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HumanComputerInteraction:GestureMouse

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ABSTRACT

Inthe newageofInnovation,remotemouseoracontactlessmouseutilizesgadgets,sinceitutilizes power from the gadget sources like battery and gain extra space. During COVID pandemic it is encouraged to makesocial separationand keep awayfrom contact things. This paper proposes a wayto control the position of cursor with the bare hands without touching any electronic devices. In this way it makes Human-Computer Interaction simple by using hand gestures. As computer technology is growing up, HCI is rapidly increasing. By using Hand Gestures, we can perform all basic mouse functions (Left-right click, Double click, Drag and copy, etc). This system takes frames using Webcam or built in camera. It can be an alternative way for traditional touch screen. This project makes use of Machine Learning and computer vision algorithms to recognize hand gestures which work smoothly. Our goal of AI Virtual Mouse is to form a replacement for the traditional mouse system that can perform mouse functions. We used Python

programming language for implementation of this project.

Keywords:*Handgestures,AI,Media-Pipe,Open-CV,VirtualMouse,HCI(Human–ComputerInteraction).*

INTRODUCTION

Inthistechnologicalworld,it'salmostimpossibletoimaginelifewithoutcomputers.Theinventionofcomputersiso ne ofthegreatestinventions ofhumankind.Indailylife,weinteractwithcomputerstomakeourtaskseasier.Thus Human- Computer Interaction has become a treading topic for research.

Vision and gestures areimportant approaches for communication amonghuman beings and the same role is played bythe mouse in GUI (Graphical User Interface) computers. So a combined methodology can be used to make a better interactive system for Human-Computer Interaction devices.

We can interact with mouse byusing hand gestures. Basically,Gestures is a movement ofhand, orother bodypart that is intended to indicate something.

In this project, a finger tracking based virtual mouse application will be designed and implemented using a webcam. To implement this, we use Artificial Intelligence object tracking concepts such as Open-CV python, Media-pipe, PyAutoGUImoduleof python. The processing of images and videos and capturing

activities like face and object detectionallmakesusesofOpen-CVpackage.Forhandtrackingandhandtricksweusedl MediaPipe.Additionally,the desktop window operations like scrolling and left-and right-clicking are carried out using the Autopy and PyAutoGUIpackages.

Thistechnologyisquiteefficientandhelpstoprovidequicksolutionsto AIprojects.

Requirements

- PythonVersion3.8.5
- MinimumRAM4gb
- Webcam
- CodeEditor(VS code)

Objective

1. Tocreateasystemwhich won'trequireanyhardwaretooperatethe mousein thiswayitwillreduce hardware cost.
2. Tofindalternativewaystouseatpublic placestoreducethespreadofvirus through touch.

LimitationsofExistingSystem

- The existing systems are our traditional hardware mouse system either wire or wireless. This means the actual hardwarerequirede.g.forwiremouseitrequireswiretoconnectwithdevicesanditalsorequiremousesensors (CMOS sensor) for detecting the surface, this means physical mouse also require flat surface to operate.

- Other existing virtual mouse controls consist of simple mouse operation which uses colored tips like red, green, bluecolor.Thesecoloredfingersactasanobjectthatwebcamsensestocaptureactionandthenimageprocessing technique is applied.
- Someexistingsystems usea fewfingerstoperformspecificoperations.Suchsystemsaremorecomplex to use.

ProposedSystem

There is no specific algorithm which we have used for virtual mouse but there is some python in builds modulesusedwhichwillhelpinprocessingthissystem.ThemodulesnamesareOpenCV,MediaPipe,PyAutoGUI, and maths.

AlgorithmUsedforHandTracking

The system will be taking the real- time video as a input from the webcam and converting it into the array form tofindthecoordinatesoftheframe.Thesecoordinateswillhelptheprogramtolocatethefingersinanaccurateposition. By identifying the finger position, the system will perform certain functions.

