

AirDraw: An Alternative Drawing Tool

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ABSTRACT

Looking around, drawing and painting digitally have become very popular with the help of accompanying hardware tools such as tablets, stylus pens and computer mice. But in the absence of such tools- which can be either expensive or not feasible to be carried everywhere- and primarily for people with physical limitations, it becomes challenging to draw/paint on one's whim. Through these observations, a hand gesture-based drawing tool could prove to be a fitting solution for such situations. The proposed solution aims to implement a sketching application that uses hand gestures like the user's fingertip to draw/paint objects, change hues, save the created drawings etc.

INTRODUCTION

Digital art and drawing originated in the 1960s with the advent of one of the first user interactive computer-graphics interfaces called Sketchpad [1]. It paved the way for Human-Computer Interaction to develop as well acted as the early ancestor of modern computer-aided design software. It was the foremost instance which showed that art and technology could be combined together in order to create a novel way of Human-Computer interaction.

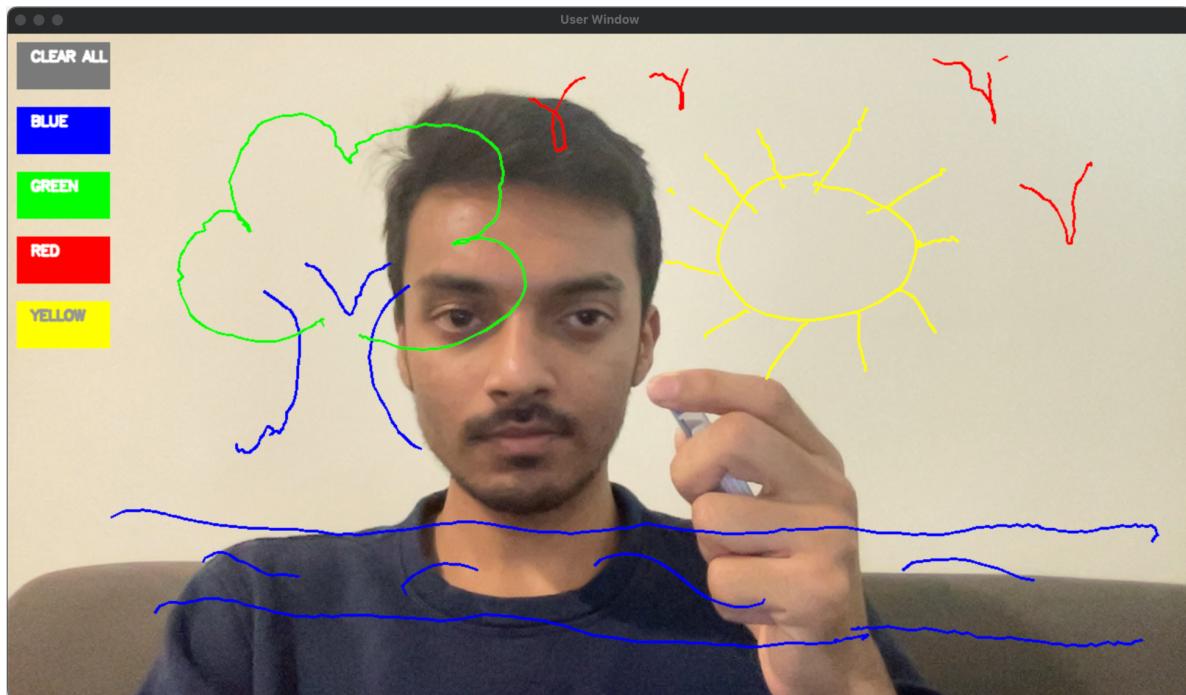


Figure 1: A drawing made using AirDraw

Nowadays, Digital art and drawing have become a major form of artwork, being boosted by the COVID-19 pandemic [2] and the NFTs trend [3,4]. Its rising popularity has led to a quite significant impact on the job market. An online study conducted in the United States in the year 2021 found that about the majority (66%) of artist jobs came with an annual salary of over 60 K. These jobs were found to be related to digital art and come from technology sectors. This research provided a practical and quantitative method to investigate the impact of the rising popularity of digital art on the national job market for artists today.

