PROJECT APPROVAL

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2.	Seat No	:	229620
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4.	Title of the Project	:	VIRTUAL AIR CANVAS
5.	Name of the Guide	:	**Dr. Hiren Dand**
6.	Teaching Experience of Guide	:	**30 years**
7.	Is this your first Submission	:	**Yes**

Signature of the Student

Date: ……

Signature of the Coordinator / Guide

Date: …….

Parle Tilak Vidyalaya Association's

MULUND COLLEGE OF COMMERCE

(Affiliated to University of Mumbai)
NAAC Re-Accredited A Grade – III Cycle
MULUND WEST, MUMBAI 400080
MAHARASHTRA, INDIA

DEPARTMENT OF INFORMATION TECHNOLOGY

CERTIFICATE

This is to certify that the project entitled, **"Virtual Air Canvas"**, is bonafide work of **CLERESSA PHILIP D'SOUZA** bearing Seat. No: 229620 submitted in partial fulfilment of the requirements for the **Third year** of **BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY Semester VI** during the academic year 2022 – 2023.

Internal Guide and Coordinator

External Examiner Principal

Date:

College Seal

VIRTUAL AIR CANVAS

A PROJECT REPORT

Submitted in partial fulfillment of the

Requirements for the award of the Degree of

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

Submitted By:

Cleressa D'souza

Roll no. :- 229620

UNDER THE ESTEEMED GUIDANCE OF :

Dr. Hiren Dand

Coordinator , Department of Information Technology

DEPARTMENT OF INFORMATION TECHNOLOGY

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MULUND WEST, MUMBAI 400080 MAHARASHTRA, INDIA 2021 – 22

ABSTRACT

Topic: Virtual Air Canvas

Writing is an integrated form of communication that can convey our thoughts. Typing and writing are standard ways to record information today. Letters or words are written in a relaxed space by marker or finger. These wearable devices can see and understand our actions.A computing process that attempts to recognize and interpret human gestures through the use of mathematical algorithms is known as gesture recognition.

To track finger movement, the application will employ computer vision. Other uses for the created text include sending emails and texts, among others. It will be a helpful means of communication for the deaf.

The most fascinating and challenging research area in the field of image processing and pattern recognition in upcoming years is hype for drawing characters or visualizing characters in real-time.

A few projects in the respective field have been constructed but the focus over time is to increase the accuracy and resolution with reduced tension on the timing of producing the resulting image by the system.

Air canvas is another project in the respective field where the user can draw characters in real-time with the help of a pre-defined object by feeding it to the system about the object to track in order to let the user draw characters in real-time.

The project proposes to reduce the usage of papers, reduce the discomfort of marking an important part in a presentation, and much more. We will be using computer vision

in the open cv to build the project. The required language for this project is python, which has exhaustive libraries that would help us attain the desired result.

ACKNOWLEDGMENT

The presented project, as a part of the curriculum was a first of its kind experience for me. I had looked upon this project not merely as a syllabus to be completed but as an aim to know, study, develop and experience the commercial software technologies. I would like to thank and appreciate the support of few, who served a helping hand physically, mentally and intellectually in the course of this project. Foremost regards to my guide, I would thank our H.O.D, Dr. Hiren Dand and Principal Dr. Sonali Pednekar who made available the facilities required for the project work. I am pleased to be able to say that, in an acceptable manner, I have achieved my goals and goals to make this project a result. I also wish to mention the unsaid support of my parents who, as always helped me in every possible way to make this work of mine, a success. The contribution made by my friends and mates, directly or indirectly was indispensable, and will always be remembered. This opportunity has given me a valuable experience about software development Thanking You.

DECLARATION

I, hereby declare that the project entitled, **"Virtual Air Canvas"** done at **Mulund College of Commerce**, has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfilment of the requirements for the award of degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as final semester project as part of our curriculum.

CLERESSA PHILIP D'SOUZA

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Chapter 1:Introduction

1.1 Background:-

With the evolution in technology, we will slowly move from the traditional pen and paper method to the more advanced human computer interaction systems. Due to covid 19 situation we have come up with this idea as we faced ample difficulties while studying online where teachers had to write on the paper and teach or while sharing screen, they had to draw on MS paint which was a difficult task.

The aim behind our project is to build the hand movement recognition system to write digitally where drawing in air is made possible. Our system has the potential to challenge the old methods. Digital art includes many ways of writing like by using keyboard, touch-screen surface, digital pen, etc.

But in this system, we are using hand movement recognition with the use of python programming language, which creates natural interaction between man and machine. Here, we have built an Air Viwhich can draw the output as expected by the user on the screen by just capturing the motion of the coloured marker with the help of camera. A marker will be used as an object with a specific colour, where it can either be a pen, or a small cloth attached to the finger of the user. It works by creating a mask around the path that the user creates, which resets when the user clears the canvas and finally shows the output on the screen. For implementing this project, we will be using the Python language due to its exhaustive libraries and easy to make use of the syntax.

But first, we need a good understanding of the basics of python and OpenCV. So, mainly focusing on its interface created to detect the solid colours from the environment such that its reference point is taken as input. This project’s execution is not exclusive to Python language. It can be implemented in any OpenCV supported languages. Along with OpenCV, we will also use some Python modules and some Scientific Python packages and libraries like NumPy, Tkinter, PyAutoGUI is one of the automation library used for the movement of cursor, OpenCV has a function to read video where cv2 library is used, The Deque library has the methods for adding

and removing elements which can be invoked directly with arguments, machine learning language is also used for taking screenshots by using tkinter library which provides fast and easy way to create graphic user interface applications. Air Canvas also has a feature named ‘Clear All’ which will reset the output screen when the user clicks on it with the marker so once the program runs, there is no need to touch the computer screen. All the features will be accessible to the user just by using their coloured marker in the air as a navigation tool.

The proposed system eradicates the usage of cell phones for captivating notes. Fingertip detection and finger movement techniques are used to develop the system.Using Python, OpenCV and CNN techniques fingertip is first detected and then the trajectory of fingertip is traced and displayed on the screen.

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.

Traditional and digital art are interdependent and related to one another. Although social progress is not a result of popular demand, basic human necessities nonetheless serve as the primary impetus. In art, the same thing takes place. Because conventional and digital art currently coexist in a symbiotic state, it is important to carefully comprehend the fundamental differences between the two types of art. The writing methods that are traditionally used include chalk and a board and a pen. Building a system to recognise hand gestures for digital writing is a key goal of digital art. Many different writing techniques are used in digital art, such as the keyboard, touch-screen surface, digital pen, stylus, electronic hand gloves, etc. However, in this method, we use a hand

Python programming is used for developing the virtual mouse system, and also, the lending library for computer vision that is OpenCV is used in the AI virtual mouse system. In the proposed system, the model uses the MediaPipe package for the tracking of the hands and for tracking the tip of the fingers, also, Pynput, Autopy, and PyAutoGUI packages are used for moving around the window screen of the

computer for performing various functions such as left click, right click, and scrolling functions. The results of the proposed AI virtual mouse model showed very high accuracy level, and the model can work very well in real-world application with the use of a CPU without the us e of a GPU.

This paper's remainder is categorized as follows: The first section consists of the Abstract and Introduction followed by the second Section presents the other pieces of literature that we referred to before working on this project. In the next section i.e. Section three the challenges we faced while making this system are mentioned. In Section four, we define the problem statement we were solving and in Section five the system methodology and workflow that we followed in given. The subsections of section five include - Colour Recognition Dataset Creation and Colour Recognition Model Training. Finally, in Section six, information about algorithm of workflow is mentioned followed by the last section seven which concludes this paper.

1.2 Objective:-

The existing system only works with your fingers and no highlighters, paints, or relatives.Identify and distinguish something like a finger from RGB image without depth sensor great challenge. Another problem is lack of top and movement under the pen. The system uses a one RGB camera that you can overwrite. From the depths discovery is impossible, jobs up and down of the pen cannot be traced. So, everything finger path is drawn, and the result the image will be abstract and unseen by model. Using real-time hand touch to change position the process from one region to another requires a lot of code care. In addition, the user should know many movement to control his plan adequately. The project focuses on solving some of the most important social issues Problems.

