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REAL TIME DYNAMIC HAND GESTURE RECOGNITION FOR HUMAN COMPUTER INTERACTION

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Abstract: *Gesture is so natural way to communicate. Hand Gesture is invariably used in everyday life style .A novel method of dynamic hand gesture recognition based on Speeded Up Robust Features (SURF). Hand gesture recognition method is widely used in the application area of Controlling mouse and/or keyboard functionality, mechanical system, 3D World, Manipulate virtual objects, Navigate in a Virtual Environment, Human/Robot Manipulation and Instruction Communicate at a distance. This system consists of four stages: image acquisition, feature extraction, classification and recognition. In the first stage input video of hand gestures are acquiesced by digital camera in approximate frame rate. In second stage a rotation, translation, scaling and orientation invariant feature extraction method will be introduce to extract the feature of the input image based on SURF(speeded up robust method). Finally, a artificial neural network is use to recognize the hand gestures. The performance of the system is tested on real time data. The proposed algorithm is tested on Waving hand gestures and yields a satisfactory recognition rate which is 100% on the training set and 91.2% on the testing set.*

Keywords- *Hand gestures, SURF, Artificial neural network, JAVA library, Mouse control operation*

I. INTRODUCTION

Human-Computer Interaction (HCI) is a field of study focusing on the design of computer technology and, in particular, the interaction between humans (the users) and computers. It encompasses multiple disciplines, such as computer science, cognitive science, and human-factors engineering. While initially concerned with computers, HCI has since expanded to cover almost all forms of information technology design.

In this novel system we are using gesture. A gesture is a form of non-verbal communication or non-vocal communication in which visible bodily actions communicate particular messages, either in place of, or in conjunction with, speech. Gestures include movement of the hands, face, or other parts of the body. In our project we can use the hand gesture. Hand gestures recognition provides a natural way to interact and communicate with machines of different kinds. Compared to the currently used human-machine-interfaces (HMI) such as a keyboard or a remote control, dynamic hand gesture recognition does without any supplementary devices which are used to give instructions to a machine. In a process, which is generally known and referred to as dynamic hand gesture recognition, a person instructs the machine using his bare hands, whereas images of the persons hand gestures are captured and analyzed in order to determine the meaning of the hand gesture. In hand gesture there are two types one is static hand gesture and other is dynamic hand gesture. In a process, which is generally known and referred to as static hand gesture recognition, a person instructs the machine using his bare hands, whereas images of the persons hand gestures are captured and analyzed in order to determine the meaning of the hand gesture. A dynamic gesture is a moving gesture, represented by a sequence of various images. Dynamic hand gesture means we have gesture recognition using dynamic hand.

To improve the interaction in qualitative terms in dynamic environment it is desired that the means of interaction should be as ordinary and natural as possible. Gestures, especially expressed by hands have become a popular means of human computer interface now days[1].This paper involves ,A novel method of dynamic hand gesture recognition based on Speeded Up Robust Features (SURF) tracking is proposed .To improve the recognition rate. The *k*-curvature algorithm is then used to locate the fingertips over the contour and the dynamic time warping algorithm is used to select a candidate gesture as well as to recognize gestures by comparing them with a series of pre-recorded reference gestures. The system achieves an average performance of 94.6% for one or two hand static and dynamic gestures, with which it is able to deal simultaneously[2]. India The vision-based gesture recognition is more comfortable than the glove based, as

the sensors attached to the gloves restrict the gestures. In vision based the 2D research has reached a better level in terms of accuracy and algorithm complexity. For 3D imaging the challenges such as the environment condition, the hardware setup compactness, the resolution of the camera matters and the work has to be concentrated on. The methodologies employed in recognition have proved that there is no specific method which is better than the other[3].

This paper describes a new method to extract gesture features, which make the system rotation, scaling and translation independent. The performance can be made even smoother by using a camera that records video at a higher resolution and frame rate combined with a latest generation processor. The proposed method consistently produces better results than the existing vision based hand gesture recognition in terms of recognition rate and response time.

