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Gesture Recognition For Human-Computer Interaction

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Abstract

We know that our future completely depends on robots, so Human-Computer Interaction (HCI) plays a major role in communication with the systems. By this normal people can easily communicate with the system but in case of dumb HCI has no support. In this case, gestures are more useful to communicate with systems. Gesture is a type of non-verbal correspondence in which visible body activities impart a specific message motion incorporating hands, face, and different pieces of the body. In our proposed work, detection and recognition of hand gestures using various Learning algorithms are used. GR is one of the significant procedures to fabricate well-disposed interfaces. For instance, a robot that can perceive hand motion can take orders from people, and for the individuals who can't talk or hear, this innovation is helpful.

KEYWORDS*—palmprint, Numpy , OpenCV, Convex hull, Contours.*

I.Introduction

The goal of this project is to bring an easy way of communication between human and computer. Hand is the most effective part to communicate with the system both in static and dynamic and it is a general purpose interaction tool in the HCI research field. There are some type of hand gestures recognition techniques like Electronic based, Glove based, Marker based and Simple hand based. Electronic based uses hardware and physical attachment with the system is required which makes it complex to use. Glove based requires a glove, this technique is environment dependent and complex to use. Marker based use different colour makers in fingers and wrist as if it contains multiple colours it will be more complex compared to previous techniques main thing is marker positions are fixed. Simple Hand based model contains histograms which means it graphically represents pixels exposed in image. A new kind of hand gesture technique was evolved so called Vision based. In this the interface will be more natural and 3d implementation of image will take place. By this lot many technologies came into focus such as HMM based recognition, neural networks, Fuzzy systems and syntactical analysis. In OpenCV it is easy to create image processing techniques like feature tracking, detection and extracting due to it containing a large amount of inbuilt library functions [1]. By using Hand Gesture, we can acquire more information in less time, HCI is used to improve the interaction between users and computers. Specific gesture has a specific identity to control the things using body organs such as arms, hands, and face to get meaningful information from sender to receiver. Data Gloves based method is one the technique to recognize hand gestures. Optical sensors, Actuator and Accelerometer are used to detect hand gesture. To manage the real time environment users have to carry load cables which are difficult to maintain. Because it was a complex structure. Vision based methods in this feature are extracted from a video frame with the help of integrated webcam. OpenCV is very popular software compared to other image processing applications, it provides real time image processing such as detection and gesture recognition. By using OpenCV we can easily integrate the code with hardware with help of library function in OpenCV software [2].

II.LITERACY SURVEY

There are many methods and techniques for processing the gesture using the hand and other physical parts of the body like Convolution Neural-Networks,Hand Segmentation & Tracking,Hidden Markov Model etc. CNNs is powerful image processing that will be used in all sorts of processes and it produces good results. It is also used in the gesture identification process. It

contains so many applications in different areas like speech processing, video retrieving and NLP. [1].The HST is to distinguish the skin shading and expel the intricate foundations and it gives the key accomplishment towards any signal acknowledgment, due to for certain difficulties of vision based strategies, such as shifting lighting condition, complex foundation and skin shading recognition, due to variety in human skin shading complexion. Segmentation is mainly used for color detection because color is a very powerful descriptor for detection of objects. Color components such as brightness, saturation and hue component are calculated in percentage for primary colors like Red, Green and Blue.Tracking is used to remove noise present and background distortion and after track the hand[6].

HMM is used in speech recognition and this technique was greatly successful in it. Later this was introduced to the vision area where the time variant is significant . HMM have intrinsic properties which make hand gesture recognition attractive and also explicit segmentation is not necessary for either training or recognition.[7]

In[1], they embrace another strategy a programmed acknowledgment procedure of communication through signing to build up the personal satisfaction of these impaired individuals. In future by utilizing techniques for Image handling the informational index would be improved with the goal that the framework perceive signal all the more proficiently. Regardless of foul pictures our precision is a lot higher contrasting and different works. While leading the investigations, they utilized distinctive brightening conditions and fluctuated removes between hand sign and camera regularly happened. In such cases, affirmed the outcome is viable when the proposed technique is utilized however the proposed strategy is touchy with various foundation conditions and pivoted hand sign pictures.