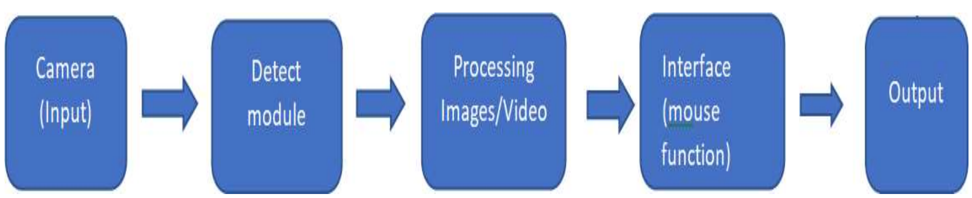


***Fig.1**:BlockdiagramforSystem*

AboutMediaPipe:

MediaPipe is an open-source framework developed by Google that enables the development of multimodal machine learningpipelines.Itisdesignedtobeflexible,scalable,andhigh-performanceanditcanbeusedtobuildawiderange of applications that involve real-time video and audio processing. Some examples of the types of applications that can be built with Mediapipe include:

- Gestureandhandtracking
- Facedetectionand recognition
- Objectrecognitionandtracking

- Augmented reality
- Audiorecognitionandtranscription
- Speechrecognition

Italsoincludestoolsforvisualization,debugging,andprofiling.Mediapipeiscross-platformandcanbeusedona variety of devices, including mobile phones, tablets, and desktops.

Fig.2:*HandLandmarkspointusedbyMediapipe*

Open-CV Module

Computer vision is a process by which we can understand the images and videos how they are stored and how we can manipulate. Computer Vision is the base or mostly used for Artificial Intelligence. Computer-Vision is playing a major role in self-driving cars, robotics as well as in photo correction apps.

OpenCV (Open-Source Computer Vision) is a free and open-source library of computer vision and machine learning algorithms. It is designed to provide developers with an easy-to-use interface to develop applications that process visual data, such as identifyingobjects, facial recognition, and image stitching. It was used to construct the AI virtual mouse system. It builds real-time computer vision applications. It is a huge open-source library for computer vision, machine learning and image processing and now it plays a major role in real-time operation, which is very importantintoday'ssystems.Whenitis integratedwithvariouslibraries,suchasNumPy,pythoncan process the OpenCV array structure for analysis. To identify image pattern and its various features we use vector space and perform mathematical operations on these features.

Working/Methodology

A. Creatingthespaceforthesystemandgettingnecessarylibraries

WeuseVScodeforcreatingourproject.Weinitializeourworkspaceandinstallallournecessarylibraries (Open CV, Mediapipe, and Autopy) in VS code. Then we import this libraryin our program.

