Framework of ASL Silhouette Gesture Recognition System

Prathap C, Pradeep Kumar B P

Abstract: The Sign language is an approach to impart for hard of hearing individuals, which rigid shapes are utilized as a sound patterns. In this paper, we exhibit a system intended for identifying letters and the numeral's in the American Sign Language in light of saliency identification of the images. In the wake of identifying saliency, the images were handled by Independent Component Analysis (ICA), with a specific end objective is to decrease measurements and expand the class internal similitude and diminish class external resemblance. At final resultant vectors will be taught and classified through support vector machine (SVM).The utilization of this framework in the communication of the deaf people and in addition toward connecting with the computer, this is because of the utilization of standard letters in the sign language. The acknowledgment rate of the framework was 99.92% utilizing 4-fold cross validation method in which training conditions lying on the average. The consequences of the proposed system speak to high exactness and legitimate execution of this system compared among the others.

Keywords: Support vector machine. Independent Component Analysis, Sign language, Depth image, Hough method.

I. INTRODUCTION

Hands are one of the primary organs of the body which have a vital part in communication. Human-computer cooperation, human-robot connection, virtual reality and gesture based communication in mandate to communicate with hard of hearing individuals can be specified as the fundamental employments of them. These routines are partitioned in two general gatherings. In the first gathering the acknowledgment is finished by some additional devices, for example, gloves, attractive sensors, and so forth this has high precision, yet the client not sufficiently at liberty in utilizing these instruments which are costly and client needs to supply them [1].

Continuous motion acknowledgment has been exceedingly investigated in the course of recent years, by means of numerous human-computer interface uses going as of virtual reality towards communication via gestures interpretation. Inside of the recent area, analysts have actualized both vision-based and sensor-based acknowledgment. While both systems have created good results, vision-based recognizers don't oblige equipment to be worn by the client, delivering a further regular feel. Neural systems are a famous machine learning strategy for gesture based communication acknowledgment [2].

American Sign Language (ASL) comprises of both static as well as element signals. For consistent correspondence, hand shape as well as area is urgent elements amid interpretation. The many-sided quality presented by worldly data gives itself well to systems, for example, shrouded Markov models [3], intermittent neural systems [4]. All the more for the most part, element motions support highlight extraction instead of picture based information to acknowledgment models.

To perceive hand signs in light of machine vision, a few routines are introduced. The motivation behind these routines is towards build the acknowledgment rate of framework by means of suitable pace. Towards accomplish this objective a comprehensive dataset comprise of different conditions, for example, variety in scale, spot and turn of items ought to be watched. In the vision routines a few pictures are information and the point is diminishing the picture's sizes possession in mind the finale objective to expand pace and precision in the following process. This phase is termed as highlight extraction. This is one and only the supreme imperative phases amongst vision based framework, because of this reason different routines are introduced, that the objective of every one of them is great reduction in inputs as well as build the contrasts amongst lessening inner class inputs as well as augment outer class inputs. This can assist process with continuing quicker and extra precise.

In a few papers attention is further going on the restricted quantities of hand signs in addition to signals rather than comprehensive standard gesture based communication. Perceiving complete indications of gesture based communication can be utilized to make association with hard of hearing individuals notwithstanding correspond with a computer and robot, on the grounds that its signs are standard and every single hard of hearing people are acquainted with them. In this paper, we put forward a framework for perceiving letter set as well as numbers in American Sign Language. Projected framework by means of utilization of shape and saliency discovery of image instrument as well as ICA, linear discriminant analysis furthermore support vector machine as a classifier framework could accomplish fitting execution and outcomes on a standard as well as impeccable American Sign Language dataset. In accompanying, prior workings will be explored succinctly, in following portion proposed framework by means of its points of interest are clarified lastly tests consequence and conclusions are exhibited.[7]

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Prathap C, Assistant Professor, Dept. of ECE, Siddaganga Institute of Technology, Tumakuru, India.

Pradeep Kumar B P, Associate Professor, Dept of ECE, HKBKCE, Bangalore, India.

