AI-VIRTUAL PAINTING USING PYTHON

MINI PROJECT REPORT

Submitted by

AATHIRA P R : TJE19CS001

ABHIRAMI ANANTHAKUMAR : TJE19CS005

AMAL CEZNA : TJE19CS017

JEWELNA T J : TJE19CS045

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING

Thejus Engineering College

'Knowledge is the ultimate goal'

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THRISSUR-680584

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CERTIFICATE

Certified that this project report " **AI VIRTUAL PAINTING"** is the bonafide work of **AATHIRA P R** , **ABHIRAMI ANANTHAKUMAR, AMAL CEZNA** and **JEWELNA T J** of Department of Computer Science and Engineering in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering under the APJ Abdul Kalam Technological University during the year 2021-2022.

Mrs. JYOTHI P JOY
Project Guide

DR SURESAN PARETH
Head of department

Place: Vellarakkad

Date:

ACKNOWLEDGEMENT

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ABSTRACT

This project is a use of hand tracking technology.We know that the artists create a paintings on the canvas.But what if we can draw on air just by simply waving our hands.Here we are using our own finger tip as the tool. In this project it is the combination of two methods.First method, tracking of our hand using hand traking code . The tip of the finger is captured by a webcam. Then identifies the object. Second method, is the importing necessary packages and images to the exact code of Ai virtual painting using python.The main function of the project is OpenCv.It is an open source computer vision library for performing various advanced image processing tasks. we will be using the computer vison techniques of OpenCv to build this project.And mediapipe is used for the hand tracking for hand gesture. The working of the project is as soon as the user shows up his/her hand in the camera. The application detects it,and draw a bounding box the hand .if users shows only index finger than he/she is drawing mode.To select different colour or eraser from the top of the canvas.Users must select it by taking his/her both index and middle finger together at the top of icon.The preffered language is PYTHON.Here colour detection and tracking of hand is used in order to achieve the object in the air.

Requirements:

- Python v-3.7 or more
- OpenCv
- Numpy
- Pip
- Mediapipe

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LIST OF ABBREVATIONS

AI	ARTIFICIAL INTILLIGENCE
VP	VIRTUAL PAINTING
LED	LIGHT EMITTING DIODE
CCD	CHARGE COUPLED DEVICE
ELM	EXTREME LEARNING MACHINE
AR	AUGMENTED REALITY
HSV	HUE SATURATED VISION
MP	MACHINE PIPELINE
ML	MACHINE LEARNING
GNU	GNU NOT UNIX
GPL	GENERAL PUBLIC LICENCE

1. INTRODUCTION

1.1 BACKGROUND

Nowadays, the interaction between people and the machines is mainly completed through the mouse, keyboard, remote control, touch screen, and other direct contact manner, while the communication between people is basically achieved through more natural and intuitive non-contact manner, such as sound and physical movements. The communication by natural and intuitive non-contact manner is usually considered to be flexible and efficient; many researchers have thus tried efforts to make the machine identify other intentions and information through the non-contact manner like people, such as sound, facial expressions, physical movements, and gestures. Among them, gesture is the most important part of human language, and its Gestures play very important roles in human communication also. They are considered as the most easy means of communication between humans and computers.Gesture recognition can be simply categorized into two methods based on devices which are used to capture gestures: wearable sensor-based methods and optical camera-based methods, In optical camera based method, optical cameras are used which record a set of images to capture gesture movements from a distance. This optical cameras recognize gestures by analyzing visual information extracted from the captured images so they are also called vision-based methods. optical cameras are easy to use and also inexpensive while compare to wearable sensor based method.

1.2 OBJECTIVE

Drawing or Sketching using hand is everyone’s wish. Some or the other time we imagine writing in air using our hand. So, here came the project from this concept where we create a canvas and pick the colours required using ur hand and draw the required design or write anything you wish. The working of the project is as soon as the user shows up his/her hand in the camera. The application detects it,and draw a bounding box the hand .if users shows only index finger than he/she is drawing mode.To select different colour or eraser from the top of the canvas.Users must select it by taking his/her both index and middle finger together at the top of icon.And finally it will display on the screen.

1.3 PROMBLEM STATEMENT

Most of the existing systems are having tools and objects on the hand.And it is very expensive and very hard to use.sometimes if the object have any kind of issues we should replace it with new object.price cost may increase at certain kind of periods.so here we are implementing our project by mainly focusing on tool/object.it should be affordable,easy to use,we can take it anywhere.so this was the ultimate aim of our project,This project mainly focusing on solving some major social problems like,In the field of teaching.it is very difficult for the teachers to take the class especially during online.uncomfortable of using touching panel,pen,marker to write notes etc,sometimes it is very difficult for the teachers to replace the tool if it fails.And secondly wastage of papers.To overcome these all issues we are using our tip of the finger as the tool,it is very easy to use and no kind of wastage of money to buy tools,there is no need to replace because our tool is our tip of the finger,and it is implementing using hand tracking code and hand gestures. One can quickly write in the air and continue with your work without much distraction. Additionally, writing in the air does not require paper.Everything is stored electronically.

2. SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

The existing system contains of the generic mouse and trackpad system of monitor controlling and the non-availability of a hand gesture system. Most of the existing systems are having tools and objects on the hand.And it is very expensive and very hard to use.sometimes if the object have any kind of issues we should replace it with new object.price cost may increase at certain kind of periods. The remote accessing of monitor screen using the hand gesture is unavailable. Even-though it is largely trying to implement the scope is a simply restricted in the field of virtual mouse. The existing virtual mouse control system consists of the simple mouse operations using the hand recognition system, where we could perform the basic mouse operation like mouse pointer control, left click, right click, drag, etc. The further use of the hand recognition is not been made use of. Even-though there are a number of systems which are used for hand recognition,the system they made use is the static hand recognition.

2.2 LITERATURE SURVEY

In the paper[1],The Robust Hand Recognition with Kinect Sensor.They are facing the problem which is due to the difficult of the touching panel.so in this paper they are solving the problem by using a Kinect sensor. The Kinect contains three vital pieces that work together to detect your motion and create your physical image on the screen: an RGB colour VGA video camera, a depth sensor, and a multi-array. The camera detects the red, green, and blue color components as well as body-type and facial features. Detect the parts of a person’s body. This is done using a decision tree. The patterns for

making those decisions were obtained in the learning phase with more than a million examples.This is a very shorthand for how the algorithm works. Behind all this there is a very extensive mathematical base.
Probability and statistics, multivariate calculations, linear algebra, complex analysis, graph algorithms, geometry, differential equations, topology, etc. are used.

Kinect captures the movement of people through more than 48 points of articulation.The main drawback of this paper is that the it cannot detect small kind of objects on the air. It is the ultimate drawback of this paper[1]

In the paper [2], The uncomfortable usage of touching panel is the main crises/issues which is facing by the users.So in this paper which is called LED fitted finger movement.they are solving the problem by fitting an LED on the tip of the finger.And by the movements of the hand it is captured by the webcam and it will display on the screen.Here LED is used as the tool and the object.if it fails at any time we should need to replace it with new one.so that there will be wastage of money.and it is not necessary that the tool which is using here must be available in the near by shops.so the drawbacks which we mentioned above should take in note.

In the paper [3], which is called Augmented desk interface,the main issues is the difficulty in the touching panel and at the same time usage of certain kind of tools and the object.so here in this paper they are using there two hands touching mode on the screen.one for clicking the menu options which is shown in the screen and the another for selecting the colour which is given in the screen and drawing the objects on the air as the canvas.The main drawback of this paper is that the user must use their two hands for selecting colours and drawing and clicking the menu which is shown on the screen n the paper [4], AI has become a catchall term for applications that perform complex tasks that once required human input such as communicating with customers online or playing chess. The term is often used interchangeably with its subfields, which include machine learning and deep learning There are differences, however. For example, machine learning is focused on building systems that learn or improve their performance based on the data they consume. It’s important to note that although all machine learning is AI, not all AI is machine learning. According to the way of the input of gestures, the current gesture recognition techniques can be divided into two categories: based on the vision and based on the data gloves. In order to cope with some problems existed in currently data glove. In this paper,it is using a novel data glove called YoBu to collect data for gesture recognition. And we attempt to use extreme learning machine (ELM) for gesture recognition Detection using data gloves A glove is fabricating using five resistive flex sensors, which can be attached on each of the fingers, respectively.The main drawback of this paper is that the data glove is not that much affordable,And it is very expensive,normal people cannot afford it.

