A Hybrid Gesture Recognition Method for American Sign Language

B. P. Pradeep Kumar^{1*} and M. B. Manjunatha²

¹Electronics Engineering, Jain University, Bangalore - 560069, Karnataka, India; pradi14cta@gmail.com ²Akshaya Institute of Technology, Tumkur - 572106, Karnataka, India; manju.kari29@gmail.com

Abstract

Gesture based communication is a method of correspondence between the ordinary and hard of hearing people in which the vision based procedure is utilized. This paper proposes a novel methodology of hand gesture recognition system for American Sign Language (ASL), which will perceive communication via gestures signals in an ongoing situation. A hybrid based descriptor, which joins the benefits of LBP (Local binary pattern), SP (super pixels) and SURF (Speeded Up Robust Features) strategies, is utilized as a consolidated list of capabilities to accomplish a improved identification rate beside among a little moment in time computational difficulty. In additional increase the detection speed and create the appreciation framework strong to view-point varieties, the idea of derived features from the accessible list of capabilities is presented. K-Nearest Neighbor (KNN) and Support Vector Machine (SVM) are utilized for hybrid arrangement of single marked letter. Comparative investigation of these strategies with other well known methods demonstrates that the constant proficiency and robustness are better. The performances parameters will be used in this method are accuracy, sensitivity, precision, FNR and FDR.

Keywords: American Sign Language, FNR, FDR, Hand Gesture Recognition, KNN, LBP, Recognition Rate, SP, SURF, SVM

1. Introduction

Gesture recognition is a zone of current flow research in PC vision. Body language communication is one of the critical methods for correspondence among the people. In this way, gesture recognition framework would be a perfect methodology for enhancing human-machine communication. This sort of human-machine interfaces will permit assortment of devices remotely through hand motions. The point of the gesture acknowledgment is to empower people to associate in the company of the human being prepared apparatus in regular route with no mechanical device and the numerical conditions will be the interpreter that deciphers the postures between the motion and the telerobotic¹. The gesticulation acknowledgment is exceptionally

difficult and complex task, since the full recognition framework should be have a capacity to distinguish the hand in various scales, positions, orientation, differentiations, radiance, and others.

In the prior phases of research, numerous researches have proposed diverse methodologies for the gesture recognition framework. Hand gesture acknowledgment discovers applications in fluctuated areas including virtual situations, smart reconnaissance, and communication through signing interpretation, medicinal frameworks and so forth. Hand gesture recognition framework comprises of the accompanying strides (a) Pre-handling and segmentation, (b) Hand identification and tracking, (c) Hand posture acknowledgment and (d) Hand gesture arrangement as appeared in fig 1.



Figure 1. Block diagram of Hand Gesture Recognition System.

The Kinect sensor is a movement detecting device. Its name is a blend of active and associates. It was initially outlined as a Natural User Interface (NUI) for the Microsoft Xbox 360 computer game console to make another control experience for the client where there's no more requirement for an info controller. The client is the controller. It empowers the client to communicate and control programming on the Xbox 360 with gesture acknowledgment and voice acknowledgment. What truly separates Kinect from different gadgets is its capacity to catch profundity. The device will make out of various sensors. In the center it has a RGB camera permitting a determination up to 1280x960 at 12 pictures for every second. The typical utilized determination is 640x480 pixels at 30 pictures for each second most extreme for hued video stream as the profundity camera has a greatest determination of 640x480 at 30 outlines for every second.

There are a few difficulties that are confronting the procedure of gesture recognition and these difficulties are capable to originate in pre-processing footstep and these are basic for all the motion recognition appliance¹, if the gesture are all around acquired then this will influence all the last pending procedure. The difficulties can be condensed by the Fig. 2 the gesture recognition is extremely troublesome and complex task, since the full recognition framework should be have the capacity to recognize the hand in various circumstances.