II. SYSTEM MODEL

The system proposed in this paper is designed to recognize hand gesture in real-time. The technique that is used to recognize hand gesture is based on computer vision. The overall system architecture is shows in figure 1. The whole system of hand gesture recognition divided into five phases: Video Acquisition, frame/second, Image Pre-processing, Feature Extraction, Classification and Hand Gesture Recognition. The overall model is designed to be a simple gestural interface prototype for various PC applications**.**

This system uses dynamic gestures for mouse interfacing application. In this system the video are captured through the webcam. This video is converted into frames/second .It is segmented to recognize the hand region. There are different Dynamic hand gestures segmented into five class, these are representing one-A class, two-B class, three-C class, four-D class, five-E class. RGB images are converted into gray scale images and these gray scale images are used for hand gesture recognition system model.

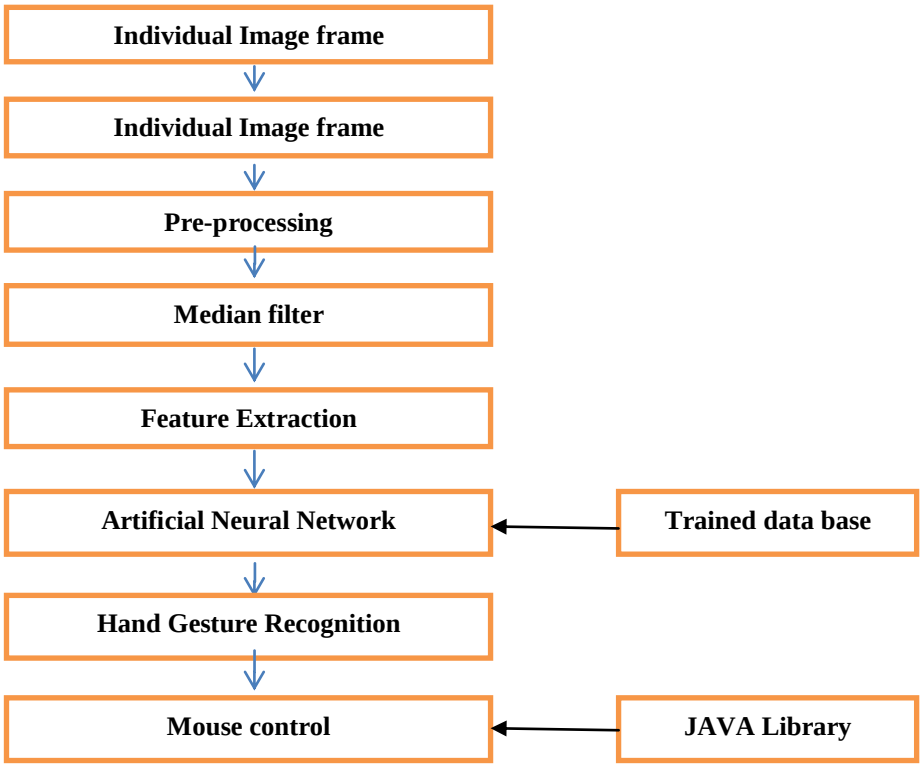


Figure1.Architecture of the Hand Gesture Recognition System

2.1. Video Acquisition:

The system uses a *Logitech-c270* digital camera to capture the desk area where the user's hand is located. The user simply is moving his/her hand into view of the camera to begin interaction with the system. The background of the video is white and has good lighting system. Video is acquiesced by approximate frame rate/snapshot. The image database contains totally 125 images for 5 classes of Hand gesture, each class containing 25 images. For creating the

image database, 3 images for each class were captured with 3 signers and archived. All the gestures in the hand gesture database are dynamic in nature.

2.1.2 Pre-processing:

2.1.2.1. Image Resizing

The captured video of hand gesture is converted into frame rate, this images are in RGB color space. In the pre-processing step, the input image is first resized into the size of 200 x 200 pixels. Image resizing is done to reduce the processing time by the computer and to improve the accuracy of the system. The resized image is then converted into a gray scale image which has the gray level intensity ranging from 0 to 255. It is used to reduce the effect of illumination changes and scaling.

2.1.2.2. Median filter

The median filter is used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is used in digital image processing because, under certain conditions, it preserves edges while removing noise

2.1.3. Feature Extraction:

The aim of this phase is to find and extract features that can be used to determine the meaning of a given gesture. features lead to a better recognition of hand gestures even if the hand gesture is captured in a different angle.

