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Accessibility And Control the System Using Hand Gestures

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Abstract: The work demonstrates a touchless Human- Computer Interaction (HCI) solution that allows computer users to interface with their PC via natural, intuitive hand movements. Utilizing machine learning and computer vision technology, the system employs a webcam and the mediaPipe framework for real-time identification and tracking of hand landmarks. By smart gesture recognition and mapping, users can carry out system actions like mouse movement, clicking, scrolling, volume and brightness adjustment, screenshot capture, double click and all without ever having to physically touch an input device. It was implemented in Python and incorporates a number of libraries such as OpenCV, mediapipe and other.

I.INTRODUCTION

The COVID-19 pandemic has increased the awareness of the necessity for touchless interfaces in public and personal computing. This project presents a virtual cursor system controlled by hand movements alone, recorded by a regular webcam. These interfaces enable users to control and interact with digital systems using hand and body gestures, offering a touchless and often more immersive experience. It illustrates an inexpensive, accessible contactless system control solution, particularly applicable in hygienic or assistive interface scenarios.The system incorporates gesture debouncing, hold duration checking for sensitive actions, cursor smoothing, and adaptive sensitivity scaling according to frame area. This technology is often used for enhancing accessibility for individuals with disabilities or for creating hands-free interfaces for various devices, including computers, smart TVs, and other interactive environments

II.LITERARURE SURVEY

[1] Zhang, Z. (2012). Microsoft Kinect Sensor and Its Effect. IEEE Multimedia, 19(2), 4–10.

[2] The paper titled *"Finger tracking using depth sensors and machine learning"* by Lee and Kim (2011) focuses on using a depth sensor, specifically depth-sensing cameras like Microsoft Kinect, to track finger movements in real time.

[3] Shao, Y., & Wang, X. (2014). "Real-time Hand Gesture Recognition with Depth Sensors." They discuss how depth sensors and machine learning algorithms can track hand gestures in real-time and be applied to HCI applications.

[4] Mittal, A., Zisserman, A., & Torr, P. H. S. (2011). Hand Detection Using Multiple Proposals. British Machine Vision Conference (BMVC).

III.EXISTING SYSTEM

Existing gesture recognition rely on specialized hardware, such as Leap Motion sensors. In previous systems we used mouse, keyboard, joysticks and scroll wheels to operate the system. Hence limited gesture recognition only possible where extra specialized hardware must be used out which requires external cable wires.

IV.PROPOSED SYSTEM

Our aim is to develop a real-time, camera-based hand gesture recognition framework for controlling computer functions. Our approach utilizes a simple web camera to track hand movements and identify predefined gestures. The proposed method is less cost, highly adaptable, and operates efficiently. Our project allows to perform multiple actions along with double click and screenshot capturing

V.IMPLEMENTATION

The implementation of a hand gesture recognition system designed to control a computer. The process begins with the system continuously capturing images using a webcam.

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These captured images are then passed to the computer for processing. The core of the system lies in the "Determining hand gesture".If a recognizable hand gesture is detected , the system proceeds to the next stage where this identified hand gesture is converted into a specific command that the computer can understand. If no recognizable hand gesture is detected in the captured image, the system loops back to the initial step of continuously capturing images, ensuring a real-time and continuous monitoring for hand gestures. This cyclical process allows for dynamic and interactive control of the computer based on user-defined hand movements.This type of system has potential applications in various fields, including hands- free computing, accessibility solutions, interactive gaming, and virtual reality interfaces, offering a novel way for users to interact with digital environments.

MODULES

- cv2 – Allows to capture real time video.
- mediapipe – The real time hand detection can be possible with the help of mediapipe.
- Numpy – Helps in numerical computations especially for distance calculations.
- pyautoGUI – Controls mouse and keyboard interactions. It is used to simulate the mouse actions based on the detected gestures.
- Screen_brightness_volume –It is used to adjust system settings like screen brightness and volume based on gestures detected via webcam.
- Pynput – The pynput library is used to simulate mouse inputs.
- ctypes – A Python library used to call system-level functions in response to detected hand gestures.
- comtypes – A Python library used to access Windows audio or media controls, enabling gestures to control system volume and playback.
- Pycaw – A Python library used to control system audio (like volume and mute) in response to hand gestures.

ALGORITHMS

Gesture Recognition Algorithm:

A gesture recognition algorithm is a type of computer algorithm that can recognize and interpret human gestures, such as hand movements, body language, or facial expressions.

TECHNIQUE

Computer Vision:

Computer vision is a field of artificial intelligence (AI) that enables computers to interpret and understand visual information from the world. It involves the development of algorithms and statistical models that allow computers to process, analyze, and understand digital images and videos.