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II. RELATED WORK

One of the primary issues in perceiving gesture based communication is perceiving more signs and access to legitimate pace and exactness in the acknowledgment operation under different circumstances, for example, scale, turn and so on less looks into have done on a complete and standard gesture based communication. Practically comparable signs as well as great quantity of signs among standard gesture based communication letters in order can be said as the reason[8]. This can bring about diminished precision and expanded many-sided quality in characterization of information. In figure 1 a few signs in the American Sign Language with verging on similar component are displayed.
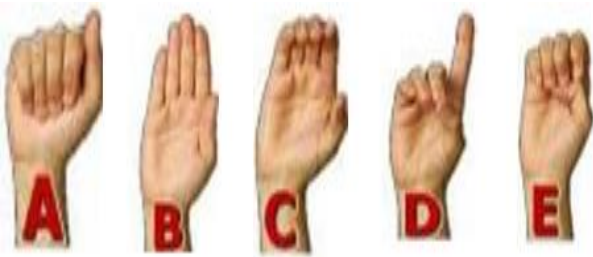

Fig. 1 A few signs in the American Sign Language

There are four primary hypotheses in the writing proposed to clarify the authorization impact (additionally alluded to as the subject performed undertaking (SPT) impact). One hypothesis, proposed by Cohen and Bean [5], recommends that the sanctioning impact is programmed and nonstrategic. Proof exists that conventional key learning impacts, found in verbal review undertakings, are not discovered when looking at establishment [6]. Another hypothesis [7, 8], proposes that the establishment impact is halfway programmed and gets its advantage from the multimodal engagement that happens amid authorization, including visual, sound-related, and material incitement [6]. A third hypothesis suggests that order encoding is composed into autonomous visual, sound-related and engine programs, with the motoric being the most productive, prove by the sanctioning impact [9]. At last, a fourth hypothesis negates the nonstrategic proposition of Cohen by recommending that the establishment impact is totally because of self-inclusion and experiential enlistment, or roundabout encoding of an individual affair [10].

In 2009, Munib et al displayed a technique aimed at perceiving 20 signs in American gesture based communication [11], at first in that framework, the picture's span change in fix sum, then hued picture get to be grayscale picture and after that the edges were distinguished utilizing shrewd edge locators. Next they came about pictures were being prepared by the Hough change and some element will be extricated lastly removed elements will prepare the NN in addition will be arranged. Utilization of entangled edifice for NN by means of high quantities of neurons in concealed layers is one of the principle issues of this framework which effect over fitting in preparation info accumulations and lessens the precision and builds the season of preparing. Likewise, in light of the fact that in these technique just edges of shapes is utilized, the greater part of the picture's data will vanish and the framework will be delicate in the direction of readable vicissitudes of edges. Additionally Karami and his associates in 2011 displayed a framework intended for perceiving Persian communication through signing letter sets [12], which could perceive 32 sign amongst 37 Persian gesture based communications. Voguish this framework at the first span of shading pictures transformed to 350×280 pixel as well as afterward gotten to be dark scale pictures, then hand's range will remain recognized as well as cutting encompassed by the limit, in the wake of cutting hand territory, the measure of picture will be alterations to 200×300 in addition a few components will remain extricated by two-dimensional discrete wavelet change, then these elements characterized using multilayer perceptron neural system. This framework has the capacity perceive 32 letters of the Persian gesture based communication letter set by means of the 94.06% acknowledgment rate on preparation as well as test information. Likewise utilized dataset readied by the essayist himself that has 640 pictures, 20 pictures intended for every sign, 13 pictures are in preparation stage and 7 pictures be there in test stage. Sansanee as well as his colleagues in the year 2013 introduced a framework towards perceive 10 indications of Thai gesture based communication by means of the utilization of SIFT and HMM Descriptor [13]. Voguish this framework hand's region is fixed physically and what's more of utilizing hand's territory, position and fingers' state are utilized. The aftereffects of this framework are exhibited intended for distinctive conditions, intended for the client reliance way between 86 to 95%, for semi reliance way around 75 to 79%, and for client freedom way 76 to 56%. In the year 2013 Yang et al proposed a framework for perceiving 13 hand signs in the American gesture based communication [14]. Which utilizes the manual and non-manual components taking into account CRF and SVM, possibly will acquire 84.1% exactness. Voguish these system non labour-intensive elements are those which removed from people groups' appearances by utilization of AMM technique. It is important to say that this framework is not online. Premaratne et al in the year 2007 displayed an electronic gadget control framework in view of the hand motion acknowledgment by means of the utilization of Hu minute and NN [15]. In this framework at the first place, there are 20 signs voguish the information set, then in every preparation as well as testing framework certain of them, which has a smaller amount acknowledgment rate wiped out lastly 7 signs are reminded. In 2013 Lee et al. proposed a framework by means of the point of making an intelligent meeting by utilization of hand signal acknowledgment [16]. This framework has the capacity of perceiving 9 hand motions. This one is controlled by means of skin identification of the face and hands utilizing the molecule channel strategy. In this paper quantity of conceivable ideas as well as what ideas can transfer these 9 signs as well as notwithstanding ordering as well as perceiving information were not said. However, acknowledgment's exactness on the dataset incorporates 90 recordings which is readied by the authors himself is 9 [17].