Gesture recognition plans can be extensively ordered into two gatherings. In the primary gathering, a gesture is demonstrated as a period grouping of state. In the second gathering, one uses dynamic time twisting to adjust for the velocity varieties that happen during gesticulation. Gestures acknowledgment plans can likewise be arranged on the premise of the parameters that are utilized to demonstrate the presence of the hand e.g., hand outline based model, diagram based model, utilization of Fourier descriptors, b-splines, and so forth.



Figure 2. Gesture challenges.

Gestures utilized to denote letters in order and digits are normally static, including just a solitary key stance of the body. This is in opposition to element motions where development of the hands is likewise related that prompts various key stances. Proposed wor centers manual static motions of ASL, contrasted with double gave communications via gestures, has higher number of vague static motions which makes its acknowledgment a challenging task (Fig. 3).

A large portion of the gesture acknowledgment frameworks work for the most part in taking after strides; gesture signal procurement, preparing of obtained gesture sign and descriptor extraction, lastly order of descriptor to one of the plausible motions. Gesture recognition procedures for communications via gestures can comprehensively be arranged as sensor glove based, EMG (Electromyography) sensor based and vision situated in vision based motion acknowledgment strategies, one or more cameras catch the signals performed by an underwriter in a image or video stream. Hand blobs are extricated from caught pictures or outlines and prepared further for descriptor (features) extraction.

We have proposed a framework which can perceive the different letters in order of American Sign Language for Human-Computer connection giving more precise results at any rate conceivable time. It won't just profit the deaf and dumb persons of India additionally might be utilize as a division of different applications in the innovation field. Segment II gives a particular work done by numerous explores. Segment III gives the proposed strategy alongside usage technique. Segment IV gives the outcomes and discourse. Segment V gives the conclusion and also future examination work.



Figure 3. A portion of the database pictures (ASL) considered for the proposed framework.

2. Literature Review

In this section we have focused our discourse of the endeavors made by scientists on gesture based communication acknowledgment when all is said in done. As of late, numerous analysts have concentrated on building dual handed static gesture acknowledgment frameworks. Solitary static gesture, be that as it may, posture more acknowledgment multifaceted nature because of the high level of shape ambiguities. This paper displays a gesture acknowledgment setup fit for perceiving and accentuating the most questionable static solitary gestures. Execution of the proposed plan is tested on the letter sets of ASL.

Singh et al.² exhibited a novel methodology including the decay of motions into independent or twofold gave

signal. Grouping motion into these subcategories rearranges the procedure of motion acknowledgment in the ASL because of nearness of lesser number of signals in each subcategory. Different methodologies making utilization of Histogram of Gradients (HOG) highlights and geometric descriptors utilizing KNN and SVM classifiers were attempted on a dataset comprising of pictures of every one of the 26 English letter sets present in the ASL under factor foundation. Pig highlights when grouped with Support Vector Machine productive methodology bringing about a precision of 94.23%.

Singh et al.³ proposed a novel method based ISL motion acknowledgment method. Here DWT is utilized for decreasing the dimensionality of the information and also to find the most suitable limit purposes of hand signals. After that MFCC is connected as an element extraction method for finding the ghostly envelope of every picture outline. This ghastly envelope quality is helpful for perceiving hand signals in complex environment. Here bolster vector machine (SVM) classifier for ordering an obscure signal. From test comes about it has been watched that DWT with MFCC gives high acknowledgment rate SVM as contrast with KNN.

Rekha et al.⁴ proposes a programmed motion acknowledgment method for ASL. This communication through signing utilizes both hands to speak to every letters in order. We propose a methodology which addresses nearby worldwide uncertainty recognizable proof, between class changeability improvements for every hand motion. The shape, surface and finger elements of every hand are extricated utilizing Principle Curvature Based Region (PCBR) locator and many-sided quality imperfections calculations individually for hand stance acknowledgment process. The execution of the proposed methodology is broke down with understood classifiers like SVM, KNN and DTW. Trial results are contrasted and the traditional and existing calculations to demonstrate the better effectiveness of the proposed approach.

