VIRTUAL TEACHING BOARD

USING DEEPLEARNING

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Abstract: Till now we have different types of White board softwares for online teaching. Each softwares has its own pros and cons. One of the main disadvantages of these traditional whiteboard softwares is, they require hardware pointing devices or a touch sensitive screen for interaction like stylus, digital pens, mouse etc. So to avoid usage of such pointing devices and to make online learning more interesting and effective, we are introducing Virtual Teaching Board, which is a hand movement based writing in air software. It uses different hand gestures of the fingertips in air to write on the whiteboard instead of using external hardware devices like mouse, stylus, digital pens etc,. It provides users with an amusing environment. This project is divided into different modules namely Virtual board Module, Presentation Module and Calculation Module. In the Virtual board module, we are providing the user interface with functionalities selecting types of board (Normal and Blackboard) , Selecting colors for writing, Eraser mode, Presentation Mode and Calculator Mode. In the Virtual Board Module, By selecting writing mode and board type, users can write on the screen using different colors by just fingertip movements in air, and user can erase the board partially using eraser option or completely by waving five fingers on the screen And by selecting Presentation mode the user enters into Presentation module and there user can give presentation by moving slides forth and back just by hand gestures in air and user can also write or markup on the slides. Sometimes a user may need to perform some mathematical operations, so to make his job done easily, we are providing a calculator module. User can simply select calculator mode and can perform mathematical operations. User can also have an option of changing fingertip pointer dimensions, means user can increase or decrease the size of the fingertip pointer for writing and also for erasing by using hand gestures. We used Open-cv, Mediapipe , NumPy libraries and Python Programming language in this Project. This software can be further upgraded by adding some additional features like Physical properties and Physical Stimulations to the objects created on the virtual board in Stage-02 .

1. INTRODUCTION

1.1 Motivation

In the age of this digital world, the need for user-friendly whiteboard software is essential. The traditional whiteboard software requires a hardware pointing device or a touch screen for interaction. These traditional whiteboard software requires highly cost devices, Needs the latest device equipment which are not affordable to every user. So the main motive behind this project is to build a software that is user friendly and cost affordable.

1.2 Problem Definition

To create a virtual teaching software tool that may be used as an alternative to traditional ways of teaching. This is cost-effective, it can be used by any teacher to make their teachings more informative and effective. We also sought to make it as simple and user-friendly as possible, with very minimum hardware requirements, so that even someone with no prior computer experience could use it.

1.3 Objective of the Project

To provide a virtual teaching board platform that uses hand gesture recognition in air to write on screen. To make the teaching process more effective we developed presentation mode, Calculation mode, different user interfaces with functionalities selecting types of board(Normal and Blackboard), Selecting colors for writing and Eraser for erasing with the help of Open-CV, MediaPipe , NumPy libraries and python programming language in this Project.

2. METHODOLOGY

2.1 Cam Setup

The runtime operations are managed by the webcam of the connected laptop or desktop. To capture a video, we need to create a Video Capture object. Its argument can be either the device index or the name of a video file. Device index is just the number to specify which camera.Since we only use a single camera we pass it as '0'. We can add additional camera to the system and pass it as 1,2 and so on. After that, you can capture frame-by-frame. But at the end, don't forget to release the capture. We could also apply color detection techniques to any image by doing simple modifications in the code.

2.2 Capturing frames

The infinite loop is used so that the web camera captures the frames in every instance and is open during the entire course of the program. We capture the live feed stream, frame by frame. Then we process each captured frame which is in RGB(default) color space to HSV color space. There are more than 150 color-space conversion methods available in OpenCV. But we will look into only two which are most widely used ones, BGR to Gray and BGR to HSV.

2.3 Masking technique

The mask is basically creating some specific region of the image following certain rules. Here we are creating a mask that comprises of an object in red color. After that we perform a bitwise AND operation on the Input image and the Threshold image, which result in only the red colored objects are highlighted. This result of the AND operation is stored in res. We then display the frame, res and mask on 3 separate windows using imshow() function.

2.4 Display the frame

The imShow() is a function of HighGui and it is required to call the waitKey regularly . The processing of the event loop of the imshow() function is done by calling waitKey. The function waitKey() waits for key event for a "delay" (here, 5 milliseconds). Windows events like redraw, resizing, input event etc. are processed by HighGui. So we call the waitKey function, even with a 1ms delay.