In the paper [5], Implementation of a Low Power Motion Detection Camera Processor,Here in this paper they are using an Cmos image sensor for solving difficulty in the toucing panel. The working principle of a CMOS (complementary metal oxide semiconductor) image sensor was conceived in the latter half of the 1960s, but the device was not commercialized until microfabrication technologies became advanced enough in the 1990s. Image sensors built into today's digital cameras and mobile phones mostly use either the CCD (charge coupled device) or Cmostechnology.

Both CCD and CMOS are semiconductor devices that serve as "electronic eyes." While they both use photodiodes, they differ in terms of manufacturing process and signal readout method. Although the CCD technology was dominant at first due to superior sensitivity and picture quality, various improvements in CMOS sensors led them to surpass CCD sensors from 2004 onwards in shipment volume. CMOS image sensors cost less to produce than CCD image sensors, because existing semiconductor manufacturing equipment can be repurposed for their production. Unlike CCD sensors that use high-voltage analog circuits, CMOS sensors employ a smaller digital circuitry that uses less power, and are in principle free from smear (vertical white streak in the image taken under bright light) and blooming (corruption of images such as white spots). Since a logic circuitry can be built into the chip during the manufacturing process, CMOS sensors with an onchip image processing circuit are being developed for such applications as image recognition and artificial vision, and some devices are already being put to practical use.The main drawback of this paper is that the Cmos sensor, uniformity and image quality is poor as each pixel does its own conversion.and The frame rate of commonly used image sensor is 30 frame per second. This is not adequate to achieve high data rate communication. And there are several active devices in the readout path that can produce time-varying noise.

In the paper [6], implementation of colour filtering with a pen tool.Here with the help of an OpenCv.It find the colour range of the target object and then it will save.apply the correct morphological operations to reduce noise in the video.it will detect and track the coloured object with contour detection.it will find the object x and y locations coordinates to draw n the screen.and adding a wiper to wiper off all the screen.and the eraser to erase the objects.Here they are using a tool which is a pen.colour filtering is using with the help of a pen.Here when there is any kind of issues in the pen it should be replaced with a new pen tool.And it is not that much easy task to replace the tool,and it is not eco-friendly.And the price cost will be high for such a tool.Here the tool which is a pen,that pen should be easily available to all the near by stores and the risk is very high. This all are the main drawbacks to this paper implementation of colour filtering with a pen tool,The pen will be captured by a web camera and the motion of the pen will create a object on the screen.It is not much necessary that the pen should touch the screen.This pen can also work in the air,Here air can also be a canvas.This is the basic implementaion of colour filtering with a pen.

In the paper [7], this paper is titled by virtual marker.And here due to the difficulties of the touching panel and a pen tool etc they are using a marker on the tip of the finger.which is fully green coloured marker.And when we write in the air with the help of the marker on the tip of the finger,it is captured by a web camera and it will display on the screen.Here marker which is green in colour on the tip of the finger cannot be displaced by another colour.Here coloured marker is the tool. Only the green colour will detect by a web camera.This process is done with the help of OpenCv.Here hand tracking is also used to track the movements of the hand.Thus the movement of the hand is detected by web-camera.The virtual marker is a interactive whiteboard you can control the computer directly from the image.There is no need to go to the keyboards or mouse,with the virtual marker solutions we are cable to write on the whiteboard without actually writing with the help of a ink this is actually virtual marker means.An augmented reality marker is an image or an object that can be recognized by an AR-enabled.Here marker means an image recognition AR,The main disadvantages of this paper is that the marker which is used here is high of cost and it is not available at every time.

In the paper [8] which is titled by ball tracking.Here due to the difficulties of touching panel.They are implementing a tool with the help of ping-pong,Here the tool which is used is a Ping-pong with the help of the tool there are creating an object and it is captured by a web-camera and the captured object will display on the screen.Here in this paper the tool which s used is tracked and for that tracking is need as one of the code to track the tool,and it is saved on the code.The main drawback of this paper is that the tool is high of cost and it is not easily available to all,and at the same time the ping-pong is not easily replaced by a new one.

Table 2.2 Literature survey

Paper Name	Problem Addressed	Solution Proposed in the Paper	Drawbacks of the Paper
Robust hand Recognition with kinect sensor	Due to the difficulties of touching panel	A hand gesture recognition system with Kinect sensor	It cannot detect small kind of objects
LED fitted Finger movements	Due to the difficulties of the Touching panel	An LED is mounted on the Users finger and the web camera is used to track the finger	LED want to be replace with new one if it fails

Augmented Desk Interface	Due to the difficulties of the touching panel	Using a 2 hand touching mode on the screen to detect One for - menu Another for selecting/drawin g	It cannot be so easy because of the two hand movements
Detection using Data gloves	Due to the difficulties of the touching panel	Using a data gloves	The data glove is high of cost and it is not easily replaceable
Implementatio n Of A Low Power Motion Detection Camera Processor	Due to Difficultie s of touching panel	CMOS image sensor	The main drawback of this paper is that the delay of time

Implementation of colour filtering using a pen	Due to the difficulties of touching panel and one colour recognition	Adding Colour filters and pen as a tool	The pen should need to be replaced by a new one if it fails.
Virtual marker	Due to the difficulties of touching panel	Using a coloured (green)marker as a tool.	The marker which is green in colour will only detect
Ball tracking	Due to the difficulties of touching panel and coloured marker as tools	Creating a glove with ping pong ball.mapping the motion of ball to predefined gestures Image is converted to from RCB space to HSV space	High cost of ping pong ball and it is not that much affordable to every one

2.3 PROPOSED SYSTEM

By taking considerations of the literature survey, it can be concluded that object Recognition and tracking with the real-time smart camera plays an important role in many modern vision applications such as work force tracking intelligence
surveillance and many more.The hand is tracked by a hand tracking code.
and the hand is captured by camera.and it will displayed on the monitor.
The main motivation of this is to extract the gesture detection and color segmentation technique from camera sensor to perform virtual paint.Here the hand is the tool.

2.3.1 SYSTEM DIAGRAM

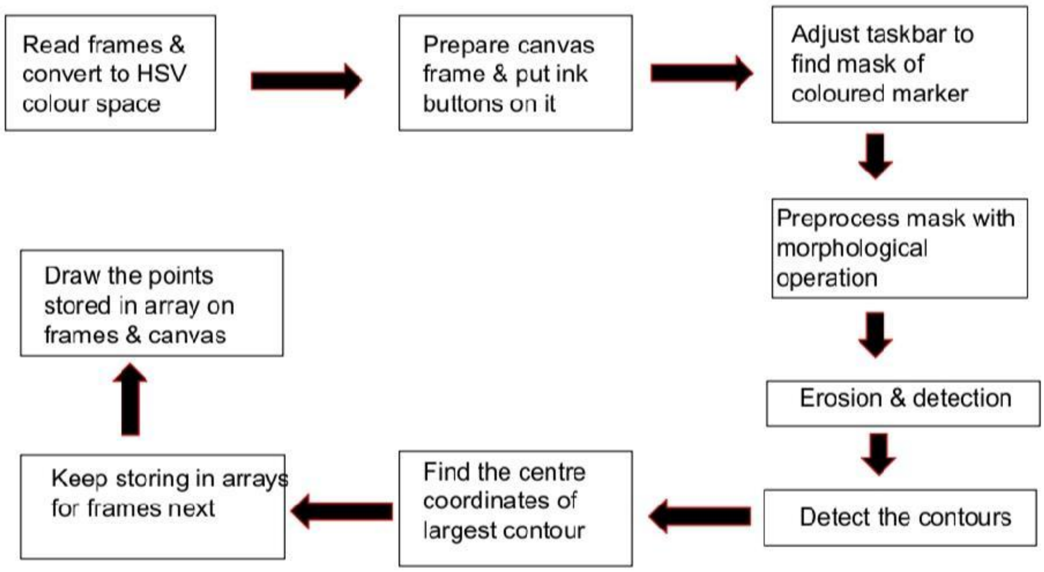


FIG 2.3.1 SYSTEM DIAGRAM

3. SYSTEM SPECIFICATION

3.1 HARDWARE SPECIFICATION

- System: Intel Core i5 above
- Hard Disk: 20 GB
- Monitor: used(DELL inspiron)
- Mouse: Logitech
- Ram: 4 GB
- Webcam