III. PROPOSED METHOD

In this paper, we proposed a framework to perceive 36 American static hand signs, in which 26 indications of them are identified with manual letterset American Sign Language. In this framework, there is no compelling reason to whichever Accessories, for example, gloves and particular stamping framework, and fundamental pictures can get ready by only single straightforward camera. Point of the proposed framework is corresponding by means of hard of hearing individuals notwithstanding speak with the computer and robot, which was generally utilized as a part of prior scrutinizes. This framework can be utilized as an interface or an interpreter between hard of hearing individuals and normal individuals that not just can make a written work sentences comparable to gesture based communication additionally can make a communication via gestures equal to composing sentences. This makes a straightforward correspondence between hard of hearing individuals and customary individuals and there is no compelling reason to any pre instruction.[18]

In this framework at a first shape and saliency of sign images will be extricated, which its yields are pictures that show not so much feature but rather more the principle fragments. This can expand the precision and pace of acknowledgment, and afterward as a result of high measurement of came about picture we attempt to decrease it, in a manner that minimizes contrasts amongst inner class information and augment outside class information. We utilize LDA strategy in the framework; however this technique has constrained memory and is not ready to chip away at information with high measurement. So at the first pictures entomb to ICA as a framework which each segment is a picture. Also, subsequent to decreasing measurements by the ICA, Eigenvector grid as data measures of LDA system was utilized. Later this stage if there exist C information classes, then there will exist C-1 nonzero Eigen values, which Eigenvectors identical to these eigenvalues are inputs of support vector machine. Voguish this paper by means of 36 info classes, for every picture there is a vector with length of 35. Voguish the accompanying, all points of interest of every stage will be clarified.[19]

A. Image shape and saliency detection

In this section we present the pre-processing steps of the American Sign Language. Shape extraction is important stage of the proposed model. In our proposed model shape is extracted based on pixel ranking. The main aim of the method is to highlighting the image parts for categorizing and accurate. The process is defined below:

Colour spaces are extracted from the RGB image. A global edge (level) is figured that is utilized to change over an intensity image to a binary image. Otsu segmentation calculation is utilized for this reason. The Otsu division calculation is a dark level threshold calculation taking into account discriminate examination. The calculation treats the division of picture into a twofold picture as an arrangement issue in which the two classes (for this situation, hand and foundation) are created from the arrangement of pixels inside of the picture. Morphological operations, for example, 3-by-3 neighbourhood technique the dominant part pixel worth is doled out to the chose pixel to decrease

