Project Synopsis
on

Virtual Interactive Board

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.

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CERTIFICATE

This is to certify that Project Report entitled "**Virtual Interactive Board**" which is submitted by **Vaibhav Mittal, Vaibhav Singh and Sarthak Srivastava** 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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Supervisor Signature
Mr. Pardeep Tyagi
(Assistant Professor)

ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the synopsis of the B.Tech Mini Project undertaken during B.Tech. Third Year. We owe a special debt of gratitude to Mr. Pardeep Tyagi (Assistant Professor), Department of Computer Science, KIET Group of Institutions, Delhi- NCR, Ghaziabad, for his constant support and guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his/her cognizant efforts that our endeavours have seen the light of the day.

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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

Writing in air has lately become one of the most interesting and difficult research areas in image processing and pattern recognition. A wide range of human-machine interactions benefit from this technology's inclusion. Numerous researches have investigated new methods and tactics for reducing processing time and improving recognition accuracy. In Computer Vision, object tracking is a crucial part of the task. Object tracking systems have become more popular as a result of faster computers, more affordable and higher quality video cameras, and the increasing need for automated video analysis. Typically, video analysis involves three major steps: identifying the object, tracking its movement from frame to frame, and lastly analyzing its behavior. Object tracking takes into account four issues: object representation, tracking feature selection, object identification, and object tracking. Object tracking algorithms are utilized in a variety of real-world applications, including video indexing, autonomous surveillance, and vehicle navigation. Motion-to-text converters for intelligent wearable electronics that can write in the air are the subject of this study. This initiative serves as a time capsule for transitory movements. It will use computer vision to track the path of the finger. Messages, emails, etc. maybe be sent using the text that has been generated. It will be a great help for deaf individuals to communicate. It's a good way to communicate without having to write.

INTRODUCTION

In the era of digital world, traditional art of writing is being replaced by digital art. Digital art refers to forms of expression and transmission of art form with digital form. Relying on modern science and technology is the distinctive characteristics of the digital manifestation. Traditional art refers to the art form which is created before the digital art. From the recipient to analyse, it can simply be divided into visual art, audio art, audio-visual art and audio-visual imaginary art, which includes literature, painting, sculpture, architecture, music, dance, drama and other works of art. Digital art and traditional art are interrelated and interdependent. Social development is not a people's will, but the needs of human life are the main driving force anyway. The same situation happens in art. In the present circumstances, digital art and traditional art are inclusive of the symbiotic state, so we need to systematically understand the basic knowledge of the form between digital art and traditional art. The traditional way includes pen and paper, chalk and board method of writing. The essential aim of digital art is of building hand gesture recognition system to write digitally. Digital art includes many ways of writing like by using keyboard, touch-screen surface, digital pen, stylus, using electronic hand gloves, etc. But in this system, we are using hand gesture recognition with the use of machine learning algorithm by using python programming, which creates natural interaction between man and machine. With the advancement in technology, the need of development of natural human – computer interaction systems to replace traditional systems is increasing rapidly.

Sketching On Air is possible through our trending technology namely opencv ,python. Open cv is mainly known as an open source computer vision and machine learning software . The library has more than 2400 best algorithms, which includes comprehensive set of classic and state-of-the-art computer vision and machine learning algorithms. Most of these algorithms are used to detect and recognize faces, identify objects, classify human activities in videos track camera movements, track moving objects, extract 3D one’s. Python is one of the high-level-general-purpose programming language. Object-oriented approach mainly to help programmers to write clear, logical code for small as well as large scale projects. In this project we are performing the morphological operations are a set of operations that process images based on shapes. These apply a structuring element to an input image and generate an output image.

Problem Statement

Developing an interface between human hand and the system using open cv techniques and python language to pick the colour and draw using hand on the developed drawing area.

Objective

- To create a virtual canvas to sketch.
- To detect the human finger as a colour marker.
- To do the morphological operations.
- To create an interface between user and the system.

SCOPE

- To ensure that, the interface is very simple and easily understandable by the user.
- The user should be able to draw what he wishes to draw without any interruptions.
- In future, this is useful for making kids to learn drawing in schools in an interactive way.