First of all, there are many hearing-impaired people problems in everyday life. While listening again listening is taken for granted, people don’t have this communicating with a disability using sign language. Most countries in the world cannot understand yours feelings and emotions outside the middle translator. Second, overuse Smartphones: causes accidents, stress, disruptions, and other illnesses that people

can no longer tolerate find out. Although its portability and ease of use exist.very popular, its obstacles include life terrifying events. Waste paper is not uncommon. Many papers are wasted on writing,writing, drawing, etc. A4 paper production requires about 5 litres of water. 93% sources come from trees, 50% of commercial waste is paper, 25% of landfills are paper, and the list goes on. Waste paper harms the environment through use of water and trees and produces tons of waste. On-air writing can solve these problems quickly. It will serve as a communication tool for the deaf.Your online text can be displayed in AR or translated into speech. One can write on the air quickly and continue to operate without much interruption.Also, writing in the air does not require paper. Everything is stored electronically.

The project focuses on solving some major societal problems –
1. People hearing impairment: Although we take hearing and listening for granted, they communicate using sign languages. Most of the world can't understand their feelings, their emotions without a translator in between.
2. Overuse of Smartphones: They cause accidents, depression, distractions, and other illnesses that we humans can still discover. Although its portability, ease of use is profoundly admired, the negatives include life threatening events.
3. Paper wastage is not scarce news. We waste a lot of paper in scribbling, writing, drawing, etc.… Some basic facts include - 5 litres of water on average are required to make one A4 size paper, 93% of writing is from trees, 50% of business waste is paper, 25% landfill is paper, and the list goes on. Paper wastage is harming the environment by using water and trees and creates tons of garbage.
Air Writing can quickly solve these issues. It will act as a communication tool for people with hearing impairment. Their air-written text can be accessible using AR or converted to speech. 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.

1.3 Purpose, Scope And Applicability:-

1.3.1 Purpose-

The program will use a computer vision to trail finger movement.

The generated text can also be used for various purposes, such as texting, emails, etc.

It will be a useful way for deaf to communicate.

Execution of utopia into reality.

1.3.2 Scope:-

Using Python, OpenCV and CNN techniques fingertip is first sensed and then the trajectory of fingertip is traced and displayed on the screen.The scope is to create a free space where one can draw in air freely. The RGB camera detects the fingertip and tracks its motion through out the screen. Whenever the hand comes in front of the camera, the initial thing to do is detect the fingertip. There are various ways of fingertip detection.

1.3.3 Applicability:-

The applicability involves fingertip detection, tracking and tracing of it. Fingertip detection or LED light detection system is developed, where they first detect LED light and then capture the movement and by using Optical Character Recognition(OCR) and display the alphabet on the screen. However these methods which have the usage of devices have some limitations.The proposed system eliminates the usage of cell phones for taking notes. Fingertip detection and finger movement techniques are used to develop the system.Using Python, OpenCV and CNN techniques fingertip is first detected and then the trajectory of fingertip is traced and displayed on the screen.

1.4 Achievements

It increases the easiness to draw characters or write something in real-time without the need to jot down something in a notebook and then share the book. It also helps in drawing characters without the need of using a mouse or input pen. Drawing in real-time can also be made practicable which in turn would make the work for the

user easier. In the future, the functionality of the system can be made better by introducing hand gestures with a pause, that can be used to control the real-time system instead of using an object.

1.5 Organisation of report

Chapter 1: Introduction

The introduction has several parts as given below:

Background: A explanation of the background and context of the project and its relation to work already done in the area. Summary of existing work in the area concerned with the project work.

Objectives: Concise statement of the aims and objectives of the project. Define exactly what is going to be done in the project. Purpose, Scope and Applicability: The description of Purpose, Scope, and Applicability are given below:

• Purpose: Description of the topic of the project that answers questions on why this project is being done. How the project could improve the system its significance and theoretical framework.

• Scope: A brief overview of the methodology, conventions and limitations. The students should answer the question: What are the main issues being covered in the project? What are the main functions of the project?

• Applicability: The student should explain the direct and indirect applications of their work. Briefly discuss how this project will serve the computer world and people.

Achievements: Explain what knowledge the student achieved after the completion of the work. What contributions has the project made to the chosen area? Goals achieved - describes the degree to which the findings support the original objectives laid out by the project. The goals may be partially or fully achieved, or exceeded.

Organisation of Report:

Summarising the remaining chapters of the project report, in effect, giving the reader an overview of what is to come in the project report.

Chapter 2: Survey of Technologies In this chapter Survey of Technologies should demonstrate the student's awareness and thoughtfulness of Available Technologies related to the topic of the project. It will give the detail of all the related technologies

that are necessary to complete the project. This should describe the technologies that are available in the chosen area and present a relative study of all those Available Technologies. Will explain why did I selected the one technology for the completion of the objectives of the project.

Chapter 3: Requirements and Analysis

Problem Definition: Define the problem on which I am working in the project. Provide details of the overall problem and then divide the problem in to sub-problems. Define each sub-problem clearly.

Requirements Specification: Define the requirements of the system, independent of how these requirements will be accomplished. The Requirements Specification describes the things in the system and the actions that can be done on these things. Identify the operation and problems of the existing system.

Planning and Scheduling: Planning and scheduling is a complicated part of software development. Planning, for our purposes, can be thought of as determining all the small tasks that must be carried out in order to accomplish the goal. Planning also takes into account, rules, known as constraints, which, control when certain tasks can or cannot happen. Scheduling can be thought of as defining if whether adequate resources are available to carry out the plan. The student should show the Gantt chart and Program Evaluation Review Technique (PERT).

Software and Hardware Requirements: Define the details of all the software and hardware needed for the development and implementation of the project.

• Hardware Requirement: In this section, the equipment, graphics card, numeric coprocessor, mouse, disk capacity, RAM capacity etc. necessary to run the software is noted.

• Software Requirements: In this section, the operating system, the compiler, testing tools, linker, and the libraries etc. necessary to compile, link and install the software is listed. Preliminary Product Description: Identify the requirements and objectives of the new system. Define the functions and operation of the application/system

Conceptual Models: Understand the problem domain and produce a model of the system, which describes operations that can be performed on the system, and the allowable sequences of those operations. Conceptual Models consist of complete Data Flow Diagrams, ER diagrams, Object-oriented diagrams, System Flowcharts etc.

Chapter 4: System Design Describes desired features and operations in detail, including screen layouts, business rules, process diagrams, pseudocode and other documentation.

Basic Modules: Divide the overall problem into more manageable parts and develop each part or module separately. When all modules are ready, integrate all the modules into one system.

Data Design: Data design will consist of how data is organised, managed and manipulated.

• Schema Design: Define the structure and explanation of schemas used in the project.

• Data Integrity and Constraints: Define and explain all the validity checks and constraints provided to maintain data integrity. Procedural Design: Procedural design is a systematic way for developing algorithms or procedurals.

• Logic Diagrams: Define the systematic flow of procedure that improves its comprehension and helps the programmer during implementation. e.g., Control Flow Chart, Process Diagrams etc.

• Data Structures: Create and define the data structure used in procedures.

• Algorithms Design: With proper explanations of input data, output data, logic of processes, design and explain the working of algorithms.

User Interface Design: Define user, task, environment analysis and how to map those requirements in order to develop a “User Interface”. Describe the external and internal components and the architecture of user interface. Show some rough pictorial views of the user interface and its components.

Security Issues: Discuss Real-time considerations and Security issues related to the project and explain how to avoid those security problems.

Test Cases Design: Define test cases, which will provide easy detection of errors and mistakes within a minimum period of time and with the least effort.

Chapter 2:Survey Of Technology

2.1 Python

Python is a dynamic, interpreted (bytecode-compiled) language. There are no type declarations of variables, parameters, functions, or methods in source code. This makes the code short and flexible, and you lose the compile-time type checking of the source code. Python tracks the types of all values at runtime and flags code that does not make sense as it runs.

An excellent way to see how Python code works is to run the Python interpreter and type code right into it. If you ever have a question like, "What happens if I add an int to a list?" Just typing it into the Python interpreter is a fast and likely the best way to see what happens.

