Project Synopsis
on
Gesture-Controlled Virtual Mouse

Submitted as a part of course curriculum for

Bachelor of Technology
in
Computer Science

Submitted by
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DECLARATION

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

Signatures

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CERTIFICATE

This is to certify that the Project Report entitled "Gesture Controlled Virtual Mouse" which is submitted by Ayush Kumar and Deepanshu Singh in partial fulfilment of the requirement for the award of degree B. Tech. in Department of Computer Science of Dr A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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Last but not the least, we acknowledge our friends for their contribution to the completion of the project.

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ABSTRACT

A wireless mouse or a Bluetooth mouse still uses devices because a battery is needed for power and a dongle is needed to connect the mouse to the PC. The proposed AI virtual mouse system can solve this problem by using a webcam or built-in camera to record hand motions and identify hand tips using computer vision and with voice command. The computer can be controlled digitally and can do left-click, right-click, scrolling, and computer cursor functions based on hand motions without the need for a physical mouse. Deep learning is the basis for the hand detection method. The mouse is one of HCI's (Human Computer Interaction) incredible inventions. As a result, by eliminating human contact and the requirement for external devices to operate the computer. Gesture Controlled Virtual Mouse makes human-computer interaction simple by making use of Hand Gestures. All input/output operations can be virtually controlled by using static and dynamic hand gestures. The computer requires almost no direct contact. Therefore, they are not device-free. It leverages models such as CNN implemented by Media Pipe running on top of pybind11.

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CHAPTER- 1: INTRODUCTION

1.1 Introduction

Hand gestures are the simplest and most expressive form of human communication. They are universally understood and are such a kind of language that even dumb and deaf people can understand them. In experimental use, a web camera with a high-definition recording feature is mounted in a fixed position on top of the computer monitor. Red Green Blue [RGB] colour space is used to take snapshots from a set distance. Four phases, including picture pre-processing, feature extraction, feature matching, and region extraction, can be used to organise the task. The recognition and interpretation of sign language is the main barrier to communication with the deaf and hard of hearing.

1.2 Problem Statement

To design a virtual mouse which detects hand gestures and mouse operations only using fingers.

We used different combinations of fingers to perform various operations of mouse according to which particular combination of fingers is recognised without use of any device or sensors

1.3 Objective

Cursor Movement
Identifying Gesture and Performing Clicking Action
Finding Fingertips
Real time Video Capturing and Inverting Image
Movement with Voice command

1.4 Scope

This mouse system can be applicable to sign language for deaf & dumb people. It can help them to interact with computing machines.

Like HCI, the suggested technology may be used to control robots in the field of robotics. The system is capable of controlling robots and automation systems without the use of additional hardware.

CHAPTER- 2:LITERATURE REVIEW

Virtual Mouse Using Hand Gesture Recognition

In this paper is entirely device-free as a result. This issue can be resolved by the proposed AI virtual mouse system using a webcam or built-in camera to capture hand motions and recognise hand tips using computer vision. The machine learning algorithm is incorporated into the system's algorithm. Without a physical mouse, the computer can be handled digitally and can perform left-click, right-click, scrolling, and computer cursor tasks based on hand motions. The methodology used for hand detection is based on deep learning. Consequently, by removing The proposed technique will halt the spread of COVID-19 by limiting human contact and the need for external devices to control computers. A machine learning pipeline makes use of a Google framework called Media Pipe, which is designed for ASCII text files. The Media Pipe framework is helpful for cross-platform programming, provided it is made using statistical data. The Media Pipe is a multimodal infrastructure that is frequently used with a variety of audio and video files. The controlled AI virtual mouse technology is modelled after the frames that a laptop or PC's digital camera records. The video capture object is created by the OpenCV Python computer vision module, which prompts the web camera to begin recording video, taking pictures, and sending The proposed technique will halt the spread of COVID-19 by limiting human contact and the need for external devices to control computers. A machine learning pipeline makes use of a Google framework called Media Pipe, which is designed for ASCII text files. The Media Pipe framework is helpful for cross-platform programming, provided it is made using statistical data. The Media Pipe is a multimodal infrastructure that is frequently used with a variety of audio and video files. The controlled AI virtual mouse technology is modelled after the frames that a laptop or PC's digital camera records. The video capture object is created by the OpenCV Python computer vision module, which prompts the web camera to begin recording video, taking pictures, and sending It can be controlled virtually using hand gestures as opposed to the conventional physical mouse, preventing the spread of COVID-19.