In [2], users can associate with machines through hand, head, outward appearances, voice and contact, utilize one of the significant methods of connection for example hand motions to control the robot or for workplaces and family unit applications. Hand motion recognition calculations depend on different AI strategies, for example, neural systems, bolster vector machines, and Adaptive Boosting (AdaBoost). Among these strategies, AdaBoost based hand-present locators are prepared with a diminished Haar-like list of capabilities to make the identifier vigorous. They demonstrated that the comparing setting free punctuation based proposed technique gives powerful ongoing execution with incredible precision and heartiness for in excess of four hand signals. Square shapes are making some issue because of that they likewise actualize the other portrayal strategy for same signals for example fingertip identification utilizing curved body calculation.

In [8] applied multivariate Gaussian movement to see hand signals using non geometric features. The data hand picture is separated using two unmistakable techniques [8]; skin concealing based division by applying HSV concealing model and batching based thresholding strategies [8]. A couple of assignments are performed to get the condition of the hand to isolate hand feature; the altered Course Analysis Algorithm are gotten to find an association between quantifiable parameters (contrast and covariance) [7] from the data, and used to process object (hand) inclination and example [7] by finding the orientation of the hand movement.

In [3] see the static position of American Sign Language using neural frameworks computation. The data picture is changed over into HSV concealing model, resized into 80x64 and some image preprocessing exercises are applied to partition the hand from a uniform establishment, features are isolated using histogram technique and Hough count. Feed forward Neural Networks with three layers are used for movement requests. 8 models are used for each 26 characters in correspondence through marking, for each movement, 5 models are used for planning and 3samples for testing, the structure achieved 92.78% affirmation rate using MATLAB language.[3].

G. R. S. Murthy [5] applied scaled normalization for movement affirmation subject to splendor factor planning. The data picture is separated using thresholding technique where the establishment is dim. Any divided picture is normalized (cut), and the center mass [5] of the image is settled, so the bearings are moved to organize the centroid of the hand object at the reason for the X and Y rotate [5]. Since

this methodology depends upon the center mass of the article, the made pictures have different sizes [5] , accordingly a scaled normalization action are applied to vanquish this troublesome which keep up picture estimations and the time likewise [5], where each square of the four squares are scaling with a factor that is novel comparable to other square's components. Two methods are used for extraction of the features; at first by using the edge mages, and furthermore by using normalized features where simply the splendor estimations of pixels are calculated and other dull pixels are neglected to reduce the length of the part vector [5]. The database includes 6 unmistakable signs, 10 models for each movement are used, 5 models for getting ready and 5 models for testing. The affirmation rate for the normalized segment issue achieved preferable execution over the commonplace component procedure, 95% affirmation rate for the past methodology and 84% for the last one.

In [4] recommended another Self-Growing and Self-Organized Neural Gas (SGONG) arrange for hand motion acknowledgment. For hand area location a shading division strategy dependent on skin shading channel in the YCbCr shading space was utilized, an estimation of hand shape morphology has been recognized utilizing SGONG organize; Three highlights were extricated utilizing finger distinguishing proof procedure which decides the quantity of the lifted fingers and qualities of hand shape, and Gaussian dissemination model utilized for acknowledgment.

In[3], They are proposed a strategy to recognize the motion numbers from 0 to 9. They utilized diverse element extraction strategies and strategy to recognize the motions by utilizing Arabic databases and they got 90.45% exactness. For this they utilized 290 video succession for confine motions as preparation reason and 270 for testing reason. In[20], they recognized 5 statics and 12 unique motions. For this reason , they utilized 240 information tests they gathered. They recognize the motions with 98.3%.