In this our proposed method we used edge detection Harris Feature and Speeded-Up Robust Features for dynamic hand gesture recognition. To extract the feature of the hand gesture we developed a rotation, scaling, translation and orientation independent feature extraction method. The dominant movement direction of matched SURF points in adjacent frames is used for dynamic hand gesture representation. The most appealing descriptor to represent salient points seems to be the SIFT [13] descriptor which can get good performance in the case of scaling, rotation, view point changing, etc. Inspired by SIFT, the SURF descriptor outperforms SIFT in computational speed greatly and gains good robustness as well as SIFT. This brings us opportunity to adopt the SURF descriptor to describe salient feature points in object in order to satisfy the demand of both robustness and effectiveness.

Algorithmically, interest points are first found in the image by a Fast-Hessian Detector. The approximation of the Hessian determinant is used to find extreme points or interest points in each scaled image. Then, these interest points are compared with their neighbors in the scale -space. If they are still extreme, they are then considered as the feature point candidates. The localization of accurate feature points based on interpolation is performed next. For each found accurate feature point, Haar wavelet responses for both x and y directions are then calculated around it and the most dominant direction is chosen to achieve rotation invariance. Finally, Haar wavelet responses over the surrounding area of each feature point are used to form the final descriptor of that point. In the SURF algorithm, the most significant improvement in computation speed is achieved by use of integral image, which allows fast calculation of filter responses in most all steps.

2.1.4. Classification

We used a feed-forward multilayer ANNs. For this network, we used 20 hidden neurons by calculating the input vector dimension that is 33 × 20 and the output layer has 5 neurons because there are 5 outputs of the network. The network is fully connected and use back-propagation learning algorithm. Train database applies the inputs to the new network, find out the or calculate outputs, compares them to the associated targets, and calculates a mean square error. If the error goal is met, or if the maximum number of epochs is reached, the training is stopped and train returns the new network and a training record. Otherwise train goes through another epoch. The figure 2 shows the training of the network. At the beginning the Sum squared error (sse) is big, but after 100 epochs the error of the network is very small and the neuronal net can recognize the training data with a very small error. If the train and test set is same the recognition rates are 100 %, If the train and test set is s different the recognition rates are 91.2%, The overall recognition rates of test data are given bellow