Design and Development of Hand Gesture Based Virtual Mouse

OpenCV, a library based on computer vision, is used to construct this system in Python. The standard mouse and computer remote controls may eventually be replaced by this system. The lighting is the sole obstruction. Because most computers are used in dim lighting, the system still can't be sufficient to replace the conventional mouse. This can be utilised to conserve space, for people who are paralysed, and in other situations that are comparable. Instead of a conventional mouse, it is a virtual one that only functions by tracking coloured fingertips and webcam frames. The proposed webcam-based system might be able to partially do away with the requirement for a mouse. A very intriguing & successful method of human-computer connection is hand gesture interaction (Human-Computer Interaction). This curiosity has been the subject of some excellent studies. The identification of hand gestures is a popular use of sign language technology. Gesture recognition could be a cutting-edge method for computers to comprehend human gestures in the future (Body Language). Instead of crude text-based communication, it will foster more advanced human-computer connection.Most gesture recognition mice that use markers for tracking employ at least two different colours. The system becomes slow and exhibits various laggings when performing as a result of having to identify multiple colours. This mouse technology can be used to teach sign language to the deaf and dumb. It could be beneficial. they can communicate with computers. First, the coordinates of the centre of the detected rectangle are used to calculate the centres of two colour objects that have been detected. The integrated OpenCV function may draw a line between two coordinates. A system called a virtual gesture control mouse uses a live camera to direct the mouse cursor and carry out its function. We put mouse navigation, icon selection, and actions like left, right, double clicks, and scrolling into practise. To perform mouse indicator motions and icon selection, this system relies on picture comparison and motion detection technology. After analysing the data, it is possible to predict that the algorithms will operate in any domain if we supply adequate lighting and a good camera. Then We'll organise our system better. In the future, we intend to include even more functionality, such multi-window interaction, window resizing and enlarging, window closing, etc

Gesture Controlled Virtual Mouse

A technique for directing the cursor's position without a computer or other digital device using just your hands. While specific hand motions might be used to perform actions like clicking and moving of items. The proposed device will only need a Webcam as an input device. OpenCV and Python are the two pieces of software that are need to implement the suggested machine. The system's display screen may display the camera's output so that the user can calibrate it in a similar manner. Numpy, math, wx, and Mouse are the Python requirements that will be used to implement this gadget. There are a variety of hand gestures; for example, a handshake differs from person to person. A unique and varies according to place and time. The primary distinction between posture and gesture is that one emphasises the form of the hand while the other emphasises hand movement. A camera can be utilised for vision-based CC, which accurately tracks hand gestures and predicts gestures based on labels, to realise the full potential of the device. A webcam can be used for vision-based entirely cc, which can accurately monitor hand gestures and forecast gestures based on labelling, in order to fully utilise its capabilities. It is capable of performing each task because it uses a camera and computer vision technologies to control many mouse actions. That a physical mouse can. The suggested system is vision-based and makes use of camera inputs and image processing algorithms. tracking and identification of gestures based on vision. Hand motions would be used to operate the mouse, and hand tracking would be used to move the computer's pointer. A system that is effective at controlling the mouse cursor and carrying out its function using a real-time camera is known as a virtual gesture control mouse. We put mouse navigation, icon selection, and actions like left, right, double clicks, and scrolling into practise. In order to track mouse indicator movements and icon selection, this method relies on picture comparison and motion detection technology. When analysing data, it's frequently assumed that if we provide adequate lighting, a good camera, and algorithms that are applicable to any area. Then, our systems will become more organised. In the future, we hope to combine more features like palm and multiple finger interaction with multiple windows, window enlargement and window reduction, window closing, etc. Using the palm and several fingers, open and close windows, enlarge and reduce windows, etc.