Digital drawings are usually done using a drawing tablet and a stylus; they require knowledge of visual designs and technologies as well as good quality equipment that supports an artist's style of artwork. Such equipment and devices usually cost a significant amount of money and hence are not affordable to everyone. AirDraw aims to provide an alternative to these devices by using an alternative way of creating artwork. AirDraw tracks the movement of any tool of the user's choice and traces its path, enabling the user to create art 'in the air', by simply guiding the path of the tool (Figure 1).

Projects with similar objectives use techniques like contour mapping to draw using only finger gestures. However, mapping a hand contour for drawing in these projects has some inconsistencies caused by slight differences in the shapes of the hands of users and a prior setup time to adjust to each user's hand contour [5]. Projects that use colour identification inspired the *Colour Detection Module*, enabling the user to select a tool of their choice [6,7].

IMPLEMENTATION

This project consists of primarily three modules- The *Colour Detection Module*, *Contour Creation Module* and the *Drawing module*.

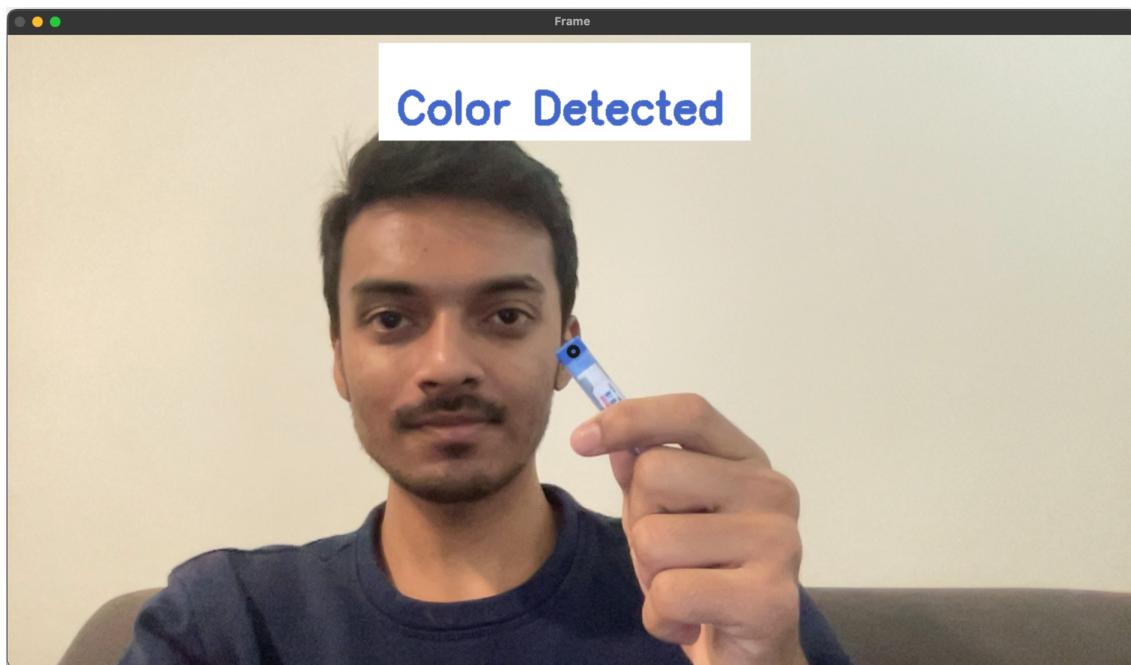


Figure 2: Blue colour detected by placing the object at the centre of the screen (on the black circle)