3.2 SOFTWARE SPECIFICATION

- Operating System: Windows 10 or Linux
- Programming Language used: Python
- Framework used:
  - OpenCv
  - Mediapipe
  - Numpy

4. SOFTWARE DESCRIPTION

4.1 OPENCV

OpenCV (*Open Source Computer Vision Library*) is a library of programming functions mainly aimed at real-time computer vision.Originally developed by Intel,

Advance vision research by providing not only open but also optimized code for basic vision infrastructure. No more reinventing the wheel.

OpenCV-Python is a library of Python bindings designed to solve computer vision problems. Python is a general purpose programming language started by Guido van Rossum that became very popular very quickly, mainly because of its simplicity and code readability.

OpenCV is a Python open-source library, which is used for computer vision in Artificial intelligence, Machine Learning, face recognition, etc.

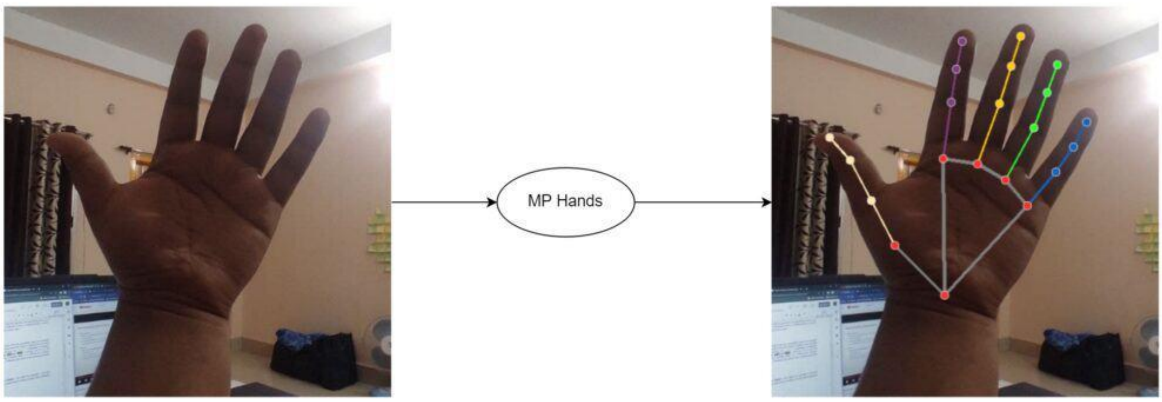
4.2 NUMPY

Numpy is one of the most commonly used packages for scientific computing in Python. It provides a multidimensional array object, as well as variations such as masks and matrices, which can be used for various math operations. Numpy is compatible with, and used by many other popular Python packages, Why is numpy so popular? Quite simply, because it's faster than regular Python arrays, which lack numpy's optimized and pre-compiled C code that does all the heavy lifting. Another reason is that numpy arrays and operations are vectorized, which means they lack explicit looping or indexing in the code. This makes the code not only more readable, but also more similar to standard mathematical notation.

4.3 MEDIAPIPE

MediaPipe is a Framework for building machine learning pipelines for processing time-series data like video, audio, etc. This cross-platform Framework works in Desktop/Server, Android, iOS, and embedded devices like Raspberry Pi and Jetson Nano.

The MediaPipe perception pipeline is called a Graph. Let us take the example of the first solution, Hands. We feed a stream of images as input which comes out with hand landmarks rendered on the images.



The flow chart below represents the MP hand solution graph.

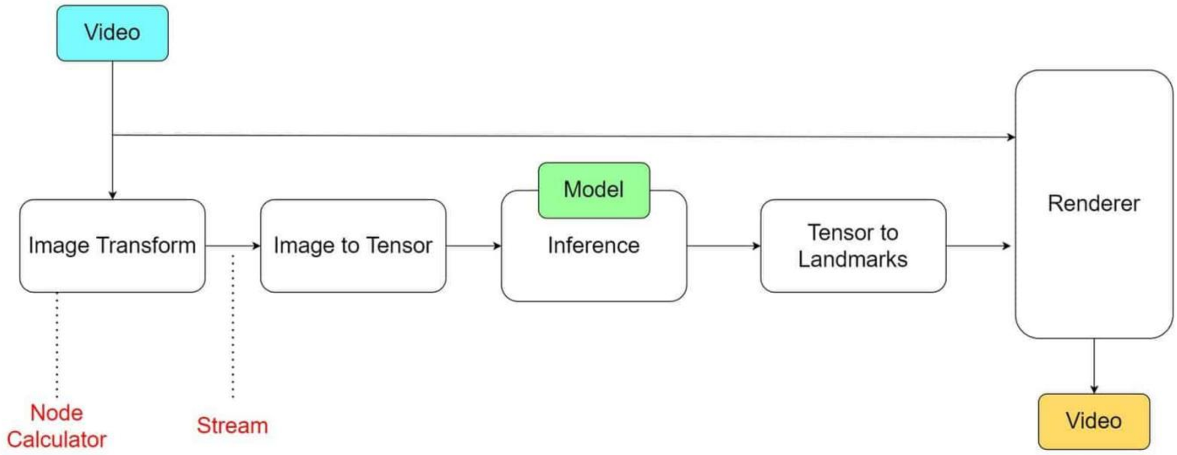


FIG 4.3.1 : MP HAND SOLUTION GRAPH

4.3.2 ML PIPELINE

The pipeline is implemented as a MediaPipe graph that uses a hand landmark tracking subgraph from the hand landmark module, and renders using a dedicated hand renderer subgraph. The hand landmark tracking subgraph internally uses a hand landmark subgraph from the same module and a palm detection subgraph from the palm detection module.

4.3.3 PALM DETECTION MODEL

To detect initial hand locations, we designed a single-shot detector model optimized for mobile real-time uses in a manner similar to the face detection model in MediaPipe Face Mesh. Detecting hands is a decidedly complex task:

ur lite model and full model have to work across a variety of hand sizes with a large scale span (~20) relative to the image frame and be able to detect occluded and self-occluded hands. Whereas faces have high contrast patterns, e.g., in the eye and mouth region, the lack of such features in hands makes it comparatively difficult to detect them reliably from their visual features alone. Instead, providing additional context, like arm, body, or person features, aids accurate hand localization

Our method addresses the above challenges using different strategies. First, we train a palm detector instead of a hand detector, since estimating bounding boxes of rigid objects like palms and fists is significantly simpler than detecting hands with articulated fingers. In addition, as palms are smaller objects, the non-maximum suppression algorithm works well even for two-hand self-occlusion cases, like handshakes. Moreover, palms can be modelled using square bounding boxes (anchors in ML terminology) ignoring other aspect ratios, and therefore reducing the number of anchors by a factor of 3-5. Second, an encoder-decoder feature extractor is used for bigger scene context awareness even for small objects (similar to the RetinaNet approach). Lastly, we minimize the focal loss during training to support a large amount of anchors resulting from the high scale variance. With the above techniques, we achieve an average precision of 95.7% in palm detection. Using a regular cross entropy loss and no decoder gives a baseline of just 86.22%.

