AI Based Virtual mouse.

Group - 2.

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Abstract

This project promotes an approach for the Human Computer Interaction (HCI) where cursor movement can be controlled using a real-time camera; it is an alternative to the current methods including manual input of buttons or changing the positions of a physical computer mouse. Instead, it utilizes a camera and computer vision technology to control various mouse events.

Keywords - open-cv, AI, mediapipe , numpy, Pyautogui

Introduction -

With the development of technologies in the areas of augmented reality and devices that we use in our daily life, these devices are becoming compact in the form of Bluetooth or wireless technologies. This paper proposes an AI virtual mouse system that makes use of the hand gestures and hand tip detection for performing mouse functions in the computer using computer vision. The main objective of the proposed system is to perform computer mouse cursor functions and scroll functions using a web camera or a built-in camera in the computer instead of using a traditional mouse device. It also aims to reduce the hardware required for a traditional pc.

Using finger detection methods for instant camera access and user-friendly user interface makes it more easily accessible. The system is used to implement motion tracking mouse, a signature input device and an application selector. This system reduces the use of any physical mouse which saves time and also reduces efforts.

Objectives -
- Create such an application which is part of AI.
- To design to operate with the help of a webcam.
- Users should be able to easily install it on their computer.
- To design a virtual input that can operate on all surfaces.

Pre-requisites-
- Should have installed python.
- Import all the specified module in the program using the command
  pip install <module name>
- Import medipipe.
- Import pyautogui
- Import numpy
- Webcam

Mouse functions -
If the index finger is up with tip Id = 1 the mouse cursor is made to move around the window of the computer using the pyautogui package of Python, as shown in Figure.
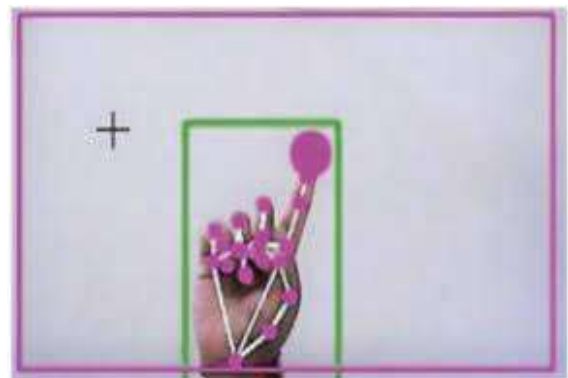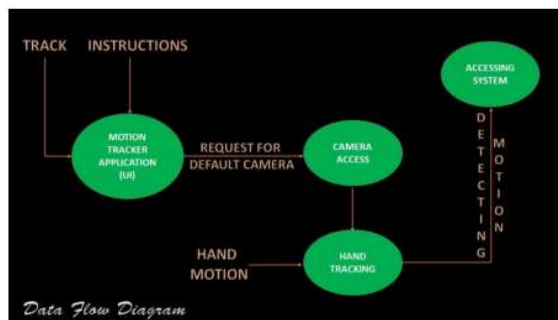

The normal movements of the mouse pointer are managed by the movements of the index finger (Id = 1)

The left click by the least distance between fingers representing Id = 1 and Id = 2.
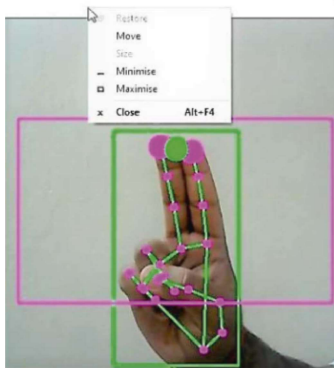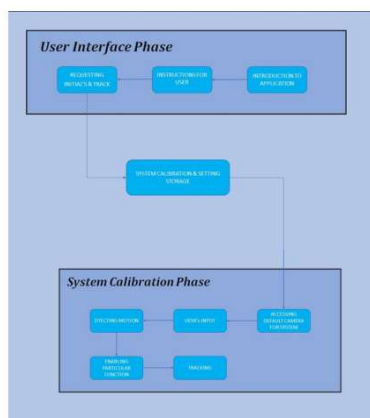
Methodology

a) Data Flow Diagram (DFD)

b) Proposed System Block Diagram

c) Algorithm for the model

There are broadly two parts to implement this model -

- First, we design and code a hand tracking module which traces the movement of our hand which controls the pointer. And its representation on the screen.
- Then we move on to the functions depicted by our hand movements. Here, we try to assign functionality corresponding to the particular movement of our fingers.