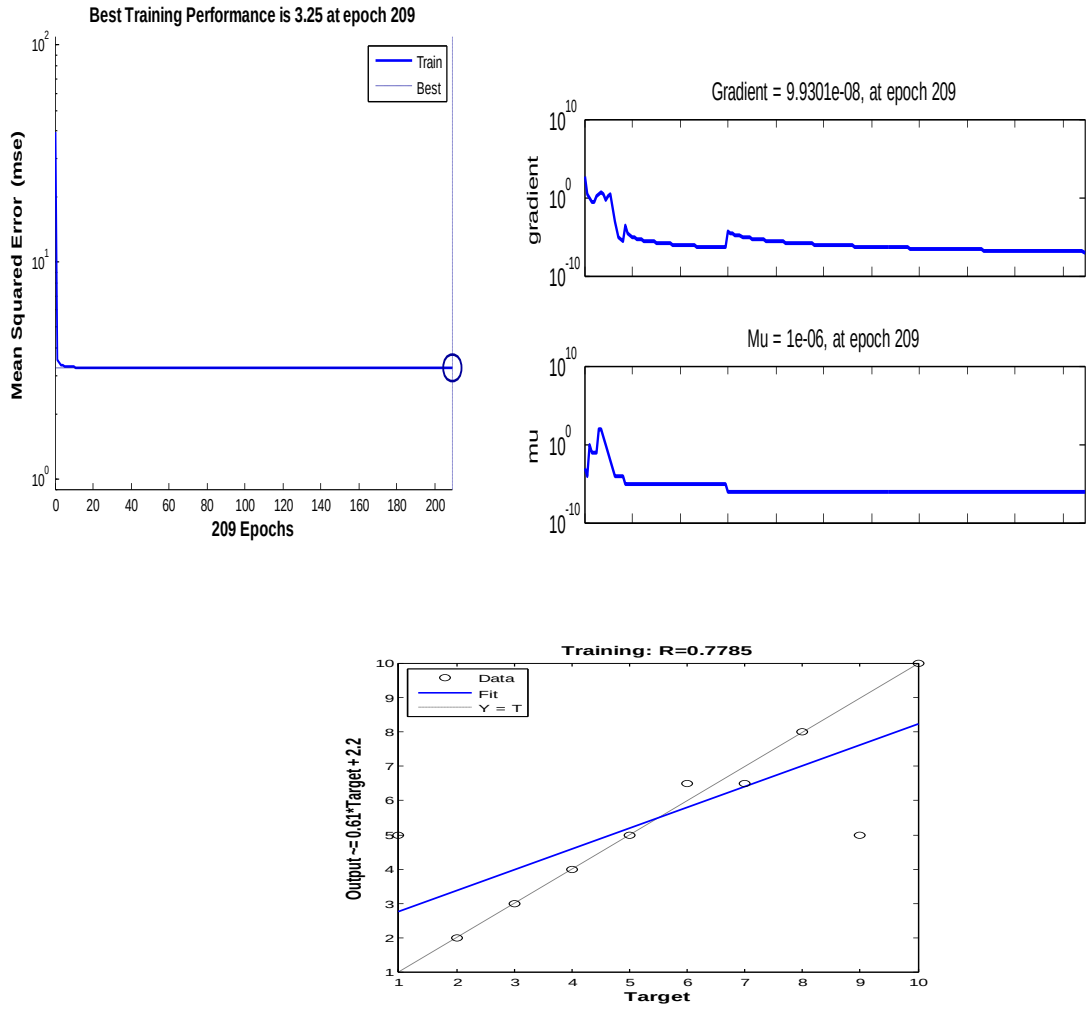


Figure 2: Training of the Neural Network

2.1.5. Mouse control operation:

There is no inbuilt function in MATLAB which can directly access the mouse drivers of the computer. But MATLAB code support integration with the other language like c,c^{++},and JAVA .since java is a machine independent language so it is preferred over the others. A java object is created and it is linked in the mouse drivers.

INPUT	ACTION PERFOREMED
A class -One finger	For left click
B class-Two finger	For left top click
C class-Three finger	For right click
D class-Four finger	For right bottom click
E class-Five finger	For canter click

Table 1. Mouse control operation

III. EXPERIMENTAL ANALYSIS AND RESULT

To develop a real-time hand gesture recognition system we use MATLAB that is a high performance language for computing. To get efficient response from this network we use 5 samples for each type of hand gesture. Instead, A data set of 25 images after feature extraction contains 33 × 20 elements. We have tested the recognition method with 5 gesture types. In Table 1 the recognition efficiency of hand gesture classification method with several trainers and tester users can be seen. It is tested by a set of 25 samples per user.

We use 25 frames for each type of hand gesture and evaluate correct recognition rate and the error rate of the system. We use the following equation to find the correct recognition rate:

correct recognition% = correct recognition / total frames

And find the error rate by using following equation: Error rate% = false recognition / total frames

3.1. If the train and test set are different the recognition rates are 91.2%` and it is tested by a class of 5 sample per user.

3.1.1Class A result:

Fig.3shows the processing result of a sample of gesture 1.The circles are SURF points existing in the next frame and are connected with the matched SURF points in the current frame by a green and red dots. It is obvious that there exists a wealth of feature points whose movement can reflect the motion of hand gesture well.

Mouse controlling operations which is depends on the JAVA event. In this project we use java command for all Class i.e. import.java.awt.event .Finally, every gesture sample is recognized and we totally have satisfactory recognition success rates of 96% on the testing data set. Result is display in the command window is GIVEN GESTURE & ACTIVE FINGER IS A & 1.mouse cursor is move top of the left.