4.3.4 : HAND LANDMARK MODEL

After the palm detection over the whole image our subsequent hand landmark model performs precise keypoint localization of 21 3D hand-knuckle coordinates inside the detected hand regions via regression, that is direct coordinate prediction. The model learns a consistent internal hand pose representation and is robust even to partially visible hands and self-occlusions.

To obtain ground truth data, we have manually annotated ~30K real-world images with 21 3D coordinates, as shown below (we take Z-value from image depth map, if it exists per corresponding coordinate). To better cover the possible hand poses and provide additional supervision on the nature of hand geometry, we also render a high-quality synthetic hand model over various backgrounds and map it to the corresponding 3D coordinates

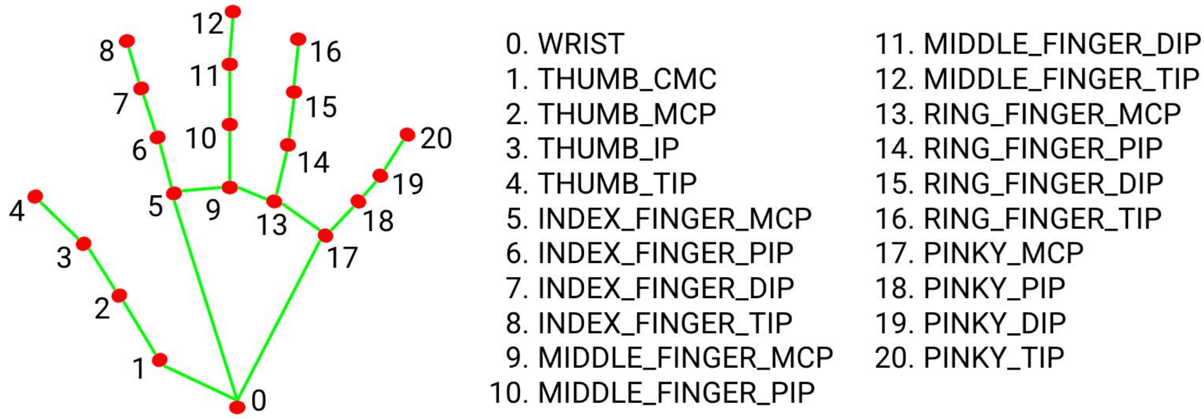
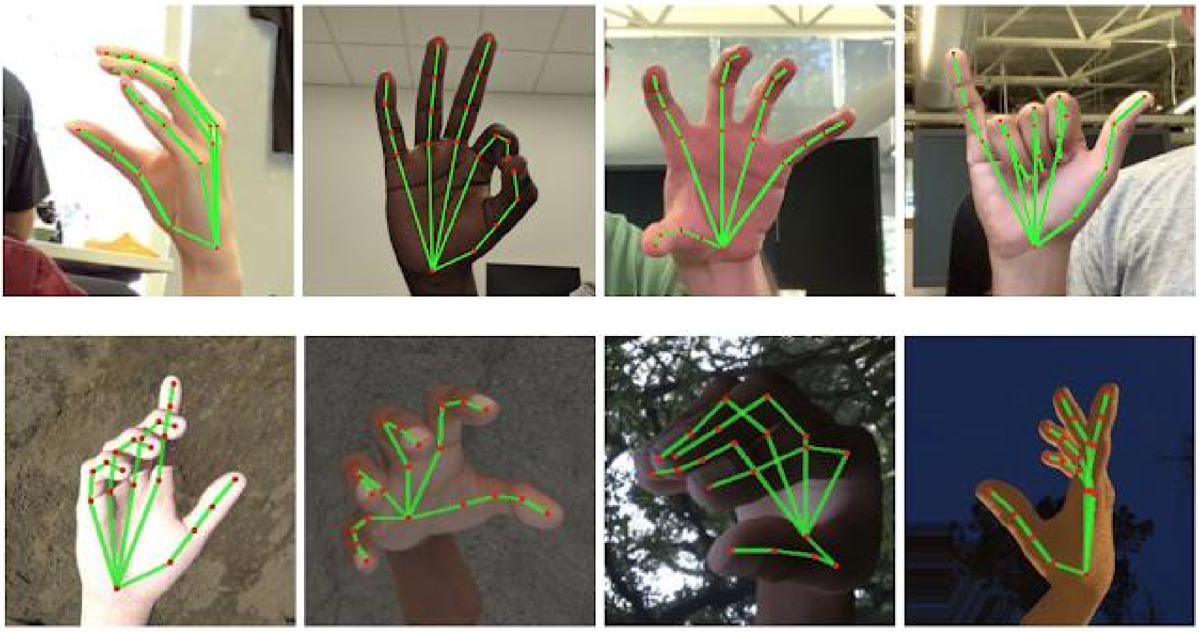


Fig 4.3.4 HAND LANDMARK



4.4 PYTHON

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985- 1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language.

Characteristics of Python:

- It supports functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.

- It provides very high-level dynamic data types and supports dynamic type checking.

- It supports automatic garbage collection.

- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java. Applications of Python:

- Easy-to-learn − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.

- Easy-to-read − Python code is more clearly defined and visible to the eyes.
- Easy-to-maintain − Python's source code is fairly easy-to-maintained.

- A broad standard library − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.

- Interactive Mode − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

- Portable − Python can run on a wide variety of hardware platforms and has the same interface on all platforms, etc.

5. PROJECT DESCRIPTION

5.1 PROBLEM DEFINITION

Most of the existing systems are having tools and objects on the hand.And it is very expensive and very hard to use.sometimes if the object have any kind of issues we should replace it with new object.price cost may increase at certain kind of periods.so here we are implementing our project by mainly focusing on tool/object.it should be affordable,easy to use,we can take it anywhere.so this was the ultimate aim of our project,This project mainly focusing on solving some major social problems like,In the field of teaching.it is very difficult for the teachers to take the class especially during online.uncomfortable of using touching panel,pen,marker to write notes etc,sometimes it is very difficult for the teachers to replace the tool if it fails.And secondly wastage of papers.To overcome these all issues we are using our tip of the finger as the tool,it is very easy to use and no kind of wastage of money to buy tools,there is no need to replace because our tool is our tip of the finger,and it is implementing using hand tracking code and hand gestures. One can quickly write in the air and continue with your work without much distraction. Additionally, writing in the air does not require paper.Everything is stored electronically

5.2 OVERVIEW

By taking considerations of the literature survey, it can be concluded that by object Recognition and tracking with the real-time smart camera plays an important role in many modern vision applications such as work force tracking intelligencesurveillance and many more.The hand is tracked by a hand tracking code.and then the hand is captured by camera.and it will displayed on the monitor.The main motivation of this is to extract the gesture detection and olour segmentation technique from camera sensor to perform virtual paint.Here the hand is the tool There are mainly two modules in this project,The first module is based on the hand Tracking module.There is a hand landmark track that is the most important module .

In this project.After the palm detection over the whole image our subsequent handlandmark model_ performs precise keypoint localization of 21 3D hand-knuckle coordinates inside detected hand regions via regression, that is direct coordinate prediction.The movement visible hand and it will detect with the help of a we-camera.each finger have their own specific landmark numbers which is shown in the landmark above in the fig.so using that specific numbers the machine can detect which is up and what the function should it perform.using this hand tracking module the hand is detection with the help of mediapipe

The second module is the Ai virtual painting module code.we need to import necessary Packages.And at the same time we should also want to import the images from the folder

The pop up window which we designed was created with the help of an canvas tool and We created necessary tools like brushes of 3 types and one eraser.And on the left side Corner we created the logo design of our AI VIRTUAL PAINTING.

