MAJOR-1 PROJECT

End Term Report

For

Project Title

Gesture Mote: Enabling Hands-Free Computer Interaction

Submitted By

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Synopsis Report

1. Project Title:

Gesture Mote: Enabling Hands-Free Computer Interaction

This name combines the concepts of gestures (hand signals) and remote control (mote) to convey the essence of your project, which is using hand gestures to control a computer without physical contact.

2. Abstract:

This project focuses on the development of a gesture recognition system that enables a computer to interpret hand movements captured by a webcam. Leveraging the power of Python and OpenCV technology, this innovative approach enables the computer to identify and respond to various hand gestures, such as waving and pointing, thereby providing an intuitive means of controlling the computer.

The application of this technology spans across diverse domains where computers are utilized. A notable application is the potential replacement of conventional computer mice with hand gestures, allowing users to perform actions like clicking, dragging, and scrolling through simple hand movements. This not only enhances user experience but also eliminates the need for physical peripherals, reducing clutter and promoting a cleaner workspace.

Furthermore, this technology has the capacity to revolutionize the world of video gaming. Instead of relying on traditional game controllers, gamers can immerse themselves in a more interactive and enjoyable gaming experience by controlling the game using hand gestures. This not only adds excitement to gaming but also enhances user engagement and immersion.

Additionally, the project delves into the realm of gaming, transforming the conventional gaming experience. Instead of relying on a handheld controller, users can control games through intuitive hand movements, enhancing immersion and enjoyment. This innovative approach opens up new possibilities in the gaming industry, paving the way for more interactive and engaging gameplay experiences.

In summary, this project not only demonstrates the technical prowess of Python and OpenCV but also showcases the potential of gesture recognition technology in revolutionizing how we interact with computers and digital interfaces. Its applications in diverse fields, from everyday computing tasks to the gaming industry, mark a significant step forward in enhancing user convenience, interactivity, and public health.

3. Introduction:

Human-computer interaction is a growing field in which computer scientists study novel ways in which humans can interact with computers naturally and intuitively. One of the most widely researched topics in this field is hand gesture recognition, where hand movements are used to control computers.

Years and years prior, utilizing PCs was so difficult and complex that anyway researchers couldn't really utilize them. Yet, presently with the progression of time and to manage the require all our circles of presence, the use of PCs has wound up so natural that everyone can utilize it. As of now, a mouse or console is being utilized to associate with the PC. At times it appears to be awkward in light of the fact that individuals would rather not get off from where they are sitting or lying. A signal acknowledgment framework gives a characteristic, imaginative, and current method of non-verbal correspondence.

Motion is an indication of actual way of behaving or an outflow of sentiments. This includes the development of the body and hand. It fell into two classes: static motion and liquid signal; for the previous, body stance or hand signal indicates an image.

It has been ages since we have been utilizing hand motions for conveying in human culture. The shaking of hands, Thumbs up and Thumbs down signs have been truly existing in the climate. It is accepted that signals are the most straightforward method of collaboration with anybody. So why not matter it to the machines that we are utilizing. In this work, we are illustrating, genuine motion. The underlying arrangement incorporates a minimal expense USB web camera that can be utilized for giving the contribution to the framework. The total interaction is partitioned into 4 stages which are outline catching, picture handling, district extraction, include coordinating. To the limit, it can likewise be called as equipment since it involves a camera for following hands . Point and objective of exploration work incorporate

- For most laptop touchpad is not the most comfortable and convenient.
- Main objective pre-processing is to represent the data in such a way that it can be easily interpreted and processed by the system.
- Reduce cost of hardware. It focuses on extracting the features over the human hands and then matching their features to recognize the movement of the hand.

Project essential feature-

- User friendly.
- Portable.
- Handle simple operation left-click dragging, minimizing.
- No hardware

The key problem in gesture interaction is how to make hand gestures understood by computers. The approaches present can be mainly divided into "Data-Glove based" and "Vision-Based" approaches. The Data-Glove-based methods use sensor devices for digitizing hand and finger motions into multi-parametric data. The extra sensors make it easy to collect hand configuration and movement. However, the devices are quite expensive and bring much cumbersome experience to the users. In contrast, the Vision-Based methods require only a camera, thus realizing a natural interaction between humans and computers without the use of any extra devices. These systems tend to complement biological vision by describing artificial vision systems that are implemented mostly in software. This approach is the cheapest, and the most lightweight. Moreover, such systems must be optimized to meet the requirements, including accuracy and robustness.

