull to determine cursor movement. The method has applications in real-time scenarios like cursor control on system and Android-based smart televisions. Unlike traditional devices such as mice and laser remotes, this approach simplifies interaction by enabling necessary screen operations through finger motion captured by a camera, reducing reliance on external hardware.[7]

III. METHODOLOGY

A. ARCHITECTURAL DESIGN

The two primary phases of color recognition in an AI virtual mouse system: calibration and recognition. During calibration, the system identifies the Hue Saturation Values of chosen colors and saves these values for later use. In the recognition phase, the system uses the saved parameters to identify colors in captured frames and interpret hand gestures through CV techniques. The process involves analyzing recorded hand movements and issuing corresponding commands to the keyboard. Overall, the system utilizes color recognition and computer vision to enable hands-free interaction with computers.

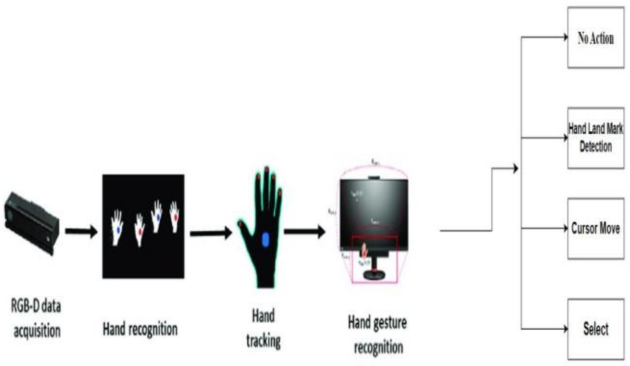

Fig. 1: Architectural Design

A transformational method used in virtual mouse technology where fingerprint coordinates captured by a camera are transmitted to a computer screen for mouse activity. A rectangular box is established on the monitor screen corresponding to the camera zone. After detecting hands, the system determines which finger is poised to perform mouse actions. By identifying the upmost finger and matching its coordinates with the tip ID obtained from MediaPipe, the system determines which finger is active. Subsequently, the system executes the required mouse function supported on the identified finger's posture and the given mouse function. Overall, this approach enables mouse interaction without physical peripherals, utilizing hand gestures and computer vision technology.

B. USE CASE DIAGRAM

A use case diagrams, are dynamic or behavior diagrams in Unified-Modeling-Language (UML). These diagrams model a system's functionality by employing actors and use cases. Use cases represent tasks, services, or operations that the method requisite perform, while actors are individuals or groups interacting with the system. Use Case Diagram illustrates a system where the user takes pictures with a webcam. Following this action, the system proceeds to handle various tasks including feature extraction, image preparation, segmentation, identification, and creating a score sheet. UML diagrams are valuable for outlining a system's functional requirements, guiding design decisions, and prioritizing development tasks.

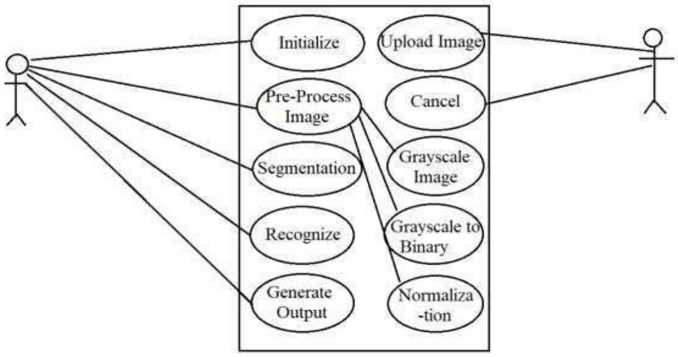

Fig. 2: Use Case diagram

C. ACTIVITY DIAGRAM

An activity diagram for a system designed to identify hand gestures from uploaded images captured via webcam. The sequential steps in the process include pre-processing, feature extraction, segmentation, recognition, and score sheet production. The user initiates the process by uploading an image via webcam. If any problem or interruption occurs during the upload, the operation halts immediately, requiring the user to restart. However, if the upload is successful, the system proceeds with the necessary actions to recognize the hand gesture depicted in the picture. This activity diagram illustrates the workflow of the system's functionality in identifying hand gestures from uploaded images.