CHAPTER 2: LITERATURE REVIEW

[1] In this paper, the author has tried to demonstrate that vision based hand interaction is more natural and efficient. In our method, firstly, a specific gesture is required to trigger the hand detection followed by tracking; then hand is segmented using motion and color cues; finally, in order to break the limitation of aspect ratio encountered. For mobile or hand held devices, their relatively small size leads to limited input space and encumbered experience with tiny keyboard or touch screen. Hand gesture is frequently used in people's daily life. It's also an important component of body languages in linguistics. So a natural interaction between humans and computing devices can be achieved if hand gestures can be used for communication between human and computing devices. The performance of vision-based gesture interaction is prone to be influenced by illumination changes, complicated backgrounds, camera movement and specific user variance. Most of hand detection methods are sensitive to complicated background. Skin color-based hand detection is unreliable for the difficulty to be distinguished from other skin-colored objects and sensitivity to lighting conditions. What makes the author's method different is that they combine fast hand tracking, hand segmentation and multi-scale feature extraction to develop an accurate and robust hand gesture recognition method. It takes advantage of color and motion cues acquired during tracking to implement adaptive hand segmentation. On the basis of segmentation, multi-scale feature extraction is executed and gestures are recognized with palm-finger decomposition. Extensive experiments show this method has promising performance with various hand gesture posture aspect ratios and under complicated backgrounds.

[2] In this study, designing of the hand gesture recognition is one of the complicated job that involves two major problem. Firstly is the detection of hand. Another problem is to create the sign that is suitable to be used for one hand in a time. This project concentrates on how a system could detect, recognize and interpret the hand gesture recognition through computer vision with the challenging factors which variability in pose, orientation, location and scale. To perform well for developing this project, different types of gestures such as numbers and sign languages need to be created in this system. The image taken from the realtime video is analysed via Haar-cascaded Classifier to detect the gesture of hand before the image processing is done or in the other word to detect the appearance of hand in a frame. In this project, the detection of hand will be done using the theories of Region of Interest (ROI) via Python programming. The explanation of the results will be focused on the simulation part since the different for the hardware implementation is the source code to read the real-time input video. The developing of hand gesture recognition using Python and OpenCV can be implemented by applying the theories of hand segmentation and the hand detection system which use the Haar-cascade classifier. The hand gesture recognition using Python and OpenCV can be implemented by applying the theories of hand segmentation and the hand detection system which use the Haar-cascade classifier.

[3] In this paper, author systematically study neural network architecture design choices for object detection and propose several key optimizations to improve efficiency.First, author propose a weighted bi-directional feature pyramid network (BiFPN), which allows easy and fast multi-scale feature fusion; Second,propose a compound scaling method that uniformly scales the resolution, depth,and width for all backbone, feature network, and box/class prediction networks at the same time. Based on these optimizations and EfficientNet backbones, author have developed a new family of object detectors, called EfficientDet, which consistently achieve much better efficiency than prior art across a wide spectrum of resource constraints. Scaled EfficientDet achieves state-of-the-art accuracy with much fewer parameters and FLOPs than previous object detection and semantic segmentation models.

[4] Augmented Airbrush for Computer Aided Painting To work our expanded artificially glamorize, the client remains before the material, allowed to chip away at any piece Of the composition, utilize any style, and counsel the PC screen in the event that the person wishes The reference and material are lined up with an aligned focus point that relates to the virtual beginning. The client can move the gadget utilizing a coordinated strategy (testing the material, cutting it, journeying shapes, and so on), a more instinctive one (irregular strolling or nearby spotlight on a solitary region), or a blend of both.The PC will mediate just the virtual following compares with a paint projection that disregards a virtual reference. In such a case, the PC mll keep the client from utilizing the maximum capacity of the artificially glamorize trigger (see next area) and applying paint where it isn't needed-A gadget depends on a Grex Genesis.XT, a gun style digitally embellish mitigated of its back paint-volume change handle. Since this is a double activity artificially glamorize, working the trigger opens both the compelled air valve and the paint liquid valve, which is made ofa needle and a spout, bringing about a stream of air blended in with paint particles.They fostered a specially crafted expansion component, to permit advanced control of the paint combination. A Grex air blower supplies compressed air at 20 PSI, and a Polhemus Fastrack attractive movement global positioning framework positions the gadget in 6DOF.

