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GESTURE RECOGNITION SYSTEM

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Abstract- Communication plays a crucial part in human life. It encourages a man to pass on his sentiments, feelings and messages by talking, composing or by utilizing some other medium. Gesture based communication is the main method for Communication for the discourse and hearing weakened individuals. Communication via gestures is a dialect that utilizations outwardly transmitted motions that consolidates hand signs and development of the hands, arms, lip designs, body developments and outward appearances, rather than utilizing discourse or content, to express the individual's musings. Gestures are the expressive and important body developments that speaks to some message or data. Gestures are the requirement for hearing and discourse hindered, they pass on their message to others just with the assistance of motions. Gesture Recognition System is the capacity of the computer interface to catch, track and perceive the motions and deliver the yield in light of the caught signals. It enables the clients to interface with machines (HMI) without the any need of mechanical gadgets. There are two sorts of sign recognition methods: image- based and sensor-based strategies. Image-based approach is utilized as a part of this project that manages communication via gestures motions to distinguish and track the signs and change over them into the relating discourse and content.

Keywords— Data Acquisition, Image Preprocessing, Feature Extraction, Classification and Comparison, MATLAB

I. INTRODUCTION

Image processing is processing of the pictures utilizing certain activities and capacities to deliver upgraded pictures or to extricate valuable data from handled pictures in which the outcome can be picture, a progression of pictures, a photo or a continuous video, or a video casing and yield might be picture or the relating qualities/highlights related with that picture. It is additionally characterized as a particular method for interpretation between the human visual framework and the advanced

imaging gadgets. There are basically two types of image processing, analogue image processing and digital image processing. Analogue image processing is utilized for printed versions like photos and printouts. Digital image processing or Computerized picture preparing takes advanced picture as info, forms it and produces relating picture as yield.

Communication amongst hearing and discourse weakened individual and an ordinary individual has dependably been a troublesome undertaking. Therefore the hand motion gesture based communication helps the discourse and hearing disabled to convey adequately. Signals are expressive body developments that should be possible utilizing distinctive parts of our body. Hand motions are the significant and expressive movements like, movement of arms, wrists and that pass on message effectively. It is one of the normal strategy utilized as a part of the gesture based communication for non-verbal correspondence. It is most generally utilized technique by tragically challenged individuals to impart among themselves or with ordinary individuals with no assistance of translator. This project exhibits a framework model that naturally perceives the gesture based communication and coverts it to discourse and content to help the discourse and hearing disabled individuals to convey all the information more adequately. Quiet individuals can't talk and typical individual don't have the foggiest idea about the gesture based communication that is utilized for the bury correspondence between quiet individuals. This framework will be useful in taking care of this issue.

II. RELATED WORK

Literature Survey is a base for research through which knowledge can be gained and also describes the various works done in the relevant field.

Amiya Kumar Tripathy, DiptiJadhav, Ste_ A. Barreto, Daphne Rasquinha, Sonia S. Mathew proposed Voice For The Mute[1]. The objective of the paper is building up a framework that takes ongoing pictures as information and yield will be gotten as content and discourse. It intends to connect the hindrance by making an application that can change over gesture based communication to voice and give them a communication medium. It is as finger spelling of alphabetic signs will be taken as information and gives the resultant voice yield. Framework utilizes webcamera for information and by utilizing Microsoft Visual Studio and Open CV preparing will be done. It helps discourse disabled individuals. To make a wearable interpreter or a portable device interpreter to perceive gesture based communication and change over to discourse is the future research here.

Hsiang-Yueh. Lai, Han-Jheng. Lai proposed Real-Time Dynamic Hand Gesture Recognition[2]. This paper proposes a real-time dynamic hand gesture recognition system, instead of pattern matching method here it uses a real-time dynamic video to capture the hand images and recognizing hand gestures. Eleven kinds of hand gestures are dynamically recognized that represent number from 1 to 9. YCbCr color space transformation to detect skin color and to find hand contour from complex background. Finger angles and fingertip positions are calculated to recognize hand gestures. Open CV is used for performing the research. Fingertip detection and tracking of dynamic videos are performed by the Hidden Markov Model (HMM). HCI is important part of the dynamic gesture recognition. It is used in application of HCI, such as games, robots, and so on, in the future.

Jayesh S. Sonkusare, Nilkanth. B. Chopade, RavindraSor, Sunil.L. Tade proposed A Review on Hand Gesture Recognition System[3]. The sign language recognition is divided into two approaches image based and device based approach. Brief comparison of various techniques used for segmentation, tracking, feature extraction and gesture recognition is shown. In future

work we can consider high precision segmentation algorithms are required for hand recognition and more emphasis should be given to improve the time rate.

KusurnikaKrori Dutta , Satheesh Kumar Raju K, Anil Kumar G S, Sunny ArokiaSwarny B proposed Double Handed Indian Sign Language to Speech and Text[4]. In this paper image processing and artificial intelligence are used to develop algorithms and many other techniques to ensure independent life for hearing impaired and mute people. It makes them independent as the gestures made by them are captured, recognized and are automatically interpreted by the system. Here we use both the hands to make gestures that represent Indian sign language which is captured as a series of images and MATLAB is used to process it and produce the output in the form of text and speech.

