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THE DESIGN OF HAND GESTURE CONTROLLED VIRTUAL MOUSE USING CONVOLUTIONAL NEURAL NETWORK

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Abstract - This exploratory paper proposes a way to implement the functionalities of the cursor based on hand gestures with the use of computer vision and deep learning models which aim to emulate the swaying motion of human hand gestures hold the key to further improving the performance of such computer vision solutions. Many technologies are continually evolving in today's technological environment. The human-machine interface is one such promising concept. The idea is to make use of hand gestures to implement the functionalities of the mouse on the screen without using any hardware, and merely by exploiting finger motions, known as gesture recognition. We present a unique Human-Computer Interaction (HCI) approach in this study. The python dependencies that will be used for implementing this system are OpenCV, MediaPipe, and the latest packages such as PyAutoGUI.

***Key Words*:** Computer Vision, Deep Learning, Human-Computer Interaction (HCI), MediaPipe, PyAutoGUI

1. INTRODUCTION

These gestures are effective ways to convey words, thoughts, and emotions. Gestures are used in nonverbal communication to express a certain message. This message can be sent through a person's body, hands, or face movements. Computers can now record and recognize human hand movements because of advances in computer vision and artificial intelligence, closing the gap between human-machine interaction. As a result of virtualization and the long-term shift towards immersive technologies like the metaverse, the traditional human-machine interaction has changed. Devices are getting smaller and smaller as technology advances. While some devices have gone unseen, some have gone wireless. The idea is to develop a gesture-recognizing virtual mouse. Instead of using a traditional or ordinary mouse to operate numerous mouse cursor operations, the idea is to use a straightforward camera. In this project, an efficient hand gesture segmentation method based on picture preprocessing techniques has been suggested.

2. SCOPE OF PROJECT

There are generally two approaches for hand gesture recognition, which are hardware based, where the user must wear a device, and the other is vision based which uses image processing techniques with inputs from a camera. The proposed system is evidently a vision-based system, which uses image processing techniques and inputs from a computer webcam.
Our goal is to implement additional gestures so that in the future, users will be able to perform more tasks efficiently. This project proposes a system that only uses the appropriate hand to perform gestures. It will therefore be possible in the future to the improvement of the currently implemented technique to utilize both hands for different gestures.
This proposed system will help the end user save both time and effort, as well as help the handicapped and blind use the computer.

3. IMPLEMENTATION

The following are the steps of implementation of our system.

1 We take real-time pictures with the webcam during this process real-time photos from the computer webcam are mostly acquired .
2 We process the video frames after breaking them down into individual frames using techniques like image segmentation , object recognition and picture compression
3 We extract several fingertips from the picture