In [6], controlling the robot utilizing motions is considered as one of the fascinating applications with regards to this field[6]. They proposed a framework that utilizes the numbering to tally the five fingers for controlling a robot utilizing hand present signs. The requests are given to the robot to play out a specific undertaking [6], where each sign has a particular importance and speaks to various capacities for instance, "one" signifies "push ahead", "five" signifies "stop, etc.

III.PROPOSED METHODOLOGY

Image processing is the method in which conversion of image into digital form takes place and performing some operations in order to acquire the fine details of the image by applying different models.
There are so many applications where we used image processing

BIOMETRIC IDENTIFICATION

It is the process of identification of humans by their behaviors and characteristics. Biometrics are used in order to identify a particular person from a group and reduce the access of a particular thing. The purpose of the biometric is to ensure the services to the authorized users other than to all. The operation of this procedure is carried out in a way where the characteristics of a person are stored and compared with the template data.

CHARACTER RECOGNITION

Character recognition is usually known as optical character recognition in which the written text/printed text is translated in order to examine the characters.

SIGNATURE RECOGNITION

Signature recognition is also an application of image processing, in order to check whether a particular signature belongs to a particular person or not based on the past signature he/she keeps. Infact it is difficult to build a signature recognition model because no one can use the same font and size of the signature.

FACE DETECTION

In this important characters in a face are examined and others are neglected. Face detection model works by examining all the characters of a face and then comparing with the template image**.**
The following figure shows the procedure followed to identify human gesture is

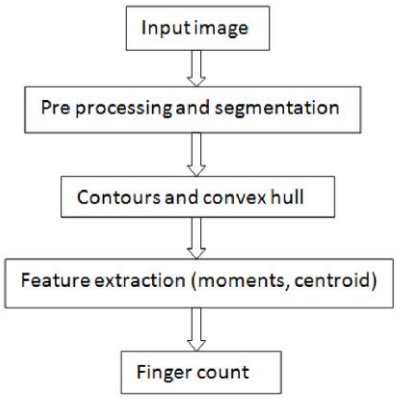


Fig.1 Methodology followed to identify the gesture

The image that is going to be used by the model is captured by a camera or acquired from a database .The captured image/image acquired from the database is then proceeded for pre-processing.
Why only images?
In present days the only way to keep the track of past actions is done only by capturing images. By capturing images one can have a comparison against the past and the future. Not only for comparison but also for examining the difference between the past and the present actions. By comparison of the captured images we can know some things might have no change in them.

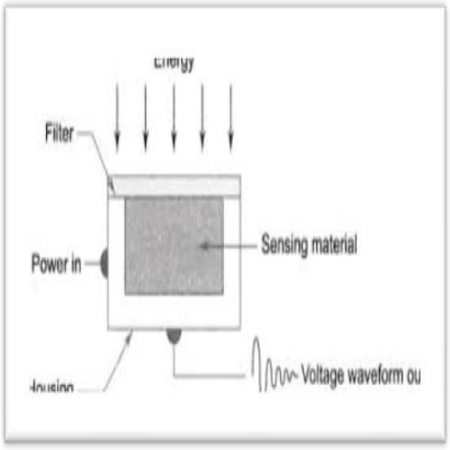
3.1. PRE-PROCESSING

In order to satisfy the requirements of the model the image should go through some steps called pre-processing. The main reason for pre-processing an image is to eliminate the unwanted things in an image and get the important features in an image for further processing.

STEPS IN PREPROCESSING

A. **IMAGE ACQUISITION**

The image that is taken as input should be in digital form because any model considers an image as a 2-dimensional matrix. If it is not in digital form then there is a need to convert the image into its digital form.
Since computer understands only the digital format there is a need to convert in digital format(not 0's and 1's) but a 2 dimensional array representing the intensity at a particular pixel. In image the only way to acquire information about the image is based on the resolution and pixels.