ArtiThorat, VarshaSatpute, AratiNehe, TejashriAtre, Yogesh R Ngargoje proposed Indian Sign Language Recognition System for Deaf People[5]. Deaf and dumb people find it difficult as they can't find a well-experienced and educated translator at all the time to recognize convey their messages. The only efficient way through which they can communicate is through sign language. The gestures are captured using a webcam and the features are extracted using Scale Invariance Fourier Transform(SIFT). The key features of the captured image is compared with the key features of the images that are already stored and the output is produced in the form of text.

MeenakshiPanwar, Pawan Singh Mehra proposed Hand Gesture Recognition for Human Computer Interaction[6].Natural, modern and innovative way of non-verbal communication can be achieved by using a hand gesture recognition system. The main aim of this paper is to discuss about the novel approach of the hand gesture recognition which is based on detecting the features of the shapes. The system setup comprises of a camera which is used to capture the gesture given by the user and take the image formed as the input to the proposed algorithm. The algorithm is divided into four steps, and they are segmentation, orientation detection, feature extraction and classification. This algorithm need not have any trained sample data as it is independent of user characteristics. 390 images have been tested using the proposed algorithm and the rate of recognition produced is about 92 percent and the average elapsed time is approximately 2.76 sec. The computation time taken by this algorithm is less when compared with other approaches.

Ruchi Manish Gurav, Premanand K. Kadbe proposed Real time Finger Tracking and Contour Detection for Gesture Recognition using OpenCV[7].Human Computer Interaction(HCI) is a new technology that is being developed to deliver commands given by the user to the robots. Interaction with machines by the users can be through facial expressions, head, voice, hand, touch, etc. The main aim of this paper is to use hand gestures that can control robot or some household applications etc. To detect the hand gestures there are few algorithms which are based on machine learning methods like SVM, neural networks, AdaBoost. From the above mentioned methods, AdaBoost hand pose detectors are trained along with reduced Haar-like feature set that makes the detector more robust. This method gives good performance with robustness and high accuracy for more than four hand gestures. Here we will be using convex hull algorithm to detect the finger tip.

Shreyashi Narayan Sawant proposed Sign Language Recognition System to aid Deaf-dumb People Using PCA[8].The objective of this paper is to recognize gestures in less time with high accuracy and produce output in form of text and speech by

translating alphabets of Indian sign language. Vision based approach is used here. The design and implementation of system is in such a way that it can recognize only 26 gestures of Indian sign language using MATLAB. Web camera captures the signs and using HSV color model preprocessing of signs are done for feature extraction. Comparison of obtained features are done by using Principle Component Analysis (PCA) algorithm. After that calculation of minimum Euclidean distance is done for sign recognition. Finally, gesture recognized is converted to text and voice.

Tsung-Han Tsai, Chih-Chi Huang and Kung-Long Zhang proposed Embedded Virtual Mouse System by Using Hand Gesture Recognition[9]. This paper introduces a Embedded Virtual Mouse system that replaces mouse function by recognizing hand gestures. Skin detection and motion detection method are used to capture the region- of-interest and distinguish the required area. The centroid of the object is detected using Connected Component Labeling algorithm. To recognize the hand area we use the convex hull algorithm. This system recognizes the hand gestures and replaces the mouse functions like drag, click, scroll. We can use more advanced algorithms to improve the time required to recognize the hand gestures.

Ashish Mhetar , B K Sriroop , Kavya AGS , Ramanath Nayak4, RavikumarJavali, Suma K V proposed Virtual Mouse[10]. E-learning is the improvement in teaching and provides better interaction between teacher and student. The existing \Virtual Marker provides all the functionalities of the mouse. In this paper we have improved the performance of the virtual marker by providing hardware implementation of virtual mouse. It explores the HID functions of a high end microcontroller and by increasing its functionality the utility of the system has been improved.

III. SYSTEM DESIGN and METHODOLOGY

An architecture diagram represents the framework of a system. It is very important to visualize a system, architecture diagram acts as a blueprint of the entire system.

