

# A REAL TIME HAND GESTURE RECOGNITION AND HUMAN COMPUTER INTERACTION SYSTEM USING OPENCV

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**Abstract:** The Project is on Real time Human Computer Interaction System based on hand gesture. The System created with 3 part : Gesture detection, Gesture recognition and Human computer interaction and it realizes the robust control of keyboard events with higher accuracy of gesture recognition. To recognize gestures and make it attainable to identify relatively complex gestures using camera. The developed system is highly extendable and can be used in human-robotics or other human-machine interaction scenarios with more complex command formats rather than just mouse and keyboard events. In the proposed system, the model is trained with a custom dataset and perform specific events specifically keyboard events to control the system. Once the model is trained, it can be easily integrated into an application with a graphical interface. The system can be implemented in various applications depending on the use case, for example a physically impaired person would be able to control device just with simple gestures, there can be a video player controlled by simple hand gestures or a person could give a presentation without the hassle of going near a system by just using simple hand gestures.

**Index terms:** Python, OpenCV, Hand Gesture, Haar Cascade, XML, Keyboard, PyautoGUI, Convex Hull Algorithm, Human Computer Interaction

## I. INTRODUCTION

Human-computer system is communication between human and computer. Trend of human-computer interaction is becoming more interested day by day and is forward operation humanity and easy. Computer vision technology is interaction between human and machines. The important input device like mouse and keyboard used to interact with computer.

By using hand gesture user can pass on more information in short period of time. Human-computer Interaction system has great application by using elaborating interface between user and computer. The main aim of proposed system is to identify the specific gesture and we can use it to express the information or can control any device or robot. Static affectation of hand is defined as posture.

There are two techniques which are used to interpret gestures for human computer interaction.

(i) Data Gloves technique:

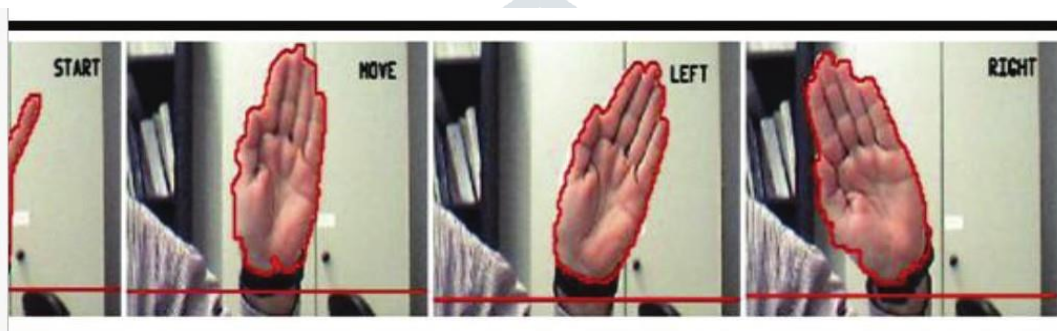
In this technique hardware part like sensors and gloves are used to detect the gestures. In this human had to wear the gloves, helmet and other apparatuses. That equipment Transfer finger flexing into electrical signals for determining the hand gesture.



**Fig 1.1:** Data gloves based Hand Gesture Recognition

## (ii) Computer Vision technique:

Computer vision technique is nature, easy and cheap in cost comparing. This technique extract the feature from the video frame. Web camera in laptop is taking the frame continuously and program extract the feature from the frame, process on the frame as required.



**Fig 1.2:** Hand Pose taken by camera

## II: LITERATURE SURVEY

In vision based approach, there are many method used in hand detection, gesture training, background subtraction and fingertip detection.

A number of recognition techniques are available. Researchers worked on various aspects like skin color or background subtraction for hand segmentation. Some worked on plain, uniform background[1][4] whereas some worked on complex background[6]. Usually a static background where no other object is moving is used. Segmentation on such static background is comparatively simpler than on dynamic background. Hand localization is much easier on uniform background.