The existing system consists of a mouse that can be either wireless or wired to control the cursor, know we can use hand gestures to monitoring the system. The existing virtual mouse control system consists of the simple mouse operation using the colored tips for detection which are captured by web-cam, hence colored fingers acts as an object which the web-cam sense color like red, green, blue color to monitor the system, whereas could perform basic mouse operation like minimize, drag, scroll up , scroll down , left-click right-click using hand gestures without any colored finger because skin color recognition system is more flexible than the existing system. In the existing system use static hand recognition like

fingertip identification, hand shape, Number of fingers to defined action explicitly, which makes a system more complex to understand and difficult to use.

The goal of Hand gesture recognition is to establish a complete system for detecting, recognizing, and interpreting gesture recognition through computer vision using Python and OpenCV techniques. To establish a people-friendly system to aid in the ease of living of the challenged people. Then, the palm and fingers are segmented to detect and recognize the fingers. Finally, a rule classifier is applied to predict the labels of hand gestures.

The scope of this project is to create a method to recognize hand gestures, based on a pattern recognition technique. Hand gestures can be used as an alternative input device that enables interaction with a computer without a mouse or keyboard, such as dragging, dropping, and moving files through the desktop environment, as well as cut and paste operations. Moreover, they can be used to control slide show presentations.

4. Literature Review:

Mitra, S.; Acharya, T. Gesture recognition: A survey. IEEE Trans. Syst. Man Cybern. Part C Appl. Rev. 2007, 37, 311–324. [1]	• The paper presents a vision-based character recognition system using a CMOS camera on an FPGA chip. It records key features from fingertip-written characters and achieves nearly 100% accuracy in recognizing digits and small lowercase letters. • This system provides an easy-to-use and highly accurate method for inputting characters.
Akira Utsumi, TsutoniuMiyasato, Fumio KishinoandRyoheiNakatsu, "Real-time Hand Gesture RecognitionSystem," Proc. of ACCV '95, vol. 11, pp. 249-253, Singapore,1995. [2]	• Gesture recognition is a vital part of Human-Computer Interaction (HCI), allowing computers to understand and act on human gestures using body, face, and hand movements. • -This survey paper discusses techniques and algorithms for gesture recognition, emphasizing their role in creating user-friendly interfaces for HCI.
Yikai Fang, Kongqiao Wang, Jian Cheng And Hanqing Lu, A Real- Time Hand Gesture Recognition Method, Â©2007 Ieee. [3]	• The paper "A Real-Time Hand Gesture Recognition Method" by Fang, Wang, Cheng, and Lu (2007) introduces a real-time hand gesture recognition approach using computer vision. • The method is designed for Human-Computer Interaction (HCI), enabling real-time interpretation of hand gestures for commands or instructions, likely discussing relevant techniques, algorithms, and results in the field of gesture-based technology.

5. Problem Statement:

The goal of our project is to create a system that can understand and interpret hand movements using a computer program called Python and a technology called OpenCV. This system aims to make life easier for people who face challenges in using a physical computer mouse.

This AI-powered virtual mouse system can be used in real-life situations where there's no space for a physical mouse or for individuals who have hand-related difficulties. Especially during the COVID-19 pandemic, it's not safe to touch shared devices because it can lead to the spread of the virus. This proposed AI virtual mouse solves these issues by using hand movements and fingertip detection to control computer mouse functions through a webcam or built-in camera.

6. Objectives:

- To develop a virtual mouse to address the problem of preventing the spread of diseases, like COVID-19, by offering a way to use a computer without physically touching it.
- Helping people who have difficulty using a regular computer mouse.
- Recognize specific hand gestures for device control.
- Achieve real-time gesture recognition.
- Control the computer without a keyboard and physical mouse.

7. Methodology:

In this project, we use the Otsu Thresholding Algorithm to distinguish between hand and background in images. It utilizes a webcam to capture frames that are processed using OpenCV. The system recognizes hand gestures and fingertip positions to perform various mouse functions. For instance, moving the cursor is done by raising specific fingers, left and right clicks depend on finger distances, and scrolling involves finger movements. Python packages like OpenCV, AutoPy, pynput, and PyAutoGUI enable these functions.

Step 1: Choose Simple Gestures

- First, we select easy and distinct hand movements for controlling the system.
- These gestures should be user-friendly and different enough from each other to make it easy for the system to recognize them.

Step 2: Use OpenCV for Algorithm Implementation

- Next, we use OpenCV to create the necessary algorithms for image processing and gesture recognition.
- The program does the following: it captures gestures through a webcam, prepares an image for labelling and detecting hand landmarks, extracts features from MediaPipe for recognizing the gestures, and finally, provides the recognized gesture or command as the output.