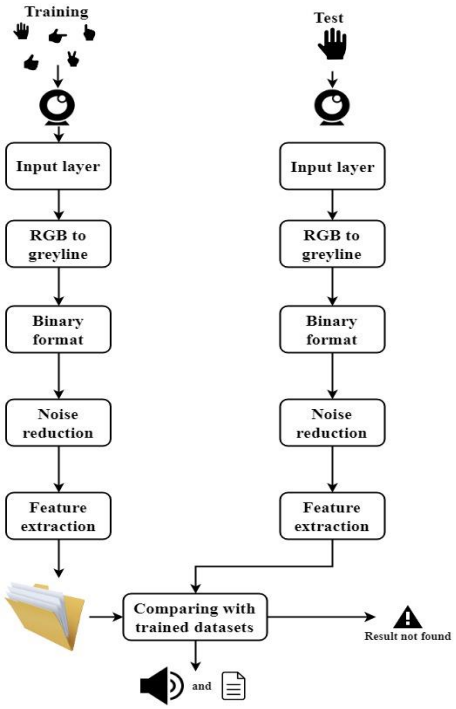

Figure 1: Architecture Diagram for Gesture Recognition System

Architecture diagram gives the overall representation of the system. It must be self descriptive and accurate. The entire flow of the project is depicted by the data flow diagram and architecture of the project. The below diagram shows the architecture of our system. The system is divided into two phases; train phase and test phase. In training phase, the gestures are captured by the camera using virtual mouse and the captured images are recognized using image processing techniques like Image Enhancement and Segmentation, Color filtering and Skin segmentation and Noise reduction technique. After the images are processed, the essential features from the image is extracted using contour analysis techniques and then the obtained features are stored in a file folder which are later used in comparison with the test images. In test phase the user makes the gestures in front of the camera, the gestures are captured as image by the camera using virtual mouse. Images are processed and the features are extracted similar to the test phase. These test images are compared with the stored images. If the gesture is recognized, the output is produced in the form of text and speech otherwise an error message is generated.

Activity diagram represents a series of actions and the control flow within a system. The Activity diagram is partitioned into columns, where each column is called a swimlane and lines, where each line indicates interactions. Admin starts the training, he opens the camera using virtual mouse and makes the gestures which is captured by the camera. The captured image is pre-processed and the features are extracted from pre-processed image. The features extracted are then stored in a file folder. When the Entrants arrive they perform similar functions to that of Admin. But after the required features are extracted from the pre-processed image they are classified and compared with the stored images. If the compared image matches the stored image, the output is produced in the form of speech and text else it is terminated.