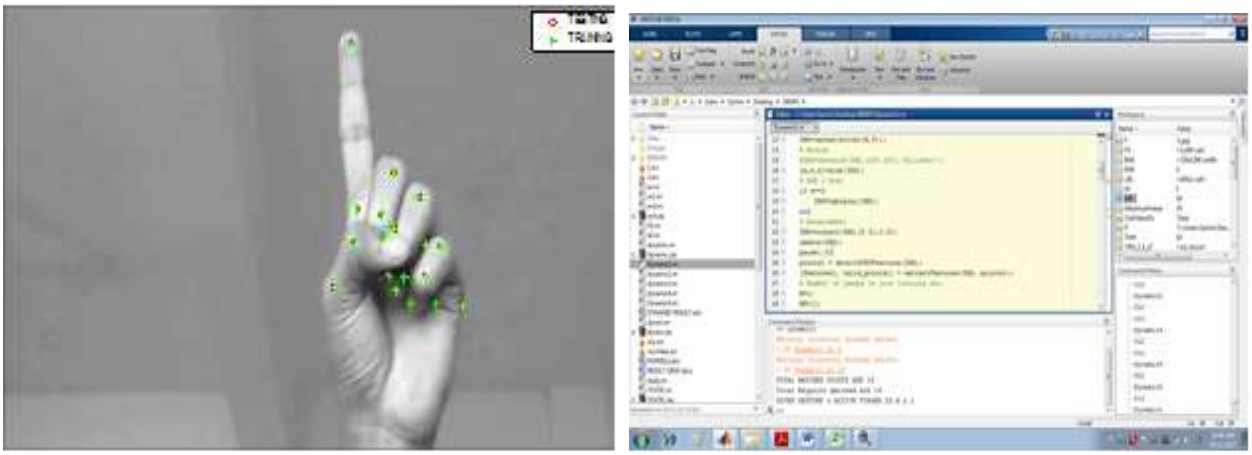


Figure 3 Matching points and MATLAB Result

3.1.2 Class B result:

Fig.4 shows the processing result of a sample of gesture 2. . Finally, every gesture sample is recognized and we totally have satisfactory recognition success rates of 86.66% on the testing data set. Result is display in the command window GIVEN GESTURE & ACTIVE FINGER IS B &2.mouse cursor is move bottom of the lift.

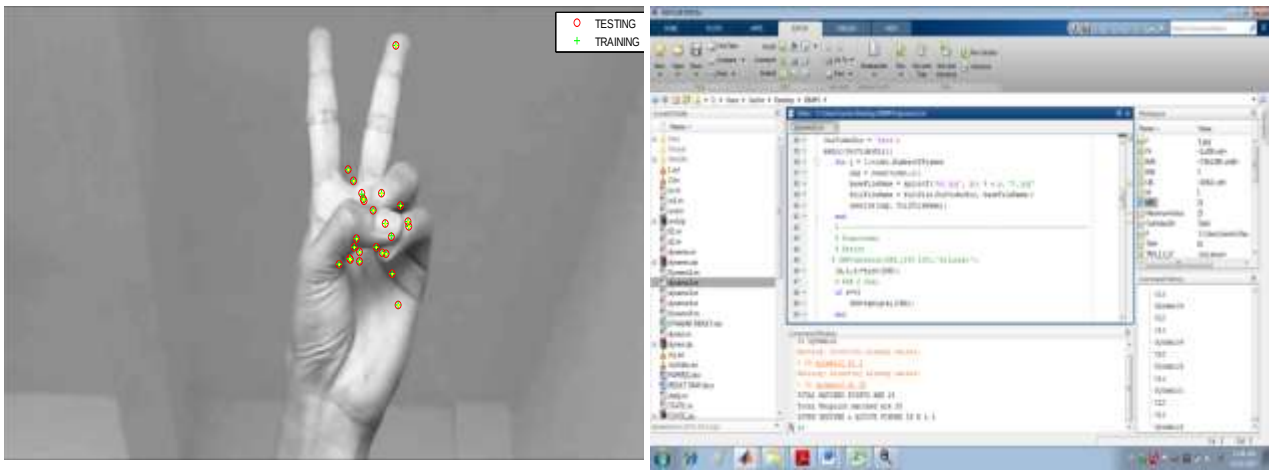


Figure 4 Matching points and MATLAB Result

3.1.3 Class C result:

Fig.5 shows the processing result of a sample of gesture 3.Finally, every gesture sample is recognized and we totally have satisfactory recognition success rates of 90% on the testing data set. Result is display in the command window is GIVEN GESTURE & ACTIVE FINGER IS C & 3.mouse cursor is move top of the right.