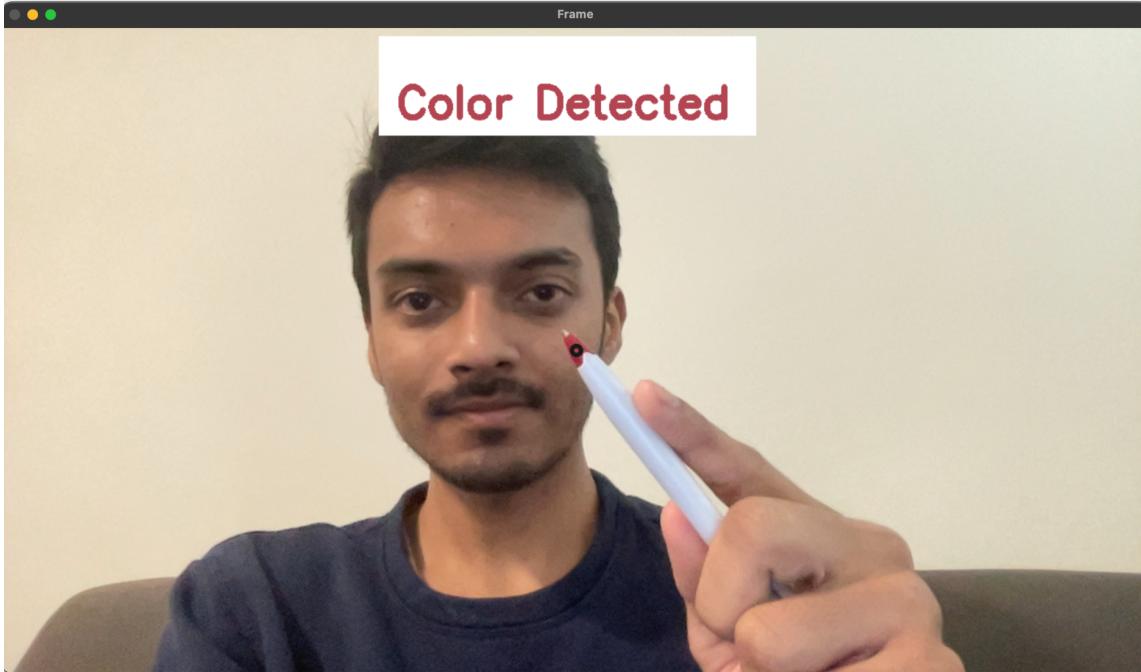


Figure 3: Red colour detected by placing the object at the centre of the screen (on the black circle)

Firstly the user is directed towards the ‘Frame’ window. Here, the *Colour Detection Module* is used to detect the hue of the drawing tool the user decides to paint with. The user needs to place the tool of their choice at the centre of the screen. (Figure 2,3). Then this module will identify the colour of the tool and use its hue value (H in HSV) as a parameter for the *Contour Creation Module*, with a slight margin for error. To confirm the colour, the user needs to press the ‘s’ key on their keyboard to start drawing.

After choosing the drawing tool, the user is directed to the ‘User Window’ where they can start drawing. With the obtained hue parameter, the *Contour Creation Module* creates a mask that converts the colours outside the hue parameter range to a binary image. This mask is then processed with erosion, noise removal and dilation techniques to refine the shape of the contour(s) obtained.

Once the hue contour(s) comes in the line of sight of the camera (Figure 4, 5), the largest possible contour is detected and marked as the contour of the drawing tool. Similarly, if the drawing tool is hidden from the view of the camera (Figure 6), the contour isn’t detected and hence its path is not traced.