B. GettingtheWebcamready

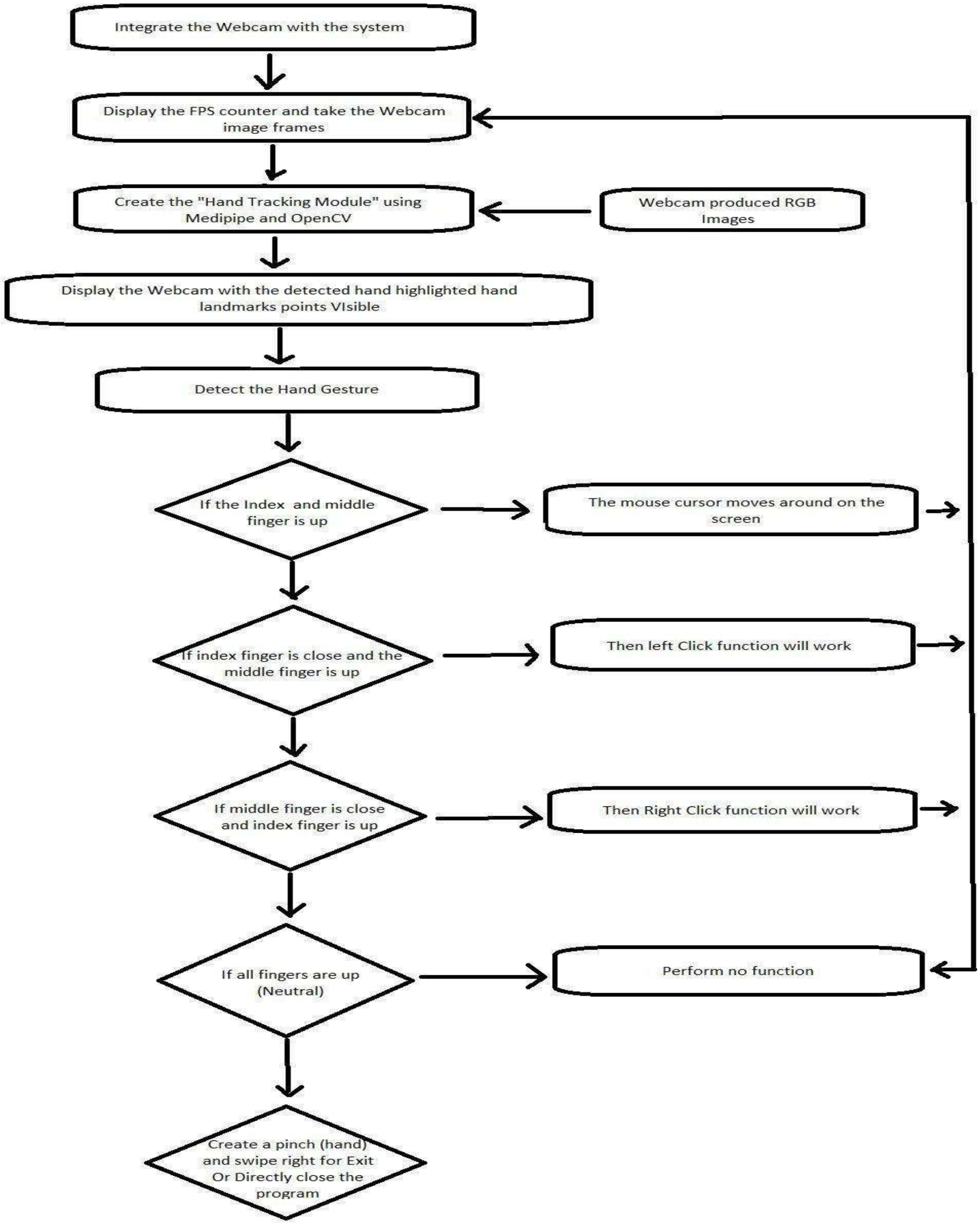
Inthisstep,weinitializethewebcamofoursystemtoopenandfunctionouraccordingtoourrequirements.

While writing the code, we give the default ‘0’ value in the webcam code, depending on the number of capturingdevices.Now wewriteasimplecodewhichgivesthereal-timeframesofthewebcamwhichisdisplayed on screen. This helps to check how the webcam will work smoothly.

C. HandTrackingModule

Afterthevideo-capturingdeviceisset,westartbywritingourhanddetectioncode. Itincludesgettingthenecessary 20landmarkpointsofthehandwhichhelpsthe gettingthepositionoffingers.WeuseMediaPipeforthisprocess as it makes is easier for us to work. We set names for left and right hands such as “major” for right hand and “minor”forlefthandinfunction.Afterthis,thecoordinatesystemgivescoordinatesvaluesforourfingerswhich arestoredintheformofanarray.Inthisway,wedefinethevariousfunctionalitiesofamouseinourhandtracking system. This is done by implementing various hand gestures for certain functions.