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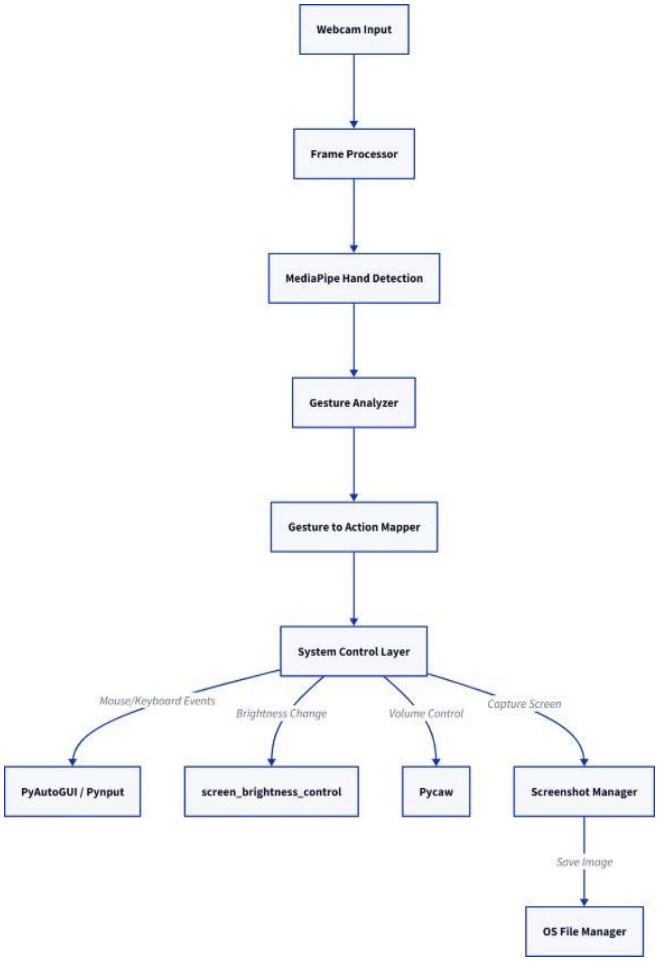
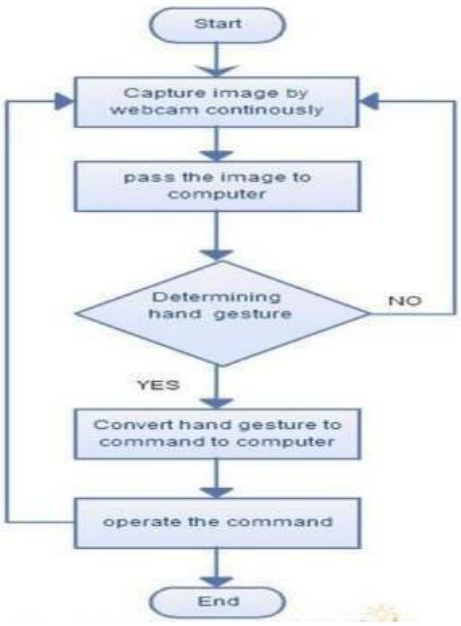
VI.SYSTEM ARCHITECTURE