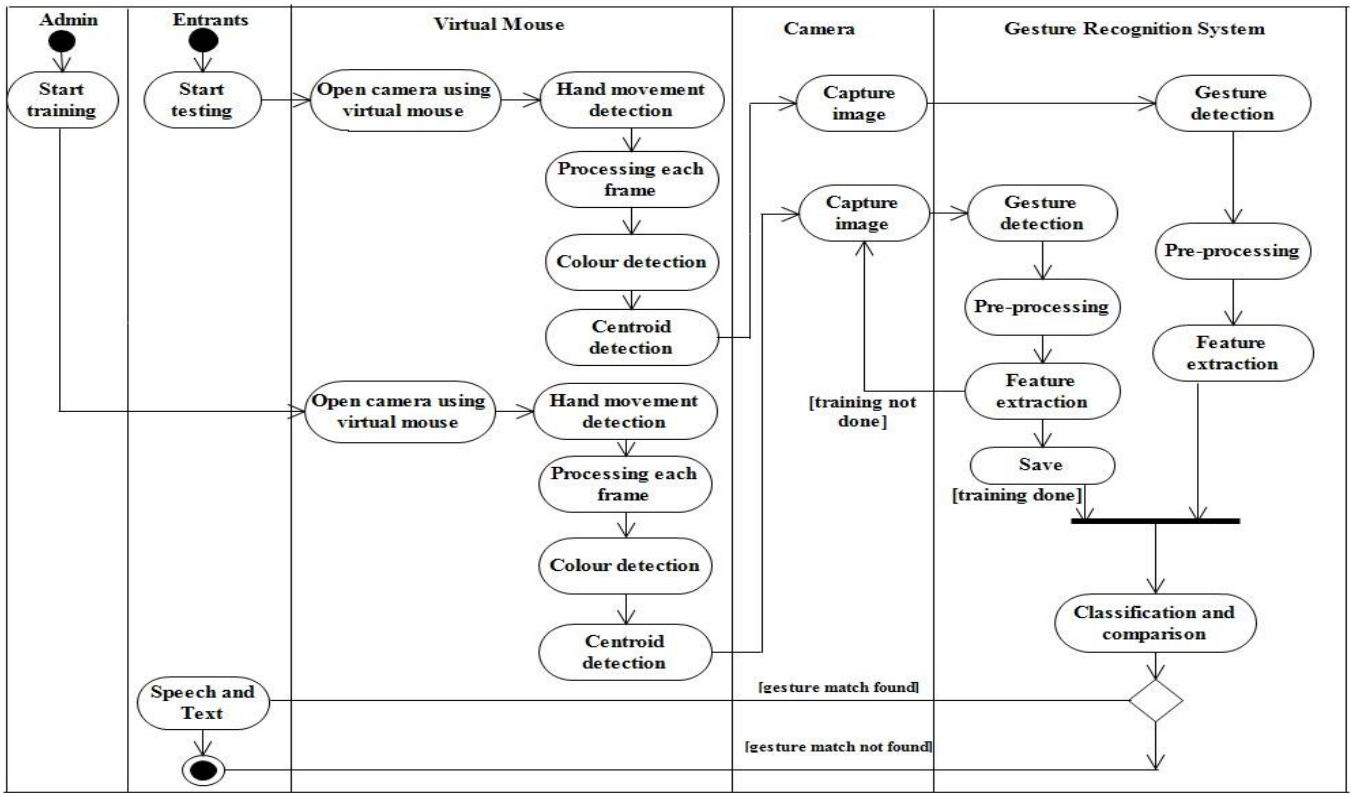

Figure 2: Activity Diagram for Gesture Recognition System

Support Vector Machine

"Support Vector Machine" (SVM) is a managed machine learning algorithm which can be utilized for both grouping or relapse challenges. Notwithstanding, it is generally utilized as a part of classification issues. In this algorithm, we plot every data item as a point in n-dimensional space (where n is number of highlights you have) with the estimation of each element being the estimation of a specific coordinate. At that point, we perform classification by finding the hyper plane that separate the two classes exceptionally well.

Using the SVM(Support Vector Machine) algorithm classification and comparison of test images is done with the trained images to obtain the recognised gestures.

Algorithm 1: Support Vector Machine

```
1: procedure MyProcedure
2: function [predFinalQueryImg,precision, recall, cmat] = svm( dataset,  query
   ImageFeatureVector)
3: img names = dataset(:, end);
4: dataset(:, end) = [];
5: lbls = zeros(length(dataset), 1);
6:      for k = 0:length(lbls)-1 do
7:          if img names(k+1) > 0 and img names(k+1)<= 5 then
8:              lbls(k+1) = 1;
9:          else if img names(k+1)>5 and img names(k+1) <= 10 then
10:             lbls(k+1) = 2;
11:         else if img names(k+1)>10 and img names(k+1)<= 15 then
12:             lbls(k+1) = 3;
13:         else if img names(k+1)> 15 and img names(k+1)<= 20 then
14:             lbls(k+1) = 4;
15:         else if img names(k+1) > 20 and img names(k+1)<= 25 then
16:             lbls(k+1) = 5;
17:         else if img names(k+1)> 25 and img names(k+1)<= 30 then
18:             lbls(k+1) = 6;
19:         end if
20:     end for

21: g gn = grp2idx(lbls);
22: trainIdx testIdx = crossvalind('HoldOut', lbls, 1/2);
23: pairwise = nchoosek(1:size(gn, 1), 2);
24: svmModel = cell(size(pairwise, 1), 1);
```



```
25: predTest = zeros(sum(testIdx), numel(svmModel));
26:       for k=1:numel(svmModel) do
27:             idx = trainIdx and any( bsxfun(@eq, g, pairwise(k,:)) , 2 );
28:             svmModelk = svmtrain(dataset(idx,:), g(idx),BoxConstraint,2e-1,
29:            'Kernel Function','polynomial', 'Polyorder',3);
30:             predTest(:,k) = svmclassify(svmModelk, dataset(testIdx,:));
31:       end for
32: pred = mode(predTest, 2);
33: cmat = confusionmat(g(testIdx), pred
34: final acc = 100 * sum(diag(cmat))./sum(cmat(:));
35: fprintf('SVM (1-against-1): accuracy = 2f', _nal acc);
36: fprintf('Confusion Matrix:'), disp(cmat)
37: precision = zeros(size(gn, 1), 1);
38: recall = zeros(size(gn, 1), 1);
39: precision = cmat(1, 1)/sum(cmat(:, 1))
40: recall = cmat(1, 1)/sum(cmat(1, :));
41:       for c = 2:size(gn, 1) do
42:             precision(c) = cmat(c, c)/sum(cmat(c:end, c));
43:             recall(c) = cmat(c, c)/sum(cmat(c, c:end));
44:       end for
45 :       for k = 1:numel(svmModel) do
46:             predQueryImg(:, k) = svmclassify(svmModelk, queryImageFeatureVector
47:       end for
48: predFinalQueryImg = mode(predQueryImg, 2);
49: fprintf('Predicted Query Image Belongs to Class = d', predFinalQueryImg);
50: end procedure
```

IV. RESULTS

The graph shown represents the accuracy of gestures that are captured by the Gesture Recognition System. Here the x-axis represents the number of gestures trained and the y-axis represents the accuracy. The accuracy is calculated based on the number of gestures that are trained to the maximum number of gestures that can be trained. We see that as the number of trained gestures increases, the accuracy also gradually increases.