Nagadeepa et al.⁵ proposed a sensor based motion acknowledgment framework which makes the instructor to write in Telugu dialect on advanced board from anyplace inside the classroom. Different characterization calculations KNN, SVM and Decision tree are independently utilized for hand motion based Telugu character acknowledgment. Here, we evaluate the execution of three characterization calculations which are contrasted and 16 distinctive Telugu character vowel motions. Every motion is gathered by utilizing an inertial sensor based implanted gadget. The dataset contains 16 motions, every signal rehashed for eleven times from three unique individuals. The signal recognizable proof exactness for k-Nearest Neighbor grouping is 97.2%, SVM is 92.8% and Decision tree is 86.5%.

Skillet et al.⁶ proposed a dream based signal acknowledgment framework which can situations with complex foundation. We outline a strategy to adaptively redesign the skin shading model for various clients and different lighting conditions. Three sorts of elements are joined to depict the forms and the notable purposes of hand motions. Rule Component Analysis (PCA), Linear Discriminant Analysis (LDA) are incorporated to build a novel various leveled arrangement plan. Our technique accomplishes the correctnesses of 99.8% and 94%, individually, which outflanks the current works.

Savur et al.^Z considered a Real-Time Sign Language acknowledgment framework was proposed by utilizing the surface Electromyography (sEMG). To this reason, sEMG information obtained from subject right lower arm for each of the twenty six American Sign Language signals. Crude sEMG information was separated, element extricated and sustained into order. Bolster Vector Machine (SVM) multi class grouping. The trial consequence of disconnected framework is achieving an acknowledgment rate of 91.% exactness and constant framework has an acknowledgment rate of 82.3% precision. The consequences of the proposed framework demonstrate that sEMG sign can be utilized for Real-Time SLR frameworks.

Ghosh et al.⁸ proposes a dream based framework for acknowledgment of static hand signal. It manages pictures of uncovered hands, and permits perceiving signal in light, revolution, position and size variety of motion pictures. The proposed framework comprises of three stages: pre-preparing, highlight extraction and characterization. The pre-handling stage includes picture upgrade, division, turn and sifting process. The joined elements are connected as contribution to multiclass bolster vector machine (SVM) classifier to perceive static hand motion. The proposed framework is executed and tried on three diverse hand letters in order databases.

Huan et al.⁹ Abstract: Human signal acknowledgment in light of picture successions is presently the exploration center. In this study, four classifiers with K-NN, Bayes, LDA and SVM were utilized, two human motions (walk and twist) were perceived. This study extricated the human body shape of picture successions, the separations between the form and focus of human body were utilized as information elements. The outcomes with a 5-fold cross-approval demonstrate that the characterization exactnesses of SVM and LDA are superior to those of KNN and Bayes. This concentrate likewise computed the AUC values (the region under the ROC bend), the same results were gotten.

Kuroki et al.¹⁰ presents a hand signal acknowledgment framework utilizing Magic Ring (a ring-shape wearable gadget) rather than information glove or camera to decipher the predefined hand motions into Japanese and to achieve remote transmission of the data/order between client bunches. The hand signals are characterized in view of improved Japanese communication through signing. The KNN technique is embraced to the example acknowledgment as indicated by the bimanual detecting information. To enhance the acknowledgment rate, three most comparative pre-saved signals and closeness are recorded, and Euclidean separation of highlight qualities is utilized to assess the motion similitude.

Ni et al.¹¹ manufactures an indoor sign database and explore the acknowledgment and characterization for the indoor sign issue. We embrace the established procedures on removing the elements, including the rule part investigation (PCA), thick scale invariant element change (DSIFT), histogram of situated slopes (HOG), and direct the condition of-craftsmanship grouping strategies, for example, the neural system (NN), bolster vector machine (SVM) and k-closest neighbors (KNN). We give the test comes about on this recently assembled database furthermore talk about the understanding for the likelihood of indoor route for the visually impaired or visual-debilitated individuals.