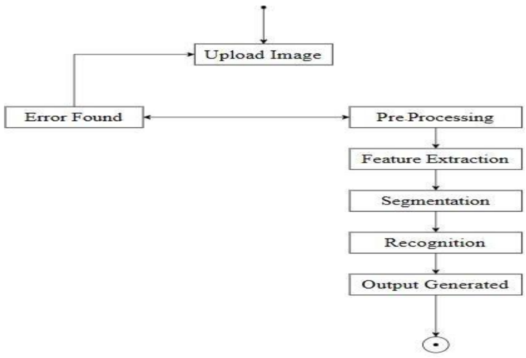

Fig. 3: Activity diagram

D. DATAFLOW DIAGRAM

The system's primary component is the exploiter interface, which includes virtual keyboard and mouse functionality. These are displayed individually at a many elaborated levels. The mouse driver simulates real mouse movement and receives input from the user via the virtual mouse. This input is then transmitted to the virtual mouse, which adjusts the on-screen pointer accordingly. In summary, the DFD illustrates the flow of data and control within the system, focusing on user interaction through the spurious mouse and keyboard components.

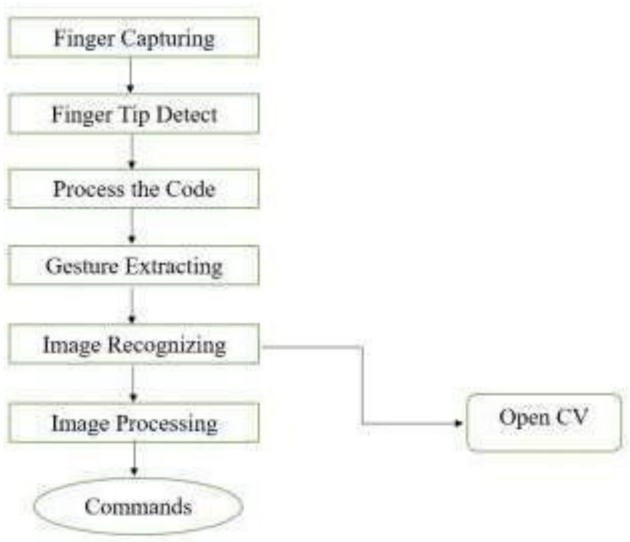

Fig. 4: Dataflow Diagram

IV. LIST OF MODULES

List of modules commonly used in the improvement of mouse and keyboard motion sensing using hand signs.

1. GUI Frameworks
2. Input Simulation
3. Image Processing
4. Gesture Recognition
5. Accessibility
6. Operating System Interaction

V. RESULTS AND DISCUSSION

The advancements achieved in utilizing hand signs to control a computer mouse and keyboard. Various conceptualization have been explored and applied with differing levels of success. The most accurate architecture proposed involves using hand signs. This architecture integrates a camera or webcam to capture hand motions and fingertips are analyzed to execute mouse commands and keyboard key presses. When dragging the hand across a designated rectangle-box, the cursor mimics the movement accordingly.This system encompasses various mouse operations such as select, move cursor, hand landmark detection, and no actions. Overall, this approach represents a significant advancement in intuitive computer interaction using hand signs.

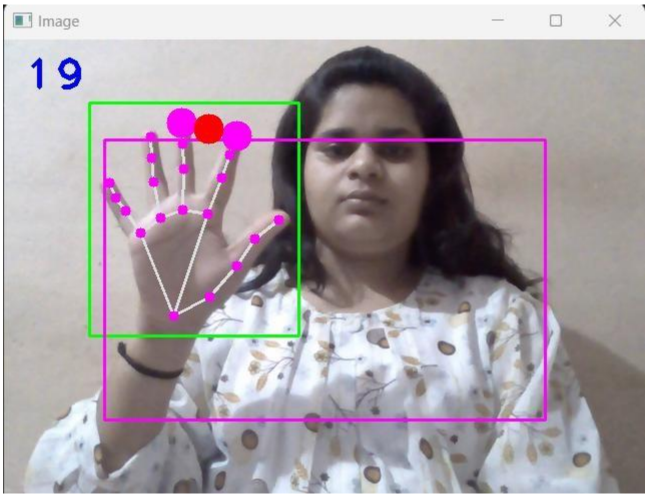

Fig. 5: Hand Landmark Detection

The hand detection gesture is shown in fig. 5.