B. IMAGE ENHANCEMENT

The idea of image enhancement is to improve the quality of the image which is better than before so that the image is more suitable for a specific application. In this we use Histogram equalization**.** Histogram equalization is an important aspect in image processing when it is concentrated over all the pixels that are present in the image.

The main reason for performing the image equalization is to improve the quality of the image.

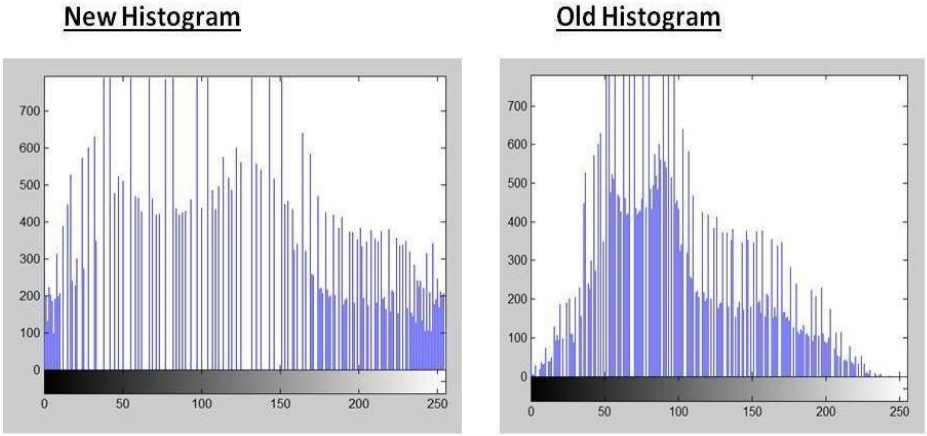


Fig. 2 Image enhancement using histogram

C. IMAGE SMOOTHING

Image smoothing is the process by which the unwanted things in the image are eliminated into negligible values, so that the important things can get more importance. We used Averaging techniques to use to handle the values.

We also applied image sharpening. It is the process by which the fine details and edges are highlighted. The need of image sharpening is to eliminate the unwanted characteristics of an image and highlighting the important characteristics of an image. Image restoration aims at restoring the degraded features in an image. Unlike image enhancement, image restoration is the process of applying mathematical models for restoration. Restoration aims at elimination of noise that is present in the image. If anything in an image is observed to be degraded then the restoration process makes the image suitable for any kind of application. But the critical task in the image restoration is to know the degraded function.