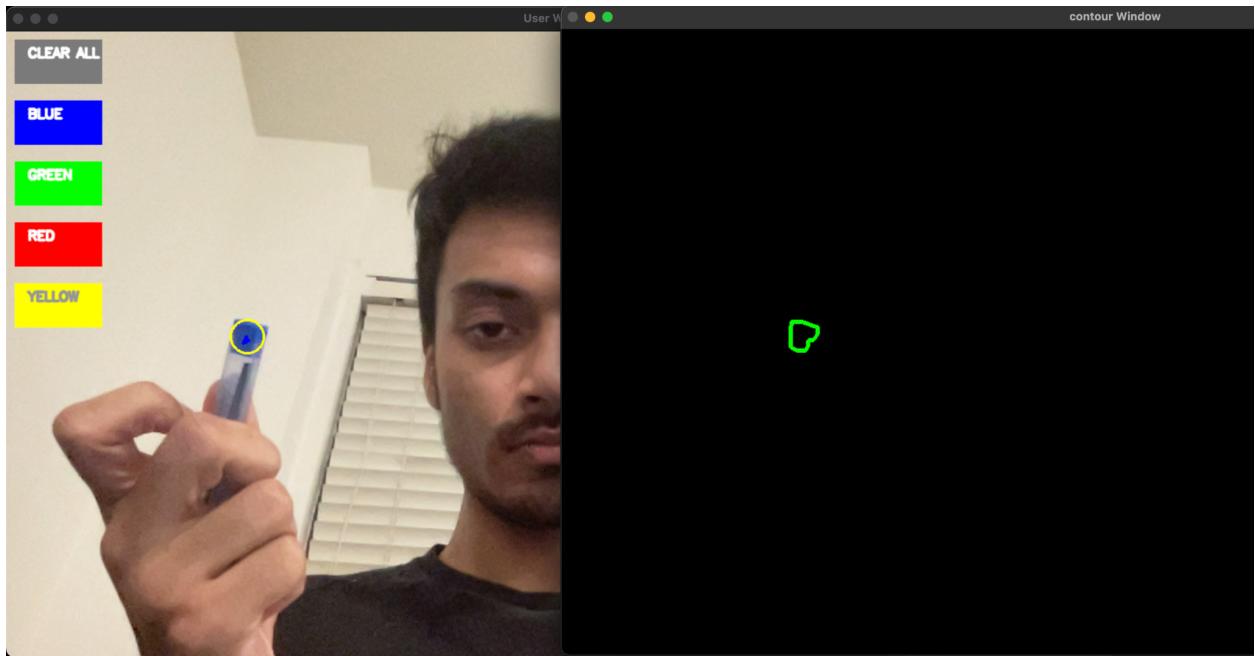


Figure 4: Contour detected as shown in parallel windows

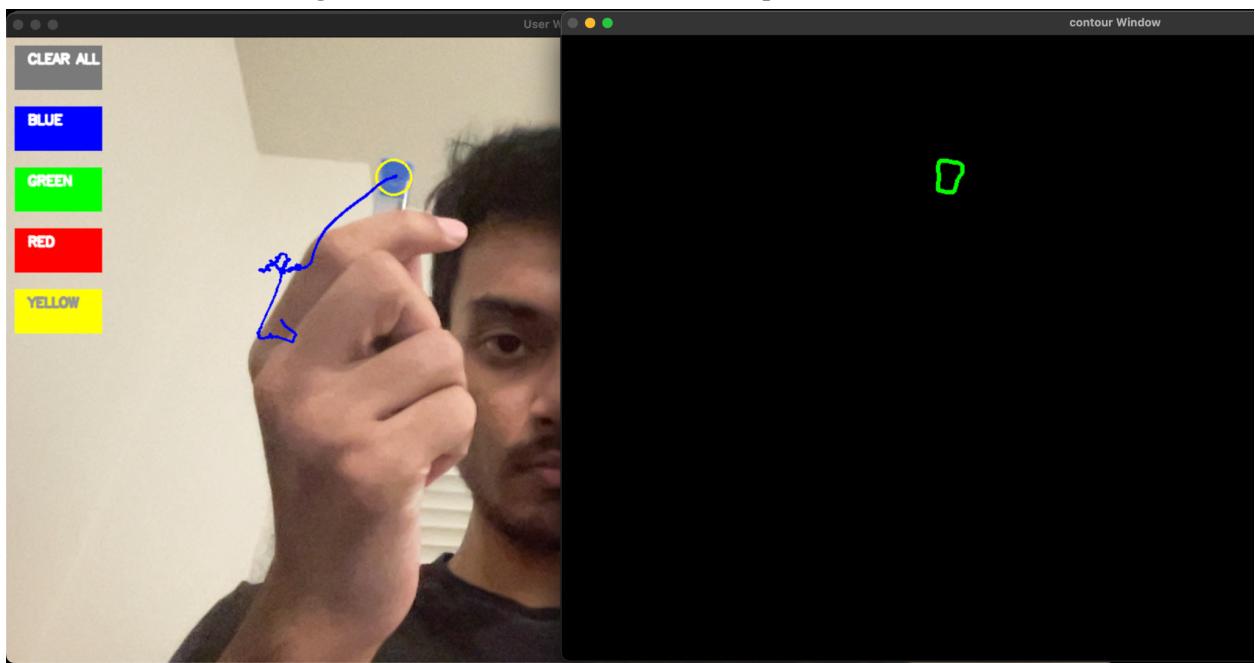


Figure 5: Drawing being made in real-time