Vishwanathan et al.¹² purposed a hand signal acknowledgment framework which can recognize hand motions of letters in order with likeness. Highlight extraction techniques assume a vital part in increasing high acknowledgment rate for a signal acknowledgment framework. This paper endeavors to assess Histograms of Oriented Gradients (HOG), the element extraction technique for its capability to recognize motions with likeness. KNN classifier was utilized for motion acknowledgment. Framework execution is assessed utilizing numerous factual measures. As by the assessment, HOG can recognize motions with a precision of 96%. The independent static communications through signing letters in order are taken for acknowledgment reason.

Plawiak et al.¹³ presents a framework for fast and powerful acknowledgment of signals of hand non-verbal communication, in view of information from a specific glove outfitted with ten sensors. In the investigation, 10 individuals performed 22 hand non-verbal communication motions. Each of the 22 signals was executed 10 times. Gathered information were preprocessed in various ways and three machine learning calculations were planned in light of classifiers (probabilistic neural system, bolster vector machine, and k-closest neighbors calculation) prepared and tried by a ten times cross-approval method. The best composed classifiers picked up viability of signal acknowledgment at $\kappa = 98.24\%$ with a brief timeframe of testing, underneath 1 ms. the investigations affirm that proficient and brisk acknowledgment of hand non-verbal communication is conceivable.

Huang et al.¹⁴ propose a novel strategy for SLR which includes the utilization of the Real-Sense. It is a camera gadget which can distinguish and track the area of hands actually. All the more intense, it gives the 3D directions of finger joints progressively. We assemble a profound neural system (DNN) taking into account Real-Sense to perceive diverse signs. The DNN takes the 3D directions of finger joints as information specifically without utilizing any carefully assembled highlights. The reason is that DNN, as a profound model, is equipped for taking in appropriate components for acknowledgment from crude information. In analysis, to show the viability of Real-Sense, we gather two datasets by Real-Sense and Kinect separately, then form DNNs in view of each dataset for acknowledgment. To approve the effectiveness of DNN, we look at the execution of DNN and bolster vector machine (SVM) on the same dataset.

Aryanie et al.¹⁵ presents finger-spelling acknowledgment technique for American Sign Language (ASL) Alphabet utilizing k-Nearest Neighbors (k-NN) Classifier. This exploration additionally looks at the impact of PCA for dimensional lessening to k-NN execution. The empiric results demonstrate that k-NN classifier accomplishes the most noteworthy precision (99.8 percent) for k=3 when the example is spoken to by full dimensional element. In any case, k-NN classifier just accomplishes 28.6 percent precision (for k=5) when the example is spoken to by PCA reduced dimensional element. This low exactness is because of a few variables, among others, is the nearness of high quantities of excess or very connected components among ASL letters in order that makes PCA not able to separate information acknowledgment time of k-NN classifier is longer than that of the strategy proposed in⁷. Along these lines, k-NN classifier is appropriate for early kid

instruction based application, for example, self-appraisal framework for unique need understudy who learns ASL letter set finger-spelling.

Wahyono et al.¹⁶ presents a relative investigation of a few order strategies for the undertaking of perceiving movement signs in urban ranges. These order strategies are simulated neural system (ANN), k-closest neighbors (kNN), bolster vector machine (SVM), and irregular woodland (RF). To begin with, HSI-based shading division procedure is connected to get competitor districts. Utilizing centroid-based component, these areas will be arranged into three shape classes, for example, circle, rectangle and triangle. Henceforth, histograms of situated slope (HOG) components are removed from every locale that will be used in perceiving step. For examination, surely understood open databases will be utilized. The correlations in light of the execution result from those information with contrast state of power and point of perspective. Complete near results to represent the execution aftereffect of every order technique is introduced.