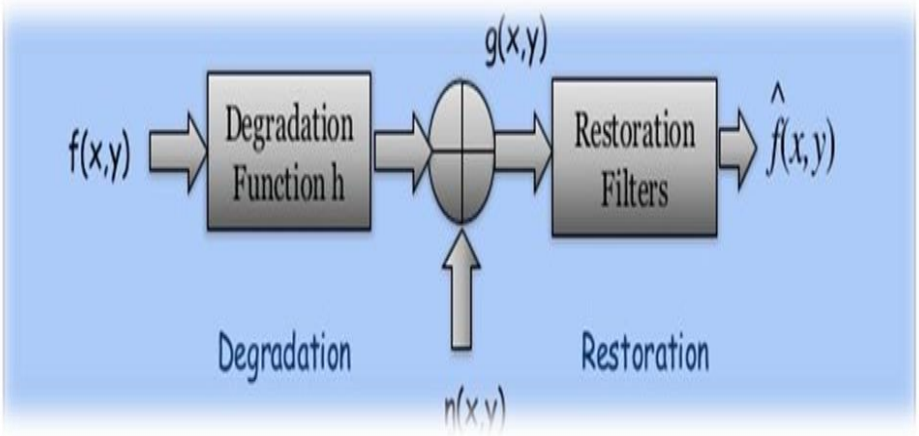
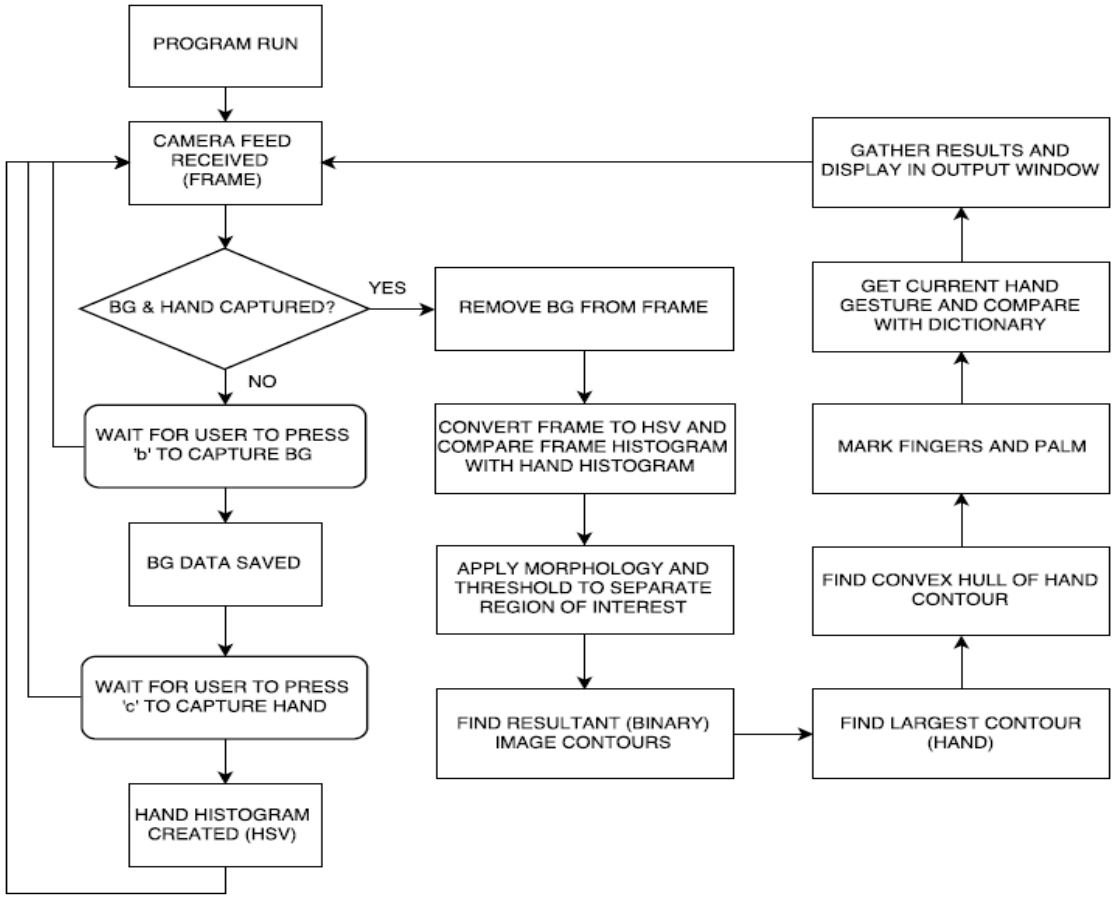


Fig.3 Restoration process

Segmentation is also applied to an image, in this an image is divided into various segments. For all applications the complete image may not be required .In such cases There is a need to eliminate the unwanted parts of an image and concentrating on a particular portion by dividing into subparts. This step is done to make the analysis part easy. Contours & convex hull used to represent the outlines of the curves that are present in the captured hand is contours. The formation of the polygon by including all the contours present in a particular area is convex hull**.** In our model the polygon is square. Next stage is Feature extraction. It is very important in gesture identification. It is the process by which the required features are identified from the fingers of a hand. The feature extraction for the fingers we used orientation of the contours.