with the contour of the tool shown beside it

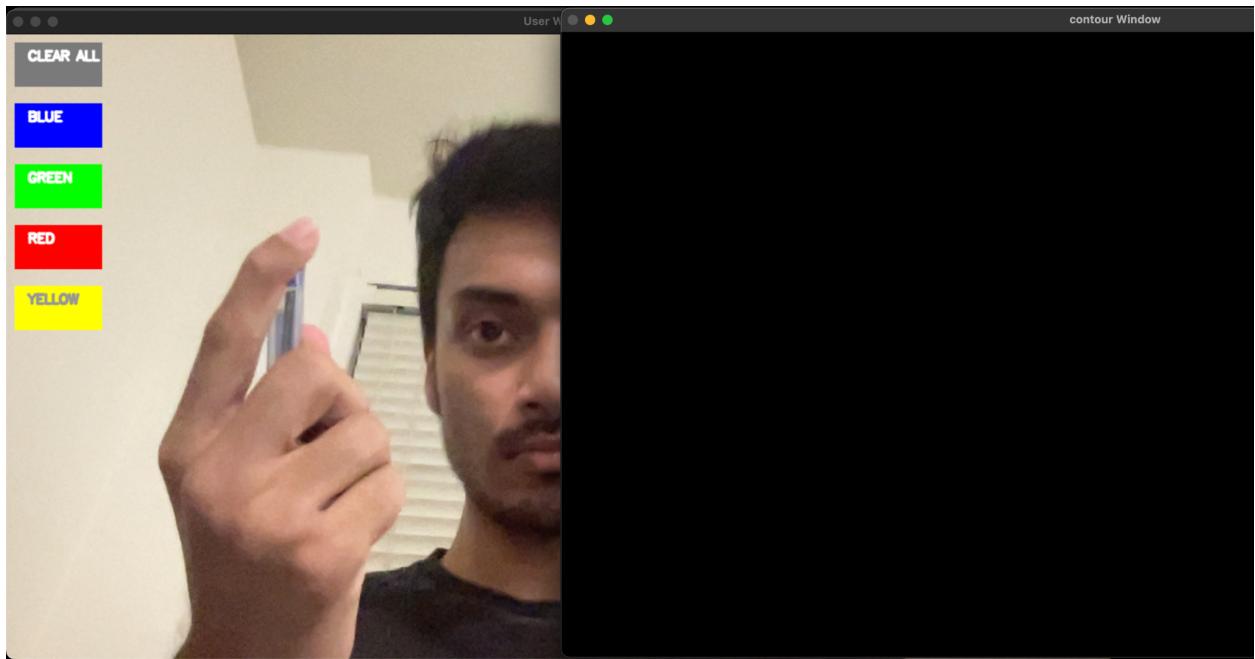


Figure 6: Contour not detected due to the object being hidden from view of the camera