irregularity. Likewise "diminishing" is connected on the picture. Figure 2 shows the feature extraction and feature matching process in proposed system [20]
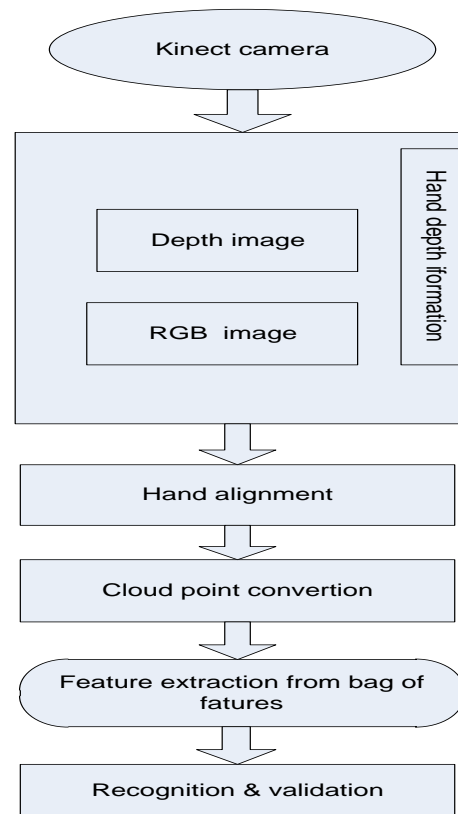

Fig. 2 Block diagram of proposed system

B. Feature Extraction

Consider an input image $I(x, y)$ and the arbitrary pixel's gray level is represented by which is $g_c = I(x, y)$. Gray value of sampling point is denoted by these points are evenly spaced in the circular neighbourhood of P and radius R around point (x, y):

$$g_p = I(x_p, y_p), p = 0, \ldots, P - 1 \qquad (1)$$

If the coordinates of centre pixel are (x_c, y_c) then the coordinates of his P neighbours (x_p, y_p) on edge of the circle with radius R can be calculated with sinus and cosines:

$$x_p = x + Rcos\left(\frac{2\pi p}{P}\right), \qquad (2)$$

$$y_p = y - Rcos\left(\frac{2\pi p}{P}\right). \qquad (3)$$

Local neighbourhood pixels can be defined as

$$L = l(g_c, g_0, g_1, \ldots, g_P) \qquad (4)$$

When these values of the points are found it is as well possible to define texture in another way.

This is completed by deducting value of the centre pixel from values of points on the circle. On this way local texture is characterised as a joint distribution of value of the centre pixel and differences:

L represents the texture of the image which can be computed as

$$L = l(g_c, g_0 - g_c, \ldots, g_{P-1} - g_c) \qquad (5)$$

Information about data can be computed by using joint distribution method

$$L = (g_0 - g_c, \ldots, g_{P-1} - g_c) \qquad (6)$$

Even though invariant against dark scale moves, distinctions are influenced by means of scaling. In the direction of accomplish invariance regarding whichever monotonic change of the dim scale, just the distinctions' indications are considered. This implies that for situation a point on the circle has a higher dark quality than the middle pixel (otherwise the same worth), one is doled out to that point, and else it gets a zero:

$$L \approx (s(g_0 - g_c, \ldots, (g_{P-1} - g_c)) \qquad (7)$$

To calculate the final feature vector binomial weight is assigned to each pixel

$$FeatVec = \sum_{p=0}^{p-1} s(g_p - g_c)2^P \qquad (8)$$

C. Support Vector Machine

Support vector machine is mostly used method intended for pattern recognition as well as classification. Voguish our method this one implements prediction as well as classification on credit card dataset in addition classifies into two classes: fraud and genuine transaction.[21]

Rudimentary function of binary classification by means of support vector machine is given as:

$$\mathcal{F}(x) = sgn(v.w) + \alpha \qquad (9)$$

v is input vector

w represents weights of input vector as well as α is a constant.

Constant α is resultant by exploiting the margin amongst two classes. This verge is calculated by utilization of hyper plane. These hyper planes are demarcated as

$$T: y = w.v + \alpha = 0 \qquad (10)$$

Dualistic classes remain unglued by means of threshold T and two parting criteria are demarcated as $T1$ and $T2$.[22] Separation conditions are demarcated as:

$$T1: y = w.v + \alpha = +1 \qquad (11)$$
$$T2: y = w.v + \alpha = -1 \qquad (12)$$

The above stated approaches are employed for linear problems of data on the other hand as we have conversed in our literature that credit card data are imbalance or non-linear, consequently to overcome this matter we suggest a kernel founded method for classification of credit card data by means of support vector machine. [23]

Cristianini N and Shawe-Taylor et. al. presented kernel function intended for support vector machine which is demarcated as

$$\langle v_i, v_j \rangle \rightarrow k(v_i, v_j) \qquad (13)$$

By means of using this equation input vector v can remain mapped into higher dimension in support vector space.[24] In our recommended methodology we used RBF kernel method intended for vector projection in the space. This kernel is calculated as

$$k(v_i, v_j) = \exp\left(-\mu\|v_i - v_j\|^2\right) \qquad (14)$$

μ is demarcated as Gaussian width.