Real-Time Hand Gesture-Based Interactiowith Objects in 3D Virtual Environments

The user interface for controlling virtual objects in three-dimensional (3D) virtual environments is described in this work and is based on hand gestures. In the real world, users can move, rotate, scale, and select things simply using their hands. In order to assess the efficacy of this protocol, a gesture-based virtual simulation system for automobile maintenance is created. It includes a number of object-manipulation functions, including the ability to open a car door, sit in a seat, replace tyres, and disassemble the engine. Our findings suggest that the suggested hand-gesture-based user interface may be used to interact with objects in 3D virtual worlds instead of a mouse or keyboard. In order to give users more control over virtual objects in 3D VEs, this article suggests a more adaptable hand-gesture-based user interface. Customers can be hands may be moved, rotated, scaled, and selected to handle items in the real world, and call-back and delegate functions can be created to manage hand-gesture events. We use Microsoft Kinect to instantly record hand movements. It was used to operate virtual cameras in virtual environments .We describe the technique in this study and broaden the target objects from virtual cameras to all kinds of objects. Furthermore, in order to assess the efficacy of the suggested methodology, we create a gesture-based virtual simulation system for car repair. The object manipulation capabilities used in the car maintenance system include opening a car door, choosing a seat and seating down in it, changing tyres, and taking the engine apart. The outcomes are extremely encouraging for object control in virtual environments. Because of Microsoft Kinect's superior real-time image-processing capabilities, recognition-based systems using Kinect have recently garnered more interest than methods that use standard 2D cameras (such webcams, video cameras, or digital cameras) to acquire a sequence of hand motions. We have created a number of applications, such as a gesture-based gallery system , a gesture-based virtual simulation system, and a gesture-based virtual reality system, to assess the efficacy of the suggested protocol. In this article, we offer a virtual simulation system for automobile maintenance that is gesture-based. This system includes several functions for manipulating objects, like opening a car door, choosing a seat and sitting in it, changing tyres, etc and taking the engine apart. It was developed on a Windows 7 platform with an Intel Core i5-2500 3.30 GHz Quad-Core processor and coded in C# using Microsoft Visual Studio 2008, Kinect, and Unity 3D. This study proposes a Microsoft Kinect-based hand-gesture user interface system that enables users to control items in 3D virtual environments. By applying a number of filtering operations to a series of hand-gesture images acquired by Kinect and processing hand gesture events with callback and delegate functions, the goal was to construct a more precise and adaptable gesture-based virtual object control system. In order to enable more accurate and natural hand-gesture-based interaction with objects in 3D VEs, this article examined a number of gesture-recognition and execution aspects. However, the investigation is ongoing, and Future research will investigate sophisticated gesture-based control by extending the method.

Virtual Mouse Using Hand Gesture Recognition

A novel camera vision-based cursor control system is proposed in this research, primarily leveraging hand motions recorded from a webcam using a colour detection method. The pros and cons of several algorithms that were previously in use have been examined and contrasted. The user can move the computer cursor with the aid of this device by holding coloured caps or tapes in their hands and making various hand motions to click and drag the mouse. It transfers files between the two systems across a single network connecting the two systems. It uses a low-resolution webcam that serves as a sensor and can track the user's hand while it is holding coloured caps in two dimensions. The system is implemented with Python and OpenCV, and the results are dispersed on the monitor's screen while colour detection is used to obtain shape and location data.

This is developed in Python, and the mouse operations are handled by the OpenCV image processing library. Only the coloured fingertips are taken from a real-time video that was recorded using a web camera. This acquired image is separated into numerous frames, and then each frame is processed separately. Since the camera automatically collects inverted photos, these individual image bytes are reversed and then concatenated to create a flipped image. For proper segmentation, the hand gesture is segregated from the rest of the image. A bounding box is typically utilised for using the hand to be monitored and the skin colour as its basis To make colour detection easier, the improved image is turned into a grayscale version. To identify the red, blue, and green object, the grayscale image is removed from the inverse color image. Erosion essentially involves cropping the image to remove the hand and causes the loss of boundary pixels. Dilation widens the area of image pixels that are not degraded by essentially filling in the missing pixels in the object. This study concentrated on creating a virtual mouse that can replace pricey touch-screen computers. Here, we performed several image processing tasks for fingertip identification and gesture using the Python language and the OpenCV module. recognition to carry out different cursor and clicking actions. This experiment produced highly accurate results that can be applied in real-world situations. We were able to recognize the green hue that was attached to our fingers with the aid of the OpenCV module. Two rectangles are immediately produced around the finger to denote the green hue as soon as it is recognized. The web camera on our computer is used by the OpenCV module, and the camera can recognise the colour green because of this. For those who don't like using touchpads and for a variety of different use situations, this notion can help save on hardware expenditures. It is crucial to perform that check since the final findings may vary if there are objects with similar colours in the web camera's field of view as the fingertips. done. This work can be improved by incorporating new features like volume control and image resizing and enlargement. We intend to incorporate more motions similar to these for future development to make a pleasant and trouble-free experience in a variety of other practical applications.