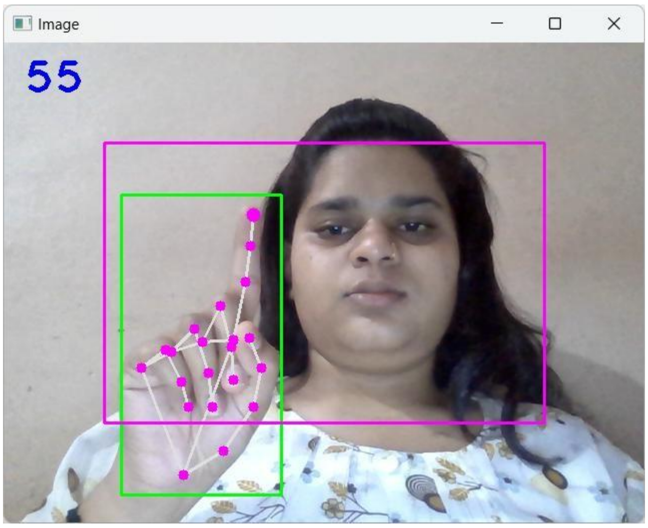

Fig. 6: Cursor Move

The movement of mouse cursor gesture is shown in fig. 6.

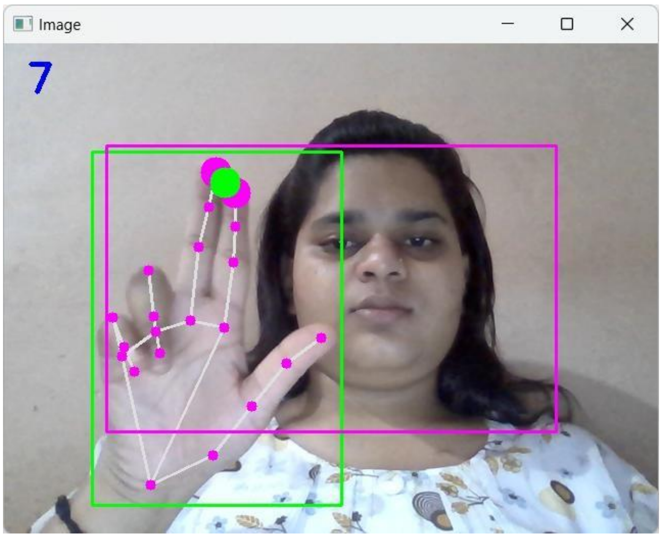

Fig. 7:Select

The selection of activity by the mouse gesture is shown in fig. 7.

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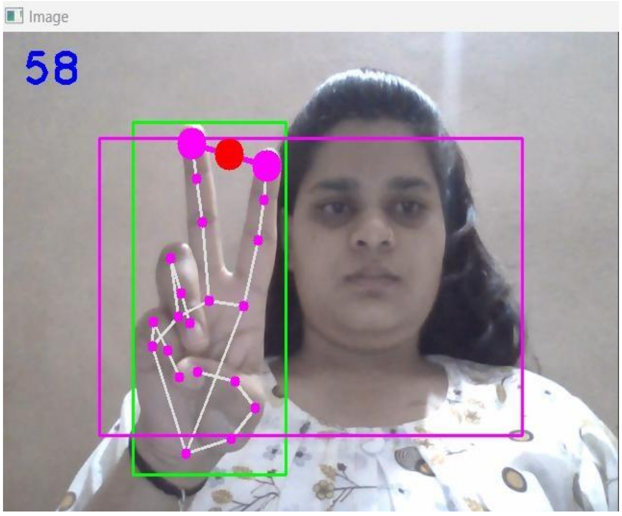

Fig. 8: Increase and Decrease Function

The increase and decrease function is shown in fig. 8.