OPENCV

It's a library of Python ties intended to tackle PC vision issues. It is utilized for picture handling and performing PC vision undertakings. It upholds a wide assortment of programming dialects like Python, C++, Java, and so on. It assists us with gaining picture handling from essentials to progress. Assuming that it gets incorporated with numpy, other development libraries and profoundly streamlined for mathematical tasks, then, at that point, the quantity of weapons increments.

PyAutoGUI

It is a cross-stage GUI robotization Python module for people. Used to automatically control the mouse and console.

The three significant working frameworks each have various approaches to control the mouse and console automatically. This can frequently include befuddling, and profoundly specialized subtleties.

The occupation of PyAutoGUI is to conceal all of this intricacy behind a straightforward API.

• On macOS, PyAutoGUI utilizes the rubicon-objc module to get to the Cocoa API.

• On Linux, PyAutoGUI utilizes the Xlib module to get to the X11 or X Window System.

• On Windows, PyAutoGUI gets to the Windows API (additionally called the WinAPI or win32 API) through the underlying ctypes module. The nicewin module at https://github.com/asweigart/nicewin gives an exhibition to how Windows API calls can be made through Python.

Pynput

A library allows us to control and monitor/listen to your input devices such as they keyboard and mouse. Allows us to monitor the mouse. A library of Python that can be used to capture keyboard inputs.

It contains subpackages for each type of input device supported:

pynput.mouse

Contains classes for controlling and monitoring a mouse or trackpad.