2.5 HAND GESTURE DETECTION AND RECOGNITION

Hand detection is related to the location of the presence of a hand in a still image or sequence of images i.e. moving images. In case of moving sequences it can be followed by tracking of the hand in the scene but this is more relevant to the applications such as sign language. The underlying concept of hand detection is that human eyes can detect objects which machines cannot with that much accuracy as that of a human. From a machine point of view it is just like a man fumble around with his senses to find an object.

The factors, which make the hand detection task difficult to solve, are:

Variations in image plane and pose

The hands in the image vary due to rotation, translation and scaling of the camera pose or the hand itself. The rotation can be both in and out of the plane.

Skin Color and Other Structure Components

The appearance of a hand is largely affected by skin color, size and also the presence or absence of additional features like hairs on the hand further adds to this variability.

Lighting Condition and Background

As shown in Figure below light source properties affect the appearance of the hand. Also the background, which defines the profile of the hand, is important and cannot be ignored.

Fig: Lighting Conditions and background

2.6 RECOGNITION

Hand detection and recognition have been significant subjects in the field of computer vision and image processing during the past 30 years. There have been considerable achievements inthese fields and numerous approaches have been proposed. However, the typical procedure ofa fully automated hand gesture recognition system can be illustrated in the Figure below:
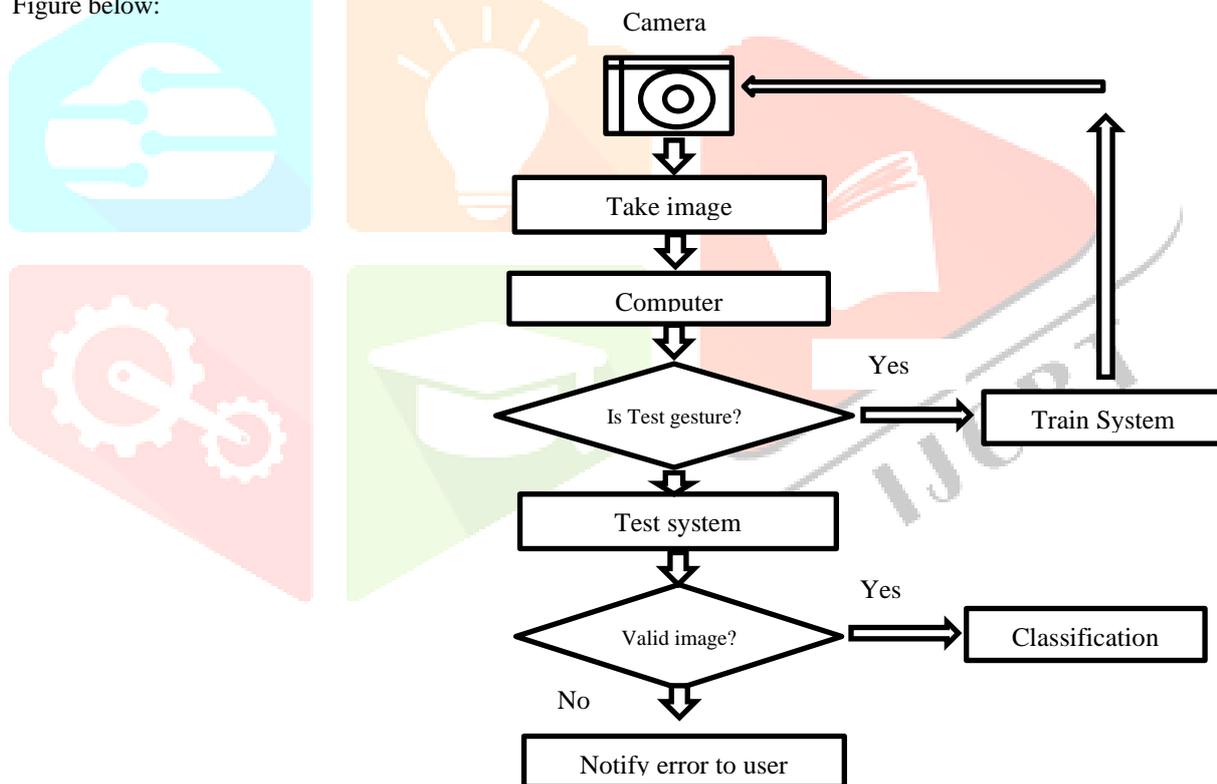
Fig 2.6: Hand gesture recognition Flow Chart