Deep Learning-Based End-to-End Composite System for Hand Detection and Gesture Recognition

Even though this difficult topic has been studied by numerous academics, a reliable method is still elusive. In order to concurrently identify and classify hand movements, we thus present a deep learning-based architecture. In the suggested architecture, hand areas are extracted from the entire image using a one-stage dense object detector before being fed through a lightweight convolutional neural network (CNN) for hand motion detection. The Oxford, 5-signers, Ego-Hands, and Indian classical dance (ICD) datasets for hand detection, as well as two hand gesture datasets with various gesture vocabularies for hand gesture recognition—the LaRED and Tiny-Hands datasets—were all used extensively in our studies to assess our methodology. Here, experimental findings show that the suggested architecture is effective and reliable. Additionally, it performs better. The study of hand gestures is generally divided into two classes, namely, static and dynamic hand gestures, in both the hand detection and gesture classification tasks. Dynamic hand gestures require a series of frames to execute a single gesture, but static hand gestures simply need one image to communicate relevant information. The goal of this research is to identify static hand gestures in which the naked hand assumes positions to convey particular meanings. The proposed architecture is trained in a stage-by-stage manner. In order to create a trustworthy detector, we began the experiment by training the hand detector using the data we had gathered. Then, we trained the lightweight CNN architecture using the trained detector to extract hands, understanding hand gestures During the inference process, the architecture takes an input image of any size, extracts the hand region from it, and then sends the extracted hand region through a light-weight convolutional neural network to recognise hand gestures. For many human-computer interaction applications, the detection and recognition of hand movements is a necessity. A reliable system for the simultaneous detection and interpretation of hand gestures has not yet been developed, despite the fact that numerous studies have concentrated on detecting hands or identifying motions independently. In this section, we discuss the pertinent research on algorithms for hand detection and gesture identification that employ both traditional handmade features and deep learning networks. A backbone makes up the suggested hand, two task-specific sub-networks for bounding, and a network that is required for constructing a convolutional feature map over the full input image. box categorization and regression on the output from the backbone Many interactive apps require the ability to detect hands and recognise gestures. The majority of earlier efforts made an effort to split up the problem into discrete jobs. Due to the malleable and articulated nature of hands, as well as the possibility of crowded settings, these tasks are also difficult. In this paper, we suggested a deep learning network architecture with the dual objectives of hand gesture detection and recognition. The suggested design is based on a lightweight CNN network for gesture categorization and a one-stage dense object detector for hand identification. Various hand detection and hand gesture recognition standards were the subject of experiments. To show how reliable and successful our strategy is. Additionally, to ensure the generalizability of the learned model, our architecture was trained and evaluated using datasets obtained under

Hand Gesture Recognition and Implementation for Disables using CNN'S

Utilizing cutting-edge techniques like gesture control and recognition will be made possible by the development of numerous automated technologies, including machine learning, deep learning, neural networks, and computer vision. These motions can be employed in a way that assists those who find it challenging to operate computers or other electronic equipment. Here, the model is being developed in a way that will facilitate our understanding and application. Since many businesses have launched futuristic gadgets for the company's growth, visual communications like augmented reality and virtual reality have gained attention for such advances. Think about smart glasses with realistic characteristics and a variety of applications that have been created by numerous businesses. The system that achieves the ideal conceptual balance considered to be extremely powerful and well-performing computers. Between humans and technology, gestures can serve as a communication barrier. Additionally, relationships between people who have communication issues can emerge. A CNN [10-13] useable dataset of picture data was used to create this model. It has up to 20,000 photos and takes up more than 1.2GB. This data will be incorporated into our model to build a trained model that is used for gesture recognition and implementation for some operations in systems. Convolutional neural networks [9] are used by the model to recognise hand gestures. The majority of researchers and developers categorised this gesture recognition system as primarily receiving input images and data from cameras or other input devices. When it comes to features in an excel data set, we can observe several parameters like variance, mean, and standard deviation. We can also draw certain graphs based on the values of the attributes. The creation of this model and its ability to cooperate with additional models, examples, and models that are given the ability to transform inputs and samples into system-operable operations are both possible. And the easier it is to make the system accessible to everyone, the better the operations may be. Therefore, some of these layers would be included in the model that we are going to develop. Processing images more quickly and loading the features based on the amount of samples used for training and the number of training runs. The neural network library that will be imported to enable CNN on our system is Keras [18]. We can examine a variety of metrics when it comes to features in an excel data set, such as variance, mean, and standard deviation. We can also draw certain graphs based on the values of the attributes. The user will be assessing the accuracy of the model's performance using data from the dataset's 10 given folders. We can infer from the models that have been created that it is able to handle some hand movements supplied by any and assist us in determining the gesture's meaning. The key aspect that may be considered is that the machine's ability to comprehend visuals and be able to recognise what they are is very beneficial in many ways.