Hand tracking module -

Here we import the basic python modules required for hand tracking.

```
import cv2
import time
import mediapipe as mp
import math
import numpy as np
```

Opencv module is used for hand detection.
Initially we convert the input image (from the webcam which is in bgr format) to rgb format as hand recognition works only for rgb format images.

After detection we move on to the plotting part. Here we plot the joints of our hand inorder to convert them to landmarks which can be traced further.

After this we check for fingers which and how many are open, i.e., used for movement of the cursor and their respective positions with regard to each other and the surroundings. Then we proceed to find the distance between two fingers in order to perform a click operation. The distance is measured by the relative distance between the plotted circles of the two fingers.

TABLE 1
Hand Tracking Functions Created And Their
Use

Name	Description
def findHands(self,img, draw=True)	Process the input image and mark the joints of our hands.
def findPosition(self,img ,handNo=0,draw=Tr ue)	Find the coordinates and pixels of each landmark.
def fingersUp(self)	Checking which finger is open for use.
def findDistance(self, p1, p2, img, draw=True,r=15,t=3)	Find the distance between the landmark points
def main()	To implement other functions.

AI Virtual Mouse

The basic modules required for AI Virtual Mouse are -

```
import cv2
import time
import handtrackingmodule as htm
import numpy as np
import pyautogui
```

Here the handtrackingmodule is a module created by us.

This python file is the final implementation of our entire project. In this all the earlier methods are brought together to give us the complete model.

In this function we focus mainly on live video tracking our hand and the control of the pointer granted to us by it.

Then we check how many fingertips are up in order to know which operation is being performed by the user.

For the case of a single fingertip we are to perform a cursor movement operation. Performing the cursor up operation is simple enough but for downward movement we have to specify the region of the setting.

We also have to convert the size of our virtual window as the screen is full hd but the size of the window is 640*480 only. We also smoothen the movements of the cursor according to our requirements and then use pyautogui for moving the cursor in accordance with the movement of our finger.

Implementing the click mode is relatively simple as we just check for the minimum distance between two fingers for left clicking.

Components used

1- MediaPipe
MediaPipe is a framework which is used for applying in a machine learning pipeline, and it is an open source framework of Google. The MediaPipe framework is useful for cross platform development since the framework is built using the time series data.The steps involved in the system that uses MediaPipe are carried out in the pipeline configuration. The pipeline created can run in various platforms allowing scalability in mobile and desktops. The MediaPipe framework is based on three fundamental parts; they are performance

evaluation, framework for retrieving sensor data, and a collection of components which are called calculators, and they are reusable.

2-Opencv

OpenCV is a computer vision library which contains image-processing algorithms for object detection . OpenCV is a library of python programming language, and real-time computer vision applications can be developed by using the computer vision library. The OpenCV library is used in image and video processing and also analysis such as face detection and object detection
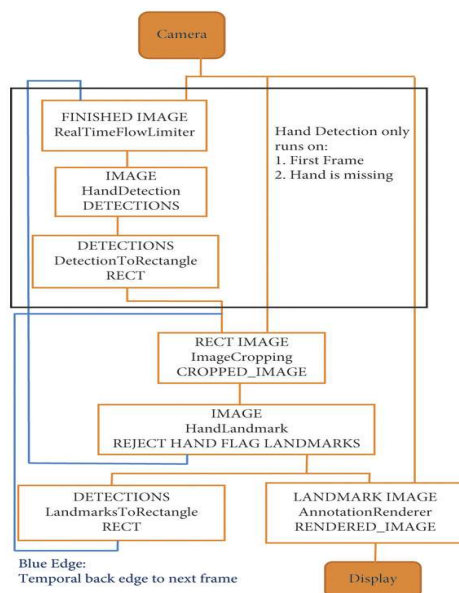
3-PyAutoGUI

PyAutoGui lets the python program scripts control the mouse and keyboard to automate interactions with other applications. It's main features are: moving the mouse, sending keystrokes,taking screenshots, locating an application's window and moving, resizing, maximizing or closing it.