[5] 3D Drawing with Augmented Reality A mobile application that runs on Android devices and lets the user draw on the world, treating it as a canvas, implement real-time sync of the drawing on all instances of the application running in the same network room and provide a tool for creative content producers to quickly sketch their ideas in3D spaces. The Freehand procedure permits the client to draw constantly as coordinated by hand developments. To begin a line the client plays out the air-tap motion. The line is drawn constantly at the list cursor position until the client ends the line by playing out a subsequent air-tap.

[6] Frames are captured from camera, difference is estimated from the consecutive frames and CNN is applied. A Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in an input image, assign importance (weights) to various aspects/objects in the image and be able to differentiate one from the other. Support Vector Machines (SVM) are a kind of supervised machine learning algorithm that gives analysis of knowledge for classification. Creating a hyper-plane that separated the data-set into classes that allow us to start with a sample problem. The SVM model tries to enlarge the space between the 2 classes by creating a well-defined decision boundary within them. A program is then created with CNN algorithm and applied in Open-CV Python library, trained to detect 21 different objects with 90% accuracy.

[7] In this system, hand gesture recognition is used with the use of machine learning algorithm by using python programming, which creates natural interaction between man and machine.
The system proposed used the depth and colour information from the Kinect sensor to detect the hand shape It requires a red-coloured LED pointed light source is attached to the finger. It is assumed that there is no red-coloured object other than the LED light within the web camera's focus. Two-second videos of a person's hand motion were captured in different environments, broken into 30 separate images. Total 2000 images processed Models used: Single Shot Detector (SSD), RCNN Hand gestures for "Writing", "Color mode" and "Backspace" 94% accuracy is achieved

[8] Tracking Objects using Frame Differencing: Using OpenCV we define a function to first compute the difference between the current frame and the next frame of a video. Tracking Objects using Colorspace: We convert a captured frame from RGB to HSV color space and then use color thresholding to track any given object. Tracking Objects using Background Separation: It detects the background, building a model for it, and then subtracting it from the current frame to obtain the foreground, which corresponds to moving objects. Optical Flow-Based Tracking: Define a function to start tracking an object using optical flow by initializing the video "capture" object and scaling factor. The number of frames to track and the number of frames to skip are then decided. Canny's Edge Detection Algorithm: Multi-stage algorithm to detect a wide range of edges in images, uses Gaussian blur to reduce noise.

[9] Tmcking of Brush Tip on Real Canvas : Silhoutte-Based and Deep Ensemble Network-Based Approaches Working-Ihe proposed profound outfit community is ready disconnected using records stuck thru an outer tracker (Optitrack VI 20) and the define primarily based totally appmach.During actual drawing. The organized organisation appraises the brush tip function via way of means of taking the brush deal with act like an records, allowing us to make use of actual cloth with a actual brush.During the checking out system. The framework works continuously, considering that round then, it tracks the brush deal with present (function and direction) and the proposed profound troupe community takes this brush deal with act like information and predicts the brush tip function in genuine time. For information assortment, played out various strokes for 60 seconds on superficial level inside the following area.

[10] LED fitted finger movements Authors in [4] suggested a method in which an LED is mounted on the user's finger, and the web camera is used to track the finger. The character drawn is compared with that present in the database. It returns the alphabet that matches the pattern drawn. It requires a redcoloured LED pointed light source is attached to the finger. Also, it is assumed that there is no red-coloured object other than the LED light within the web camera's focus

CHAPTER 3 PROPOSED METHODOLOGY

Based on the web camera frames that were captured, a virtual paint programme was offered. The web camera sends the system the frames that it has received. Until the application is finished, the approach uses a web camera to collect each frame.