2.2 Numpy

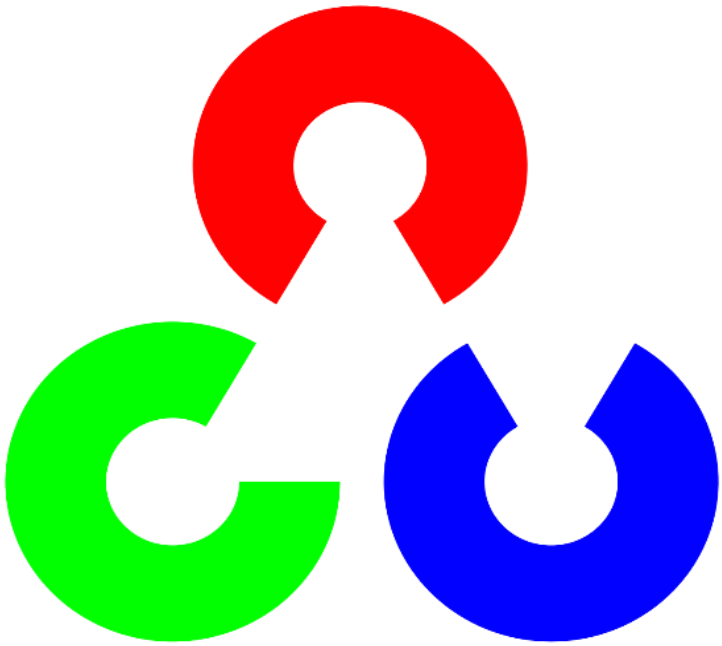
NumPy is a Python library used for working with arrays.It also has functions for working in domain of linear algebra, fourier transform, and matrices.NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely.NumPy stands for Numerical Python.

In Python we have lists that serve the purpose of arrays, but they are slow to process.NumPy aims to provide an array object that is up to 50x faster than traditional Python lists.

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

Arrays are very frequently used in data science, where speed and resources are very important.

2.3 Opencv



OpenCV is a programming library/package that has been created especially for allowing programmers to enter the world of Computer Vision. The primary developer of the OpenCV package is Intel Corporation, and the package was released to the public during the year 1999-2000.

OpenCV stands for Open-Source Computer Vision (Library). It is the most commonly used, popular, and well-documented Computer Vision library. It is open-source, which means that one does not require a license to utilize the software.

As one may know, most Machine Learning Algorithms require inputs to be quantitative in nature, i.e., numerical. OpenCV allows us to apply Machine Learning techniques to images, however, oftentimes we are required to preprocess and prepare the raw images for them to be transformed into features (columns of data) that are useful and usable by our Machine Learning Algorithms.

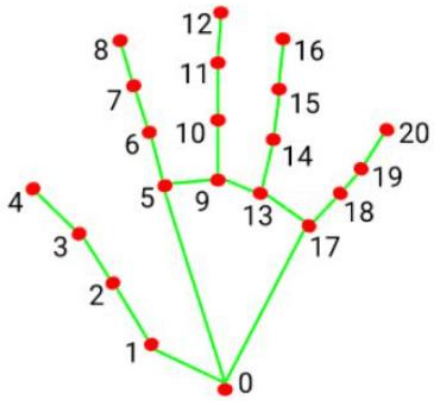
2.4 MediaPipe

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.

MediaPipe is an open-source framework for building pipelines to perform computer vision inference over arbitrary sensory data such as video or audio. Using MediaPipe, such a perception pipeline can be built as a graph of modular components. MediaPipe is currently in alpha at v0.7, and there may still be breaking API changes. Stable APIs are expected by v1.0.

2.5 Hand Landmark Model

Hand Land Marks



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

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.

Chapter 3:Requirement And Analysis

3.1 Problem Definition:-

The project focuses on solving some of the most important social issues Problems. First of all, there are many hearing-impaired people problems in everyday life. While listening again listening is taken for granted, people don't have this communicating with a disability using sign language. Most countries in the world cannot understand yours feelings and emotions outside the middle translator. Second, overuse Smartphones: causes accidents, stress, distractions, and other illnesses that people can no longer tolerate find out. Although its portability a nd ease of use exist.very popular, its obstacles include life terrifying events. Waste paper is not uncommon. Many papers are wasted on writing,writing, drawing, etc. A4 paper production requires about 5 liters of water. 93% sources come from trees, 50% of commercial waste is paper, 25% of landfills are paper, and the list goes to. Waste paper harms the environment through use of water and trees and produce tons waste. On -air writing can solve these problems quickly. It will serve as a communication tool for the deaf.Your online text can be displayed in AR.

3.1.1 Existing System:

The existing system only works with your fingers and no highlighters, paints, or relatives.Identify and distinguish something like a finger from RGB image without depth sensor great challenge. Another problem is lack of top and movement under the pen. The system uses a one RGB camera that you can overwrite. From the depths discovery is impossible, jobs up and down of the pen cannot be traced. So, everything finger path is drawn, and the result the image will be abstract and unseen by model. Using real-time hand touch to change position the process from one region to another requires a lot of code care. In addition, the user should know many movement to control his plan adequately.

3.1.2 Purposed System:

The proposed method is not supported by skin color patterns and can work even in the wrong divisions. They include both the classification and recognition process is used cross-cluster process. Their results show better 5% performance loss on both models. Neumann et al. he built a way to find out and see text in real photos. In their

own article, they use a hypothesis framework that can manage multiple lines of text. They also use artifacts characters to train the algorithm, and, finally, they use the most stable (MSER), delivery firmness in geometric shapes and lamps . In addition, Wang et al. discussed colors internal and external motion detection system places. In the proposed way, use a webcam and t-shirt tracking item.The result of the proposed method shows that the method can be applied to the physical reality applications. Jari Hannuksela et al. Toshio Asano et al. and Sharad Vikram et al. babe finger recognition systems are finger-based to track. the author introduces the based movement a tracking algorithm that combines two Kalmans filtering techniques and expected expansion (EM) methods for measuring two different movements. Finger movement with the camera. Rate supported in moving buildings the place we count each image. Its idea is to control the cell phone devices by simply swiping a finger in front of a camera. the authors discuss visually seeing Japanese katakana characters in the wind. Following hand movements, they use LED pen and camera. They change the signal pencil in traffic codes. Codes are there usually up to 100 data items to complete the result of typing speed, in which there are 46 Japanese characters explained. With one camera, they get a 92.9% character recognition accuracy, too multiple cameras, action 9 ° directional accuracy.

3.2 Requirement Specification:

Requirement's analysis is the process of defining what the user requires from the system and defining the requirements clearly and in an unambiguous state. The outcome of the requirement analysis is the software developing activities. Thus, it deals with understanding the problem goals and constraints. This specification part mainly focuses on what had been found during analysis. A requirement is a relatively short and concise piece of information, expressed as a fact. It can be written as a sentence or can be expressed using some kind of diagram. Requirements are divided into two major types functional and non-functional.

3.3 Planning and scheduling

In Planning and scheduling the process of planning primarily deals with selecting the appropriate policies and procedures in order to achieve the objectives of the project

and in Scheduling the scheduling converts the project action plans for scope, time cost and quality into an operating timetable.

3.3.1 Gantt-chart:

A Gantt-chart is a type of bar-chart that illustrates a project schedule. In this chart lists on the vertical axis the tasks to be performed, and on the horizontal axis time intervals are listed. The width of the coloured horizontal bars in the graph shows the duration of each activity.

Months	June				July				August				September				October			
Weeks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Requirement Gathering																				
Planning																				
Analysis																				
System Planning and Design																				

Table No. 3.3.1.1 :Gantt chart

3.4 Software and Hardware Specifications:

3.4.1 Software Requirements:

Supporting Software : Python, Numpy, Opencv

3.4.2 Hardware Requirements:

Operating System : Any Operating System

Processor : Intel Core i5 7th Gen 2.50GHz

RAM : 8GB

Monitor : Any colour monitor

Webcam

3.5 Preliminary Project Description

Real-time hand gesture recognition employs a variety of techniques. A system created by Shomi Khan, M. Elieas Ali[3], and Sree Sourav Das employs a skin colour identification algorithm to translate American Sign Language (ASL) from real-time video into text. It could be difficult to identify the hand because skin tone and hand form vary from person to person. The technology uses two neural networks to overcome t his. The SCD (Scalable color descriptor) neural network is the first algorithm. The picture pixels are fed into the SCD neural network, which determines whether or not they are skin pixels. The second is HGR (Hand gesture recognition) neural network in which the extracted features will be added. The features are to be extracted by two distinct algorithms namely Finding the fingertip and Pixel segmentation algorithm.