In our proposed methodology μ is used to adjust the kernel stricture which supports to answer the unfair problems intended for classification.[25]

IV. EXPERIMENTAL RESULTS

In this framework the system uses the untrained dataset for sign language recognition. which includes 36 American sign language signs. Among 26 of them are about the American Sign Language alphabet and 10 of them are associated to the numbers 0 to 9. Figure 3 shows the collected datasets by kinect camera[26] using kinect camera RGB and depth image is captured and aligned in order to get precise silhouette of acquired hand sign. the datasets are captured in different scenarios to analyse the robustness of the proposed framework. while collecting samples for the proposed model different scenarios are considered to the whole thing standards, such for instance variance in illumination, spin, etc. The database comprises 780 images in which there are 10 images intended for every single user sign. For analysis purpose we considered 3 untrained user databases.[27]
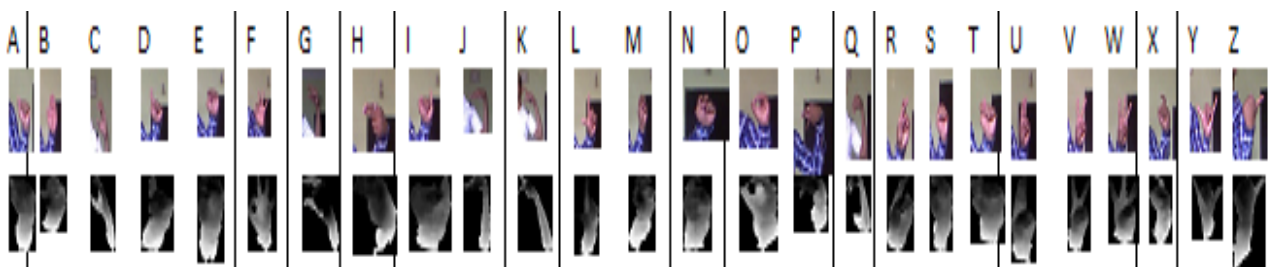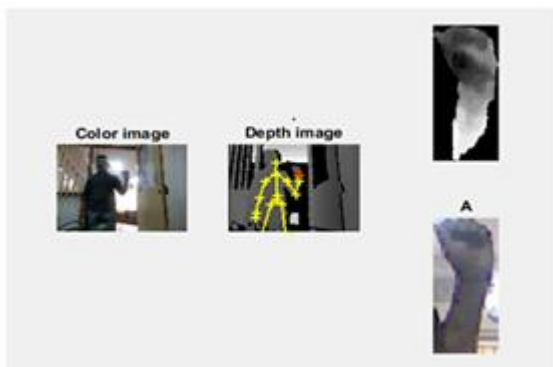

Fig. 3 Untrained data base

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Fig. 4 Recognition of sign A by skeleton identification using kinect camera
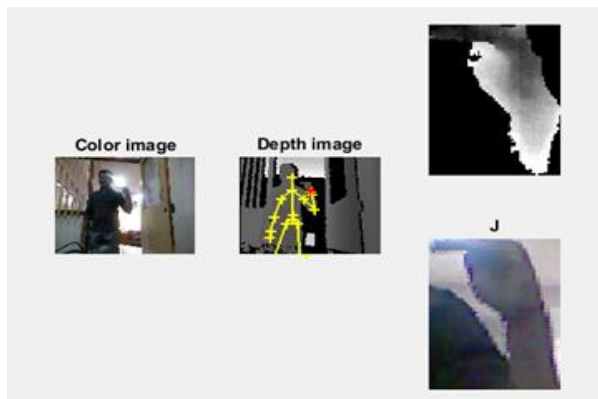