This image folder and the hand tracking code are imported in to the AI VIRTUAL CODE

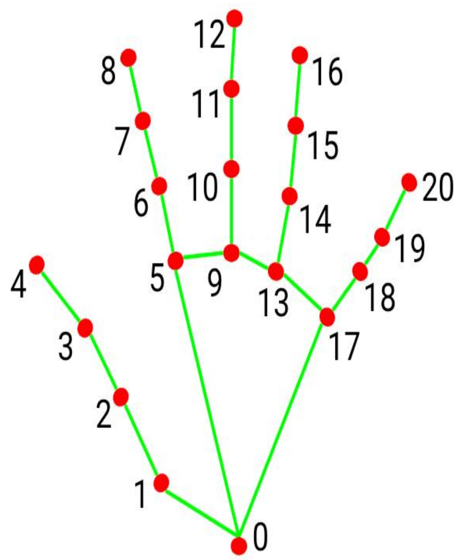
5.3 PHASES

There are 3 phases in this project:

1. Detection of hand using web camera
2. Importing necessary packages into the Ai virtual painting code
3. Combine the result of both 1 and 2 form our project

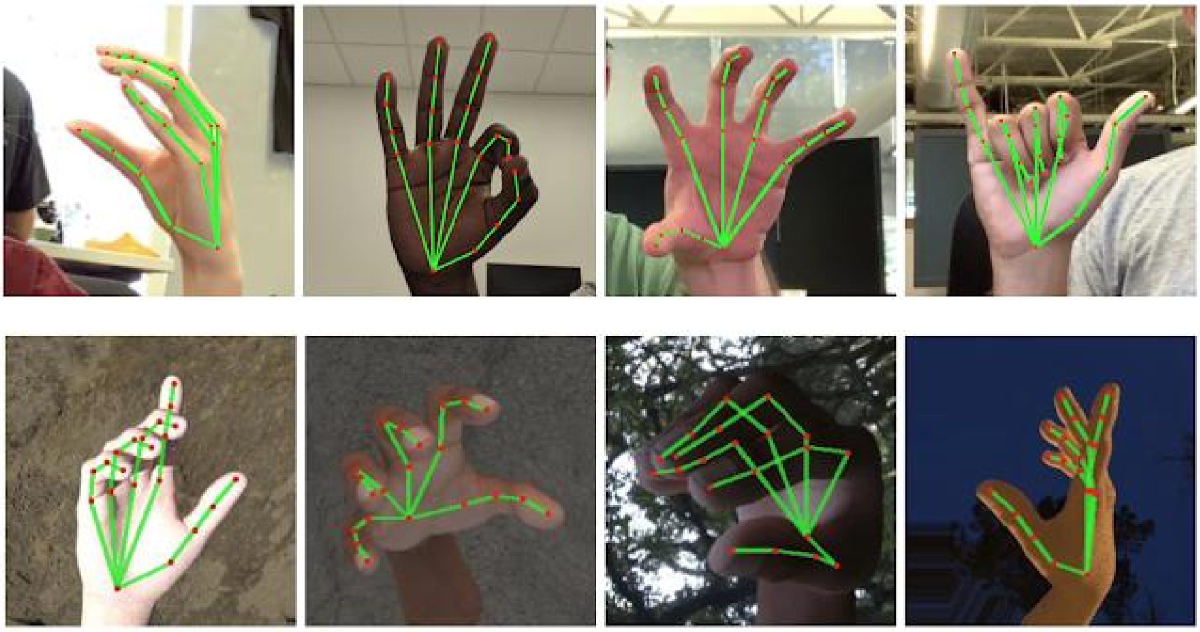
5.3.1 DETECTION OF HAND USING WEBCAM

Phase 1 of the analysis starts from the data taken by the webcam. We use the webcam to capture the hand data of the person.There are 20 different numbers that given to each points of the fingers,and this is written in a code and it is importing it into the actual code of the project.with the help of the web camera the hand is detected and recognise which finger is shown and what action should it perform (ML)By this method the machine can understand what action should perform



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Figure 5.3.1 hand landmarks



5.3.2 IMPORTING NECESSARY PACKAGES INTO AI VIRTUAL PAINTING CODE

- Importing hand tracking code(which is shown below)
- Importing images from a folder into actual code of Ai VP

There are mainly 4 different types of images that created using canvas.com

For selecting : Rectangular shape : 2 finger (index finger + middle finger)

For writing : circle shape : 1 finger (index finger)

Fig 5.3.3 <u>While selecting blue colour :</u>

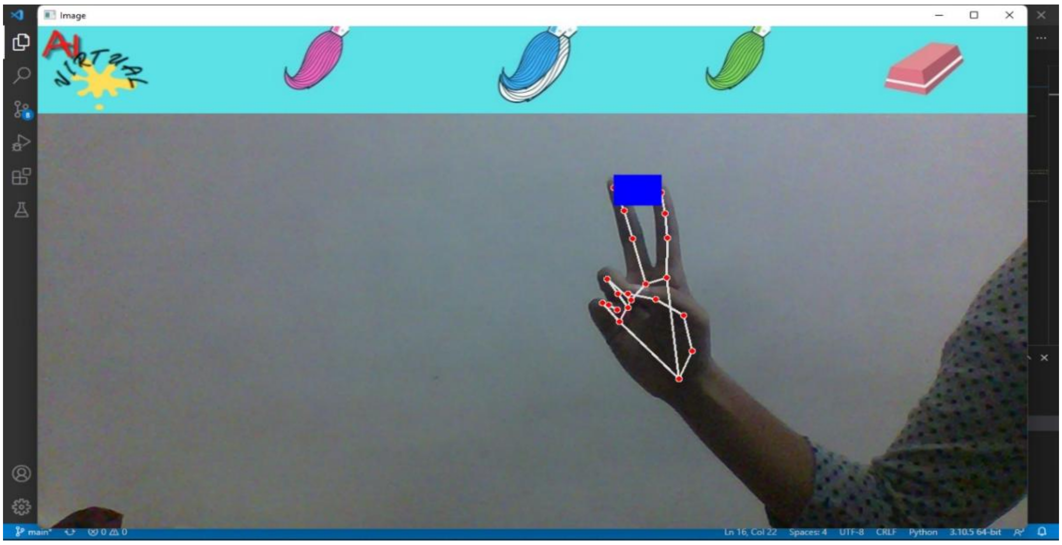


Fig 5.3.4 <u>While selecting pink colour:</u>

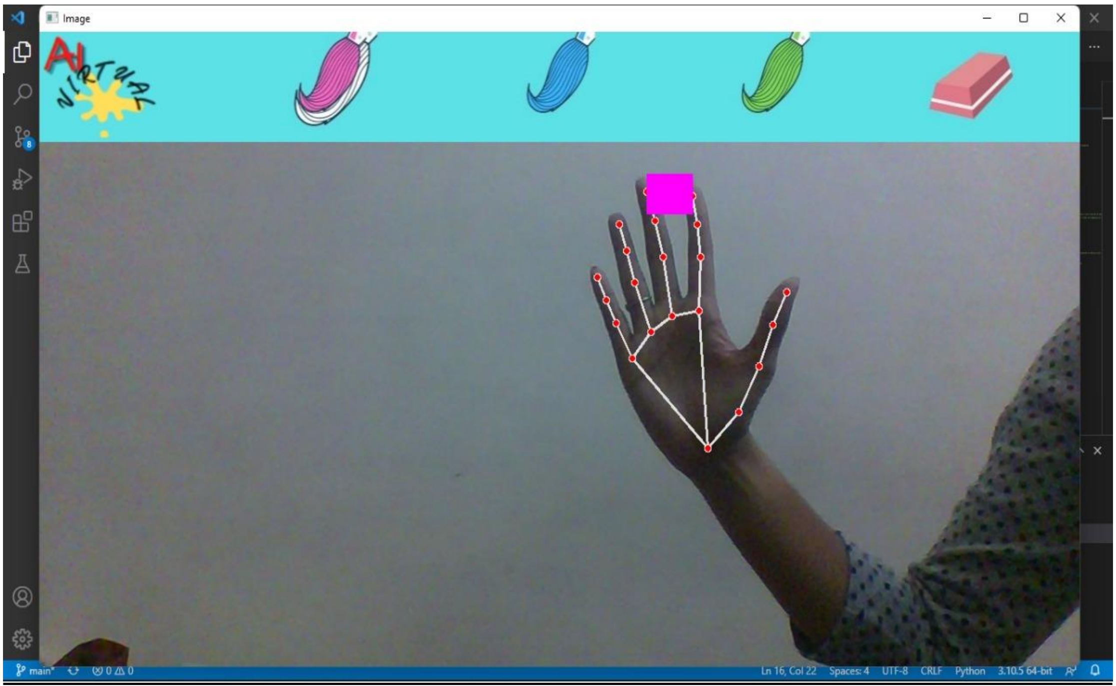


Fig 5.3.5 while selecting green colour and drawing :

