



HAND SIGN DETECTION

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Abstract: This paper presents an approach of two-stage convolutional neural network (CNN) for detection of fingertips so that an interaction of the fingertips with a 3D object in the virtual environment (VR) can be established. The first-stage CNN is assigned to detect and locate the hand. Subsequently, the detected hand is cropped, resized, and fed to the second stage CNN for predicting the coordinates of fingertips. Next, a tracker is employed to track the hand continuously so that the system becomes reliable in real-time performance. The VR environments are designed to demonstrate the performance of the fingertip-based interaction system.

Keywords –Hand Detection, Media Pipe, NumPy, Hand Tracking.

I. INTRODUCTION

Gesture recognition is an active field of research that is constantly evolving. It is used to interpret hand and body movements such as waving, pointing, and touching. It can also be used to interpret facial expressions and body language. Gesture recognition technology has a wide range of applications, ranging from gaming and entertainment to medical and industrial. It can be used in fields such as robotics, virtual reality, computer vision, and natural language processing. With advancements in technology, the accuracy and speed of gesture recognition systems are constantly improving. Furthermore, new technologies such as machine learning and deep learning are being used to improve the accuracy and speed of gesture recognition systems.

- **Gesture-Based Interaction:** The method of using hand movements and gestures to control digital environments, offering a more natural and intuitive form of interaction.

- **Augmented Reality:** The technology that superimposes computer-generated information onto the real world, often through the use of AR glasses or mobile devices.

- **Digital Art:** The creation of visual art in a digital format, encompassing a wide range of artistic expressions, from drawing and painting to 3D modeling.

- **Technology:** The application of scientific knowledge for practical purposes, such as the development of the hand detection system.

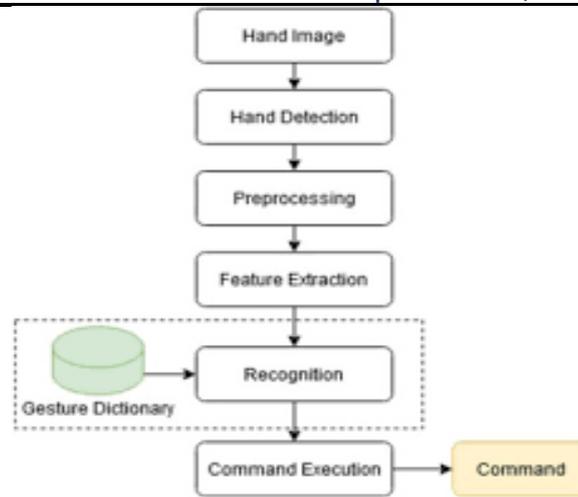
- **Human-Computer Interaction:** The study and design of the interaction between humans and computers, focusing on making this interaction more user-friendly and efficient.

- **Motion Sensing:** The process of detecting and tracking the movement of objects or individuals using sensors, often used in hand detection for gesture recognition.

- **Augmented Reality Applications:** Various uses of augmented reality technology across different fields, including gaming, education, and healthcare.

II. RESEARCH METHODOLOGY

This methodology needs a lot of data to be stored and sometimes it leads to wrong prediction due to background difference or skin color difference. Some of the existing papers followed the process of image processing using threshold values and database data of different images. To overcome all these limitations and drawbacks, we proposed a system using mediapipe. In the proposed system hand sign detection is done using a media pipe which first detects hand landmarks and then obtains positions according to it. Figure 1 describes the flow of a system or the process of project in which it works. This is the complete workflow that occurs to execute the system and draw images just by waving hands in efficient manner.