Fig. 5 Recognition of sign j by skeleton identification using kinect camera
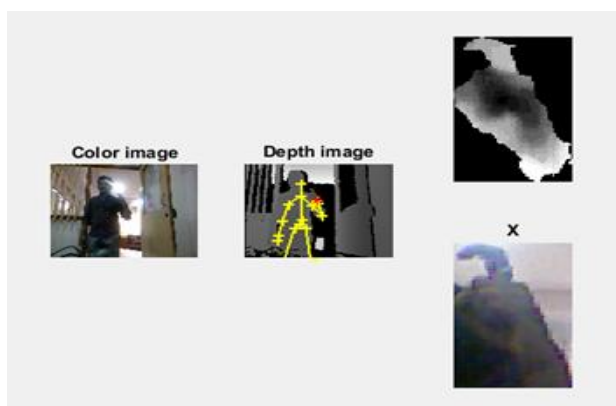

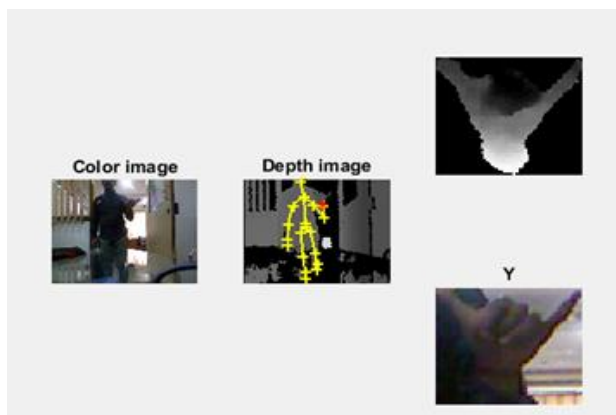**Fig. 6 Recognition of sign x by skeleton identification using kinect camera**

Fig. 7 Recognition of sign Y by skeleton identification using kinect camera

Figure 4 shows the recognition of sign A with user skeleton in front of the kinect camera. From the figure 5, 6, 7 the system will give clear indication of user hand. In this model user skeleton is identified by reference points, after identifying the reference points for different joints the kinect itself will draw the skeleton view. After taking the skeleton view of the Eyes user the system will identify the user right hand. After the tracking process of right hand it will segment the hand sign generated by the user in front of the camera at different distance. System considered value of 4 for K for inspecting system in K-Fold Cross Validation method. As well, we contemplate the rate of sample assortment from every single class analogous in direction to avoid non uniform dissemination of data in procedure of training as well as testing system. In this process complete sample is used intended for training as well as testing system as well as in the direction of upsurge consistency of results. As well, we used recognition rate in direction to assessment the system, designed by equation 15. The outcomes of testing proposed method and particulars of these outcomes are specified in table 1 and table 2, correspondingly.

Span of learning period in our proposed system is a smaller amount compared to method [2]. Some of the cause is by a suitable network structure as well as extra coherent specific vectors.[28] As well for studying the need of using PCA and LDA at the same period, we design system devoid of LDA. Voguish this way the dimension of feature vectors reminds upper as well as for the reason that PCA method in the calculating does not consideration to this stuff that every single input fits to which class, so that is why system is prominent to learn data entirely as well as accuracy will be abridged. As well, by means of just LDA is not conceivable for the reason that of the higher dimension of features before using PCA. LDA is not capable to work through these dimensions of data and also has inadequate memory.[29] By means of confusion matrix the complete performance of system is calculated. Standard confusion matrix is revealed in table 1.