3.2. FINGER COUNT

Finally the model outputs the no.of fingers that are present in the captured image of a hand. Finger count is based on the status of the finger and centroid of the finger. The following figure shows the flowchart of system architecture which we used in gesture identification



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3.3.PSEUDO CODE

1. When the program gets started the data buffer gets initialized.
2. Since we are giving the webcam access anything that is placed is identified as a thing the system waits for input whether to capture the image or not.
3. For reference**:** If the image is not to be captured then the model waits for b as input. If the image is not for reference then proceed with step 6
4. If the input is b, then background data is saved. Waits for users input c.
5. If the input is c then stores the hand histogram that is the reference data.
6. Since, the image is captured it separates hand and the background i.e. removes the background from the frame.*here frame refers to the area that is going to be examined by the model.
7. Convert the frame into hue saturation value (hsv) .
8. Compare the frame histogram and hand histogram.
9. By applying morphology separate the region of interest.
10. Find the resultant binary countours.
11. Find the largest countour.
12. Find the convex hull of hand.
13. Mark fingers and palm.
14. Get a hand gesture and compare it with a dictionary.
15. Gather all the output and display as output.
16. That is again used as reference stored in a buffer.

WORKING PROCEDURE

When the program starts the data that is previously stored in the data buffer is initialized inorder to store new records into it or to use already stored data in the buffer. Since the model that is going to be developed is based on the real time processing there is a need for capturing of the present scene by webcam. Without any old data that is previously taken as input and processed by the model ,we cannot get a reference data for processing. If the input given by the user is “b” then the background is saved and waits for user input .If the user input is “c” then the image of the hand is saved. The complete image is converted into histogram .The use of histogram is to distribute the intensity values equally throughout the image. It improves the quality of the image,which makes the image more suitable for comparison. If the image is not for reference then there is need to capture the image. Our interest is to process the hand the background of the image that is captured other than hand is eliminated and hand is stored in a frame. converting the image into hsv is done in order to detect the colour images into specific colour .

Fig.5 RGB verses HSV images

In the above picture the first image represents the rgb image whereas the second image represents the hsv image .The blue colour in the rgb is the area of interest so that is highlighted and others are eliminated.

Compare the hand histogram and frame histogram .By applying the morphology techniques the required resolutions of both the images are selected and others are eliminated. Find the contours that are present in the image. Out of all the contours present in the image find the largest contour.Find the

convex hull that is formed by joining all the countours. Mark separately the palm and the fingers. Compare the hand gesture with the dictionary of data. Gather the required output and display .Store the processed images again to buffer.