pynput.keyboard

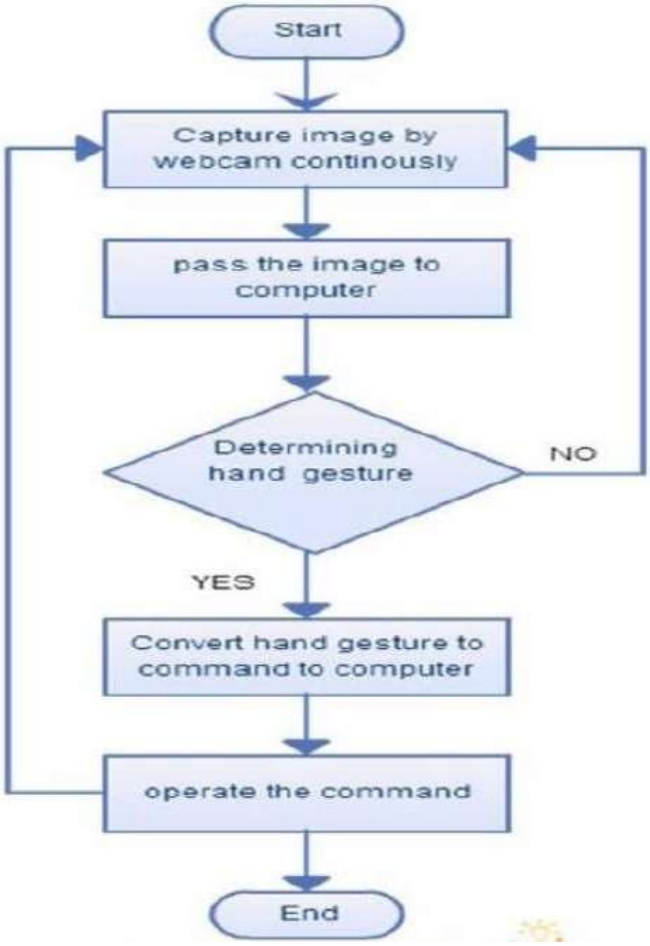


Fig 1. Flowchart showing the steps followed in the project

8. PERT Chart

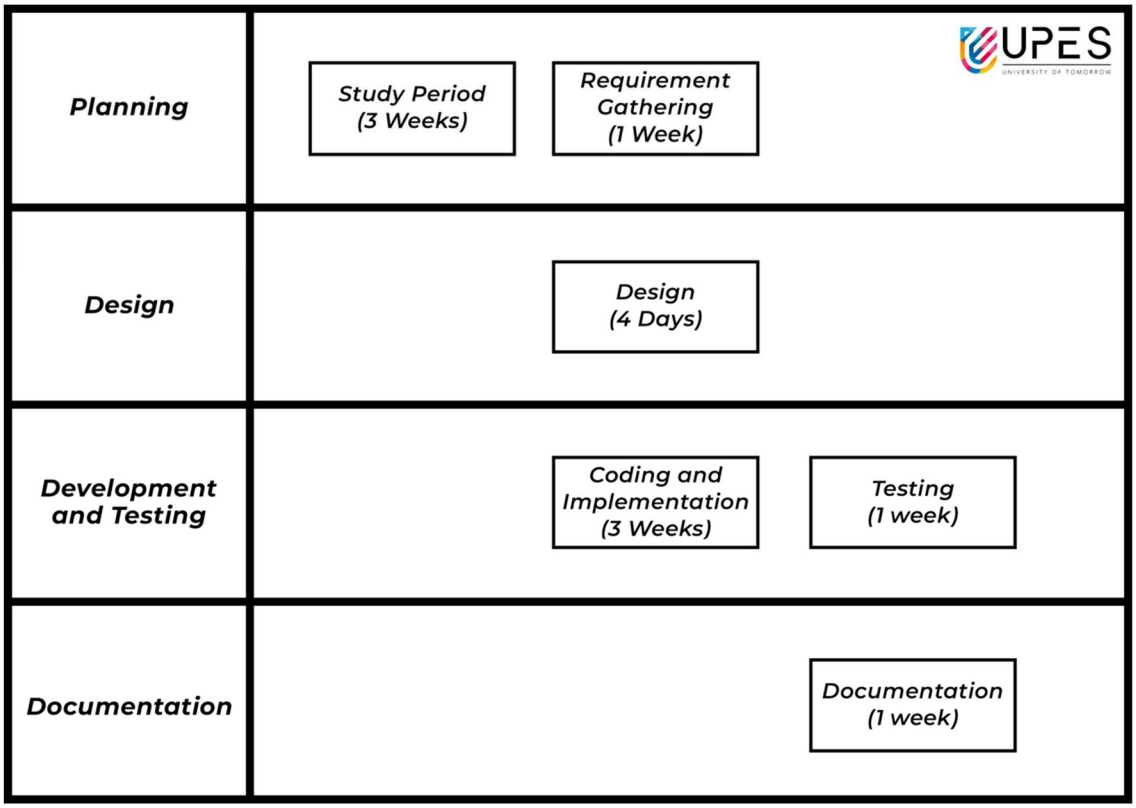
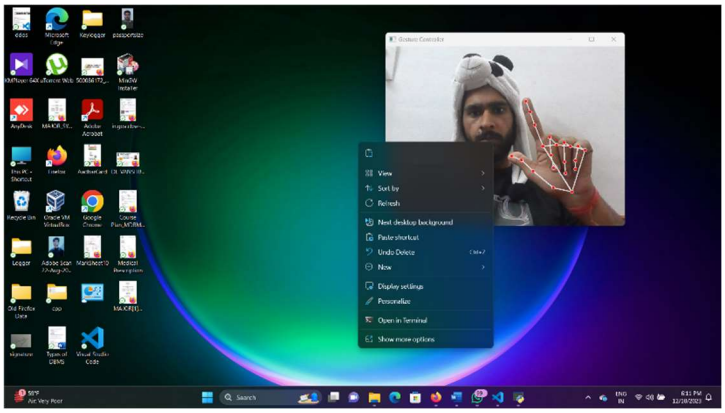
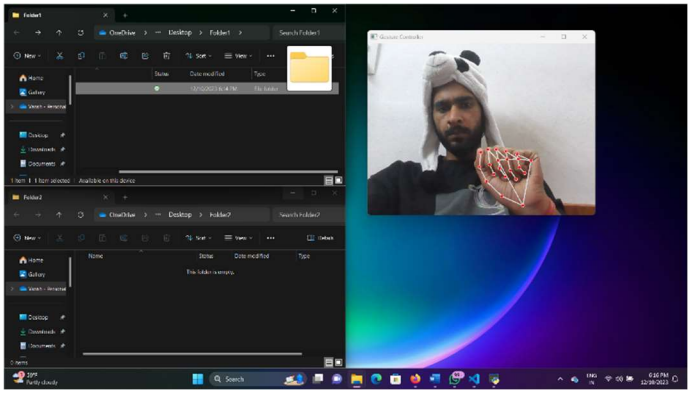
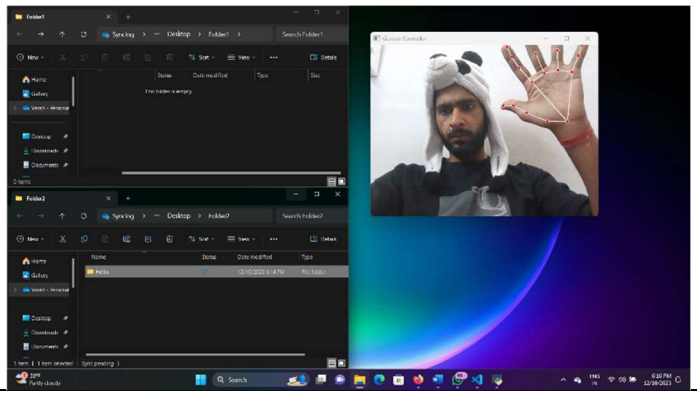
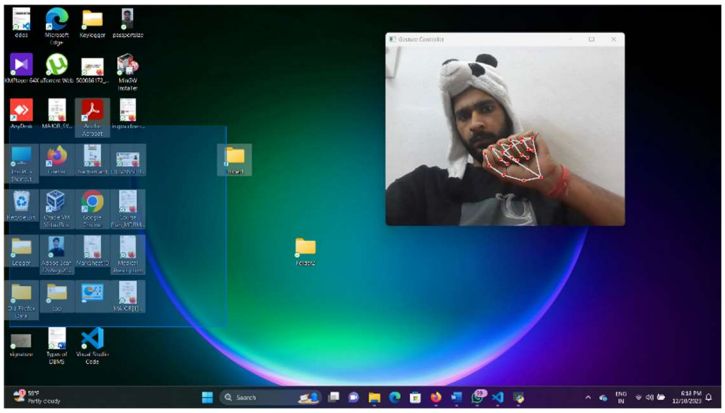
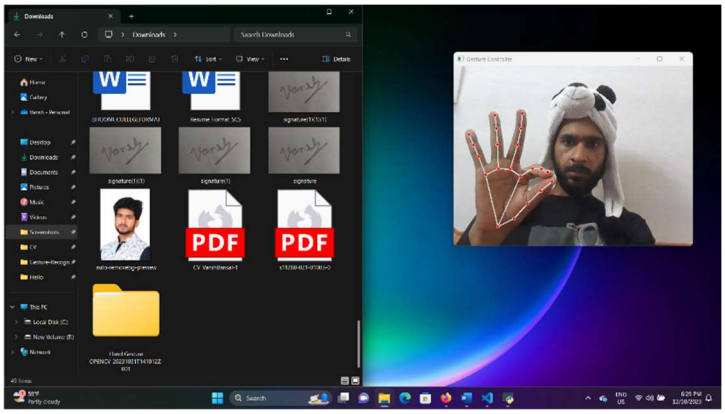