Table. 1 Confusion Matrix

		Predicted	
		Positive	**Negative**
Actual Data	Positive Data	True Positive Rate	False Negative Rate
	Negative Data	False Positive Rate	True Negative Rate

$$True\ Positive\ Rate \qquad (15)$$
$$= \frac{True\ Positive}{True\ Positive + false\ Negative}$$

$$False\ Positive\ Rate \qquad (16)$$
$$= \frac{False\ Positive}{True\ Negative + False\ Positive}$$

True positive rate and false positive rate can be calculated by means of Eq. (15) and Eq. (16)

Precision and recall performance of the proposed system is revealed in figure 8. It is the measurement of relativity. Precision is the measurement of retrieved data that are alike, while recall is the measurement of pertinent data that are alike.[30]
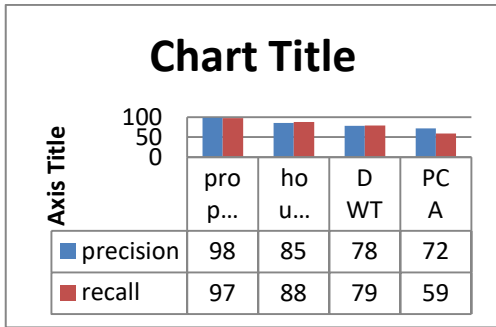

Chart Title

	prop...	hou...	DWT	PCA
precision	98	85	78	72
recall	97	88	79	59

Fig. 8 Precision vs. Recall

Table. 2 Comparisons with other methods

Method	Recognised Gestures	Training Images Recognition Rate	Testing Images Recognition Rate	Total Recognition Rate
Proposed Shape based method	36	100%	99.96%	99.92%
Hough method	36	99.85%	86.15%	93%
DWT	36	36.59%	32.87%	35.36%
PCA	36	80.17%	65.28%	72.23%

Comparisons of the proposed method with other methods are shown in table 2 and figure 9, recognition rate of proposed shape based method is 99.92%. Recognition rate of Hough method is 93%, recognition rate of DWT is 35.36% and recognition rate of PCA is 72.23%. Proposed shape based method has high recognition rate compared to other methods.[31]
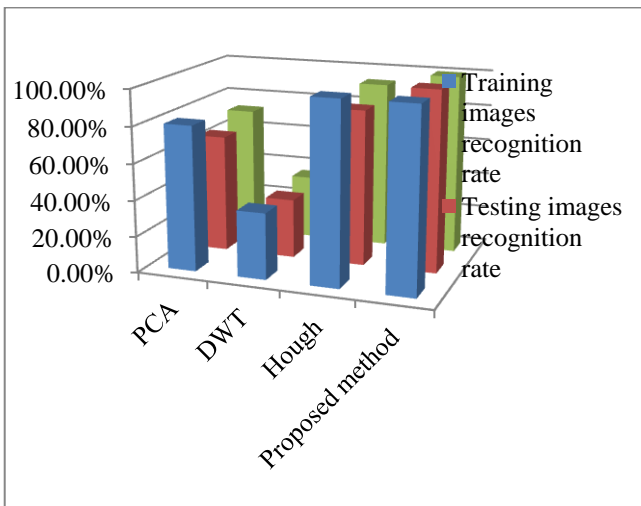

Fig. 9 Comparisons with other methods

V. CONCLUSION

PCs and keen innovations impact most some piece of human life and consistently another smart innovation is showed up. The primary issue we face is the way communicates with them. The exploration of human and PC communication speaks the truth it. Bunches of endeavors be present in this field in request towards communicate human and PC devoid of frill the same as people. In gesture based communication hand shapes are utilized rather than voice designs for make correspondence what's more, transmit originations. Communication through signing is a correspondence dialect for hard of hearing individuals which can be used to make speaking with PCs. Voguish this paper, we exhibit a technique intended for perceiving American sign dialect letters in order and numbers taking into account the saliency of pictures. In this paper at to begin with, info pictures process by the saliency identification and its yield prepared by ICA routines. What's more, this can diminish dimension as well as minimalize an interior class separates and expand an outside class separations. Subsequently in this stage we have one vector intended for every one picture as well as accumulations of these vectors are info of SVM. Utilization of the proposed system is corresponding by means of hard of hearing individuals notwithstanding speaking with PC, robot and all machines. In a manner that, the framework is a interpreter for hard of hearing individuals and conventional individuals and make communication via gestures comparable to composing sentences and bad habit versa keeping in mind the end goal to make a simple relationship. The outcomes demonstrate this framework working extremely fine in perceiving numbers as well as letters in order of American communication via gestures with 99.92% as the normal of acknowledgment.

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