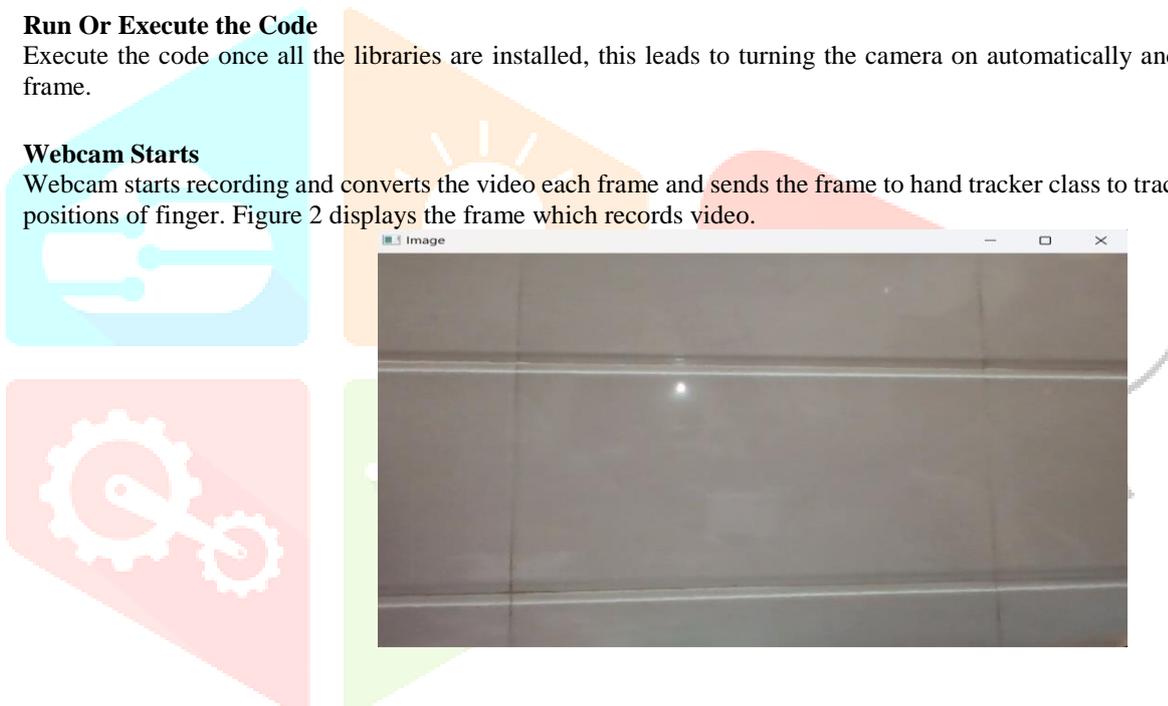
Air Canvas using Mediapipe, Opencv is the proposed system that improves the efficiency for the existing system. Each stage of the flowchart and its methodologies are explained in detailed below. The methodologies or the stages of the proposed system are discussed below:

1. Run Or Execute the Code

Execute the code once all the libraries are installed, this leads to turning the camera on automatically and the OpenCV frame.

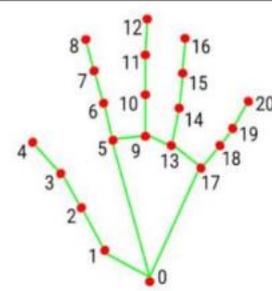
2. Webcam Starts

Webcam starts recording and converts the video each frame and sends the frame to hand tracker class to track or detect the positions of finger. Figure 2 displays the frame which records video.



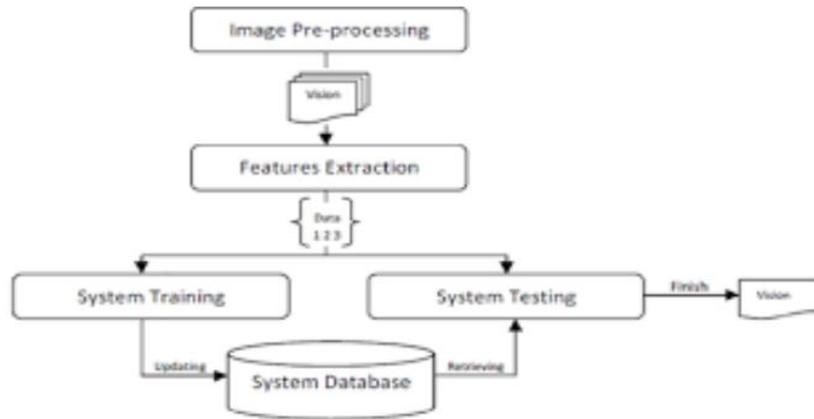
3. Detects Hand Landmarks

Each frame received is compared with media pipe hand landmarks i.e, the Figure and positions of finger are found using getPositions() and which finger is opened using getupFingers() functions of hand tracker class. These 2 functions are part of the Handtracker class.