Sinith et al.¹⁷ concentrated on an instrument for perceiving letters in order level ceaseless American Sign Language utilizing Support Vector Machine to track the gesture based communications spoke to with hands is introduced. Six letters are prepared and perceived and got a productivity of 92.13%. The static pictures of hand motions speaking to the six letters are taken in a camera and handled for preparing and acknowledgment. The picture taken in the camera was so expansive to process so we resized the picture to one eighth of its unique size. At that point the picture is changed over to dim and the edges of it are discovered utilizing the Sobel channel. The directions of the edges are given as the contribution to the Support Vector Machine which will prepare and characterize the same so that that next time when a test information is given it would get grouped appropriately. Both the line and segment position of the last picture (comprise of just three associated parts) are taken as the components of test lattice utilized for preparing the pictures. The SVM instrument is utilized for order and preparing.

3. Motivation and Proble Description

In the recent days improvement of proficient systems for preparing images makes individuals comprehend, the interest for taking care of, in the specialized world, where recognizing certifiable images are high. The requirement for perceive the different letters in order of American Sign Language for Human-Computer communication giving more precise results at any rate conceivable time. It won't just profit the hard of hearing and unable to speak individuals of India additionally could different applications in the innovation field in image processing field, yet it serves to convey everybody nearer to the uncovered learning about the subject. What's more, the need for normal people to relish gesture applications has gotten to be one of the significant worries after some time. Along these lines, the proposed algorithm studies to discover better approaches to perceive the signal and to share the specialized insight about the related points moreover.

4. Proposed Method and Implementation

The input image data is taken through the camera and the data training sets of pictures are stored in a database. At that point pre-handling of the continuous picture and the training set of picture is finished. At that point the LBP, SP and SURF algorithms are implemented to the preparation sets of pictures for compressing and examining the pictures, and then the KNN and SVM orders are utilized to group the constant picture with the right match of the preparation set of images. The fig 4. & fig 6. Demonstrates the framework architecture of planned Gesture Recognition scheme. The input image is taken through the camera, and for interface the camera with the MATLAB software. Image acquisition tool kit of the MATLAB is utilized.



Figure 4. Block diagram for the proposed system.

SVM is a promise novel method, it can be grouped both straight and nonlinear information. Non-direct mapping is utilized to change the preparation information inside a higher measurement into another measurement; straight mapping is utilized to hunt down a direct ideal line to isolate hyperplanes. SVM comprises of hubs used to prepare a bolster vector machine on the info information. It bolsters various diverse parts (hyper digression, polynomial, and spiral premise capacity). The SVM learner underpins numerous class issues too by processing the hyperplane between every data set as well as the rest of the class. In this study, they utilize SVM with polynomial bit to arrange and examine relapse of human motions. Since additional the division of the information, better the execution. SVM classification process shown in fig 5.



Figure 5. The SVM classified scheme.



Figure 6. System architecture for the proposed system.

The k-nearest neighbor calculation is an arranging strategy which groups an article where most of the neighbor has a place with. The decision of the quantity of neighbors is optional and up to the decision of the clients. Normally the article is grouped enchanting into description the script of its k closest neighbors by dominant part vote. In the event that k=1, the article is named the class of the item closest to it. At the point when just two classes are available. After we change over every picture to a vector of settled length with genuine numbers, we utilized the most well-known separation capacity for KNN which is Euclidean separation. KNN arrangement methods shown in fig 7.



Figure 7. KNN arrangement. At the inquiry purpose of the circle contingent upon the k estimation

Since hand motions are extremely rich fit as a fiddle variety, shading, surface and movement, highlight extraction is critical for signal acknowledgment. Signals are generally spoken to by different elements, which are formats, changes, geometric, and non-geometric components⁵. Formats are the most straightforward components to register; they are essentially the info signal in its crude structure with no additional counts. Changes, for example, pivot, interpretation, or scaling can be connected to decrease the quantity of highlight vectors in layouts and afterward diminish the database size which may accelerate the acknowledgment time. Geometric elements are the components that ascertained in some way or another straightforwardly from the motion skeleton or shape applying some pre-handling operation; these elements incorporates the width of the motion, the tallness of the motion; the quantity of fingers, the separation between the hand fingers, and so forth; however geometric elements not generally appropriate because of self-impediment and varieties in lighting conditions. Non-geometric components incorporate every one of the