Hand gesture recognition for a virtual mouse application using geometric feature of finger's trajectories

Authors: Behnam Maleki, Hossein Ebrahimnezhad, Min Xu, Xiangjian He

We aim to alter a pc to grasp and perform the mouse functions by analyzing a video with hand motions. For this purpose, dynamic gestures are captured by an internet cam and are recognized as pre-defined gestures that are wont to counsel mouse functions. The planned algorithmic program at first detects the hand. Then, it tracks fingertips' trajectories **a**mong a frame sequence. Finally, hand gestures are recognized through computing a group of planned geometric options of fingers' trajectories and **s**crutiny with our collected gestures dataset. during this paper, four sorts of descriptors are outlined for a dynamic gesture. every descriptor includes **a** different range of options, that compose a feature vector with a hundred thirty-five dimensions. different classification algorithms (e.g. KNN, LDA, Naïve mathematician, and SVM) ar**e** applied to check the detection results. The lowest misclassification error rate (MCR) reaches regarding four-dimensional (i.e. Correct Recognition rate of 96%). what is more, we tend towards applied Principle elemen**t** Analysis (PCA) to scale back the number of options. With thirty dimensional options (principle components), the LDA classifier is able to do regarding zero.09% misclassification error rate.

Design of a virtual mouse using gesture recognition And machine learning

By hritik joshi, Nitin wahbase,Rattnish latoriya

The emergence of the pandemic has resulted in a technological paradigm shift. the event and use of a virtual mouse in situ of a true mouse is one such eld of analysis. this is often a leap forward within the eld of HMI (Human-Machine Interaction). notwithstanding wireless or Bluetooth mouse technology has nonetheless to be established, it's not device-free. A Bluetooth mouse necessitates the usage of a battery and a connected electronic device. The presence of extra physics during a mouse makes it an additional di cult to use. this technique takes frames employing a digital camera or inbuilt camera and analyses them to form them traceable, so detects and performs mouse functions supported by the gestures performed by users. As a result, the advised mouse system eliminates the requirement for a tool.
The objective is to develop and implement an alternate system to manage a mouse pointer. the choice technique is hand gesture recognition mistreatment digital camera and color detection technique. the last word outcome of this paper is to develop a system that acknowledges hand gestures and controls the mouse pointer mistreatment color detection technique of any laptop. The projected paper is on the dominant mouse function's mistreatment of hand gestures. most functions square measure mouse movement, left button click, right button click, double click, and scrolling up or down. during this system, the users will choose any color from multiple colors. Their square measure some color bands American state ned & the users will choose any color from the colors consistent with the backgrounds

AI Virtual Mouse Using Hand Gesture Recognition

The computer mouse is one in every one of the wondrous developments of individuals within the field of Human-Computer Interaction (HCI) innovation. In the new age of innovation, a remote mouse or a contactless mouse truly utilizes gadgets and is not liberated from gadgets utterly, since it utilizes power from the gizmo or could be from outside power sources like battery and gain house and wattage, likewise throughout the COVID pandemic it's inspired to form social separating and keep from to contact things that gave by varied folks teams. within the projected AI virtual mouse utilizing hand signal framework, this constraint could be resolved by involving an advanced camera or sacred camera for understanding the hand motions and fingers recognition abuse computer machine vision. The formula employed in the framework utilizes the artificial consciousness and AI formula. Upheld the hand signals, the gizmo could be controlled just about and may do left click, right snap, wanting over capacities, and computer gizmo pointer perform whereas not the use of the real mouse.
Index Terms: deep learning base pc vision, real-time mouse system, Media-pipe, HCI

PROPOSED METHODOLOGY

3.1 Flowchart

3.2 Algorithm Proposed

MediaPipe

MediaPipe is an open-source, cross-platform Machine Learning framework used for building complex and multimodal applied machine learning pipelines.