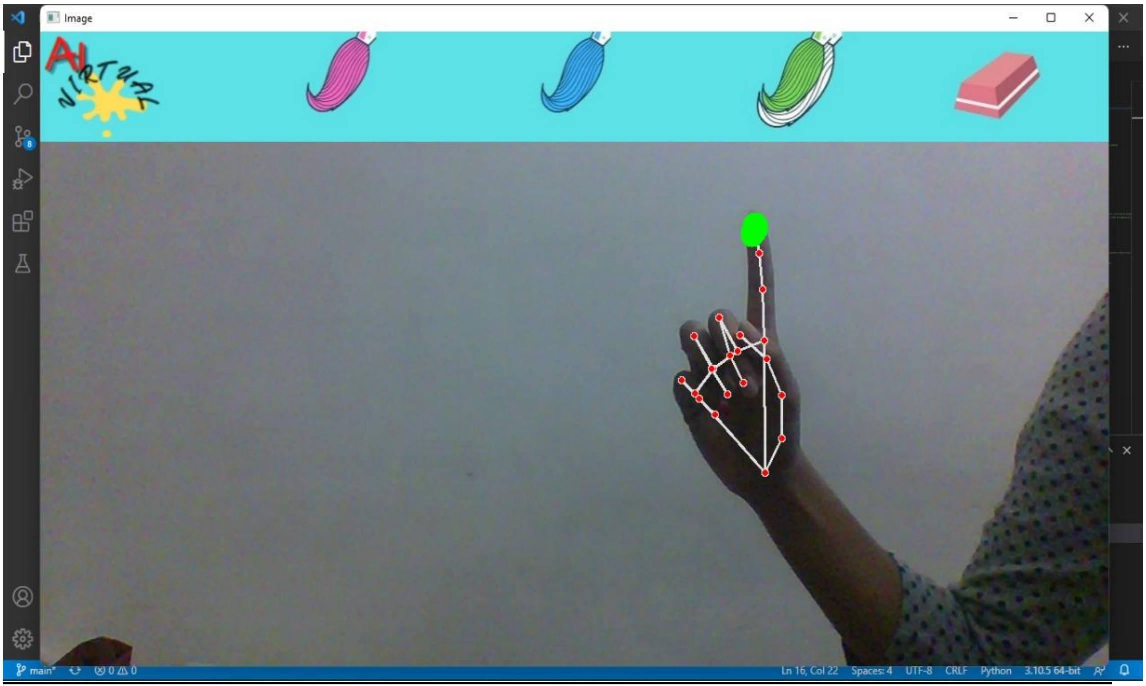
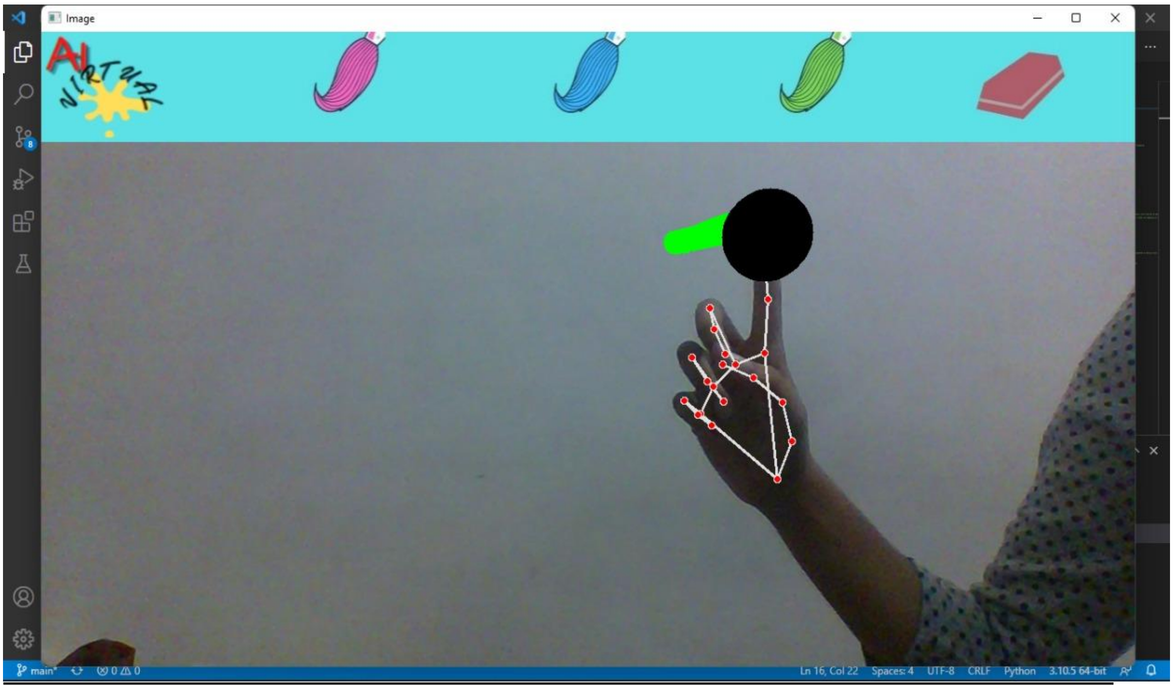


Fig 5.3.6 While using eraser :



5.4 OVERALL ALGORITHM

Step 1: start

Step 2: The movement of fingers of hand is detected with the help of a web camera

Step 3: The rectangular shape is saved in the code for selecting an object

Step 4 : The circle shape is saved in the code for drawing

Step 5 : while selecting a colour the middle finger and the index finger is used for drawing

Step 6 : while drawing something on canvas index finger is used

Step 7: just simply drawing on air infront of the camera will display on the screen when Obey the rules shown above