3.6 Conceptual Models

A. Fingertip Detection Model:

Air writing can be merely achieved using a stylus or airpens that have a unique colour [2]. The system, though, makes use of fingertip. We believe people should be able to write in the air without the pain of carrying a stylus. We have used Deep Learning algorithms to detect fingertip in every frame, generating a list of coordinates.

B. Techniques of Fingertip Recognition Dataset Creation:

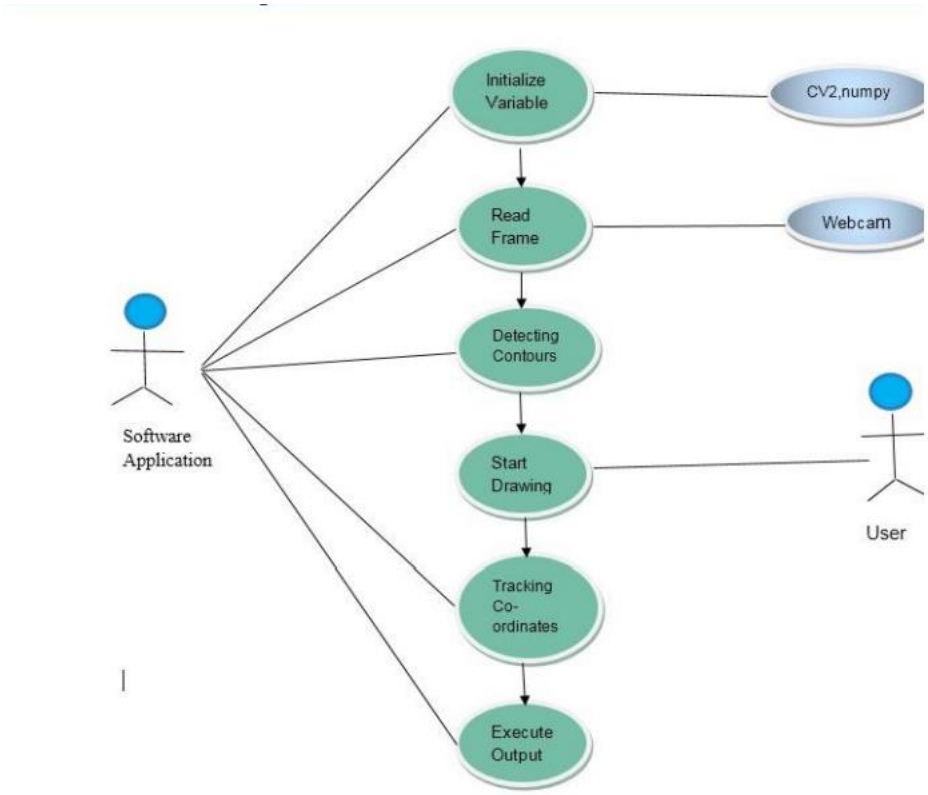
a. Video to Images:

In this approach, two-second videos of a person's hand motion were captured in different environments. These videos were then broken into 30 separate images, as shown in Figure . We collected 2000 images in total. This dataset was labeled manually using LabelImg[13]. The best model trained on this dataset yielded an accuracy of 99%. However, since the generated 30 images

were from the same video and the same environment, the dataset was monotonous. Hence, the model didn't work well for discrete backgrounds from the ones in the dataset. Figure 3: Video to Images

b. Take Pictures in Distinct Backgrounds:

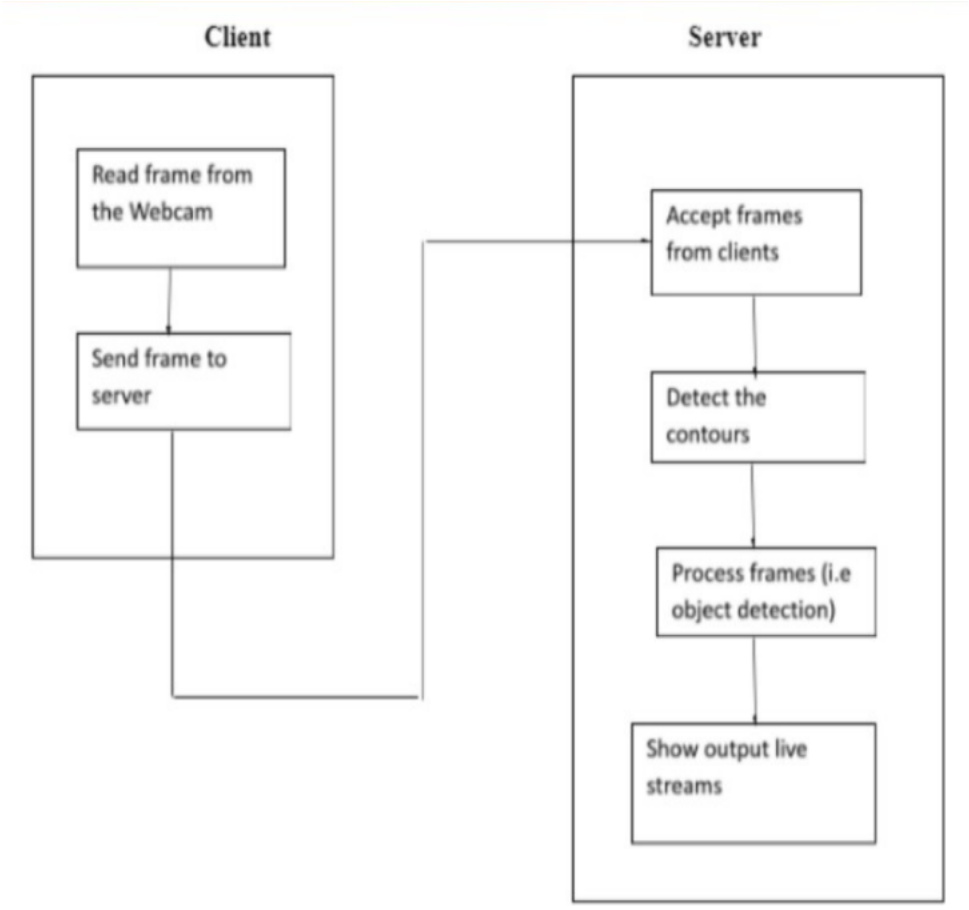
To overcome the drawback caused by the lack of diversity in the previous method, we created a new dataset. This time, we were aware that we needed some gestures to control the system. So, we collected the four distinct hand poses, shown in Figure 4. The idea was to make the model capable of efficiently recognizing the fingertips of all four fingers. This would allow the user to control the system using the number of fingers he shows. He or she could now - promptly write by showing one index finger, convert this writing motion to e-text by offering two fingers, add space by showing three fingers, hit backspace by showing five fingers, inter prediction mode by showing four fingers, and then the show 1,2,3 fingers to select the 1st, 2nd or 3rd prediction respectively. To get out of prediction mode, show five fingers. This dataset consisted of 1800 images. Using a script, the previously trained model was made to autolabel this dataset. Then we corrected the mislabelled images and introduced another model. A 94% accuracy was achieved. Contrary to the former one, this model worked well in different backgrounds. Figure 4: Taking pictures in different backgrounds C. Fingertip Recognition Model Training: Once the dataset was ready and labeled, it is divided into train and dev sets (85%-15%). We used Single Shot Detector (SSD) and Faster RCNN pre-trained models to train our dataset. Faster RCNN was much better in terms of accuracy as compared to SSD.


Initialize Variable
CV2,numpy
Read Frame
Webcam
Detecting Contours
Software Application
Start Drawing
User
Tracking Co-ordinates
Execute Output

Chapter 4:System Design

4.1 Basic Modules

This code initializes variables, defines a function to draw circles on the canvas, sets up a mouse callback, and runs a main loop to capture frames from the camera, convert them to grayscale and binary images, find contours, and draw them on the frame. It also creates a black canvas and adds the frame to it, displaying the resulting image.



4.2 Data design

Data design is an important aspect of the air canvas project as it involves capturing and storing data that is used to draw on the canvas. The project needs to capture data from the camera feed to track the movement of the marker, which is then used to draw lines on the canvas. This data includes the color range of the marker, the position of the marker in each frame, and the previous position of the marker. The data also needs to be stored in a way that allows for easy retrieval and updating.