The Camera Used in the AIR CANVAS The frames that have been recorded by a laptop or PC's webcam serve as the foundation for the proposed AIR CANVAS. The web camera will begin recording video after the video capture object is created using the Python computer vision package OpenCV. The virtual AI system receives frames from the web camera and processes them

Capturing the Video and Processing The webcam is used by the AIR CANVAS system, and every frame is recorded up until the end of the application. As illustrated in the accompanying code, the video frames are converted from BGR to RGB in order to find the hands in the video frame by frame.

```
def findHands(self, img, draw = True):
imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
self.results = self.hands.process(imgRGB)
```

Detecting Which Finger Is Up and Performing the Particular Function Using the tip Id of the specific finger that we located using the MediaPipe and the corresponding co-ordinates of the fingers that are up, as shown in Figure 6, we are able to determine which finger is up at this point. Then, in accordance with that determination, the specific mouse function is carried out.

For the Mouse to Perform ACTION The pynput Python module is used to programme the computer to execute the right mouse button click if the middle finger with tip Id = 2 and the index finger with tip Id = 1 are both up and the distance between the two fingers is less than 40 px

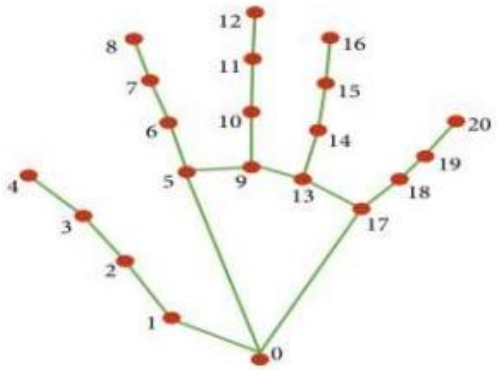
ALGORITHM

MediaPipe

- The user experience can be significantly enhanced across a range of technological domains and platforms by being able to recognise the shape and motion of hands. For instance, it can provide as the foundation for hand gesture control and sign language comprehension.
- It can also make it possible for digital information and material to be superimposed on top of the real world in augmented reality. Although it comes effortlessly to individuals, robust real-time hand perception is an extremely difficult computer vision problem due to the fact that hands frequently occlude themselves or each other and lack high contrast patterns.
- A high-fidelity hand and finger tracking solution is MediaPipe Hands. It uses machine learning (ML) to deduce 21 3D hand landmarks from a single image.Our solution delivers real-time performance on a cell phone, and even scales to several hands, unlike existing state -of-the-art systems, which mostly rely on powerful desktop environments for inference.
- We anticipate that making this hand perception functionality available to a larger research and development audien ce will lead to the creation of innovative use cases, igniting new research directions

Hand Landmark Model

- After detecting the palm over the whole image, our subsequent hand landmark model uses regression, or direct coordinate prediction, to accomplish precise keypoint localization of 21 3D hand -knuckle coordinates inside the detected hand regions.
- The model acquires a reliable internal hand posture representation and is unaffected by selfocclusions or partially visible hands. We manually added 21 3D coordinates to around 30K real-world photos to obtain ground truth data, as shown below (we take Z-value from image depth map, if it exists per corresponding coordinate).
- We additionally render a high-quality synthetic hand model over a variety of backgrounds and map it to the associated 3D coordinates in order to better cover the range of possible hand poses and provide additional supervision on the nature of hand geometry.