ActivityDiagram:


Integrate the Webcam with the system
Display the FPS counter and take the Webcam image frames
Create the "Hand Tracking Module" using Medipipe and OpenCV
Webcam produced RGB Images
Display the Webcam with the detected hand highlighted hand landmarks points VIsible
Detect the Hand Gesture
If the Index and middle finger is up
The mouse cursor moves around on the screen
If index finger is close and the middle finger is up
Then left Click function will work
If middle finger is close and index finger is up
Then Right Click function will work
If all fingers are up (Neutral)
Perform no function
Create a pinch (hand) and swipe right for Exit Or Directly close the program

HandGestures:

- **HandLandmarksdetection(Neutral)**

Above fig shows, the detection of landmarks which also detect cursor (allfingers is up). This type of gesture doesn't perform any function (Neutral).

Fig.4:HandLandmarksdetection

- **CursorMove**

Fig.5:Cursor move

Abovefigshows,cursormovinghandgestures.Thishandgesture(one index and one middle finger is up) moves cursor on the computer screen and performs all basic mouse functions.

- **LeftClick**

Abovefigshows, Leftclick.Thishandgesture(onemiddlefingerup) can perform left click just like traditional mouse.

Fig.6:Left Click

- **RightClick**

Fig.7:RightClick

Abovefigshows,rightclick.Thishandgesture(oneindex fingerup)can performrightclickjustliketraditional mouse.

- **DoubleClick**

Abovefigshows,doubleclick.Itcanbeperformedbybothmiddleandindex finger up then take both fingers close to each other.

Fig.8:Double Click

- **DragandCopy**

Above fig shows, Drag and copy gesture. This can be performed by takingcursortoanyfileandonthatfilecreateapunchfordragging and copy where you want.

Fig.9:Dragand Copy

- **VolumeControl**

Above fig shows, Volume Control gesture. This can be performed bycreating a pinch of hand just like the above picture, forlowvolumemovethisgestureslightlydownandforhigh volume move this gesture slightly up. In this way we can control the volume of our system.

Fig.10:VolumeControl

- **Exit Control**

Above fig shows, exit program gesture.
Same as volume control but different infunction, create apinchof handjust like the above picture. But if u wants to exit program or switch off your virtualmousethenswipeyourpinchtotherightside, itwill close your virtual mouse.

Fig.11: Exit Control

Advantages

Themainadvantageistointeractwitha computerasanon-contacthuman computer. Italso increases:

Human Computer Interaction.

- Itreduceshardwarecostbyeliminatinguseofmouse(suchasUSBcable, Mouse sensors - CMOS).
- Convenient forusers.
- Wedon'tneedtocarryanywhereliketraditionalmouseandalsoreduce

space.

- System can be extending to eye recognition-based system where we can control thesystemwitheye.Thiswillbeefficientforhandicappedpeople

Disadvantages

- Sincethesystemisdependentonwebcam,indimlightthecameraisnot

abletocaptureanymovementorhandgesturedtoacertainextent.Butif we use day and night cameras it will work.

- Lessaccuracybutfastascomparedtotraditionalmouse.

Scope

The scope of this project is to develop AI Virtual mouse that will be operated without touching and devices. In this pandemic world, a touch less mouse will be useful to eliminatetheriskofspreadingviruses.Likeaself-ticketingsystematthe railwaystation, manypeopletouchthesamescreenwhichcanincreasethechancesofspreadingviruses. It can also improve the scope of HCI technology. In this way, Virtual mouse can be useful.

Conclusion

Since,wearedevelopedasystemtocontrolthemousecursorusingareal-timecamera. It is based on computer vision algorithms and can do allmouse functions. This system could be useful in presentation and to reduce workspace. Virtual mouse technologyis a useful tool for providing an alternative way to interact with a computer's GUI in situations where a physical mouse is not available or practical. It can also be used to makethecomputerexperiencemoreaccessibletopeoplewithdisabilities,ortoprovide additional functionality. The development of this technology will be key in helping users interact with their devices even more efficiently. However, there are also some challenges to using hand gestures to control a virtual mouse. One challenge is that it mayrequirealot oftrainingandpracticetobecomeproficient atusing hand gesturesto control the cursor accurately. This would lead to a new era of Human Computer Interaction (HCI) where no physical contact with the device is required.

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