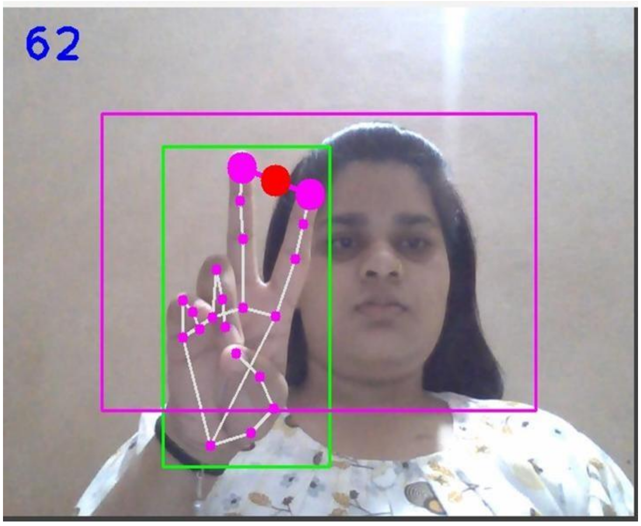

Fig. 9: Zoom in and Zoom out

The zoom in and zoom out action by mouse is shown in the form of gesture in fig. 9.

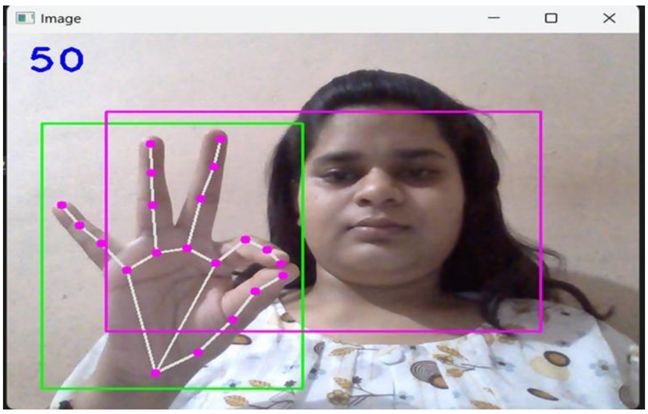

Fig. 10: Key Selection

The selection of keyboard keys is shown in the form of gesture in fig. 10.

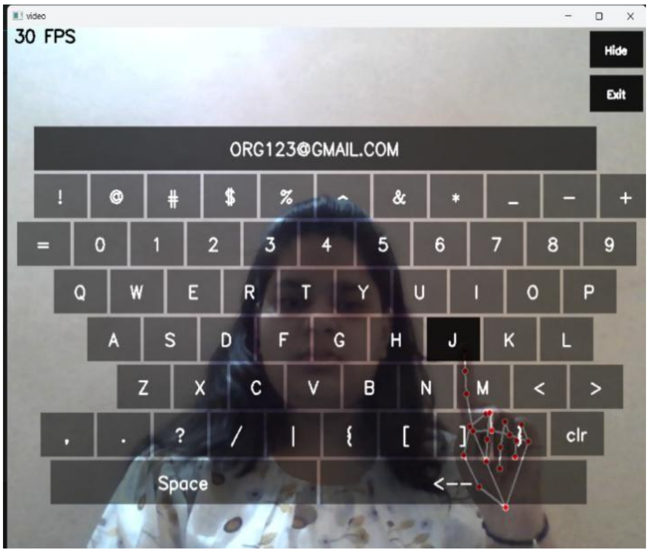

Fig. 11: Keyboard display

The display of virtual keyboard on system is shown in fig. 11.

VI. CONCLUSION

In Conclusion, in the domain of Human-Computer Interactions (HCI), any mouse movements can be executed with a brief movement of the fingers, irrespective of position or limits enforce by the environment. A color recognition program was built as part of this project. The idea behind this solution is to make it easier to manage the application with less trouble. As a result, precise mouse operations can be activated with the least amount of trial and error.

All things considered, instead of the other way around, modern advances in technology have made society's quality of life and productivity far better. As a result, society cannot coexist using outdated technology while refusing the need for advances in technology. Instead, it suggests that they accept the modifications in order to have a more productive and efficient lifestyle.

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