One approach is image segmentation which uses HSV color space model rather than RGB color space to determine the color of human skin. This algorithm gives better result for background separation and region boundary but it can't detect the object of skin color with similar color background [3]. Another approach is learning based gesture recognition in Adaptive Boosting algorithm that can integrate the information of same category of objects. It trains the network by combining all weak classifiers into one strong classifier.

Another technique is based on convex hulls. Palm Detection have many algorithm. In this section some of existing algorithms will be discussed which are used in our proposed technique. Jarvis's March or Gift wrapping Algorithm, Divide and Conquer algorithm, Graham's Scan Algorithm, Quick hull algorithm and Chan's algorithm. Graham Scan computes the convex hull of any given set of points. To implement the system for hand tracking and simple gesture recognition in real time, there is no need to touch or carry a peripheral device by user. By comparative analysis, we can conclude that only one detection technique not enough because different kind of methods can deal with different problem during detection & recognition. There are various available machine learning algorithms that are AdaBoost, support vector machine technique, hidden markov model, & principle component analysis for training classifiers [2]. There may also have different convex hull and contour detection of boundary of hand region.

Using this method, we implemented system for hand detection and haar classifier algorithm to train the classifier. Here we tend to additionally use HSV color model for background subtraction & noise removal, convex hull algorithm for drawing contour around palm and fingertip detection.

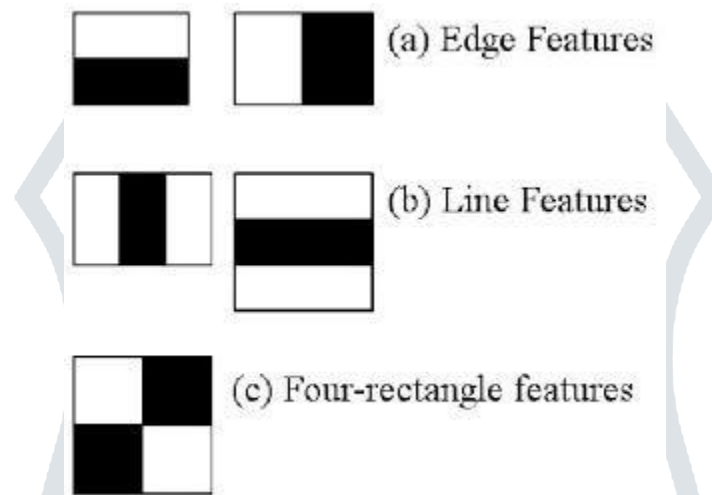
There are multiple softwares for image processing application but among them OpenCV (Open Source for Computer Vision) software is very popular for Real time image processing applications such as object detection & gesture recognition. The major advantage is that one will simply integrate the code with hardware. We implement the projected system on OpenCV library supported UNIX operating system setting.

### III: METHODOLOGY

In this System, we start taking the input from web camera. Based on the input system will detect the gesture and do the further process on the frame as required and remove the noise also eliminate the background from the image and recognize the gesture.

The simple Haar-like features are used in the Viola and Jones algorithm. The integral image at the location of pixel  $[x, y]$  contains the sum of the pixel intensity values located directly above the pixel location  $[x,y]$  and at the left side of this pixel. So  $AI[x,y]$  is the original image and  $AI[x,y]$  is the integral image that is calculated by below equation 1:

$$AI[x,y] = IA[x',y']$$



**Fig 3.1:** Common haar like features for integral images[5]

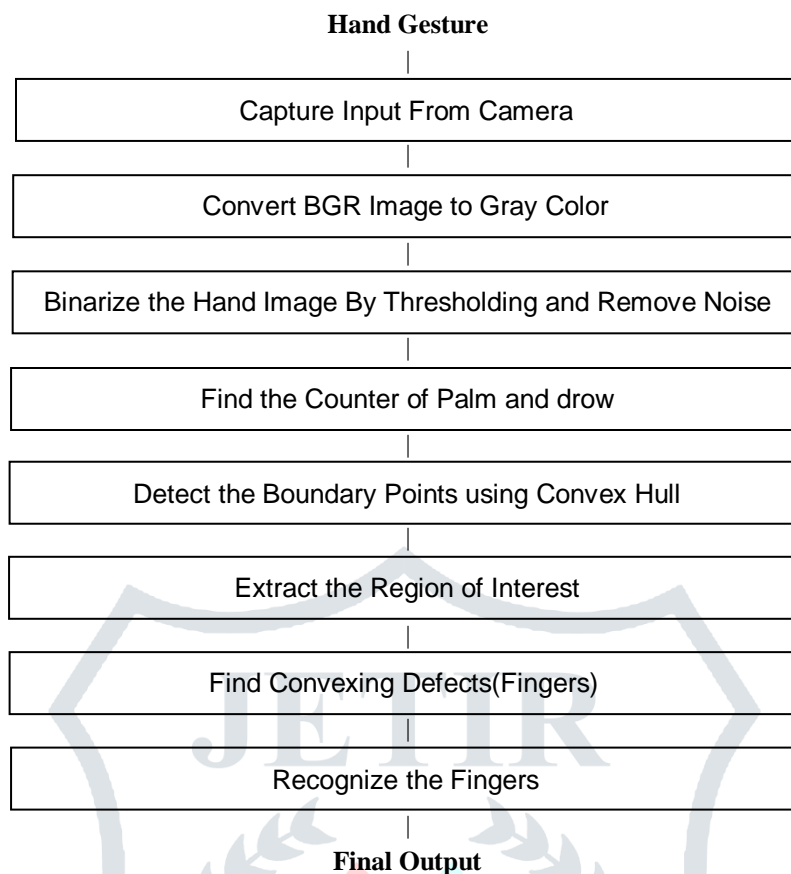
Not one Haar-like feature can identify the object with high accuracy. However, it is not complex to find one Haar-like feature-based classifier that has good accuracy than the random guessing.

In convex Hull algorithmic rule start is segmentation of the hand image that contains the hand to be placed. In order to create this method it's potential to use shapes, however they'll be modified greatly in interval that hand moves naturally.

So, we tend to choose skin-color to induce characteristic of hand. The skin-color could be a distinctive cue of hands and it's invariant to scale and rotation.

In the next step we tend to use the estimated hand state to extract many hand options to outline as settled method of finger recognition. After the hand is segmented from the background, a counter is extracted. The counter vector contains the series of coordinates of edges of hand. Then the process of counter vector provides the placement of the fingertip.

Calculate the points with min and max of x and y coordinates in Convex Hull and join these points. There also are other points for that find convex defects i.e. between each arm of hull. We have used opencv library for this project is called open computer vision (openCV).



**Fig 3.2:** Flow of Methodology for finger counter

#### IV: SOFTWARE IMPLEMENTATION

Human Computer Interaction, robotics, biometrics, image processing and other area where openCV library can be used. Visualization is most important and that include implementation of Haar Classifier detection and training. Two set of images are required to train the haar classifier. One set which refers positive image which will be our model object for gesture recognition and another set image refers negative image which does not contains an interested objects. It is also important that they should be different in background and lighting.

In our trained model, 4 hand postures are tested the "palm" posture, "fist" posture, "OK" posture, "point" posture against negative postures. Low cost Web camera of laptop is used for the video input. Camera Provides video capture with max resolution of 640\*480. Gaussian blur is applied in implementation for smothering the image. we collected positive image in range of 400 to 500 with different scales for each posture and 500 random images for negative samples. after all positive images and negative image samples are ready, it is generated in xml file which will latter used in system for detection and recognition of gesture.

#### V: RESULT AND CONCLUSION

First, We try palm detection based on our trained xml file in openCV. Then capturing live streaming of camera the initialization has been done. Four gesture such as palm, fist, okey and point by green rectangle which is trained by integral images. Second step is extracting image gesture which is compared with stored positive-negative integral image dataset and perform finger tip tracking by contour detection. which is compared with stored positive-negative integral image dataset and perform finger tip tracking by contour detection. With help of 2.40 GHz intel® coreTM processor Linux based opencv image processing software & jupyter notebook and sublime text editor is used to analyze a 640 x 480 image size, a frame rate of 30 frame/second has achieved.