Gestures Information

VIRTUAL TEACHING BOARD

USER MANUAL
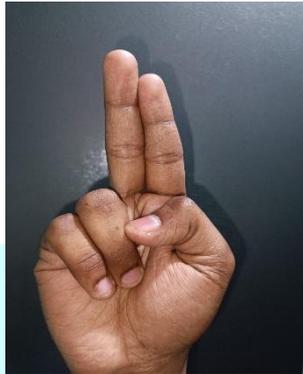
SELECTION

Using this hand gesture we can select tools to the toolbar

WRITING

Using this hand gesture we can write on the screen or board

THICKNESS INCREASE

Using this hand gesture we can increase the thickness of writing tool

THICKNESS DECREASE

Using this hand gesture we can decrease the thickness of writing tool

ERASE ALL

Using this hand gesture we can switch black board and normal board

BLACK BOARD

Using this hand gesture we can switch black board and normal board

CLOSE

Using this hand gesture we can close the calculator and ppt mode

NEXT SLIDE

Using this hand gesture we can switch to next slide in ppt

PREVIOUS SLIDE

Using this hand gesture we can switch to previous slide in ppt

UNDO WRITING

Using this hand gesture we can undo the last operation in ppt mode

3. RESULTS AND DISCUSSION
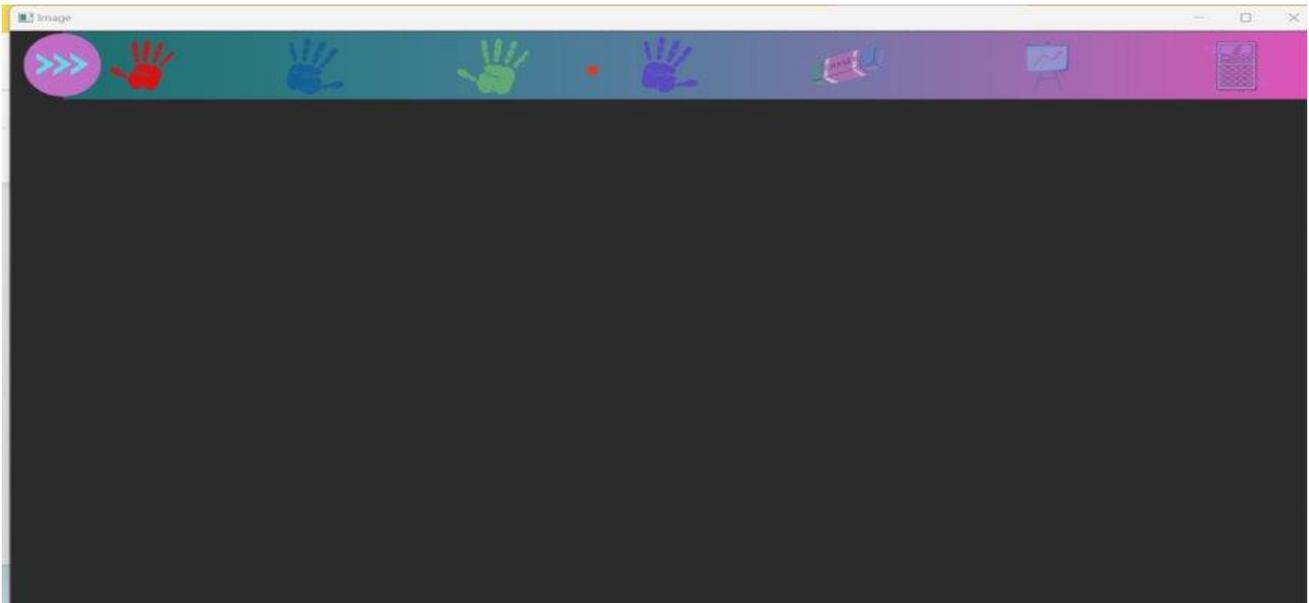
Fig 3.1 virtual black board
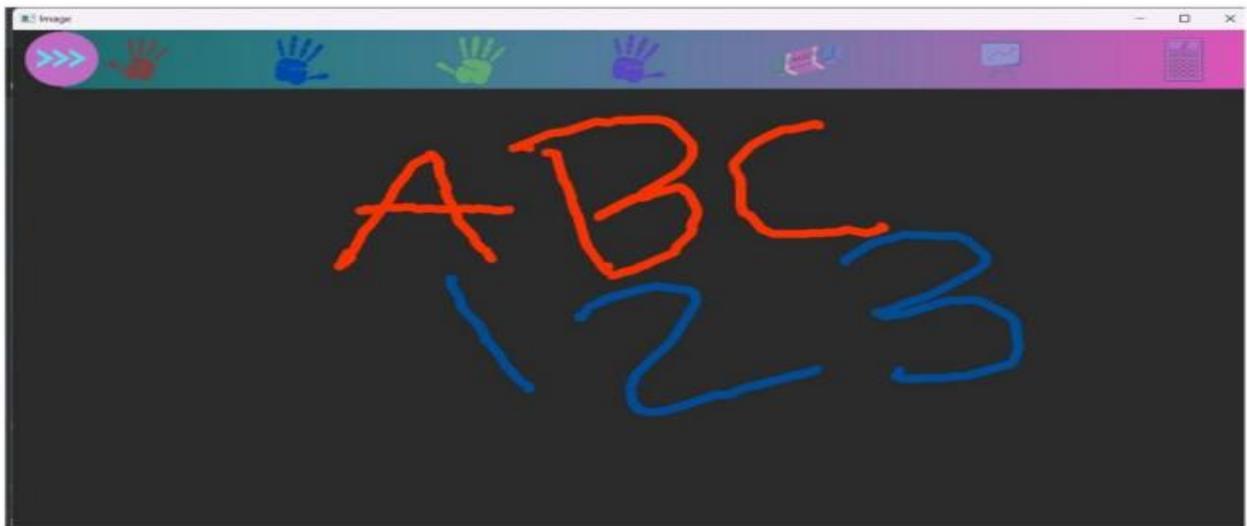
Fig 3.2 writing in virtual black board
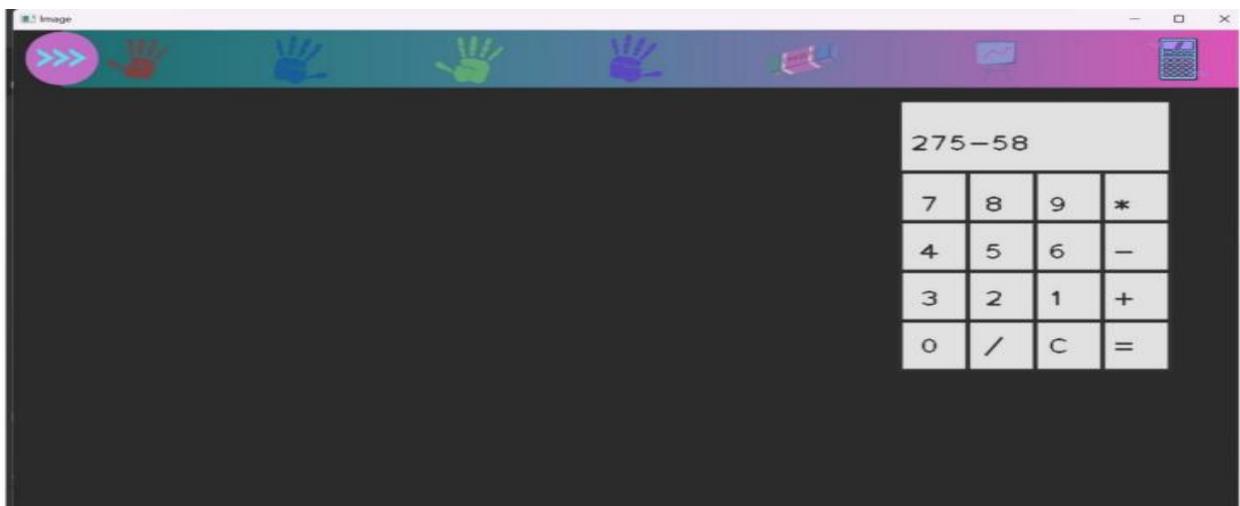
Fig 3.3 calculator in virtual black board