Fig.2 Program Evaluation Review Technique Chart

9. Results:

GESTURE	DESCRIPTION	SYMBOL
Neutral Gesture	Used to halt/stop the execution of the current gesture. **Procedure:** Show a palm on the camera, which halts the execution.	
Move Cursor	The cursor is assigned to the midpoint of the index and middle fingertips. This gesture moves the cursor to the desired location. The speed of the cursor movement is proportional to the speed of the hand. **Procedure:** Open the first two fingers (showing a "V" sign) on the camera, and it will help to move the camera.	
Left Click	Gesture for single left click. **Procedure:** Lower down the forefinger, to perform the left-click option.	

Right Click	Gesture for single right-click. **Procedure:** Lower down the middle finger, to perform the right-click option.	
Double Click	Gesture for double click. **Procedure:** Join both the fore and middle finger and show on the camera to perform a double click on an icon.	
Drag and drop	Gesture for drag and drop functionality. Can be used to move/transfer files from one directory to other. **Procedure:** Open a folder from where to select a file, and open another location where to paste that file. Close the fist and select the file and hold and move to the location of where to paste and then open the fist and show a neutral gesture.	 

Multiple Item Selection	Gesture to select multiple items. **Procedure:** Close the fist and move around the fist on the screen to select the multiple files.	
Page Up Down	Dynamic Gestures for Page Slider control. The rate of increase/decrease of speed is proportional to the distance moved by the pinch gesture from the start point. **Procedure:** Open the Page in the system, using the move cursor gesture, and then join the fore finger and the thumb and move upwards or downwards to increase or decrease the Speed of Page shift.	

10. References:

[1] Zhigang, F. Computer gesture input and its application in human computer interaction. Mini Micro Syst.1999, 6, 418–421.

[2] Mitra, S.; Acharya, T. Gesture recognition: A survey. IEEE Trans. Syst. Man Cybern. Part C Appl. Rev. 2007, 37, 311–324. [CrossRef]

[3] Akira Utsumi, TsutoniuMiyasato, Fumio KishinoandRyoheiNakatsu, “Real-time Hand Gesture RecognitionSystem,” Proc. of ACCV ’95, vol. 11, pp. 249-253, Singapore,1995

[4] Yikai Fang, Kongqiao Wang, Jian Cheng And Hanqing Lu, A Real- Time Hand Gesture Recognition Method, Â©2007 Ieee

11. GitHub Link:

https://github.com/vansh029/GestureMote