elements that are removed from applying some numerical conditions on a pre-prepared hand signals. The non-geometric components might be useful in the distinguishing proof of geometric elements however are generally insufficient in acknowledgment¹⁶. To expand the precision of the hand signal acknowledgment framework and to beat the issue of multi varieties like pivot, scaling, interpretation, SVM highlight choice methodology is embraced to concentrate shape diagram with least number of pixels for a picture outline without losing shape data⁴ keeping in mind the end goal to acquire more refined and discernable elements. The normal inspiration for utilizing SVM highlights extricated from crude information is dimensionality decrease, which would essentially lessen the extent of the information vector.

5. Results and Discussion

In order to validate the effectiveness of the proposed method, we evaluated a gesture recognition setup fit for perceiving and accentuating the most questionable static solitary gestures. Execution of the proposed plan is tested on the letter sets of ASL. We done a simulation work using Matlab software. Fig. 8 to fig.18 shows the output obtained in this work. It gives indusial result for all the 3 different algorithms as well as the comparison results for obtained the hybrid gesture recognition framework for American Sign Language. The table 1 to table 9 shows the numerical outcomes obtained in this proposed method as well as the formula obtained for the given performance parameters.

Table 1. Creating I	Bag-Of-Features
---------------------	-----------------

Creating Bag-Of-Features from 26 image sets.
* Image set 1: A.
* Image set 2: B.
* Image set 3: C.
* Image set 4: D.
* Image set 5: E.
* Image set 6: F.
* Image set 7: G.
* Image set 8: H.
* Image set 9: I.
* Image set 10: J.
* Image set 11: K.
* Image set 12: L.
* Image set 13: M.
* Image set 14: N.
* Image set 15: O.
* Image set 16: P.
* Image set 17: Q.
* Image set 18: R.
* Image set 19: S.
* Image set 20: T.
* Image set 21: U.
* Image set 22: V.
* Image set 23: W.
* Image set 24: X.
* Image set 25: Y.
* Image set 26: Z.

Table 2. Extracting feature using SP

* Extendi	ng factures using a contemplation autoation function; autoat SD
- Exuacu	ng leanues using a custom feature extraction function, extract_SF.
* Extracti	ng features from 1 images in image set 1done. Extracted 54 features.
* Extracti	ng features from 1 images in image set 2 done. Extracted 61 features.
* Extracti	ng features from 1 images in image set 3. done. Extracted 96 features.
* Extracti	ng features from 1 images in image set 4. done. Extracted 71 features.
* Extracti	ng features from 1 images in image set 5 done Extracted 67 features
* Extracti	ng features from 1 images in image set 6 done. Extracted 84 features.
* Extracti	ng features from 1 images in image set 7_done. Extracted 70 features.
* Extracti	ng features from 1 images in image set 8 done Extracted 44 features
* Extracti	ng features from 1 images in image set 9. done. Extracted 79 features.
* Extracti	ng features from 1 images in image set 10 done Extracted 100 features.
* Extracti	ng features from 1 images in image set 11 done Extracted 75 features
* Extracti	ng features from 1 images in image set 12, done. Extracted 71 features
* Extracti	ng features from 1 images in image set 13_done. Extracted 71 features.
* Extracti	ing features from 1 images in image set 14, done Extracted 81 features
* Extracti	ng features from 1 images in image set 15 done. Extracted 74 features
* Extracti	ing features from 1 images in image set 16, done Extracted 66 features
* Extracti	ing features from 1 images in image set 17 done. Extracted 60 features
* Extracti	ng features from 1 images in image set 18 done. Extracted 60 features
* Extracti	ing features from 1 images in image set 19, done Extracted 89 features
* Extracti	ing features from 1 images in image set 30 done. Extracted 49 features
* Extracti	ing features from 1 images in image set 21 done. Extracted 57 features
* Extracti	ing features from 1 images in image set 27 done. Extracted 57 relatives
* Extracti	ng fastures from 1 images in image set 22 done. Extracted 56 features
* Extracti	ing features from 1 images in image set 24 done. Extracted 30 features
* Extracti	ng fastures from 1 images in image set 25, done Extracted 57 features
* Extracti	ing features from 1 images in image set 26 done. Extracted 37 features
LAUGUI	ng reatures nom 1 miliges in milige set 20-00ne. Extracted 72 reatures.
* Keeping	g 80 percent of the strongest features from each image set.
* Balancu	ng the number of features across all image sets to improve clustering.
** Image	set 8 has the least number of strongest features: 35.
** Using	the strongest 35 features from each of the other image sets.
* Using K	-Means clustering to create a 200 word visual vocabulary.
* Number	r of features : 910
* Number	r of clusters (K) : 200
* Initializ	ing cluster centers100.00%.
* Clusteri	ngcompleted 8/100 iterations (~0.01 seconds/iteration)converged in 8
iterations.	
* Figure	and and the Official and
- ruiisnee	r creating bag-Or-reatines