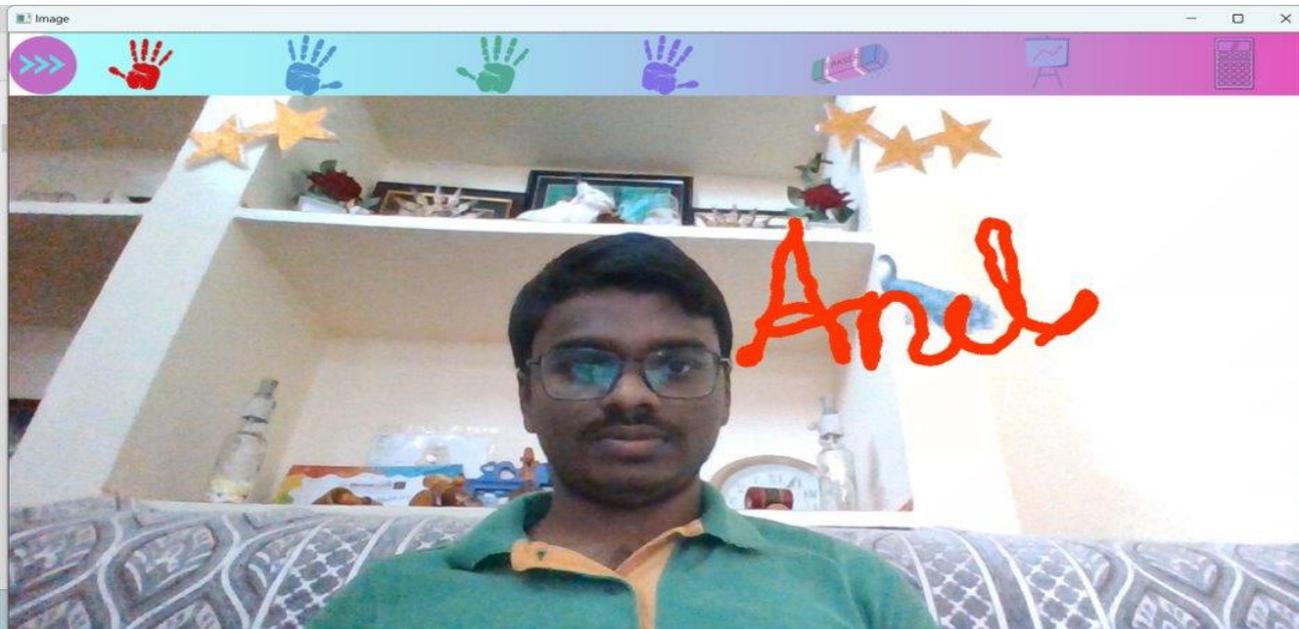
Fig 3.4 writing in window frame
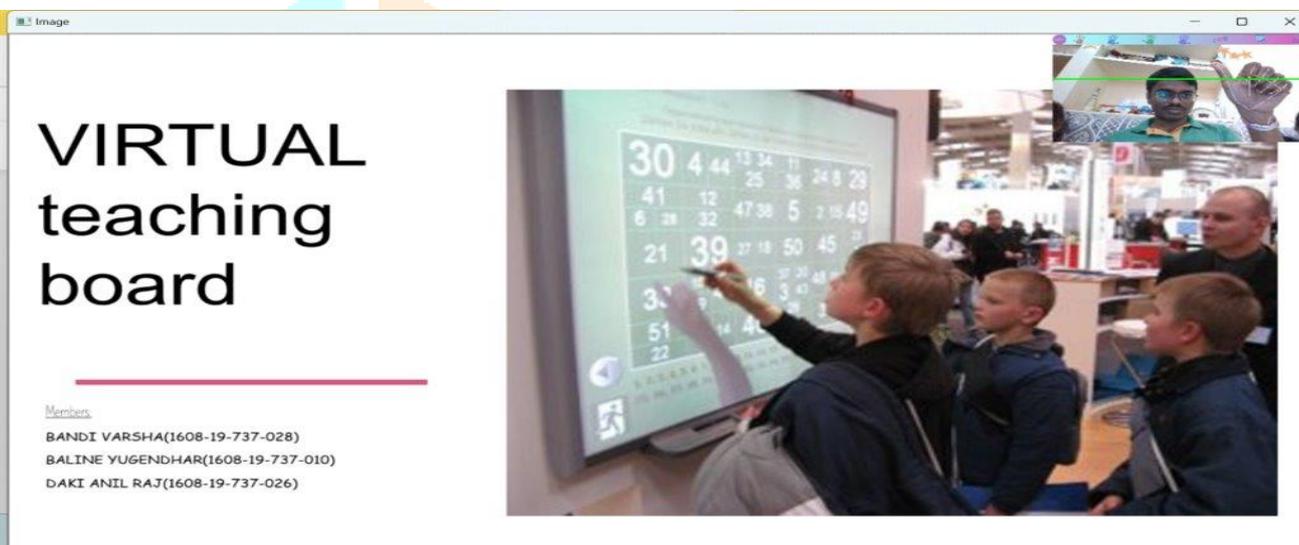
Fig 3.5 moving to previous slide using thumb finger gesture
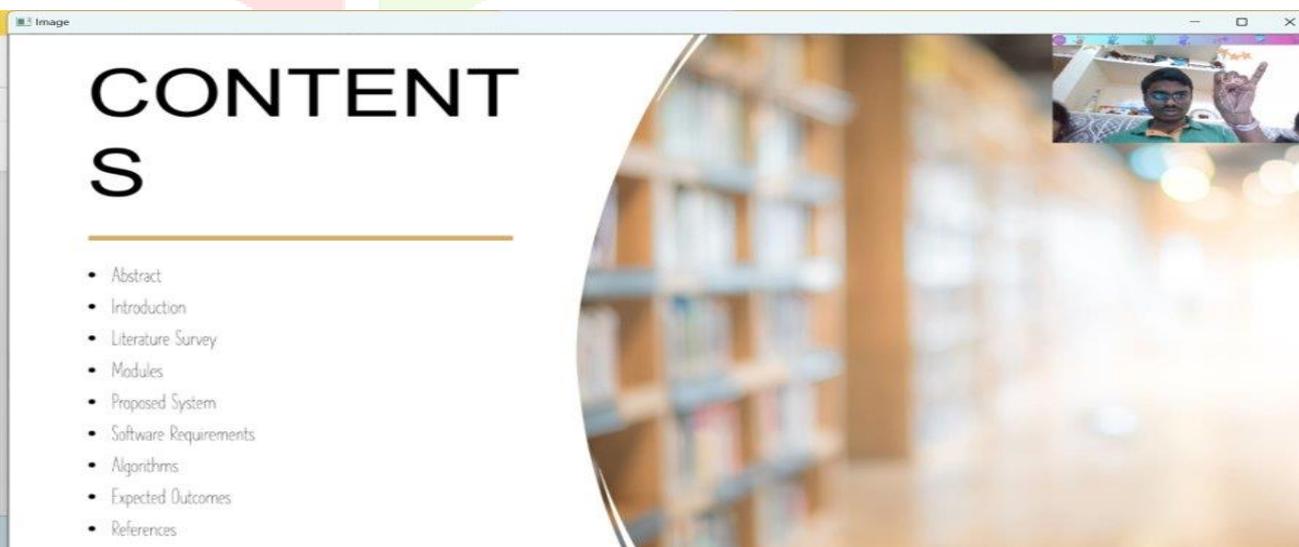
Fig 3.5 moving to previous slide using thumb finger gesture
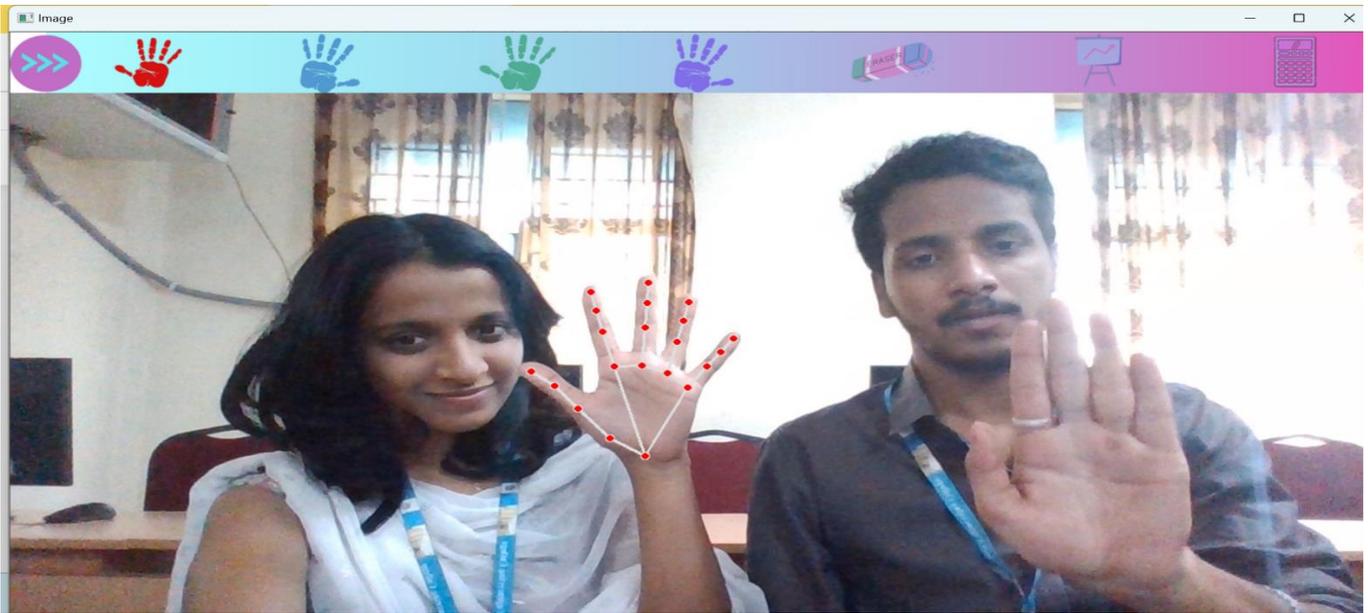
Fig 5.6 Detecting only one hand without collision with other hands