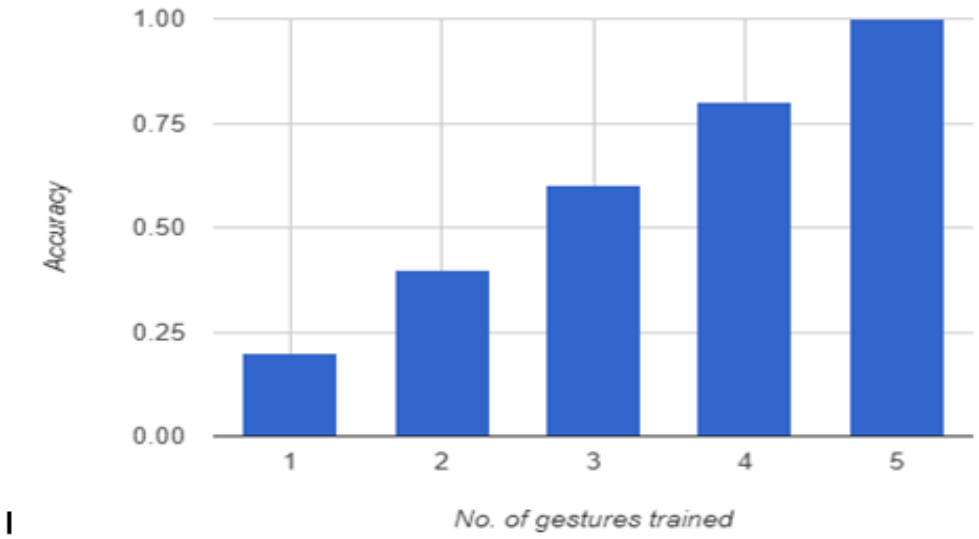

Figure 3: The graph representing the accuracy based on trained images

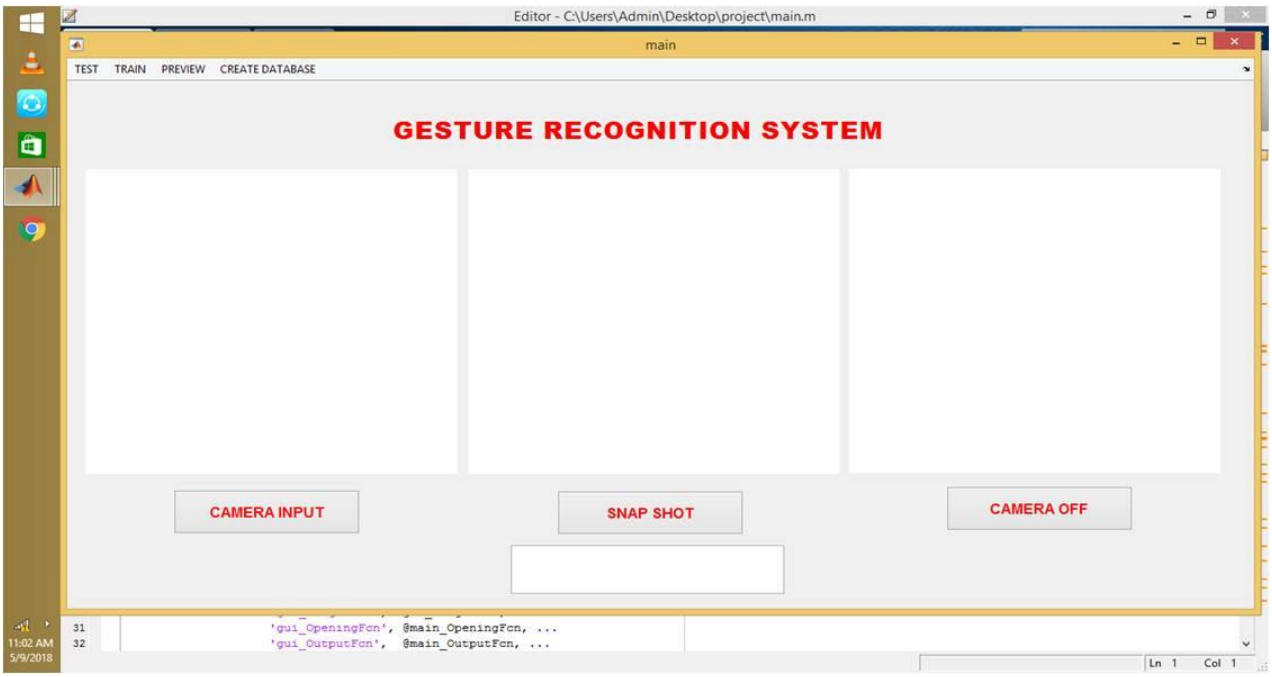

Figure 4: Gesture Recognition Page

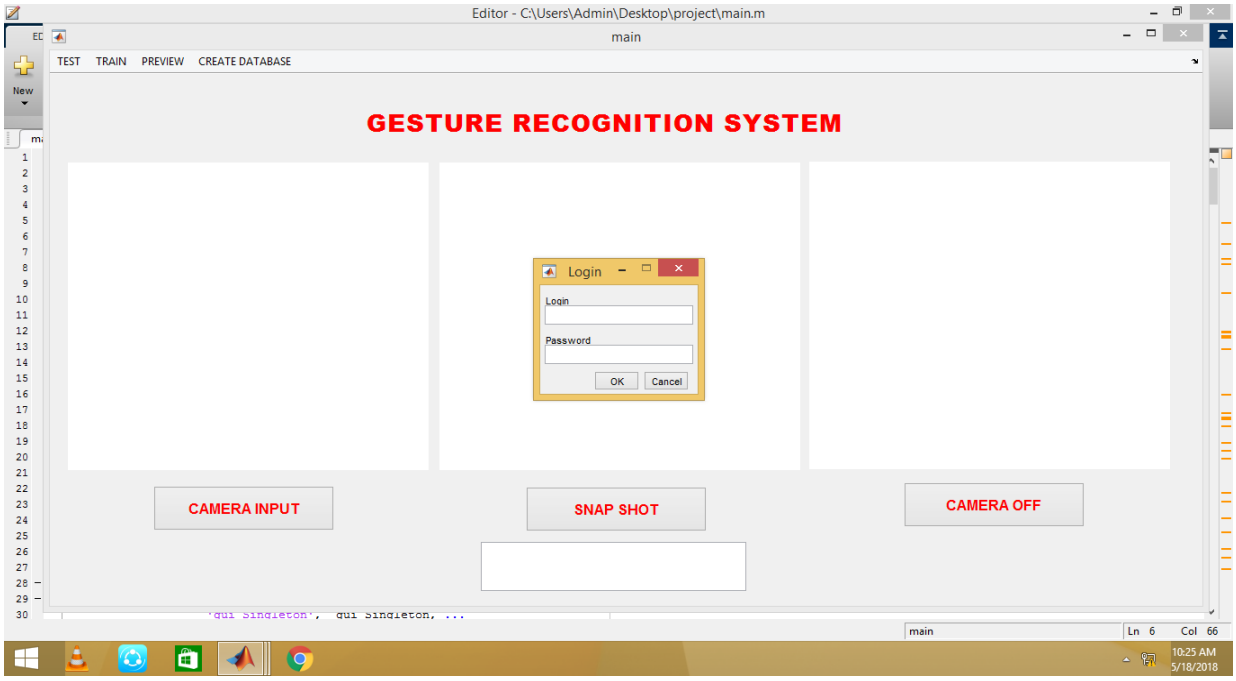

Figure 5: Login Page for the training data

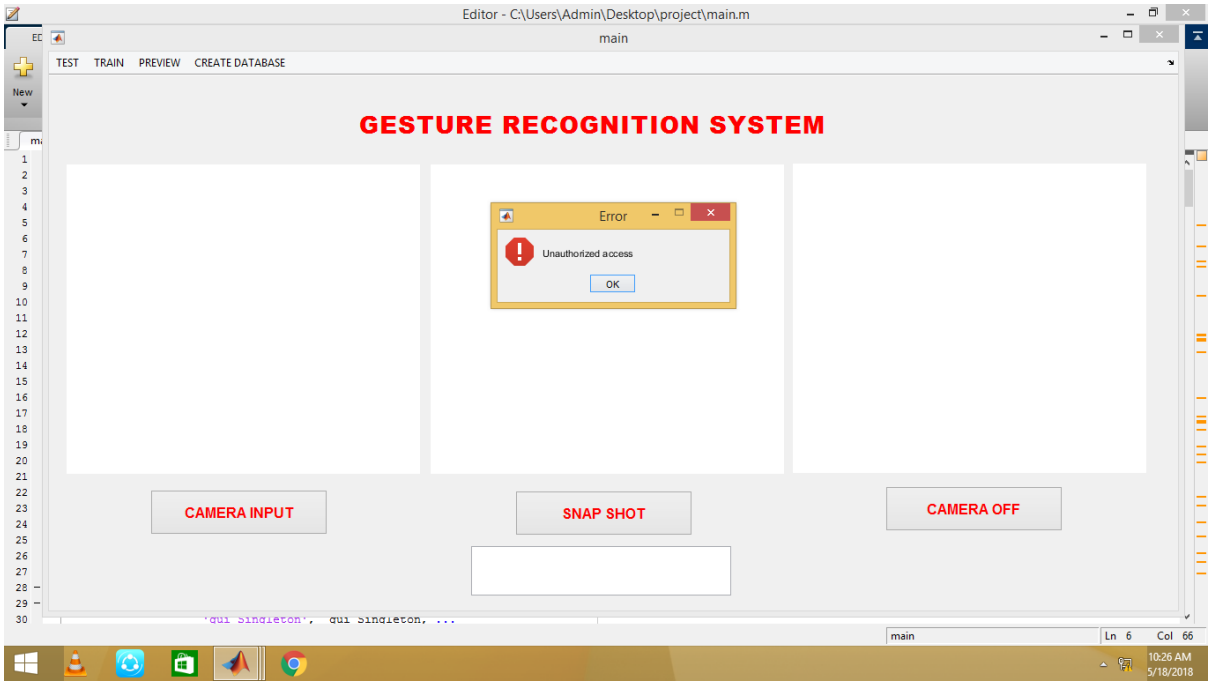

Figure 6: Invalid Login