IV.RESULTS

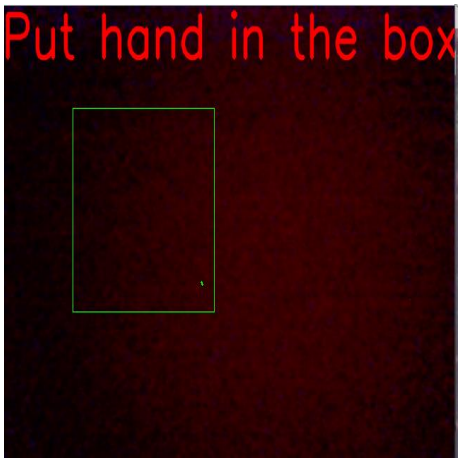

Fig 6. The region of Interest

Fig.7. No fingers in the region of square box

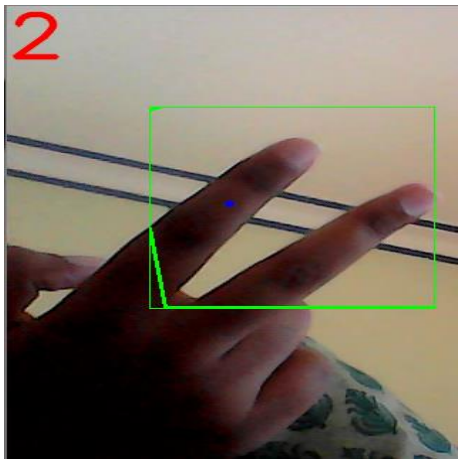

Fig.8 Two fingers in the region of rectangular box

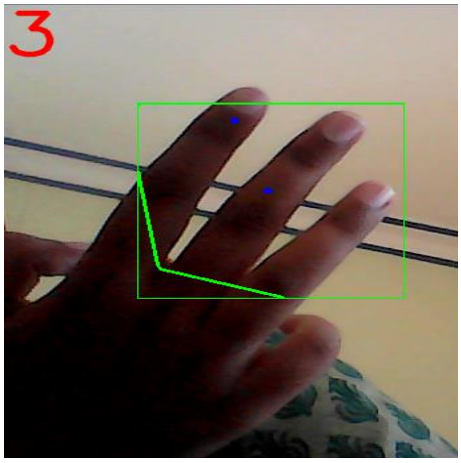

Fig.9 Identify three fingers in the region of rectangular box

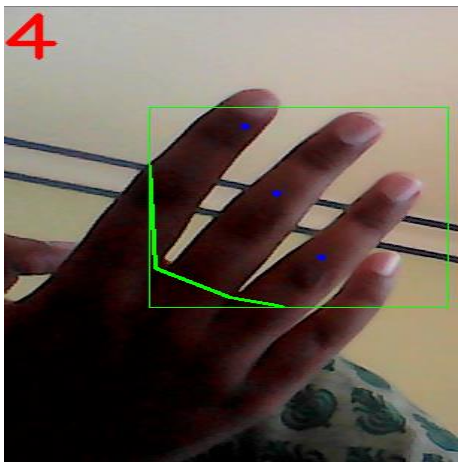

Fig.10 Identify four fingers in the region of rectangular box

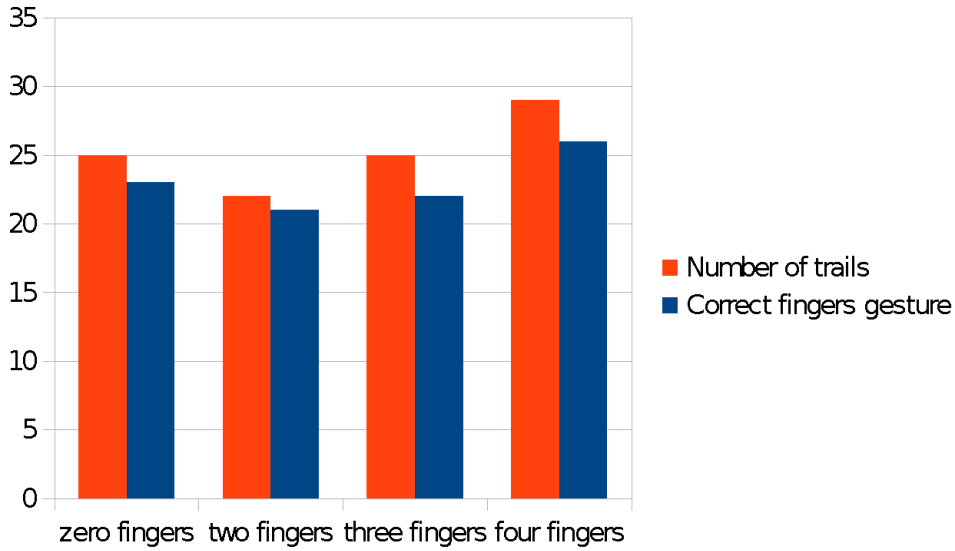

Fig.11 Statistical analysis of model performance

V.CONCLUSION

In this paper, we tried to acquire the information about the fingers by examining the image that has been captured .The paper mainly aims at counting the number of fingers in the captured image i.e . gesture identification. The whole process is done with identifying the contours and convex hulls in an image after being sufficiently preprocessed as required by the model. We have achieved 91% accuracy. This has a huge scope in future in the field of electronics and robotics .The accuracy can be increased by further adding of machine learning algorithms to this. It can also be trained to machines so that this complete process can be made automated. In electronics it can be used to manipulate actions through the gestures.

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