It can be used in Machine Learning Models like face detection, multi-hand tracking, object detection, and tracking, and many more. MediaPipe basically acts as a mediator for handling the implementation of models for systems running on any platform which helps the developer focus more on experimenting with models, than on the system. The main usages of MediaPipe holistic is to detect face and hands and extract key points to pass on to a computer vision model.

Deep Learning OpenCV

OpenCV is a library of programming functions mainly aimed at real-time computer vision. Hand Keypoint detection is the process of finding the joints on the fingers as well as the finger-tips in a given image.

a. Human–computer interaction (HCI)
b. Motion understanding
c. Object detection
d. Gesture recognition

Computer Vision

Hand gesture and hand tip detection by using computer vision is used as a HCI [1] with the computer. With the use of the AI virtual mouse system, we can track the fingertip of the hand gesture by using a built-in camera or web camera and perform the mouse cursor operations and scrolling function and also move the cursor with it.

TECHNOLOGY USED

Machine Learning

The algorithm used in the system makes use of the machine learning algorithm. Based on the hand gestures, the computer can be controlled virtually and can perform left click, right click, scrolling functions, and computer cursor function without the use of the physical mouse.

Deep learning

The algorithm is based on deep learning for detecting the hands.

OpenCV

Itis a Python library that is designed to solve computer vision problems.

Media pipe

It is Google's open-source framework, used for media processing. It is cross-platform or we can say it is platform friendly.

Screen-brightness-control

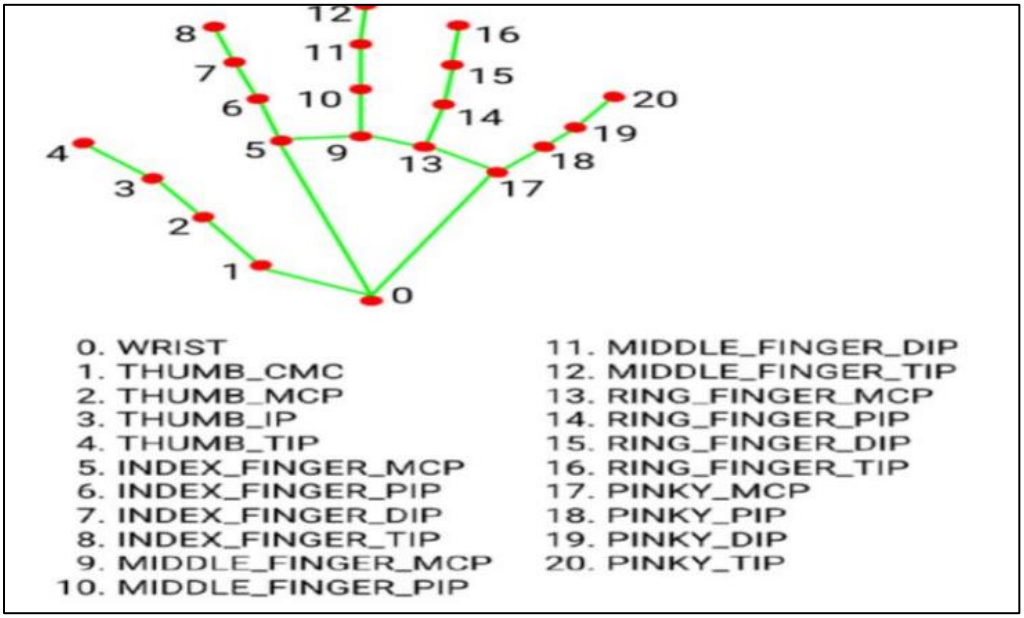
It is a python tool for controlling the brightness of your monitor. Supports Windows and most flavors of Linux.

Pyautogui(Python Library)

PyAutoGUI is a Python scripts control the mouse and keyboard to automate interactions with other applications.

DIAGRAMS

Hand Detection



Mouse

CONCLUSION

Gesture-controlled control mouse is a system that profound guides the mouse cursor and executes task using a real-time camera. This system can mouse navigation, selection of icons and its functions and tasks like left, right, double click and scrolling. This system is based on image comparison and motion detection technology to do mouse indicator movements and selection of the icon. Analyzing results, it can be anticipated that if we provide enough light, decent camera, the algorithms can work at any domain.

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