Fig 3.7 Selecting Tools with Selection Gesture
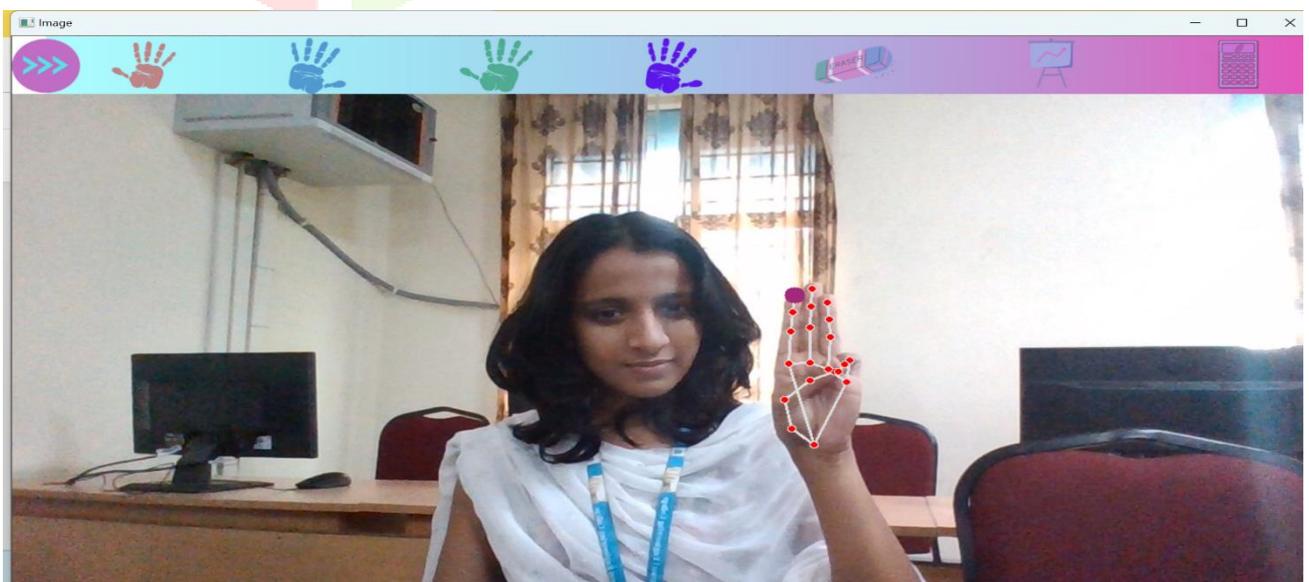