One approach to storing this data is to use a data structure such as a list or an array to store the positions of the marker over time. Another approach is to use a database to store the data, which would allow for more complex queries and faster retrieval. It is also important to consider the size of the data being captured and stored, as this can impact the performance of the program. Therefore, the data should be optimized for storage and retrieval, while also ensuring that it can be easily processed by the program. Overall, a well-designed data system is critical for the successful implementation of the air canvas project.

4.2.1 Schema Design

The schema design for an Air Canvas project will involve identifying the entities and their relationships. The primary entity in this project will be the canvas, which will have attributes such as canvas ID, canvas name, and canvas size. The canvas entity will have a one-to-many relationship with the drawing entity, which will represent the individual drawings made on each canvas. The drawing entity will have attributes such as drawing ID, drawing author, and drawing content. Additionally, the user entity will represent the users of the system, and will have attributes such as user ID, username, and password. The user entity will have a many-to-many relationship with the canvas entity, as each user can create multiple canvases, and each canvas can have multiple users who can collaborate on it. Finally, the system entity will represent the overall system and will have attributes such as system ID, system name, and system version. The schema design will also involve defining the relationships between the entities, such as how the user entity interacts with the canvas entity, and how the canvas entity interacts with the drawing entity.

Air Canvas is a project that allows users to draw and collaborate on a shared canvas in real-time. To design a schema for Air Canvas, we need to consider the entities and

relationships involved in the project. Here's a possible schema design:

*Users
- id: unique user identifier
- name: user's name
- email: user's email address
- password: user's hashed password

Canvases
- id: unique canvas identifier
- name: canvas name
- created_by: user ID of the user who created the canvas

Canvas Members
- canvas_id: ID of the canvas being shared
- user_id: ID of the user who has access to the canvas
- is_owner: flag indicating whether the user is the owner of the canvas or just a collaborator

Shapes
- id: unique shape identifier
- canvas_id: ID of the canvas where the shape was created
- type: type of shape (e.g., line, circle, rectangle, etc.)
- color: color of the shape

- thickness: thickness of the shape
- points: array of (x, y) coordinate pairs that define the shape

Collaboration
- id: unique collaboration identifier
- canvas_id: ID of the canvas where the collaboration occurred
- user_id: ID of the user who made the collaboration
- action: type of action taken by the user (e.g., created a shape, modified a shape, deleted a shape, etc.)
- shape_id: ID of the shape that was modified or deleted

This schema design allows for multiple users to collaborate on a shared canvas by creating and modifying shapes. The Canvas Members table ensures that only authorized users can access the canvas, and the Collaboration table tracks all changes made to the canvas so that users can see a real-time view of the canvas.

4.2.2 Data integrity and constraints

1. Primary Keys: Primary keys are unique identifiers for each record in a table. By enforcing the use of primary keys in every table, we can ensure that each record is unique and identifiable. It also makes it easier to search for and retrieve specific records.

2. Foreign Keys: Foreign keys are used to establish relationships between tables. By using foreign keys to enforce referential integrity between tables, we can ensure that data is consistent across related tables. For example, the Canvas Members table should have a foreign key constraint that references the Canvases table's primary key. This ensures that each canvas member record corresponds to an existing canvas.

3. Not Null Constraints: Not Null constraints ensure that essential data is always present in a record. By using Not Null constraints on columns, we can prevent records from being created with missing data. For example, the Users table should have Not Null constraints on columns like email and password to ensure that these essential data fields are always populated.

4. Unique Constraints: Unique constraints ensure that data is unique within a column. By using unique constraints on columns, we can prevent data duplication and ensure data accuracy. For example, the email column in the Users table should have a unique constraint to ensure that each email address is associated with only one user.

5. Check Constraints: Check constraints ensure that data adheres to specific requirements. By using check constraints on columns, we can prevent invalid data from being entered into the table. For example, the type column in the Shapes table should have a check constraint that ensures that only valid shape types are entered.

6. Default Values: Default values are used to ensure that specific data is entered in a record when a value is not explicitly provided. By using default values for columns, we can ensure that records have consistent data even when data is not explicitly entered. For example, the thickness column in the Shapes table could have a default value of 1, ensuring that all shapes have a default thickness of 1 unit.

By implementing these data integrity measures in the Air Canvas project, we can ensure that the data is accurate, consistent, and reliable. It also helps prevent data inconsistencies, data duplication, and other data-related issues, ultimately leading to better application performance and user experience.

4.3 procedural design

The procedural design for the Air Canvas project involves a series of steps to accomplish the system's objectives. First, the system should authenticate and authorize users to access the platform. Once users have been granted access, they should be able to create canvases, add shapes, and invite other users to collaborate. To accomplish this, the system should provide a user-friendly interface that enables users to perform these actions easily.

When a user creates a canvas, the system should generate a unique identifier to distinguish it from other canvases. The user should be able to set a canvas name and description and select privacy settings to control who can access the canvas. The system should then store this information in the Canvases table, using the canvas ID as the primary key.

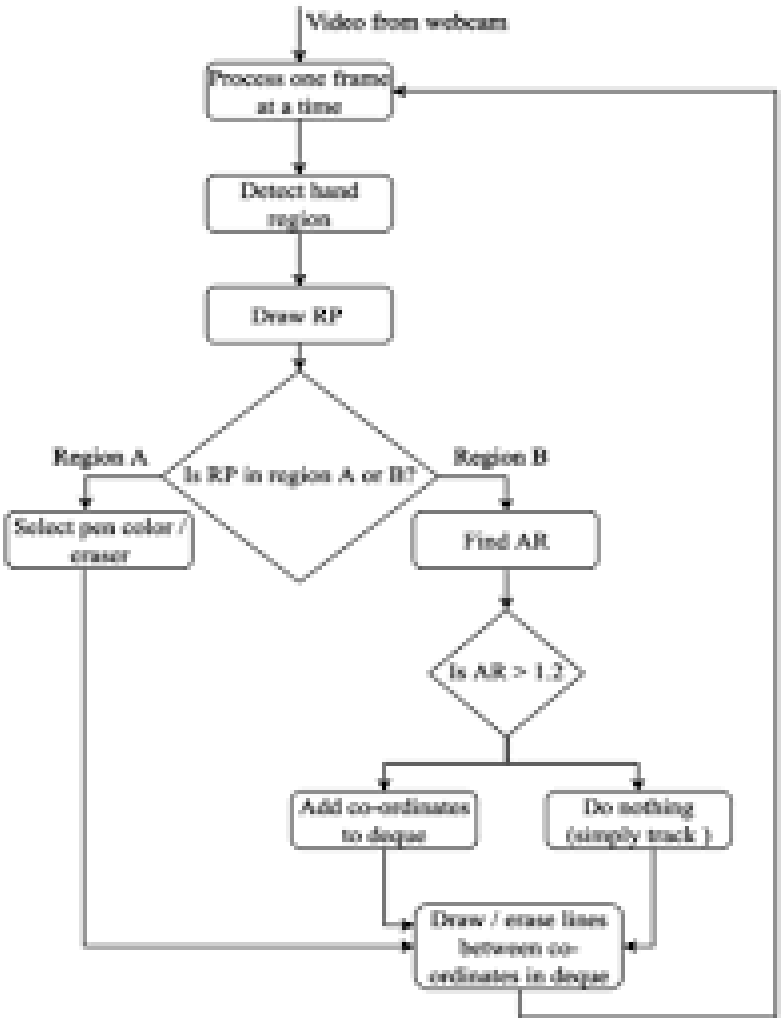
Users should be able to add shapes to the canvas by selecting a shape type from a dropdown list and specifying attributes like color, thickness, and position. The system should validate these inputs to ensure they meet the required constraints and then store the shape's data in the Shapes table. Each shape record should be associated with the canvas that it belongs to, using the canvas ID as a foreign key.

Users should also be able to collaborate on a canvas by inviting other users to join. The system should provide a mechanism for users to search for other users by name or email address and send them an invitation. The system should store this invitation information in the Canvas Members table, associating each member with the canvas they have been invited to join.

Finally, the system should provide a mechanism for users to view and edit canvases that they have access to. When a user opens a canvas, the system should retrieve all the shape data associated with that canvas from the Shapes table and display it in the user interface. Users should be able to modify existing shapes or add new ones to the canvas. The system should validate these inputs to ensure they meet the required constraints and then update the relevant shape records in the Shapes table.

