



## Virtual Pen Using Python

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**Abstract**— Even though the mouse was a ground breaking invention, it is still difficult to use for drawing creative art as well as accurate shapes. Virtual Pen System is a software designed to draw shapes in 3D space. This will be achieved by tracking movement of finger using hand detection using Mediapipe. It can also be used to draw free-hand. The user can experience the joy of writing or drawing in a 3D free space with ease as the application is user friendly. The peripheral drawing tablets are indeed expensive. This is where the digital pen truly shines. Being entirely software driven with a decent device and lots of modifications, it can be the first choice of digital artists as well as common users to draw/ create and for typing i.e., writing too. The current application is developed using Mediapipe, OpenCV and other supporting libraries in python.

**Keywords**— *Virtual art, Python, Hand detection, Computer vision*

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### I. INTRODUCTION

Everyone imagines themselves, drawing in the air, with just their hand. Now, it is possible to do exactly the same, through the virtual pen. Sketching in 3D is possible through upcoming technology called virtual pen using python libraries namely OpenCV, NumPy, MediaPipe. Open CV stands for open-source computer vision. Numerous algorithms are included in these libraries. These are very modern and useful for OpenCV and ML. MediaPipe is used for building machine learning pipelines for processing time-series data like video, audio, etc. NumPy is fundamental package for scientific calculation in python. Here, a virtual pen using above mentioned libraries has been prepared.

Virtual pen is an ongoing research field with the aim to develop a software that can interpret letters and symbols drawn in air i.e., 3 d space. A common feature of many such attempts is using hand gesture recognition. The technology has a wide scope as it can be built to interpret common language. A picture is worth 100 words. Yet, it is quite difficult to draw on computer using a mouse or a trackpad. This generates the necessity for a Virtual text Recognition mechanism that can analyse and process any sign or symbol which is drawn in the air and save the input.

The objective is to study ongoing research and make prototype software to the best of our abilities. This software should be able to use a virtual canvas onto which we will be sketching. This sketch will be drawn by detecting the user's that is the human finger. This will help develop a platform for

user-system interaction which will facilitate convenient drawings on any form of surface.

The problem statement for the project is as follows: - To develop an interface by the implementation of OpenCV and Python between the user's hand and fingers and the system to draw using hand on the virtual canvas.

### II. LITERATURE SURVEY

Following are the works of individuals related to the Virtual Pen and its working:

Aman Preet Gulati et. al. , in the article, proposed a hand landmarks detection model using the Mediapipe library. The hand-landmark detection is implemented by processing image of the user's hand, containing 21 landmark points. After System Initialisation image processing takes place which draws the landmark positions on image. This part of the research is also implemented within this virtual pen[1].

M. Naveenkumar et. al. studied the concept of image processing which is a type of signal processing. In this, OpenCV is the library which plays an important role in the application of image processing. The devised model has low-level image processing but high-level algorithms. Various methods for image processing namely-Image filtering, Image transformation, Object Tracking and feature detection are implemented here[2].



Pranavi Srungavarapu, Eswar Pavan Maganti, et al devised a solution which allows the user to draw just from the movements of a colourful marker. The movements are recognized via a camera. The major advantage is that the user can change the colour of the virtual pen[3].

Gangadhara Rao Kommu, in his article, presented a design by which any marker can be used to draw, by recognizing the marker's colour and movements. On initiation, the camera is turned on allowing the user to draw on the virtual screen, just by moving the object which is being tracked. One of the downsides is the demand for high colour contrast. This project facilitates convenient drawings on any form of surface as well as the availability of multiple colours[4].

Shubham Deolekar et. al. [5] implemented an application, helping the user to draw a free-hand drawing in order to create artwork in 3D space over the screen. The major noticeable drawback was that there wasn't any feature to clear/erase a particular part of the screen. Also, there were no features for drawing various shapes like circles, lines, rectangles directly. The best feature that they have introduced was the availability of various colours.

Amit B Waghmare et. al. [6], implemented a system that offers a less difficult manner to retrieve information from an information Kiosk. The system gives clean coping with a consumer-pleasant interface which would interactively get hold of facts from massive database handiest by way of hand gestures.

So, after studying the aforementioned studies and papers, we can surmise that the key drawback of these systems is the need for the use of an actual pen/tool for detection as well as the lack of various subsequent tools to draw shapes and/or free hand, which we tend to overcome by devising a system where the user's finger itself is the tool and providing ease of selection of various supplementary tools.

### III. METHODOLOGY

The proposed application makes drawing and sketching on air possible. It is developed using Open Cv. Open Computer Vision is an open-source software for computer vision as well as for machine learning[8]. Its library includes numerous algorithms, which are used to detect faces and things, classify people's movements in videos, track moving objects, etc.

#### A. System Architecture

The developed system implements various technologies like OpenCV, coloured target-marking and masking techniques. Besides these, palm detection using MediaPipe library is also incorporated into the system. The camera on the device detects various hand movements and applies the required instructions according to those movements.