Fig 3.8 Writing brush Thickness decrease gesture
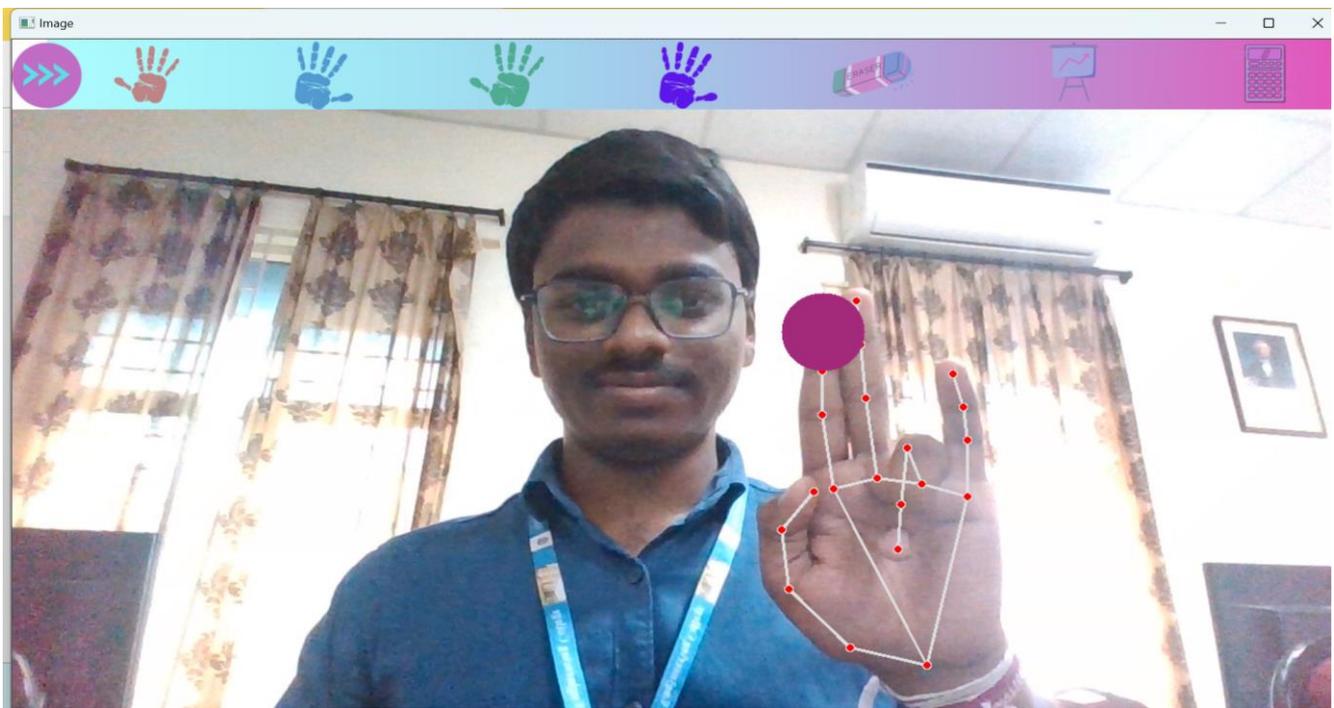
Fig 5.6 Writing brush Thickness increase gesture

4. CONCLUSION AND FUTURE SCOPE

4.1 Conclusion:

This project is useful for the virtual teaching process without interacting with the system or no involvement of any electronic gadgets . This project cuts the utilization of digital stylus and interacting with the screen. The proposed system assist the user to accomplish hand gesturing in systematic and cost-effective manner. later the system is set up, the User involvement can be increased highly, which makes it even easier for a user because they can interact easily and effectively with the system, alternate usage of traditional softwares . User can simply use his hand gestures in the air to perform different operations like writing, clearing, giving presentations and performing calculations using calculator. This project makes online teaching more interesting, efficient and low cost.

4.2 Future Scope :

In Future this project can be improved by adding a lot of additional features like Physical Properties like gravity, motion etc, Physical simulations to the objects created on Virtual Board and conducting virtual quizzes.

Virtual teaching board used in classrooms, business purpose , industrial , conference halls etc.., Virtual Teaching Board is less expensive , Eco-friendly , Avoid paper usage ,and encourage real-time audios and videos.

REFERENCES

- https://google.github.io/mediapipe/

- https://docs.opencv.org/4.x/

- http://www.numpy.org/