Hand Land Marks	
	<ul style="list-style-type: none"> 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

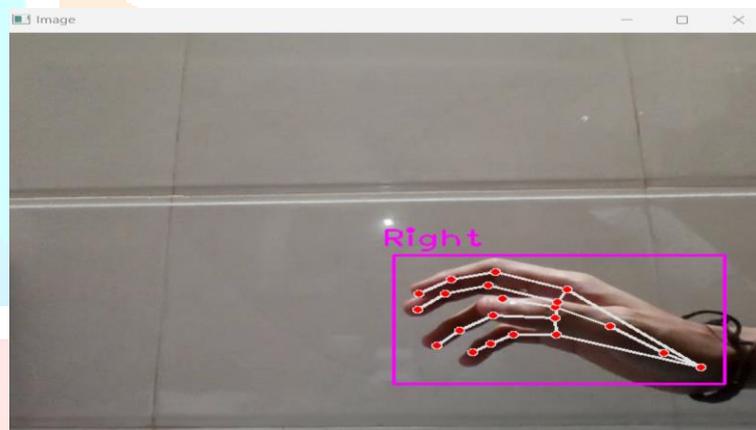
4. Perform actions according to button

Different buttons are chosen with the help of finger hover over those buttons. Each button has its own functionality to perform over. If colors are chosen, then functionalities are performed on the canvas. Figure 4 shows the hand landmarks and colors options.



5. Depict on canvas

We can clear or erase the content on the canvas.



6. Exit

By hovering index finger over exit closes the frame.

III. APPLICATION AREAS OF HAND GESTURES SYSTEM

Hand gestures recognition system has been applied for different applications on different domains, as mentioned including; sign language translation, virtual environments, smart surveillance, robot control, medical systems etc. overview of some hand gesture application areas are listed below.

- A. **Sign Language Recognition:** Since the sign language is used for interpreting and explanations of a certain subject during the conversation, it has received special attention. A lot of systems have been proposed to recognize gestures using different types of sign languages. For example recognized American Sign Language ASL using boundary histogram, MLP neural network and dynamic programming matching. recognized Japanese sign language JSL using Recurrent Neural Network, 42 alphabet and 10 words. recognized Arabic Sign language ArSL using two different types of Neural Network, Partially and Fully Recurrent neural Network.
- B. **Robot Control:** Controlling the robot using gestures considered as one of the interesting applications in this field . proposed a system that uses the numbering to count the five fingers for controlling a robot using hand pose signs. The orders are given to the robot to perform a particular task, where each sign has a specific meaning and represents different function for example, “one” means “move forward”, “five” means “stop”, and so on.
- C. **Graphic Editor Control:** Graphic editor control system requires the hand gesture to be tracked and located as a preprocessing operation used 12 dynamic gestures for drawing and editing graphic system. Shapes for drawing are; triangle, rectangular, circle, arc, horizontal and vertical line for drawing, and commands for editing graphic system are; copy, delete, move, swap, undo, and close

IV. RESULTS AND DISCUSSION

4.1 Results of Study Variables

Table 4.1: Descriptive Statics

				
Gesture	Zoom	Double click	Left click	Cursor
Command	Zoom	Double click	Left click	Cursor
Type	Dynamic	Static	Static	Dynamic
Alexnet	78.5%	42.8%	83.3%	91%
VGG16	100%	100%	80%	100%
				
Gesture	Chrome	Undo	Swap	Scroll
Command	Chrome	Undo	Swap	Scroll
Type	Static	Static	Dynamic	Dynamic
Alexnet	100%	91.6%	57.1%	33.3%
VGG16	100%	100%	100%	66.66%
				
Gesture	Right Click	Pointer	File Manager	
Command	Right Click	Pointer	File Manager	
Type	Static	Dynamic	Static	
Alexnet	100%	85.7%	83.3%	
VGG16	100%	100%	100%	

V. CONCLUSION

The hand region is detected from the background by the background subtraction method. Then, the palm and fingers are segmented. On the basis of the segmentation, the fingers in the hand image are discovered and recognized. The recognition of hand gestures is accomplished by a simple rule classifier. The performance of our method is evaluated on a data set of 1300 hand images. The experimental results show that our approach performs well and is fit for the real-time applications. Moreover, the proposed method outperforms the state-of-art FEMD on an image collection of hand gestures. The performance of the proposed method highly depends on the result of hand detection. If there are moving objects with the color similar to that of the skin, the objects exist in the result of the hand detection and then degrade the performance of the hand gesture recognition. However, the machine learning algorithms can discriminate the hand from the background. ToF cameras provide the depth information that can improve the performance of hand detection. So, in future works, machine learning methods and ToF cameras may be used to address the complex background problem and improve the robustness of hand detection

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VII. REFERENCES

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