Hand-landmark is the main function that is used to capture the finger movements so that the various shapes, lines and drawings can be drawn by the user. NumPy library is used to

perform various numerical and mathematical operations required within the project[9].

The process starts with capturing the images through a PC video camera. It will then detect various hand gestures and finger movements so that as per the instructions given by the user, the application will perform the task. It can draw various shapes like circles, rectangles, lines or free-hand drawings. Use of erase functionality will delete the drawn stuff over the screen. To draw, to increase the shape size as well as to erase are some of the highlighted functions. Once selected, the user drags the acquired shape (i.e., If the user wishes to draw a circle, then he/she needs to virtually click on the circle shape's button and then should drag it to the required position over the screen and then the user can increase/decrease the size of that circle.).

The figure below shows the system architecture of virtual pen.

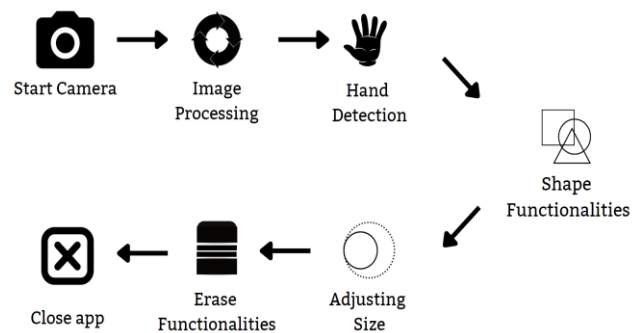


Fig. 1. System Architecture of Virtual Pen

#### B. Process of Working

The system uses python programming language and its libraries like Open CV, Mediapipe and supporting libraries like NumPy and time. We use inbuilt video capture feature from OpenCV. The captured frames are then processed using NumPy. Fig. 2. Is showing the whole method from detection of Palm up to getting the drawn shapes on the screen at the end.

- Capturing the video from the web camera using OpenCV and creating a window to then display it.
- Inserting the image of tools using corresponding function
- Using NumPy, merge the image with display window.
- Using Mediapipe solutions and Python logic for hand detection and tool selection.
- Using OpenCV, drawing the required shapes.



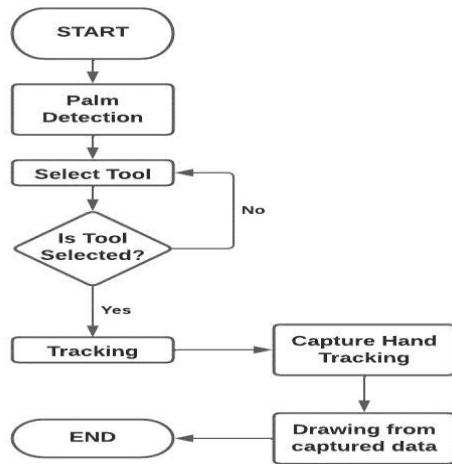


Fig. 2. Flow of Drawing Shapes over the screen

#### IV. RESULT



Fig. 3. Hand recognition using MediaPipe

In the fig. 3. you can see the result of the hand recognition done by using MediaPipe. We used the hand landmark system to detect the hand and different fingers.

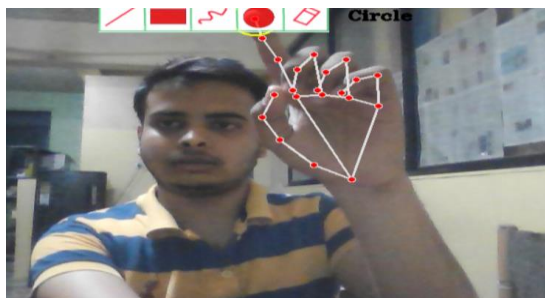


Fig. 4. Tool selection using MediaPipe and NumPy

In the fig. 4. we see the implementation of the project where the user's fingers themselves serve as the tool for drawing. The index finger is used to select the tool and index and middle finger are collectively used to draw. The tip of index finger is traced and it is assumed to be tip of pen. The user can see the various drawing tools and eraser tool in the window itself.

#### A. Conclusion And Future Scope

An interactive environment is created for the user via the implementation of virtual pen. Here, the user can draw anything he wishes to, just by selecting tools of his choice from the displayed tools. So, as our conclusion, we can say that the development of Virtual Pen by using the libraries NumPy and OpenCV, in both of which many libraries as well as algorithms are available, makes the interface more active while in use. We chose python as the programming language, as it has many built-in libraries as well as modules, that help portray the imagination on a virtual plane as well as the morphological process.

The proposed project has boundless potential. A few of the future developments can be additional features like changing the stroke colour, having variable brush width, stroke erasers, etc. By implementing machine learning we can make the pen more sensitive to motion, while still ensuring that our interface remains easy to understand. In the upcoming times, this will be useful in making children learn the virtual way of drawing in a very interactive way.

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