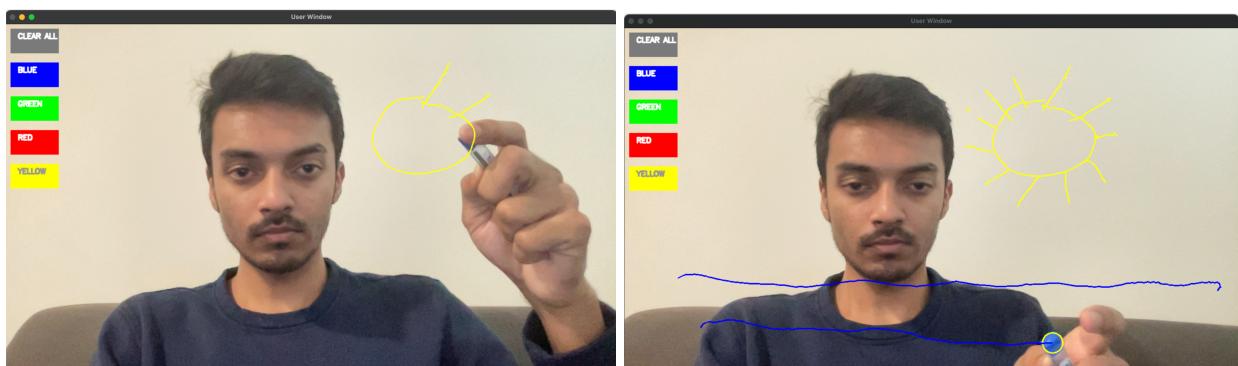


Figure 7,8: Drawing in the air using a tool

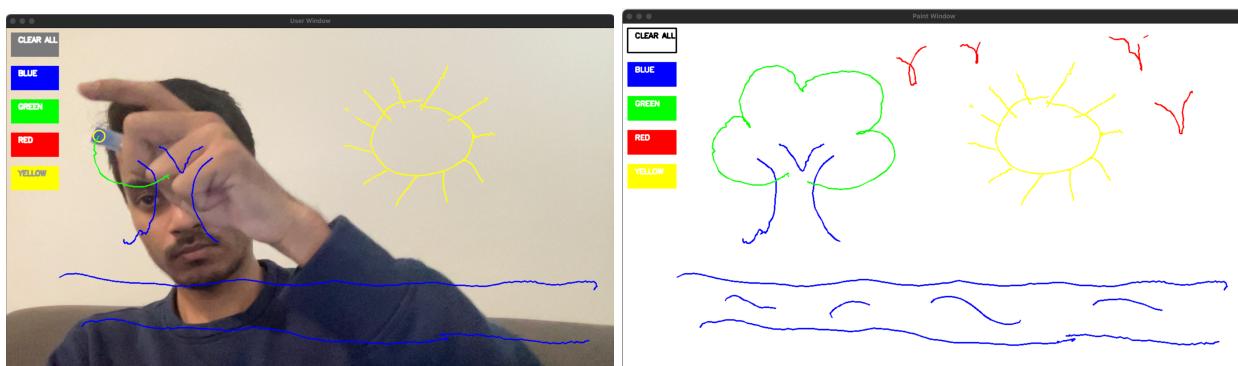


Figure 9: Drawing in the air using a tool

Figure 10: Drawing traced on the 'Paint Window'