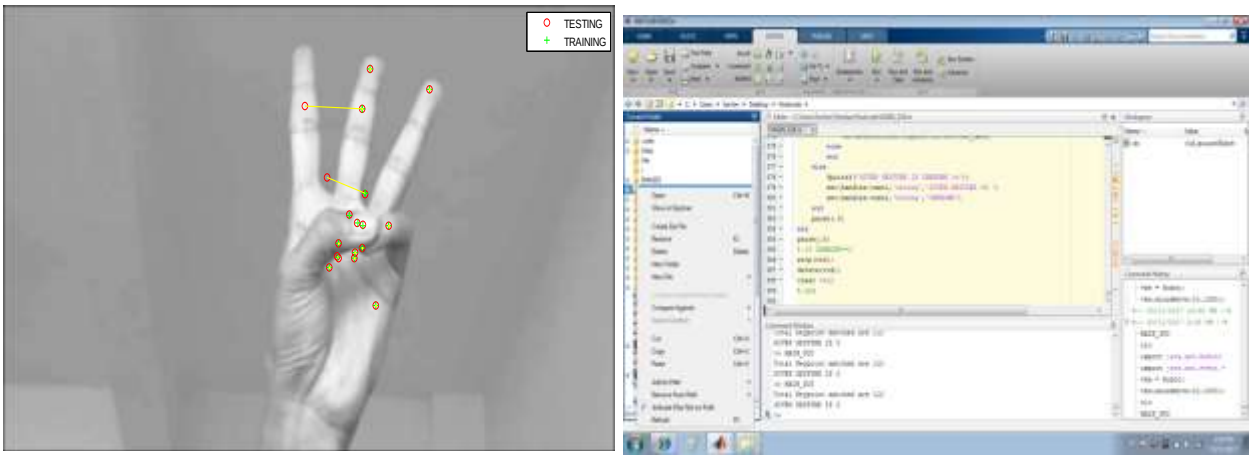


Figure 5. Matching points and MATLAB Result

3.1.4 CLASS D result:

Fig.6 shows the processing result of a sample of gesture 4.Finally, every gesture sample is recognized and we totally have satisfactory recognition success rates of 96% on the testing data set. Result is display in the command window is GIVEN GESTURE & ACTIVE FINGER IS D & 4.mouse cursor is move bottom of the right.

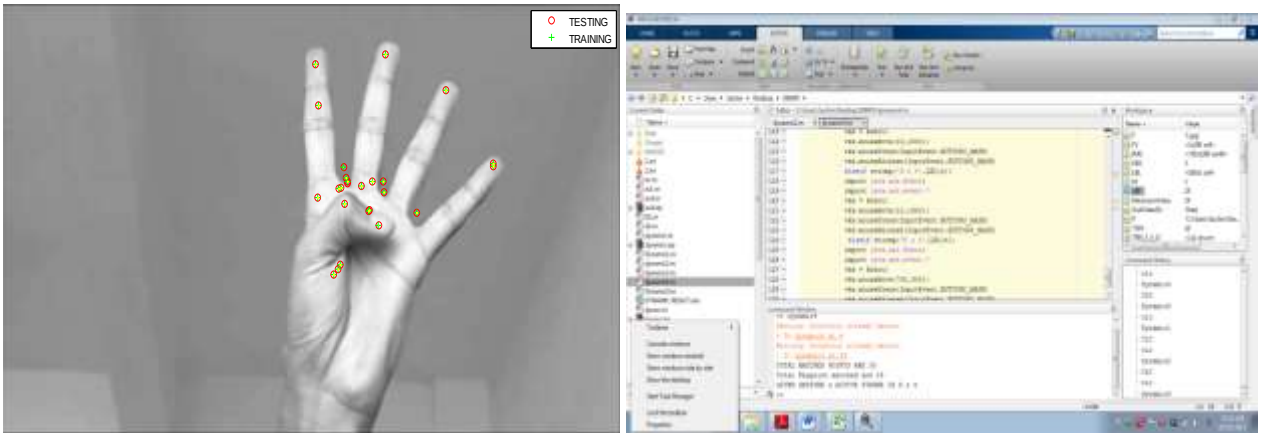


Figure 6. Matching points and MATLAB Result

3.1.5 Class E result:

Fig.7 shows the processing result of a sample of gesture 4.Finally every gesture sample is recognized and we totally have satisfactory recognition success rates of 87% on the testing data set. Result is display in the command window is GIVEN GESTURE & ACTIVE FINGER IS E& 5.mouse cursor is move center of the window.