Step 8: output will appear on the screen

Step 9 : stop

6 SOURCE CODE

6.1 HAND TARCKING CODE

```
import cv2

import mediapipe as mp

import time

import math

class handDetector():

def __init__(self, mode=False, maxHands=2, modelComplexity=1,

detectioncon=0.5;

trackCon=0.5):

self.mode = mode

self.maxHands = maxHands

self.modelComplex = modelComplexity

self.detectionCon = detectionCon

self.trackCon = trackCon

self.mpHands = mp.solutions.hands

self.hands = self.mpHands.Hands(

self.mode, self.maxHands, self.modelComplex, self.detectionCon,

selftrackcon;

self.mpDraw = mp.solutions.drawing_utils
```

```
self.tipIds = [4, 8, 12, 16, 20]

def findHands(self, img, draw=True):

imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

self.results = self.hands.process(imgRGB)

if self.results.multi_hand_landmarks:

for handLms in self.results.multi_hand_landmarks:

if draw:

self.mpDraw.draw_landmarks(

img, handLms, self.mpHands.HAND_CONNECTIONS)

return img

def findPosition(self, img, handNo=0, draw=True):

xList = []

yList = []

bbox = []

self.lmlist = []

if self.results.multi_hand_landmarks:

myHand = self.results.multi_hand_landmarks[handNo]

for id, lm in enumerate(myHand.landmark):

h, w, c = img.shape

cx, cy = int(lm.x*w), int(lm.y*h)
```

```
xList.append(cx)

yList.append(cy)

self.lmlist.append([id, cx, cy])

if draw:

cv2.circle(img, (cx, cy), 5, (255, 0, 255), cv2.FILLED)

xmin, xmax = min(xList), max(xList)

ymin, ymax = min(yList), max(yList)

bbox = xmin, ymin, xmax, ymax

if draw:

cv2.rectangle(img, (bbox[0]-20, bbox[1]-20),

(bbox[2]+20, bbox[3]+20), (0, 255, 0), 2)

return self.lmlist, bbox

def fingersUp(self):

fingers = []

if self.lmlist[self.tipIds[0]][1] > self.lmlist[self.tipIds[0] - 1][1]:

fingers.append(1)

else:

fingers.append(0)

for id in range(1, 5):

if self.lmlist[self.tipIds[id]][2] < self.lmlist[self.tipIds[id] - 2][2]:
```

```
fingers.append(1)
else:
fingers.append(0)
return fingers
def findDistance(self, p1, p2, img, draw=True, r=15, t=3):
x1, y1 = self.lmlist[p1][1], self.lmlist[p1][2]
x2, y2 = self.lmlist[p2][1], self.lmlist[p2][2]
cx, cy = (x1 + x2) // 2, (y1 + y2) // 2
if draw:
cv2.line(img, (x1, y1), (x2, y2), (255, 0, 255), t)
cv2.circle(img, (x1, y1), r, (255, 0, 255), cv2.FILLED)
cv2.circle(img, (x2, y2), r, (255, 0, 255), cv2.FILLED)
cv2.circle(img, (cx, cy), r, (0, 0, 255), cv2.FILLED)
length = math.hypot(x2 - x1, y2 - y1)
return length, img, [x1, y1, x2, y2, cx, cy]
def main():
PTime = 0
CTime = 0
cap = cv2.VideoCapture(0)
detector = handDetector()
```

```
while True:

success, img = cap.read()

img = detector.findHands(img)

lmlist, bbox = detector.findPosition(img)

if len(lmlist) != 0:

print(lmlist[4])

CTime = time.time()

fps = 1/(CTime-PTime)

PTime = CTime

  cv2.putText(img, str(int(fps)), (10, 70),
 cv2.FONT_HERSHEY_COMPLEX,

3, (255, 0, 255), 3)

cv2.imshow("Image", img)

cv2.waitKey(1)

if __name__ == "__main__":

main()
```

6.2 AI VIRTUAL PAINTING CODE

```
import cv2

import hand_tracking_module as htm

import numpy as np

import os

overlayList = []

brushThickness = 25

eraserThickness = 100

drawColor = (255, 0, 255)

xp, yp = 0, 0

imgCanvas = np.zeros((720, 1280, 3), np.uint8)

folderPath = "header"

myList = os.listdir(folderPath)
```

```
for imPath in myList:

image = cv2.imread(f'{folderPath}/{imPath}')

overlayList.append(image)

header = overlayList[0]

cap = cv2.VideoCapture(0)

cap.set(3, 1280)

cap.set(4, 720)

detector = htm.handDetector(detectionCon=0.50, maxHands=1)

while True:

success, img = cap.read()

img = cv2.flip(img, 1)

img = detector.findHands(img)

lmList, bbox = detector.findPosition(img, draw=False)
```

```
if len(lmList) != 0:

x1, y1 = lmList[8][1], lmList[8][2]

x2, y2 = lmList[12][1], lmList[12][2]

fingers = detector.fingersUp()

if fingers[1] and fingers[2]:

xp, yp = 0, 0

if y1 < 125:

if 250 < x1 < 450:

header = overlayList[0]

drawColor = (255, 0, 255)

elif 550 < x1 < 750:

header = overlayList[1]

drawColor = (255, 0, 0)
```

```
elif 800 < x1 < 950:

header = overlayList[2]

drawColor = (0, 255, 0)

elif 1050 < x1 < 1200:

header = overlayList[3]

drawColor = (0, 0, 0)

cv2.rectangle(img, (x1, y1 - 25), (x2, y2 + 25),

drawColor, cv2.FILLED)

if fingers[1] and fingers[2] == False:

cv2.circle(img, (x1, y1), 15, drawColor, cv2.FILLED)

if xp == 0 and yp == 0:

xp, yp = x1, y1

if drawColor == (0, 0, 0):
```

```
cv2.line(img, (xp, yp), (x1, y1), drawColor, eraserThickness)

cv2.line(imgCanvas, (xp, yp), (x1, y1),

drawColor, eraserThickness)

else:

cv2.line(img, (xp, yp), (x1, y1), drawColor, brushThickness)

cv2.line(imgCanvas, (xp, yp), (x1, y1),

drawColor, brushThickness)

 xp, yp = x1, y1

imgGray = cv2.cvtColor(imgCanvas, cv2.COLOR_BGR2GRAY)

imgInv = cv2.threshold(imgGray, 20, 255, cv2.THRESH_BINARY_INV)

imgInv = cv2.cvtColor(imgInv, cv2.COLOR_GRAY2BGR)

img = cv2.bitwise_and(img, imgInv)

img = cv2.bitwise_or(img, imgCanvas)
```

```
img[0:125, 0:1280] = header

cv2.imshow("Image", img)

cv2.imshow("Canvas", imgCanvas)

cv2.imshow("Inv", imgInv)

if cv2.waitKey(1) & 0xFF == ord('q'):

break
```

7. PACKAGE VERSION USED

Here we used

OpenCv , Mediapipe ,Pip, Python

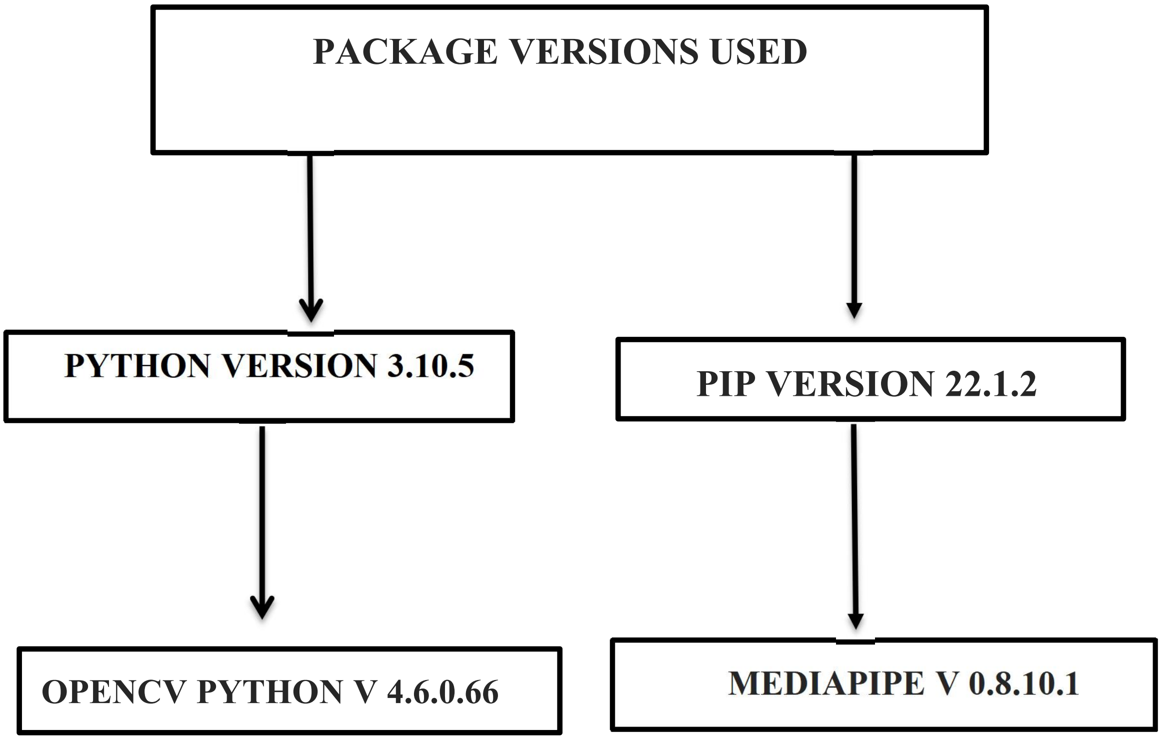


Fig 7.1 PACKAGE USED

8. APPLICATION DEVELOPMENT

The whole code is compiled and executed via Visual Studio Code, which is a streamlined code editor with support for development operations like debugging, task running, and version control. It aims to provide just the tools a developer needs for a quick code-build-debug cycle and leaves more complex workflows to fuller featured IDEs, such as Visual Studio IDE.