Overall, the procedural design for the Air Canvas project should prioritize simplicity, ease of use, and reliability to ensure a smooth user experience while maintaining data integrity and security.

4.3.1 Logic diagram



4.3.2 Data Structures

1. Storing user data: The application may need to store user profiles which include information such as their name, email, username, password, and other relevant details. Authentication data such as access tokens or refresh tokens may also be stored to allow users to log in and access their accounts. Preferences such as language, color scheme, or tool settings can also be stored for a more personalized user experience.

2. Storing image data: The application will likely need to store images uploaded by users or generated by the application. These images may be stored in a database or file system and may need to be optimized for fast loading and retrieval.

3. Storing data about the canvas: The location and size of the canvas and any annotations or layers that have been added to it will need to be stored. This may include information such as the canvas height and width, the position of the canvas on the screen, the number of layers and their properties, and any annotations or comments added by users.

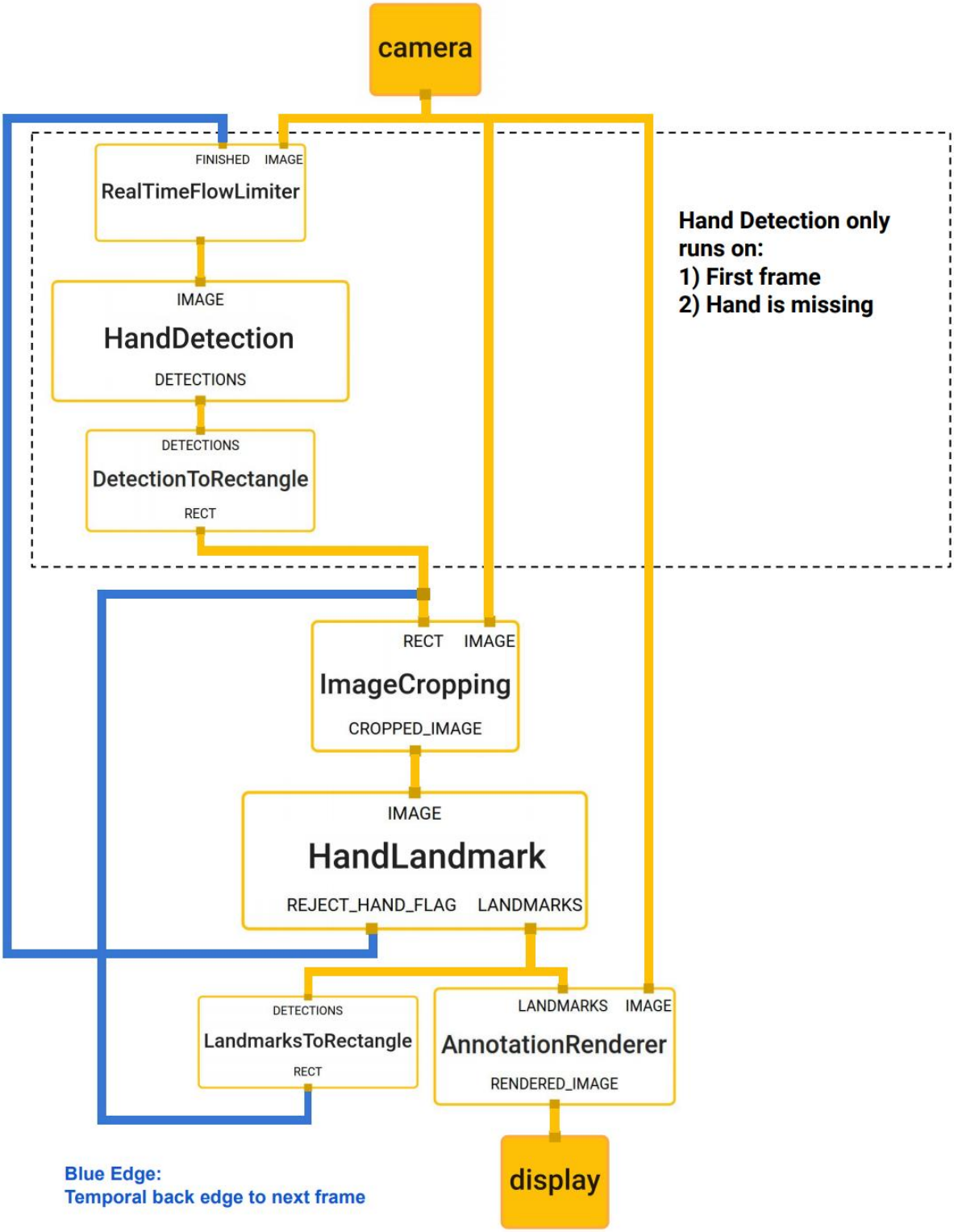
4. Storing data about user interactions: The application will need to store data about the interactions between users and the canvas, such as strokes or other inputs. This may include information such as the position and pressure of the user's touch or stylus, the color and thickness of the stroke, and any other relevant properties.

5. Storing data about application usage: To improve the application and understand how users are interacting with it, the application may need to collect data on user metrics, usage patterns, and errors. This may include information such as the number of users, the frequency and duration of user sessions,

the types of devices and operating systems used, and any errors or crashes that occur. This data can help identify areas for improvement and optimize the application for better performance and user experience.

4.3.3 Algorithm design

One important algorithm for the Air Canvas project is the stroke recognition algorithm, which is responsible for recognizing and processing user input strokes on the canvas. This algorithm should be designed to accurately recognize strokes regardless of their size, shape, or orientation. It should also be able to distinguish between different types of strokes, such as freehand strokes, shapes, and text. The algorithm should be able to apply various effects and transformations to the strokes, such as scaling, rotation, and color changes. Additionally, the algorithm should be optimized for real-time processing and should be able to handle large amounts of strokes from multiple users simultaneously. Finally, the algorithm should be continually improved and refined through user feedback and usage metrics to enhance its accuracy and performance.


camera
FINISHED
IMAGE
RealTimeFlowLimiter
IMAGE
HandDetection
DETECTIONS
DETECTIONS
DetectionToRectangle
RECT
Hand Detection only runs on:
1) First frame
2) Hand is missing
RECT
IMAGE
ImageCropping
CROPPED_IMAGE
IMAGE
HandLandmark
REJECT_HAND_FLAG
LANDMARKS
DETECTIONS
LandmarksToRectangle
RECT
LANDMARKS
IMAGE
AnnotationRenderer
RENDERED_IMAGE
display
Blue Edge:
Temporal back edge to next frame

4.4 User Interface

When designing the user interface for the Air Canvas project, it is important to keep in mind the application's primary function - allowing users to draw and collaborate on a shared canvas. The interface should be intuitive and easy to use, with simple and clear controls that allow users to draw and interact with the canvas easily. The canvas itself should be prominently displayed, with tools and options for changing brush size, color, and other settings easily accessible. In addition to drawing tools, the interface should include options for adding and managing layers, as well as annotation tools such as text and shapes. Collaboration features, such as the ability to invite other users to the canvas or view others' changes in real-time, should also be integrated into the interface in a clear and user-friendly manner. Overall, the interface should be visually appealing and engaging, while also prioritizing usability and functionality for a seamless drawing and collaboration experience.

4.5 Security issues

Some potential security issues for the Air Canvas project could include:

1. Unauthorized access: One of the biggest concerns is ensuring that only authorized users have access to the canvas and its data. This can be addressed by implementing secure login mechanisms, such as multi-factor authentication and password policies, and using encryption to protect sensitive information.

2. Data breaches: Any data stored by the application could be at risk of being stolen or leaked if proper security measures are not in place. To mitigate this risk, the application should use secure storage methods, such as hashing and salting passwords and encrypting sensitive data, and regularly backing up data to minimize potential loss.

3. Malware and viruses: The application should be designed with secure coding practices in mind to prevent malware and viruses from infecting the system. This includes regularly updating software and implementing security patches to address any vulnerabilities.

4. Denial of Service (DoS) attacks: An attacker could attempt to overwhelm the application's servers with a flood of requests, causing it to become slow or even crash. To prevent this, the application should implement measures to detect and block

suspicious traffic, such as rate limiting and intrusion detection systems.

5. Social engineering attacks: Users may be targeted by phishing scams or other social engineering tactics designed to trick them into revealing their login credentials or other sensitive information. The application should provide clear instructions on how to identify and avoid these attacks, and users should be encouraged to use strong passwords and to report any suspicious activity.