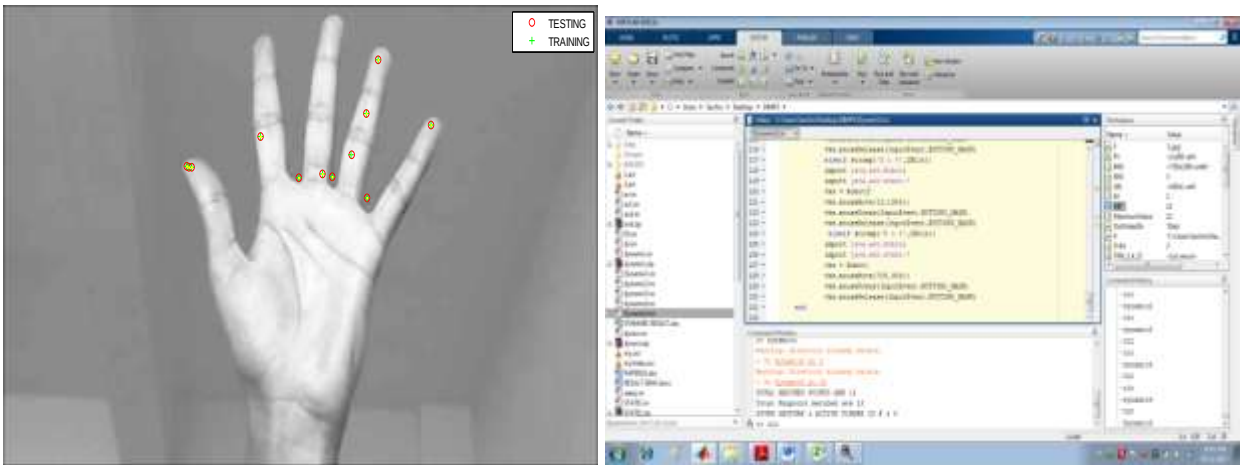


Figure 7. Matching points and MATLAB Result

In Table 2. Shows the overall result of train and test data are different

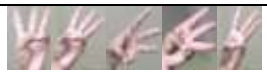
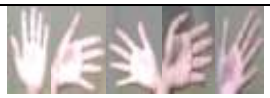
Class	Type of Gesture	No. of frames	Correct recognition rate	Error rate
A		25	96%	4%
B		25	88.66%	11.4%
C		25	90%	10%
D		25	96%	4%
E		25	87%	13%
	OVERALL RESULT	125	91.2%	8.8%

Table 2. Result of train and test set is different

3.2. If the train and test set is same the recognition rates are 100%` and it is tested by a class of 5 sample per user.

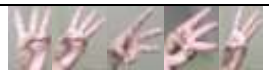
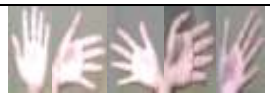
Class	Type of Gesture	No. of frames	Correct recognition rate	Error rate
A		25	100%	0
B		25	100%	0
C		25	100%	0
D		25	100%	0
E		25	100%	0
	OVERALL RESULT	**125**	**100%**	**0**

Table 3. Result of train and test set is same

We use 25 frames for each type of hand gesture and evaluate correct recognition rate and the error rate of the system.It would be more efficient if the system could learn only the faulty detected gestures by interaction with the user. The proposed system runs in simultaneous real-time at resolution of 1280*700 pixels on a single 1.7GHz Pentium processor. The proposed algorithm is tested on real time data base of hand gestures and yields a satisfactory recognition rate which is 100% on the training set and 91.2% on the testing set

IV.CONCLUSION

The proposed approach applies computer vision methodology that is sinuous, sound act in real time performance. This paper describes a new method to extract gesture features, which make the system rotation, scaling and translation independent. The gesture recognition system recognizes 91.2% hand gestures among the acquiesced frames. The overall time taken for recognition of one gesture is 1-3 seconds, thus the proposed algorithm satisfies the demand of real time. It can be made as an effective user interface with different applications like controlling VLC media player, mouse cursor controlling, home appliance etc.

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