The three major OS(windows , macOs and Linux) each have different ways to control the mouse and keyboard.This can often involve confusing and obscure details. The job of

PYautoGUI is to hide all complexity behind a simple API.

4-NumPy

NumPy offers comprehensive mathematical functions. It is a python library used for working with arrays. It can be useful for working in the domain of linear algebra ,fourier transformation and matrices. NumPy stands for Numerical Python.

The array object in NumPy is called ndarray, it provides a lot of supporting functions that make working with ndarray very easy.

5- WebCam

A webcam is a digital video device commonly built into a computer. It's main function is to transmit pictures over the internet.It is popularly used in instant messaging services and for recording images.

In our project Webcam is used for image processing ,the webcam will continuously take image in order for the program to process the image and find pixel positions

6-Python

Python is commonly used for developing websites and software, task automation and data visualization.

Our source code is written in high level python programming language.
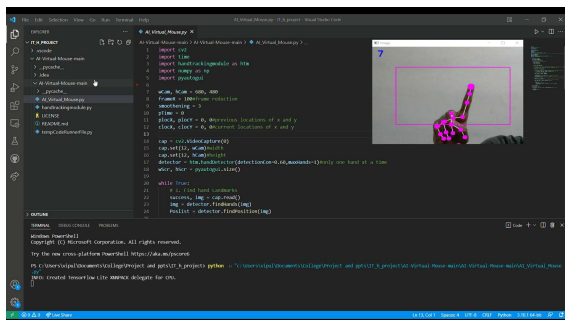
7- Raspberry pi(optional)

Raspberry pi is a tiny computer. It is used to learn programming skills, buit hardware projects, do home automation and edge computing. We can also use them in industrial applications.
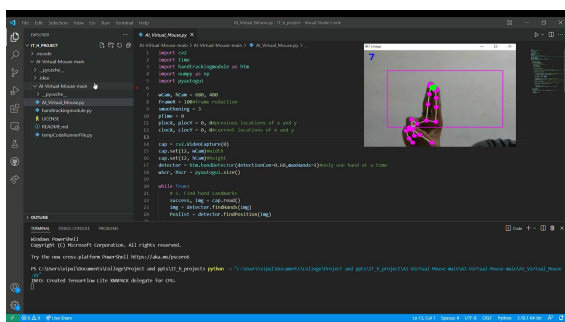
Observations

Implementing the python in vs code:
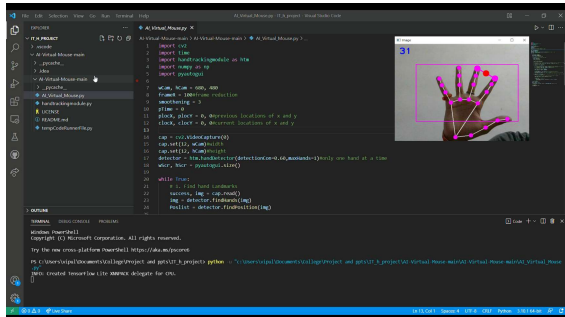
Here, we can see that all the joints of our hands are plotted.

Here, the movement of the cursor is controlled by the tracking and movement of our single finger.

Here, the clicking operation is performed by the least distance between two fingers.

Conclusions

From the results of the model, we can come to a conclusion that the proposed AI virtual mouse system has performed very well and has a greater accuracy compared to the existing models and also the model overcomes most of the limitations of the existing systems. 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.

This model has some limitations such as inaccuracy in the right click and no provision of the scroll function.Hence,we will work next to overcome these limitations by improving the fingertip algorithm.

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"We will be forever grateful for everything that our college provides to us".

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