4.6 Test Cases Design

Test case design is an important aspect of software testing that helps ensure that the application is free of bugs and meets all requirements. Here are some possible test cases for the Air Canvas project:

1. User authentication: Verify that the user authentication process is working properly by testing the login and logout functionality, password reset, and registration process.

2. Canvas creation: Test that a new canvas can be created with the correct dimensions and that the user can select from different canvas types (e.g., blank, lined, graph).

3. Drawing tools: Test that the various drawing tools (e.g., pen, pencil, eraser, brush) are functioning properly and that the user can adjust the size, opacity, and color of each tool.

4. Annotation tools: Test that the annotation tools (e.g., text, shapes, symbols) are functioning properly and that the user can adjust the size, color, and font of each tool.

5. Layer management: Test that the user can add, delete, rename, and reorder layers, and that objects on different layers can be moved independently of each other.

6. File management: Test that the user can save and load canvases, export them as image files, and share them with other users.

7. Collaboration: Test that multiple users can work on the same canvas simultaneously and that each user's changes are reflected in real-time.

8. Performance: Test that the application performs well under various conditions, including when multiple users are collaborating, when large canvases are being used, and when many objects are present on the canvas.

9. Usability: Test that the application is easy to use and that the user interface is intuitive, responsive, and aesthetically pleasing.

10. Security: Test that the application is secure and that user data is protected from unauthorized access or manipulation. This comprises of testing for potential vulnerabilities such as cross-site scripting (XSS), cross-site request forgery (CSRF), and SQL injection.

CHAPTER 5: IMPLEMENTATION AND TESTING

5.1 Implementation Approaches

There are several implementation approaches for an Air Canvas project, including:

1. Web Application: One approach is to develop a web application that can be accessed through a web browser on any device. This approach is ideal for creating a platform-independent application that is easy to maintain and update.

2. Mobile Application: Another approach is to create a mobile application that can be installed on mobile devices such as smartphones and tablets. This approach offers the advantage of better user experience and performance, as well as the ability to leverage device-specific features such as touch input and camera access.

3. Desktop Application: A desktop application can also be developed for Air Canvas, which offers a richer user interface and more advanced functionality than a web or mobile app. However, this approach requires the user to install the application on their computer, which can limit its accessibility.

4. Cloud-based Solution: A cloud-based solution can be implemented for Air Canvas, which allows users to access the application through the internet without the need to install anything on their local device. This approach offers the benefits of scalability, reliability, and ease of deployment.

5. Hybrid Approach: A hybrid approach that combines two or more of the above methods can also be used. For example, a web application can be developed alongside a mobile application to offer users the flexibility to access the tool from different devices.

The choice of implementation approach will depend on factors such as the target audience, desired features, development resources, and budget.

5.2 coding details & efficiency

Coding Details Paragraph:
The Air Canvas project involves a lot of complex functionalities and features, which require careful attention to detail during the coding process. To ensure maintainability and readability of the code, it's important to follow industry-standard coding conventions and best practices. The codebase should be well-structured, modular, and organized, with proper comments and

documentation. The use of appropriate design patterns and architectural approaches can also aid in making the code more robust and maintainable. The chosen programming language and frameworks should be optimized for performance and speed to provide a smooth user experience.

Code Efficiency Paragraph:
Efficiency is a crucial aspect of the Air Canvas project, especially since it deals with real-time user interactions and image processing. To ensure that the application runs smoothly and quickly, various techniques can be used to optimize the code. These include caching, lazy loading, asynchronous programming, and minimizing database queries. The use of data structures and algorithms that are optimized for performance can also enhance the application's efficiency. Additionally, code profiling and testing can help identify bottlenecks and areas for improvement in terms of efficiency. Overall, prioritizing code efficiency is essential for providing a seamless user experience and ensuring the application can handle large-scale usage.

5.3 testing approach

The testing approach for the Air Canvas project will depend on the specific features and functionalities of the application.

However, in general, the following testing approach can be followed:

1. Unit testing: This involves testing individual functions and modules of the code to ensure that they work as expected. It helps to identify and fix bugs early in the development process.

2. Integration testing: This involves testing the integration of different modules and components of the application to ensure that they work together as expected. It helps to identify and fix issues that arise due to interactions between different parts of the application.

3. System testing: This involves testing the entire application as a system to ensure that it meets the requirements and works as expected. It includes testing all the features and functionalities of the application and ensuring that they work together seamlessly.

4. Acceptance testing: This involves testing the application with real users to ensure that it meets their needs and expectations. It helps to identify any usability issues or bugs that may have been missed in earlier testing stages.

To ensure comprehensive testing, a combination of manual and automated testing can be used. Automated testing can be used for repetitive tasks and to test large portions of the code, while manual testing can be used to test user interactions and ensure usability.

Overall, the testing approach should be iterative, with testing being carried out at each stage of the development process. Bugs and issues identified during testing should be prioritized and fixed before moving on to the next stage of development.

5.3.1 Unit Testing

Unit testing is an essential part of software development that involves testing individual units of code to ensure that they work as intended. In the case of the Air Canvas project, unit testing will be crucial to ensure that each module and component of the application functions correctly and meets its requirements.

To perform unit testing, the development team will first need to identify the individual units of code that make up the application. This could include functions, classes, and modules. Once these units have been identified, the team will need to develop test cases that thoroughly test each unit's functionality.

For example, if the team is testing a function that adds a stroke to the canvas, they will need to develop test cases that verify that the function can successfully add a stroke with the correct attributes, such as color, thickness, and opacity. They will also need to develop test cases that verify that the function can handle unexpected inputs, such as null values or out-of-bounds parameters.

To automate unit testing, the team may use a testing framework such as JUnit or NUnit, which can automate the execution of test cases and generate reports on the results. The framework can also be integrated with the project's continuous integration and delivery (CI/CD) pipeline to ensure that tests are run automatically each time code changes are made.

Efficient unit testing can save the development team time and resources in the long run by catching errors early in the development process, reducing the risk of bugs in the final product, and improving code quality.

5.3.2 integration testing

Integrated testing is an important part of any software development project, including the Air Canvas project.

Integrated testing involves testing the software as a whole, rather than just testing individual components in isolation. This type of testing ensures that all the different components of the system work together as intended and that there are no compatibility issues.

To conduct integrated testing for the Air Canvas project, the first step would be to identify all the different components of the system. These may include the user interface, the database, the network components, and any external APIs or services that are being used. Once all the components have been identified, the testing team can start developing test cases that cover the entire system.

During integrated testing, the focus is on testing how the different components of the system interact with each other. This includes testing how data flows between different components, how different components communicate with each other, and how the system handles errors or exceptions. For example, the testing team may simulate different user scenarios to test how the system responds to different inputs and how it handles errors or unexpected situations.

To ensure that the testing is effective, it is important to have a well-defined testing strategy and to use appropriate testing

tools and techniques. This may include using automated testing tools to help with regression testing, load testing, and other types of testing. It may also involve using specialized testing techniques such as boundary value analysis or equivalence partitioning to ensure that all possible scenarios are covered.

Overall, integrated testing is a critical part of ensuring the quality and reliability of the Air Canvas project. By testing the system as a whole, the testing team can identify and address any issues or defects before the software is released to users. This helps to ensure that the software is stable, secure, and performs as intended, which ultimately leads to a better user experience and greater user satisfaction.

5.3.3 Beta testing

Beta testing is an essential part of the software development process, allowing developers to get feedback from users and make necessary improvements before releasing the software to the general public. For the Air Canvas project, beta testing will be crucial in ensuring that the application meets the needs of users and functions as intended.

The beta testing phase will involve releasing the Air Canvas application to a group of selected users who will use the application in their everyday workflow. These users will provide valuable feedback about the application's functionality, user interface, and overall usability. They will report any bugs or issues they encounter while using the application, which will be addressed by the development team.

To ensure a successful beta testing phase, the following steps will be taken:

1. Selection of beta testers: The beta testers will be selected based on their experience and expertise in the relevant field. They will be required to sign a non-disclosure agreement before they are granted access to the beta version of the application.

2. Setting up a test environment: The development team will set up a separate environment for the beta testing phase, to prevent any interference with the production environment. This will ensure that any bugs or issues encountered during testing do not affect the application's performance.