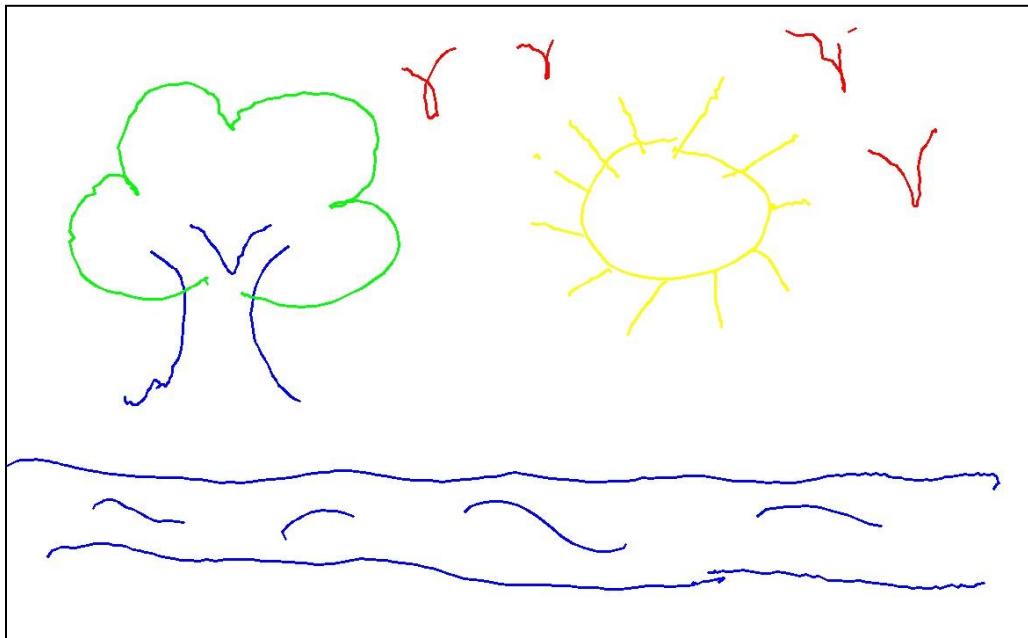


Figure 11: Sketch of a scenery made using AirDraw, saved as an image

The *Drawing module* traces the movement of the contour of the drawing tool to generate a drawing of the given colour. The user is given a selection of colours to choose from and a ‘Clear All’ option to clear the screen. The drawing is traced onto the two windows as the user draws in the air. One is the ‘User Window’ (Figure 1,7,8,9) which shows the view from the user’s camera perspective with the drawing being shown as an overlay. The other is the ‘Paint Window’ which traces the drawing on a white screen (Figure 10). Once the user is done drawing, they can press the ‘q’ key on their keyboard to quit and the drawing gets automatically saved (Figure 11).

OpenCV library was used for the following functions:

- Colour detection
- Creating a mask using the colour of the tool
- Refining of the boundary of the mask
- Removal of noise
- Increasing the mask areas of importance
- Creating contours and representing the largest contour to be the object.
- Drawing the path of the object
- Saving the resulting drawing.

VALIDATION

For the evaluation of AirDraw, qualitative analysis was done with the help of 10 users ($F=3$, $M=7$) on the basis of the following parameters on a scale of 1 to 10 (1 being the lowest rating and 10 being the highest).

- P1- Ease of Usage
- P2- Accuracy of tool to actual drawing
- P3- User Experience
- P4 - Overall Rating

The ratings given by each user are as follows, along with the average rating:

	P1	P2	P3	P4
User 1	8	9	8	9
User 2	7	9	7	8
User 3	9	7	7	8
User 4	9	8	8	9
User 5	7	9	7	8
User 6	7	7	9	7
User 7	9	8	7	8
User 8	8	9	8	8
User 9	8	9	8	9
User 10	8	8	7	8
Average Rating	8	8.3	7.6	8.2

Hence it was found that the average user rating of the overall experience was an average of 8.2 on the scale of 10.

FUTURE WORK

The project scope can be expanded to allow for more drawing functionalities like more colour options, an eraser tool, importing pictures to the frame etc. A more precise technique to detect contours and hence trace the path of the tool more accurately can also be devised. This usage for application can also be expanded to meetings and lectures where the presenter can draw on the display with help of a drawing tool.

CONCLUSION

Hence, AirDraw was successfully developed, allowing users to draw with the use of any common tool and their webcam. OpenCV library was used extensively for this project, allowing the implementation of foundational functionalities of the project. The qualitative analysis of the project yielded good results and provided directions in which the project can further be progressed.

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