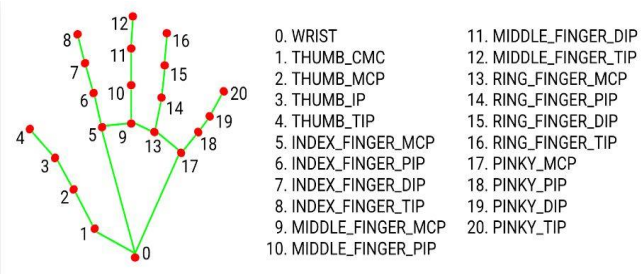
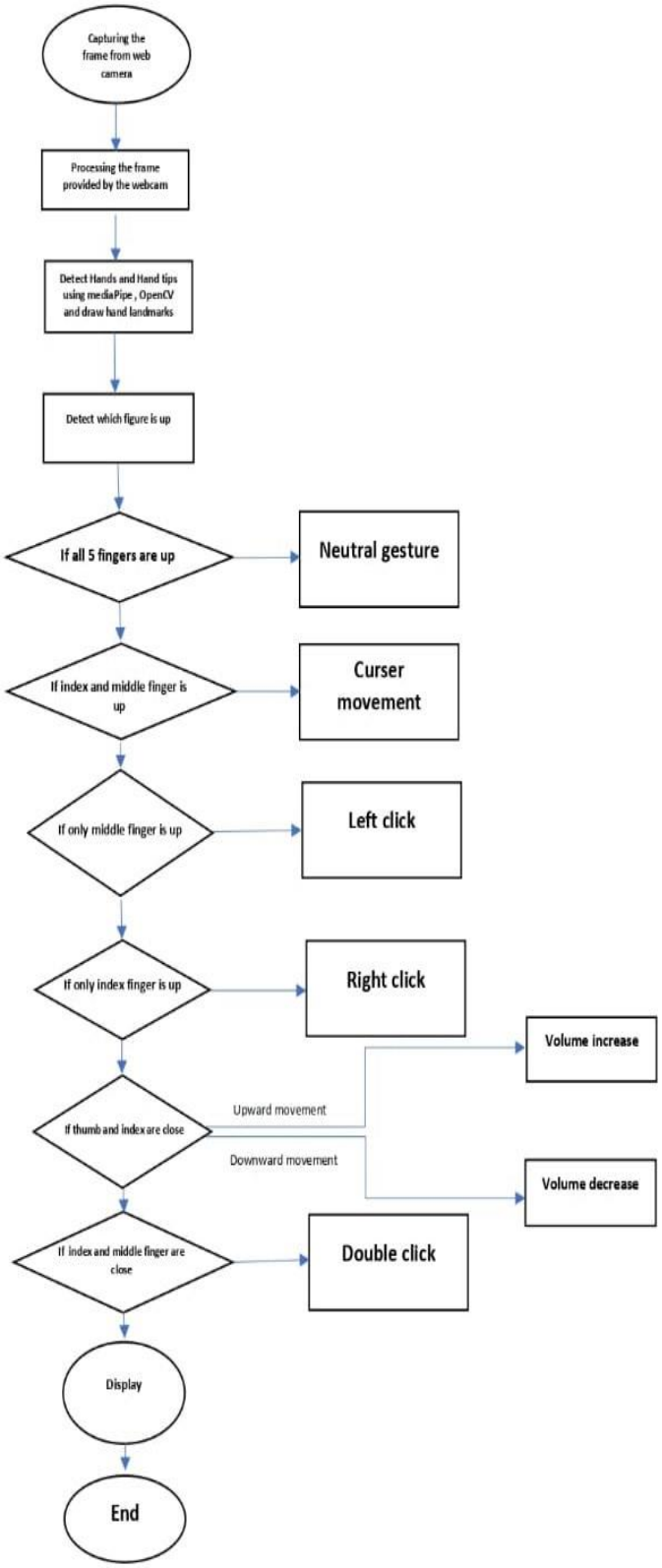


Fig.1. Commonly used hand coordinates

4. Using the tip id as shown in the figure of the relevant finger, detecting the fingertips.
5. Follow the pointer's movement.
6. Executing various mouse operations by assigning a finger id to each action.

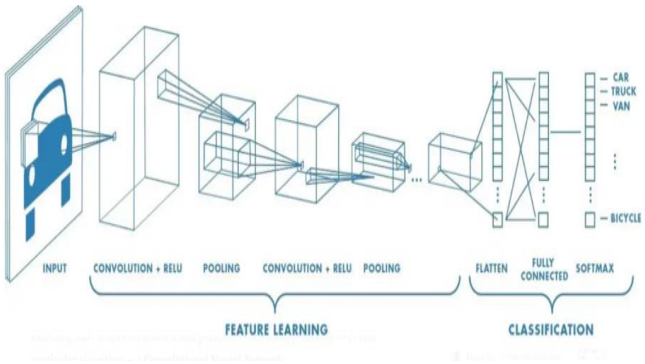
Flow chart



4. METHODOLOGY

Convolutional Neural Network (CNN):

CNN is a multi-layer neural network with a distinctive design used for deep learning according to its definition convolutional pooling and fully connected layers make up the three main components of a CNN architecture when doing image detection extraction and segmentation CNN is typically utilized to identify objects and scenes the convolutional layer conv is the fundamental component of CNN and is in charge of convolutional operations when two sets of data are combined using a convolutional operation a feature map is created by applying the kernel filter function to the input data the size of the feature maps is decreased by pooling layers which decreases the number of parameters to learn and the amount of network processing.



6. RESULT ANALYSIS

The following 7 Figures shows the various hand gestures that are used in our system to perform the various functionalities of the virtual mouse.