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

Fig-2:landmarks in the hand

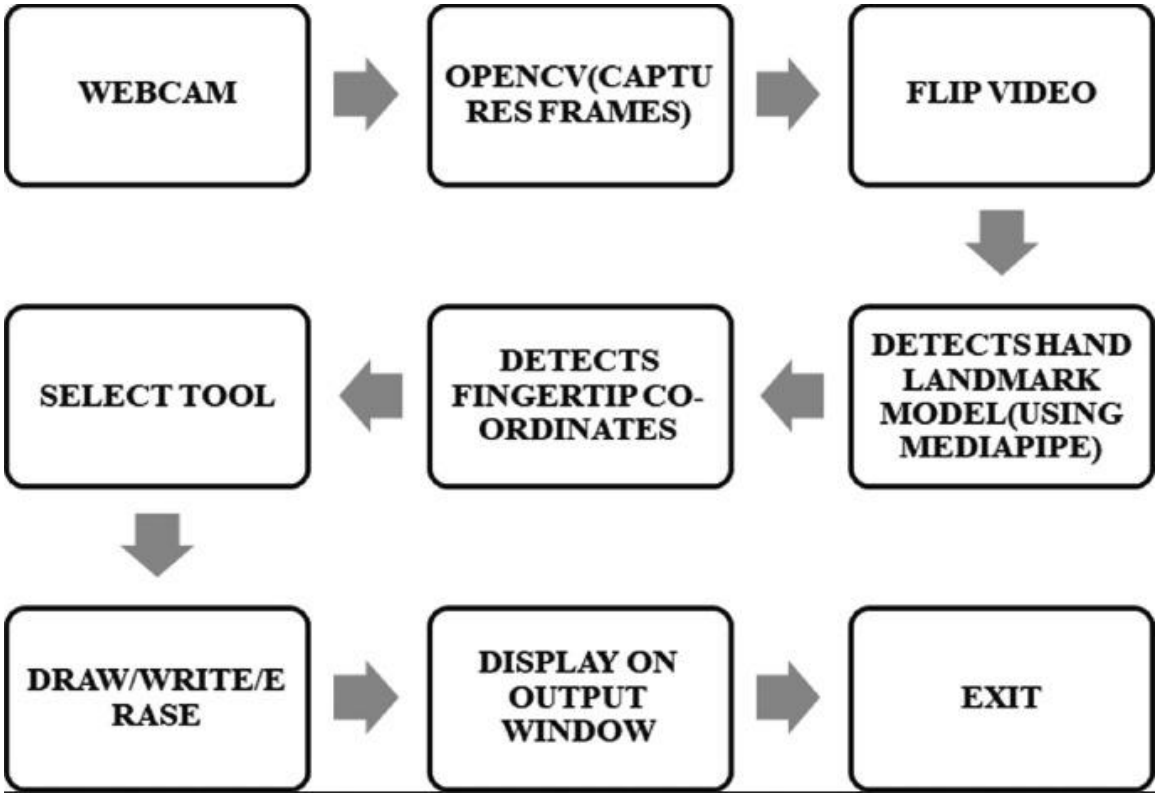
OpenCV:

- Object detection image processing methods are included in the OpenCV computer vision library.
- Real-time computer vision applications can be created by utilising the OpenCV library for the Python programming language.
- The processing of images and videos as well as analytical techniques like face and object detection use the OpenCV library.

NumPy:

- The N-dimensional array type known as nd array is the most significant object defined in NumPy.
- The collection of identically categorised things is described. A zero-based index can be used to access items in the collection.
- A ndarray's items all take up the same amount of space as a memory block. Every item in ndarray is a data-type object object (called dtype).
- A Python object of one of the array scalar types represents each item that is retrieved from an ndarray object (via slicing).

FLOWCHART


WEBCAM
OPENCV(CAPTURES FRAMES)
FLIP VIDEO
DETECTS HAND LANDMARK MODEL(USING MEDIAPIPE)
DETECTS FINGERTIP CO-ORDINATES
SELECT TOOL
DRAW/WRITE/ERASE
DISPLAY ON OUTPUT WINDOW
EXIT

CHAPTER 4 TECHNOLOGY USED

- Mediapipe:

  MediaPipe is a cross-platform pipeline framework to build custom machine learning solutions for live and streaming media. The framework was open-sourced by Google and is currently in the alpha stage.