Table 3.Extracting SURF feature.

* Contending CUDE footness using the Cold calendar method
* Exhacting SURF realities using the Orio selection method.
** The GridStep is [8 8] and the BlockWidth is [32 64 96 128].
* Extracting features from 1 images in image set 1done. Extracted 1140 features.
* Extracting features from 1 images in image set 2done. Extracted 1144 features.
* Extracting features from 1 images in image set 3done. Extracted 1836 features.
* Extracting features from 1 images in image set 4done. Extracted 1296 features.
* Extracting features from 1 images in image set 5done. Extracted 1144 features.
* Extracting features from 1 images in image set 6done. Extracted 1288 features.
* Extracting features from 1 images in image set 7done. Extracted 1700 features.
* Extracting features from 1 images in image set 8 done Extracted 768 features
* Extracting features from 1 images in image set 9 done Extracted 1440 features
* Extracting features from 1 images in image set 10, done Extracted 2300 features
* Extracting features from 1 images in image set 10done. Extracted 1400 features.
* Extracting features from 1 images in image set 17, done Extracted 1400 features
Extracting rearing from 1 images in image set 12, June Extracted 1052 features.
* Extracting features from 1 images in image set 15done. Extracted 1568 features.
* Extracting features from 1 images in image set 14done. Extracted 1352 features.
* Extracting features from 1 images in image set 15done. Extracted 2240 features.
* Extracting features from 1 images in image set 16done. Extracted 1360 features.
* Extracting features from 1 images in image set 17done. Extracted 1440 features.
* Extracting features from 1 images in image set 18done. Extracted 1104 features.
* Extracting features from 1 images in image set 19done. Extracted 1104 features.
* Extracting features from 1 images in image set 20done. Extracted 1196 features.
* Extracting features from 1 images in image set 21done. Extracted 1104 features.
* Extracting features from 1 images in image set 22done. Extracted 960 features.
* Extracting features from 1 images in image set 23done. Extracted 1104 features.
* Extracting features from 1 images in image set 24done. Extracted 1624 features.
* Extracting features from 1 images in image set 25done. Extracted 1584 features.
* Extracting features from 1 images in image set 26 done Extracted 1680 features
Estateting Readed from 1 mages in mage set 20tone. Estateted 1000 Readeo.
* Kaaning 80 parcent of the strongest features from each image set
Reeping of percent of the subligest reatures from each image set.
* Delensing the number of features earnes all image sets to improve electoring
** Image set 8 has the laset number of strangest features 614
** Using the strangert 614 features from each of the other image sets
** Using the shongest 614 reatures from each of the other image sets.
* If the ICM and the first sector 500 and the data by
 Using K-intensis cidstering to create a 200 word visual vocabulary.
* Number of features : 15964
* Number of clusters (K) : 500
* Initializing cluster centers100.00%.
* Clusteringcompleted 21/100 iterations (~0.10 seconds/iteration)converged in
21 iterations.
* Finished creating Bag-Of-Features



Figure 8. Evaluation of proposed system by the feature of local binary pattern using KNN classifier.