In the Fig.3 if all 5 figures are up as shown the system recognize it to be Neutral with the cursor being activated. The left button click is made possible by wide-opening the index finger as shown in Fig.4. The right button click is made possible by wide-opening the index finger as shown in Fig.5. Drag and drop operation, which can be useful while moving files from on location to another, can be performed by closing all fingers as shown in Fig.6. If both index and middle fingers as shown in Fig.7 are up and held wide-open it performs the cursor control operation. By pinching the index and Thumb fingers as shown in Fig.8 we can adjust the Volume and Brightness. Double-click is equal to pressing a mouse button twice which performed by joining both index and middle finger as shown in Fig.9.The Hand Gesture Controlled virtual Mouse is simmulated using Convolution Neural Network to obtain better accuracy.

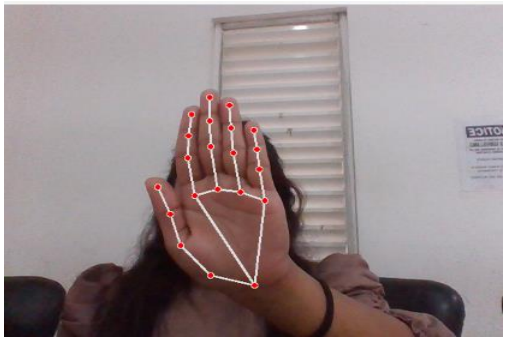


Fig.3. Neutral Gesture

Fig.4. Left Click

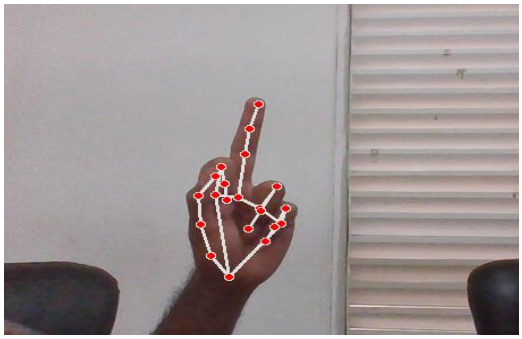


Fig.5. Right Click

Fig.6. Drag and Drop

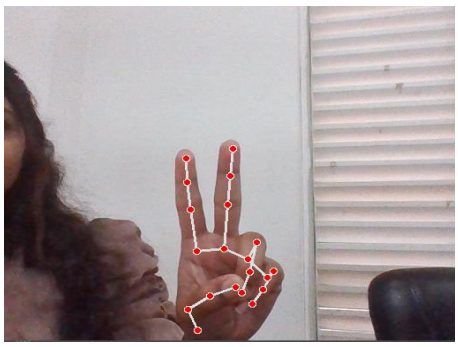


Fig.7. Cursor Control

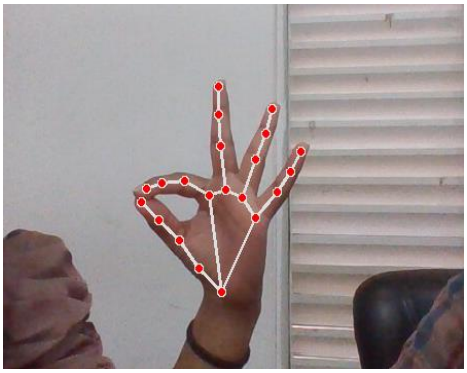


Fig.8. Volume and Brightness Control

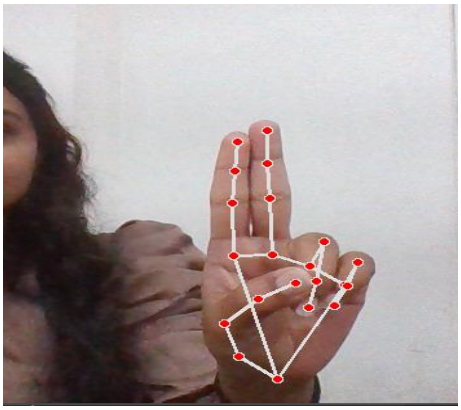


Fig.9. Double Click

7. CONCLUSION

In this project, we are working on a system to implement the functionalities of a mouse using a real-time camera. Most mouse tasks can be performed by our system which is based on computer vision algorithm. Our system would make use of Convolutional Neural Network to recognize the hand gestures. This system would make presentations simpler while also conserving workspace. Python 3.7 (64- bit) and open-source modules are used in the development of this project, making it suitable for future updates.

8. REFERENCES

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