- OpenCV

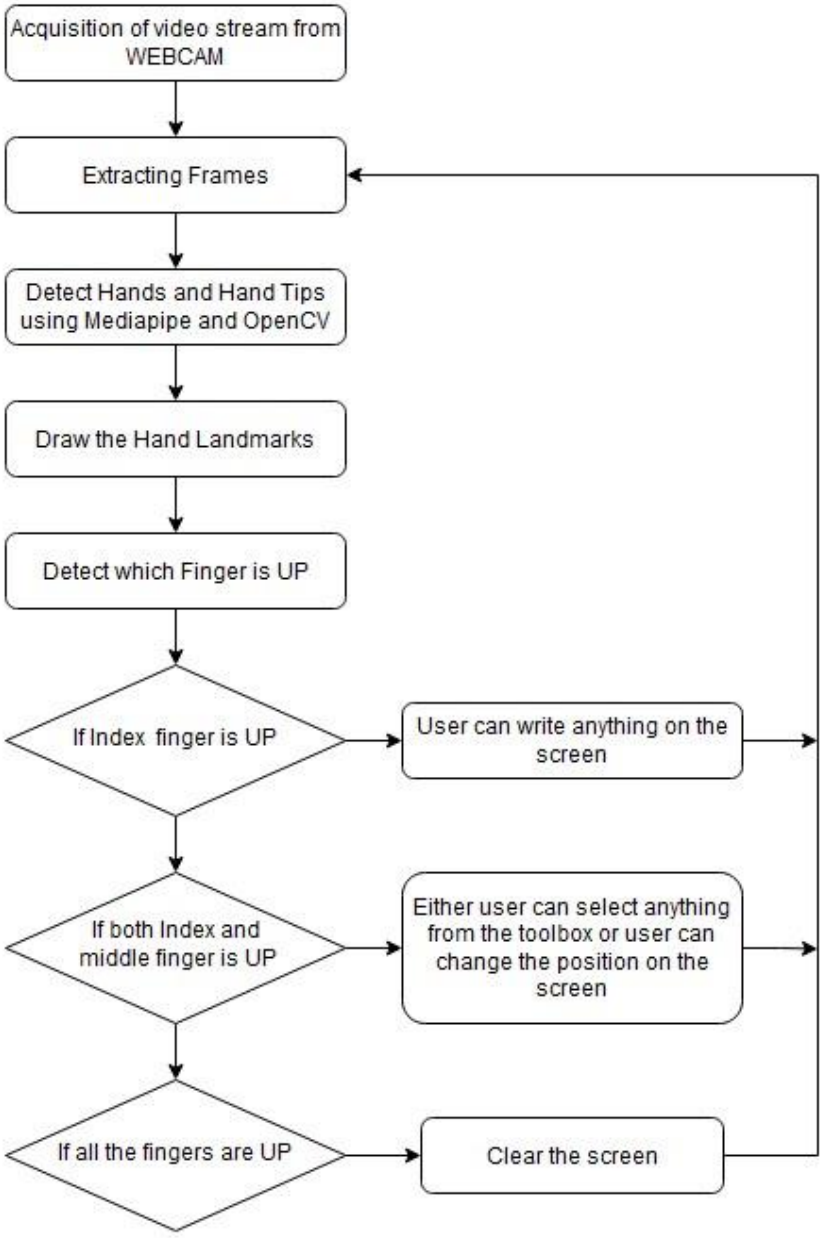
  OpenCV-Python is a library of Python bindings designed to solve computer vision problems.

- NumPY

  NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices.

CHAPTER 5 DIAGRAMS

This section includes the pictorial representation of our project, defining how our project basically works and what are the steps that are performed in between to reach the desired result.



CHAPTER 6 CONCLUSION

To avoid the use of mouse and difficulty to draw using it in the existing systems , this project Air Canvas helps us a lot. We can easily draw or present our imagination just by waving our hand . This uses the easy methods or libraries like mediapipe making the project efficient than existing one. In this system we have implemented an air canvas system using mediapipe which is efficient way to track hand positions . Mediapipe also helps us to reduce the process of image processing to detect the positions of fingers . This can be used in different aspects like teaching, drawing etc. This helps us to reduce the use of hardware components like mouse, touch screen etc. This can also be used as base project for various system that require hand tracking. The project discussed in this paper also helps to improve creativity in people. This helps us to teach and draw easily than earlier. In future, we can also use this project as base project for many other hand tracking projects. we can also use this in sign language detection , virtual mouse etc

This program has the potential to challenge traditional writing methods. Eliminates the need to carry a cell phone in hand to take notes, to give an easy way on the go to do the same. It will again work towards a greater purpose in helping especially those who know them to communicate easily. Even adults who find it difficult to use the keyboard can easily use the program. Expanding functionality, this program can also be used to control IoT devices soon. Air painting can also be made happen. This program will be very good smart clothing software using which people can work better with the digital world. The unpopular reality of taxpayers we see can make the text come alive. Wind-writing programs should listen only to their master's control touch and should not be misled by people all around. Such discovery algorithms are as follows as YOLO v3 can improve fingerprint recognition accuracy and speed. In the future, progress on Artificial Intelligence will improve the efficiency of writing in the air.

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