VII.DATAFLOW DIAGRAM



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VIII.RESULT AND ANALYSIS

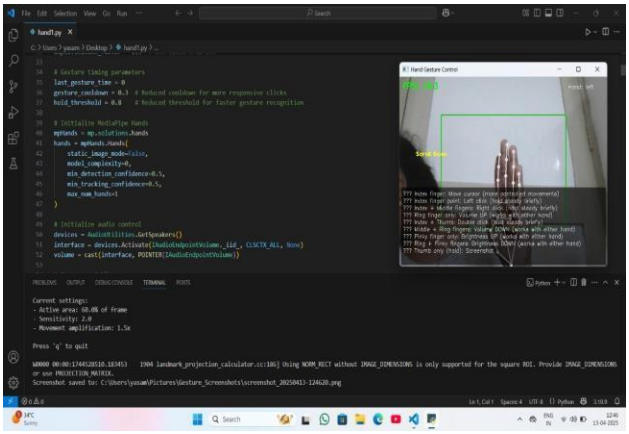

Fig 1: Scroll Down

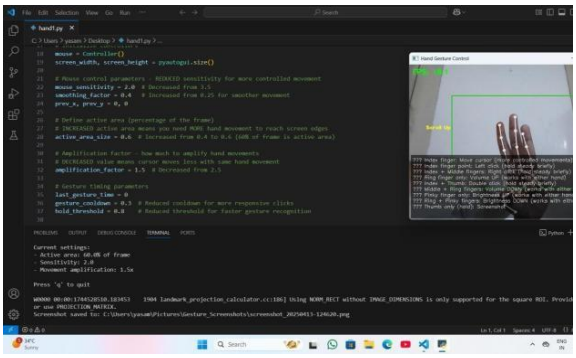

Fig 2: Sroll Up

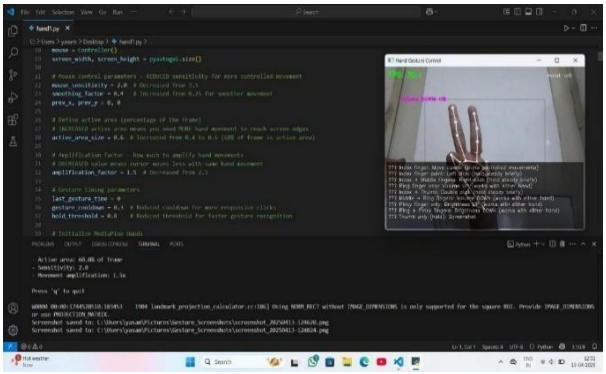

Fig 3: Volume Down

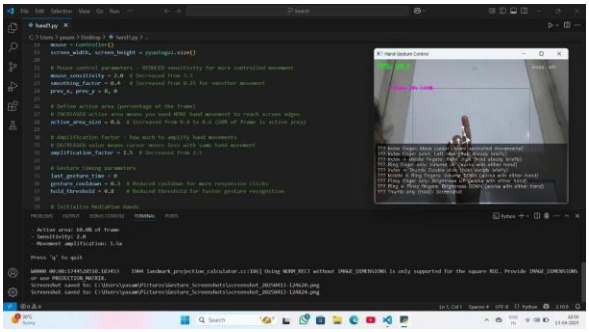

Fig 4: Volume Up

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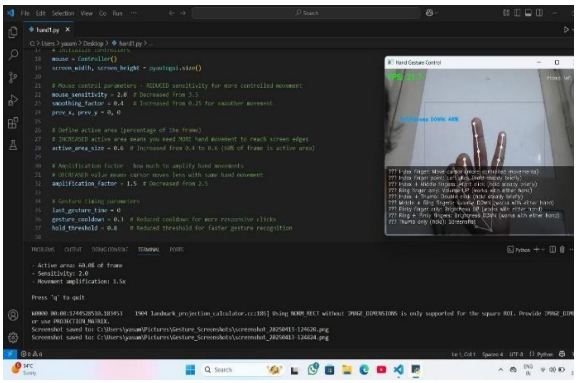

Fig 5: Volume Down

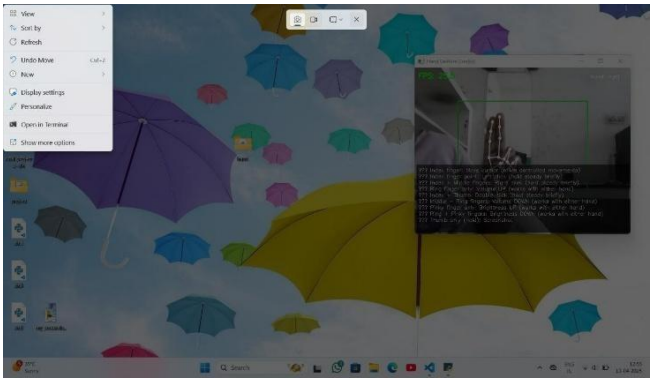

Fig 6: Right Click

Fig 7: Left Click

Fig 8: Double Click

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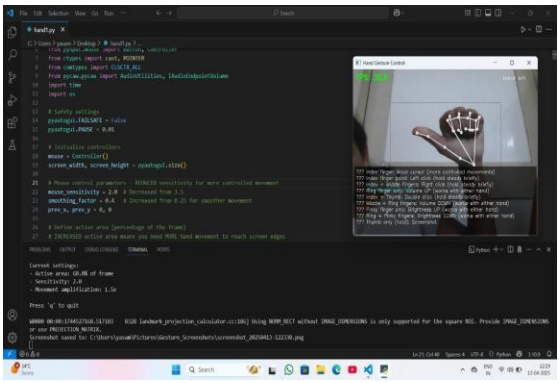

Fig 9: Screenshot

IX.CONCLUSION

The gesture recognition system offers a very intuitive and effective means of controlling a computer through hand movements alone, without the use of conventional input devices. By utilizing MediaPipe for hand tracking and combining modules such as pyautogui, pycaw, and screen_brightness_control, the system accurately captures a variety of gestures— ranging from finger combinations to hold periods—to perform operations such as clicking, scrolling, volume and brightness adjustments, screenshots, and even application closing.

FUTURE SCOPE

Smart Home Automation: Integrate the virtual mouse with smart home automation systems to enable users to control devices using hand gestures.
Voice Commands: Integrate voice commands to enable users to interact with the virtual mouse using voice inputs.

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