9.PERFORMANCE EVALUATION

The early methods that listed above on the survey have different kind of problems like touching panel,high cost of tools like data gloves,brush,ping pong ball etc.All the different papers are having different kind of issues.what we actually need is that the tool must be eco-friendly,it should be easily available all the time wherever we go etc..so we came in to a conclusion that we can have our own finger has the tool and it is having no kind of problems at all,so we used hand tracking code to detect our fingers and it is captured with the help of a web-camera,while selecting a colour it will appear a rectangular shape and while drawing on air as a canvas it will form a circle like shape.For selecting here we are using our index finger and the middle finger,and for drawing we are using only our index finger.

9.1 Key features:

- Features are automatically deduced and optimally tuned for desired outcome. Features are not required to be extracted ahead of time. This avoids time consuming machine learning techniques.

Robustness to natural variations in the data is automatically learned.

- The same neural network-based approach can be applied to many different applications to detect face etc

- The machine learning architecture is flexible to be adapted to new problems in the future

9.2 AFTER TESTING

In this section, we discuss about various issues prevailing in the traditional approaches and how depression analyzer addresses them:

Issues	Existing systems	Ai virtual painting
Time consumption	Fast but detection is slower	Same as in existing but detecting became faster

Robustness	Mainly there will be a tool which is not easily available everywhere	Anyone can access anytime from anywhere
Price value	If users using any kind of tools Its cost is high and at the same time if it fails it should need to be replace and the money is wasting again	By this one can detect fast and here our own finger is the tool.There is no nnend of money.it is free of cost
Efficiency	Not every one can use it because of the high cost of tools	Effectively everyone can use it with high accuracy

TABLE 9.3 COMPARATIVELY STUDY

10 ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

- Any one can access at anytime from anywhere.
- More accuracy
- Time consumption is fast
- Free of cost
- No wastage of money
- It can detect up to the distance of 283cm

10.2 DISADVANTAGES

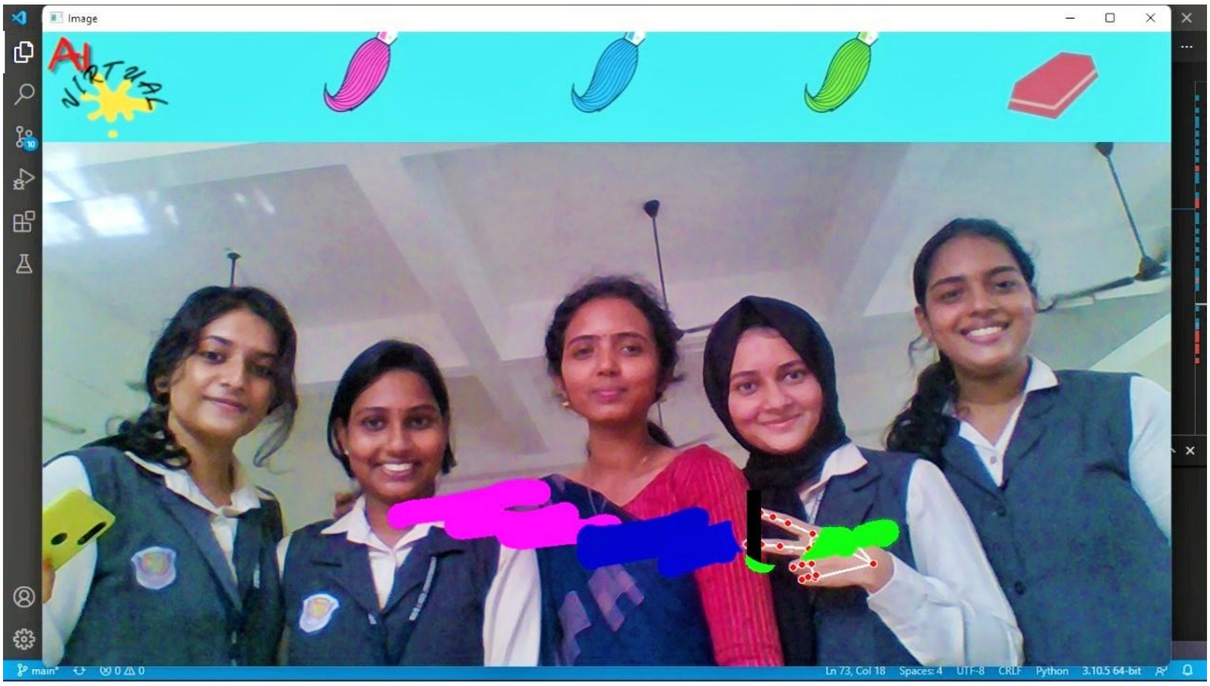
- Background should need to be blank
- if there is any kind of movement of hands of other it will detect their hand
- one person at a time
- hand want to be detect it from the closer not too far away
- intel core must be above i5

11. CONCLUSION AND FURTURE ENHANCEMENTS

This project will discuss the promising future of using Ai virtual painting it is , concluding that it is a powerful tool which is having no cost. Machine learning is a computational process related to artificial intelligence in which computer systems learn without being explicitly programmed. It includes computers that work autonomously without human intervention or supervision.. The major purpose of this project is to free of cost and available to all based on two modules. The first module, detection of hand movement using hand tracking code.The hand movement is captured by a webcam. Then identifies which finger is up.and perform actions Second method, importing necessary packages and images from folder.the images is saved in the code and it will show the result while performing necessary actions.The combination of this 2 modules gives the AI virtual painting project

By future enhancement of the project as a website hence anyone can use at any time.there is no need of wastage of money because it is easy to use.The system is having the potential to challenge traditional writing method.It is a great purpose for theu usage of teachers during the online class periods.senior citizen or people who all are having the difficulty of using keyboard can easily simply use this.it will be an excellent software which people can interact with the digital world.this is most helpfulll for the teachers during online classes.on further development we can add different colours with 3D affection,,shapes, colourfill etc.

FINAL OUTLOOK OF AI - VIRTUAL PAINTING



12 REFERENCES

1. S.Shriram" Deep Learning-Based Real-Time AI Virtual Mouse System Using Computer Vision to Avoid COVID-19 Spread", Applied Sciences, Volume 2021 Article Id 8133076,31 Jul 2021

2. Akshay L Chandra" Mouse Cursor Control Using Facial Movements An HCL Application view at publisher site

3. Google,https://ai.googleblog.com/2019/08/on-device-real-time-hand-tracking-with.html

4. A. Subramanian, N. Asokkumar, S. Poddar, and J. S. Nayak, "Hand gesture recognition for human computer interaction," Procedia Computer science vol 115 pp. 365-374,2017 view at publisher site

5. V. Bazarevsky and G. R. Fan Zhang. On-Device, MediaPipe for Real-Time Hand tracking 23

6. S Guennouni, A Ahaitouf and A Mansouriss , "Multiple object detection using Open CV on an embedded platform", 2014 Third IEEE International Colloquium in Information Science and Technology (CIST), 2014, pp. 374-377

7. G.. Chandan, Mohana A.H Jain "The Real Time Object Detection and Tracking Using Deep Learning and OpenCV", 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), 2014 pp 374-377

8. Druzhkov, P.N., Erukhimov, V.L., Zolotykh, N.Y "New object detection features in the OpenCV library", Pattern Recognit. Image Anal. 21,384 (2011)