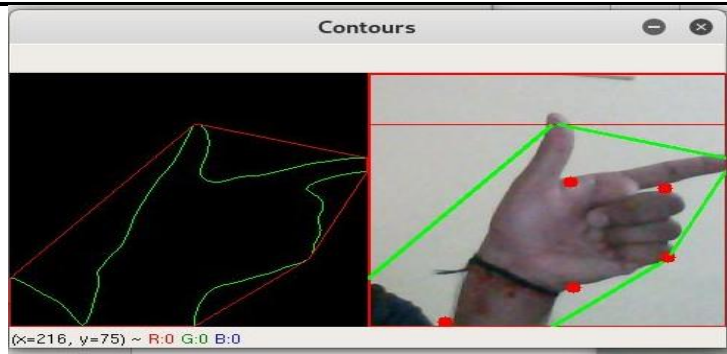


Fig 5.1: Pointdetection

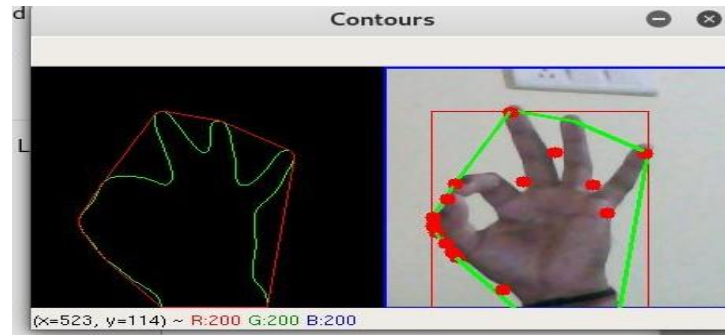


Fig 5.2: okeydetection

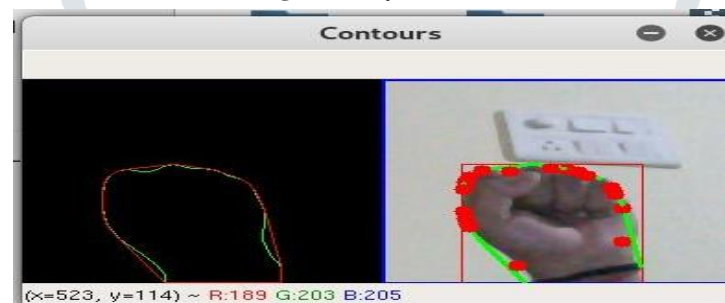


Fig 5.3: fist detection

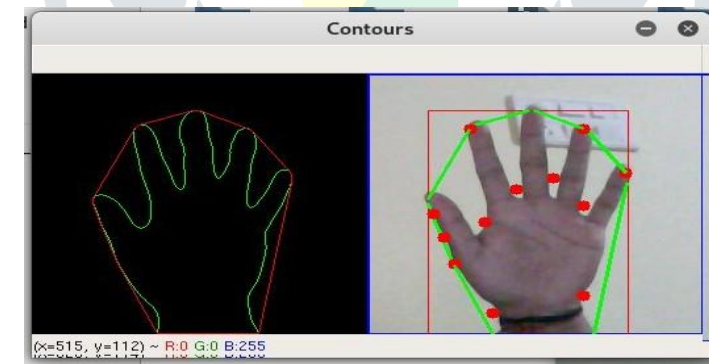


Fig 5.4: Palm detection

Fig. 5.1, 5.2, 5.3, 5.4 shows the detection of Point, Okey, Fist, Palm respectively by using python programming language. all above figure shows various finger gestures detected by proposed algorithm and also contain segmented image and Identified gestures.

The aim of project is to develop a real time hand Gesture recognition system. It is shown that contour is very important feature and can be used to discriminate two different gesture.

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