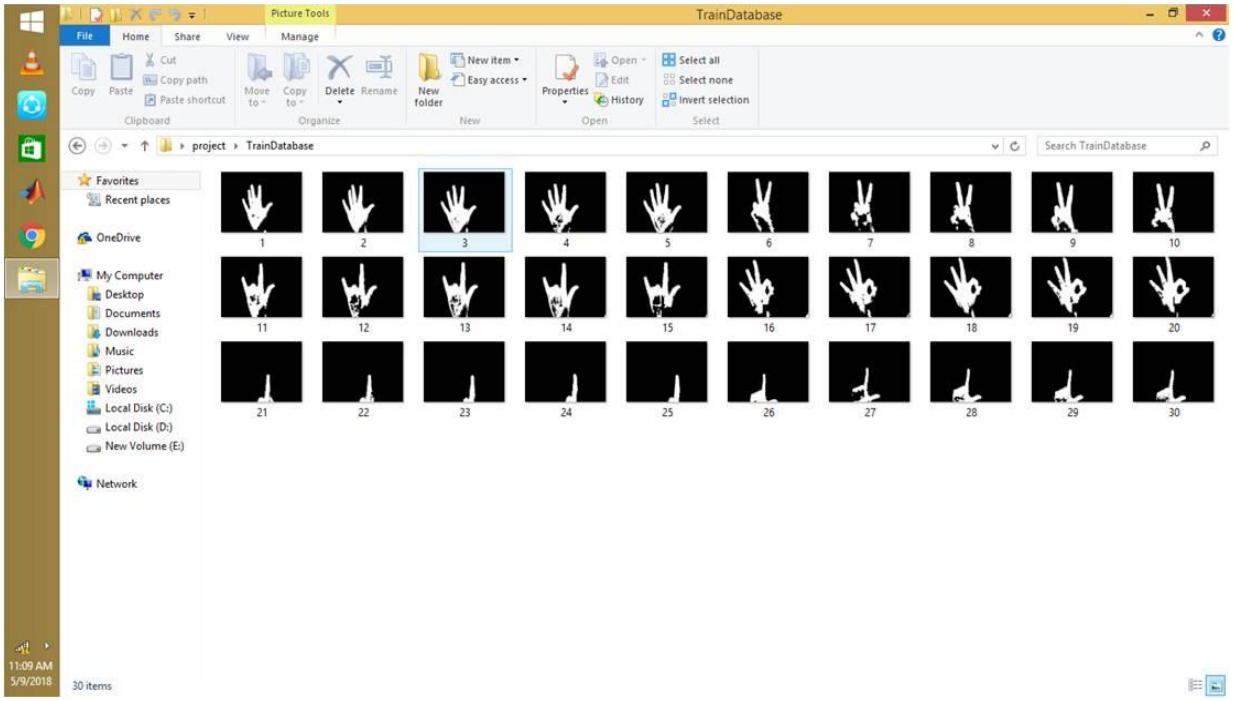

Figure 7: Trained dataset

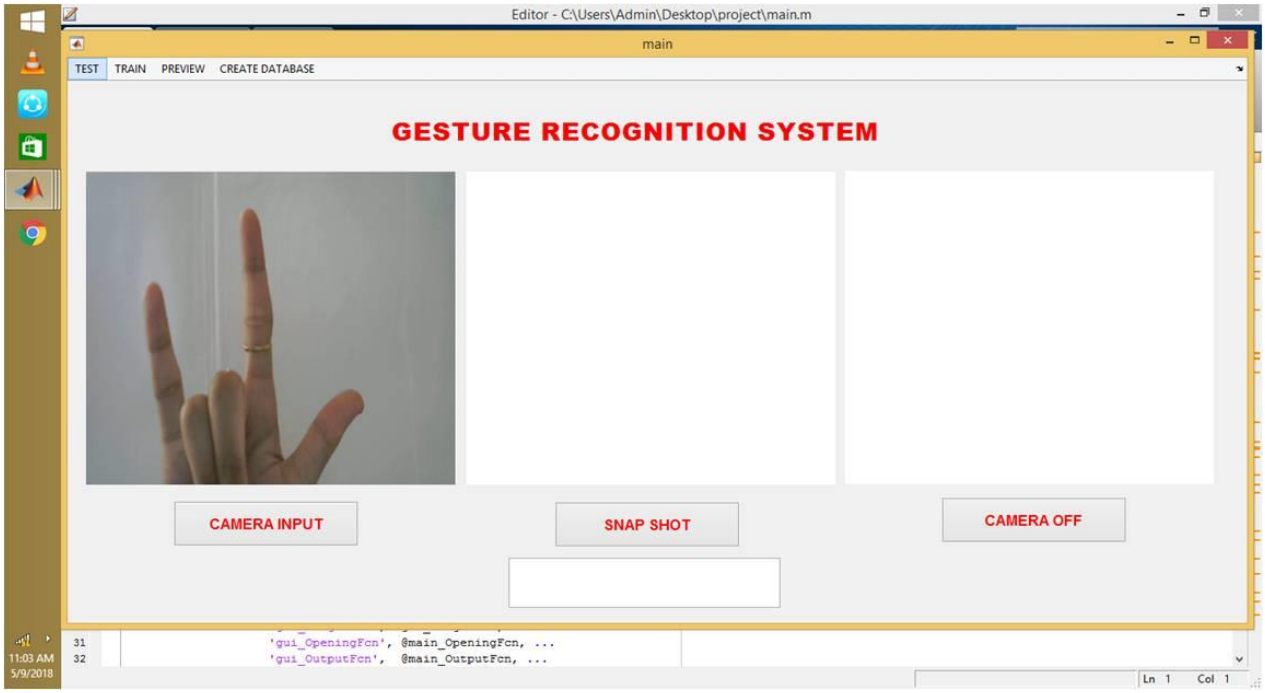

Figure 8: Preview of an gesture

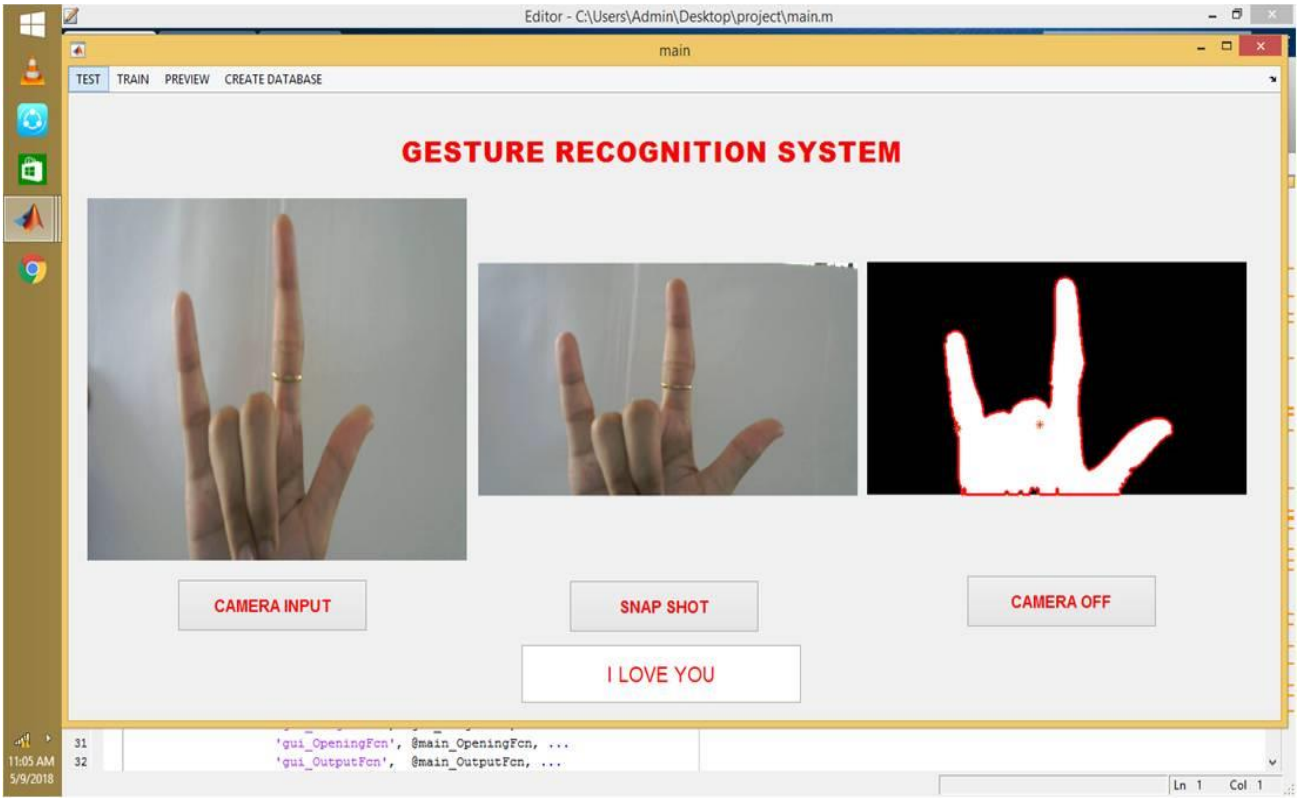

Figure 9: Output of Gesture Recognition System

V. CONCLUSION AND FUTURE ENHANCEMENTS

The Gesture Recognition System is applicable to normal people and physically challenged people for non-verbal communication between human to human and computer and human. It helps and aids dumb and deaf people to live independently. It eliminates gap among people and leads to achieve better society. Here the system takes the hand gestures as input and gives output in the form of speech and text and additional virtual mouse is used so that it is easier to use than physical mouse.

In our system the gestures have to be given in white background and in bright light conditions, in future enhancement the gestures can be given in any background conditions and phrasing of sentences from sequence of words can be done which will be helpful for advance and convenient communication.

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