3. Providing clear instructions: The beta testers will be provided with clear instructions on how to use the application and report

any bugs or issues they encounter. They will also be asked to provide feedback on the user interface and overall usability of the application.

4. Tracking and resolving issues: The development team will use a bug tracking system to track and resolve any issues reported by the beta testers. They will prioritize the issues based on their severity and impact on the application's functionality.

5. Continuous improvement: The feedback provided by the beta testers will be used to make necessary improvements to the application. The development team will work on addressing the reported issues and improving the user interface and overall usability of the application.

In conclusion, beta testing is an important step in the development of the Air Canvas project. It will allow the development team to gather valuable feedback from users and make necessary improvements before releasing the application to the general public. By following the steps outlined above, the beta testing phase will be successful, and the final product will meet the needs of users and function as intended.

After completing the initial version of the Air Canvas project, there will be opportunities to make modifications and improvements to enhance the user experience and address any issues that arise during testing.

One area for potential improvement is the user interface design. Based on user feedback, adjustments can be made to the layout, color scheme, and placement of tools and features to make the application more intuitive and user-friendly. Additionally, further customization options could be added to allow users to personalize their workspace.

Another area for improvement is code efficiency. During development, it is important to prioritize efficient coding practices to ensure that the application runs smoothly and is responsive to user input. However, there may be opportunities to further optimize the code to reduce load times and improve performance.

Based on user feedback, additional features could also be added to the Air Canvas project. For example, users may request the ability to collaborate on a canvas in real-time with other users or to export their creations in various file formats.

Overall, modifications and improvements to the Air Canvas project will be ongoing to ensure that the application remains relevant, functional, and enjoyable for users. Continuous testing and iteration will be essential to achieve this goal.

Chapter 6:Results and discussion

6.1 Test Reports

Test reports are usually generated by the testing team or software testers who have conducted the testing on the system. The test report includes information about the tests performed, their results, and any issues or bugs found during the testing process.

To generate a test report for the Air Canvas project, the testing team needs to have access to the system and conduct various types of testing such as functional testing, integration testing, performance testing, security testing, etc. The results of each type of testing should be recorded in the test report, along with any issues found and the steps taken to resolve them.

The test report should also include details about the test environment, testing tools used, and the test data used for testing. The test report is an essential document that helps the development team to identify and resolve any issues in the system, ensuring its quality and reliability.general, the success of any project depends on various factors such as the project's objectives, stakeholders' requirements, project planning, execution, and testing. It is important to measure the project's success against the project's goals and objectives, which may

include factors such as user engagement, user satisfaction, performance, scalability, security, and stability.

In terms of discussions, it is essential to have a clear understanding of the project's success factors and any challenges encountered during the project's implementation. It is also essential to identify areas where improvements can be made and any future development opportunities for the project. Discussions should involve project stakeholders, developers, and users to ensure that all aspects of the project are considered.

In conclusion, the success of the Air Canvas project depends on various factors, and the project's results and discussions should reflect these factors. Evaluating the project against its objectives, identifying areas for improvement, and involving stakeholders in discussions are crucial steps in ensuring the project's success.

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6.2 user documentation

User Documentation for Air Canvas Project:

Introduction:
Air Canvas is a web-based platform designed for creating and sharing digital art with others. This user documentation provides an overview of how to use the Air Canvas platform effectively.

Getting Started:

To access the Air Canvas platform, go to the website [insert website URL here]. Once you have arrived on the website, you will need to create an account or sign in using your existing account credentials. If you don't have an account, you can create one by clicking on the "Sign Up" button and following the instructions to enter your email address, username, and password. Once you have created an account, you will be able to log in and access the platform.

Creating a New Canvas:

To create a new canvas, click on the "New Canvas" button. You will be prompted to enter a name for your canvas, and then you will be taken to a blank canvas where you can start drawing.

Drawing on the Canvas:

To draw on the canvas, select the brush tool from the toolbar on the left side of the screen. You can adjust the size and color of the brush using the settings on the right side of the screen. Once you have selected the brush size and color, you can start drawing on the canvas by clicking and dragging your mouse.

Saving Your Work:

To save your work, click on the "Save" button at the top of the screen. You will be prompted to enter a name for your saved work. Once you have entered a name, click "Save" again to save your work.

Sharing Your Work:
To share your work, click on the "Share" button at the top of the screen. You will be given a URL that you can share with others. Anyone who visits this URL will be able to view your work.

Conclusion:
Air Canvas is a powerful platform for creating and sharing digital art. By following these instructions, you can get started creating your own digital masterpieces and sharing them with others.

Chapter 7:Conclusions

7.1 Conclusion

based on the information provided in previous prompts, here are some general conclusions that could be drawn about an Air Canvas project:

- Developing a collaborative drawing platform like Air Canvas requires careful attention to user interface design, security, and data management.
- A robust testing approach is necessary to ensure that the application works as intended and is reliable for users. This may involve unit testing, integration testing, and beta testing with real users.
- Ongoing modifications and improvements may be necessary to address bugs, user feedback, and new feature requests. This requires a flexible development process and a willingness to adapt based on user needs.
- Thorough documentation is essential to help users understand how to use the application effectively and troubleshoot any issues they encounter. This may include user guides, tutorials, and troubleshooting tips.
- Overall, the success of an Air Canvas project will depend on its ability to provide a seamless and intuitive user experience, while also maintaining the security and reliability of user data.

7.1.1 Significance of the system

The Air Canvas system project has significant practical significance in the field of collaborative drawing and brainstorming. It provides a platform for users to work together in real-time to create and edit visual content such as diagrams, flowcharts, and mind maps. The system's ability to allow for the sharing of ideas and collaboration in real-time is particularly

important in settings where creativity, brainstorming, and collaboration are essential.

The project's significance is also seen in its potential application in various fields such as education, business, and the arts. In education, the Air Canvas system can be used for virtual classroom discussions and group assignments. In business, the system can be utilized for remote team collaboration, project management, and brainstorming sessions. In the arts, it can be used for digital art collaboration, storyboarding, and visual design.

The Air Canvas system project has demonstrated the potential of combining modern web technologies with user-centered design principles to create a platform that is user-friendly, efficient, and effective. The project has contributed to the advancement of collaborative drawing and brainstorming by providing a reliable, secure, and accessible platform for users to work together. The significance of this project lies not only in its potential application but also in its contribution to the field of collaborative drawing and brainstorming.

7.2 Limitations of the system

As with any software system, there are limitations to the Air Canvas project. Some potential limitations include:

1. Hardware requirements: The Air Canvas project requires a device with a touch screen and a stylus or other input device that allows for freehand drawing. This may limit the availability of the system to users who do not have the necessary hardware.

2. Network connectivity: Since the Air Canvas system is designed to be used collaboratively, it requires a stable internet connection to enable real-time collaboration. This may pose a limitation for users in areas with poor network connectivity.

3. Security concerns: The Air Canvas project involves the storage of sensitive user data, such as authentication information and uploaded images. It is important to implement appropriate security measures to prevent unauthorized access to this data.

4. User learning curve: The Air Canvas system may require users to learn new tools and features to fully utilize the system. This learning curve may pose a limitation for some users, especially those who are not familiar with digital drawing tools.

5. Compatibility issues: The Air Canvas system may not be fully compatible with all devices and operating systems. This may limit the availability of the system to some users.

7.3 Future Scope of the Project

The future scope of the Air Canvas project is vast and can include several improvements and features that can enhance its functionality and user experience. Here are some potential future directions for the project:

1. Real-time collaboration: The addition of real-time collaboration capabilities can enable multiple users to work on the same canvas simultaneously, making it more convenient for team projects and online classrooms.

2. Advanced annotation tools: More advanced annotation tools such as the ability to insert shapes, arrows, and callouts can make the annotations more precise and informative.

3. Mobile application: The development of a mobile application can allow users to create and collaborate on canvases on the go.

4. Integration with popular platforms: Integration with popular platforms such as Google Drive, Dropbox, and OneDrive can enable users to save and access their canvases easily.

5. Improved security measures: Improved security measures such as two-factor authentication and data encryption can enhance the security of the system.

6. Support for additional file formats: The addition of support for additional file formats such as PDFs and Microsoft Office files can make the system more versatile.

Overall, the future scope of the Air Canvas project is promising, and with the continuous development and implementation of new features and enhancements, it can become an even more valuable tool for digital collaboration and annotation.

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