Figure 10. Evaluation of proposed system by the feature of SURF using KNN classifier.



Figure 11. Evaluation of proposed system by the feature of local binary pattern using SVM classifier.



Figure 12. Evaluation of proposed system by the feature of super pixel using SVM classifier.



Figure 13. Evaluation of proposed system by the feature of SURF using SVM classifier.



Figure 14. Comparing Accuracy for the proposed method using different features with respect to KNN,SVM.



Figure 15. Comparing Sensitivity for the proposed method using different features with respect to KNN,SVM.



Figure 16. Comparing Precision for the proposed method using different features with respect to KNN,SVM.



Figure 17. Comparing FDR for the proposed method using different features with respect to KNN,SVM.



Figure 18. Comparing FNR for the proposed method using different features with respect to KNN,SVM.

Tab	le 4.	Comp	parison	of A	ccuracy	(%))
-----	-------	------	---------	------	---------	-----	---

Technique	C1 Set	C2 Set	C3 Set
KNN+SURF	99	99	99.5
KNN+LBP	90	93	95
KNN+SP	87	90	91
SVM+SURF	69	80	85
SVM+LBP	85	89	89
SVM+SP	72	76	80

Table 5.	Comparison of Processing Time to recognise a let	ters

Technique	Avg Processing Time (Sec)
KNN+SURF	26
KNN+LBP	36
KNN+SP	46
SVM+SURF	33
SVM+LBP	41
SVM+SP	52

 Table 6.
 Matrices for Evaluation of Classifier Performance

Measure	Formula
Accuracy	(TP+TN)/(TP+TN+FP+FN)
Sensitivity/ Recall	TP/(TP+FP)
Specificity	TN/(TN+FP)
Precision	TP/(TP+FP)
F-Score	2*(Precision*Recall)/(Precision+Recall)

Table 7.Performance Measures of SVM

ASL	Accuracy (%)	Specificity (%)	Sensitivity (%)
А	99.00	99.62	93.33
W	98.00	98.54	92.00
С	98.00	99.24	88.57
Н	97.66	98.49	91.66
Т	99.00	99.27	95.83
F	99.30	99.62	99.67
0	98.00	98.86	91.42
Q	98.00	99.27	84.00
L	98.00	98.88	90.00
Ζ	99.00	99.25	96.67

 Table 8.
 MStatistical Features for a test and trained data samples

Statistical Feature	Train Sample	Test Sample
Mean	66.8752	54.6582
Standard Deviation	14.358	15.248
Entropy	4.258	4.689
Skewness	1.5685	1.3658
Kurtosis	149.358	75.698

SI no.	Algorithm	Accuracy (%)
1	KNN+SURF	99
2	KNN+LBP	90
3	KNN+SP	87
4	SVM+SURF	85
5	SVM+LBP	85
6	SVM+SP	72

Table 9.Algorithm Comparison

6. Conclusion and Future Work

The proposed work is to outline and build up a communication through signing acknowledgment framework to perceive motions from American gesture based communication. The Proposed SVM-KNN strategy can perceive single hand motions precisely utilizing webcam. The enhanced calculation can change over uncovered human hand signals into word and discourse design with high exactness and slightest time. The objective is to create a framework which makes simple for the correspondence amongst typical and hard of hearing imbecilic individuals with the assistance of picture preparing innovation. The enhanced SVM-KNN techniques ready to give high acknowledgment rate when contrasted and those of late commitment by considering all the conceivable hand signals of American gesture based communication.

7. References

- Wang Y, Yang R. Real-time hand posture recognition based on hand dominant line using kinect. 2013 IEEE International Conference on Multimedia and Expo Workshops (ICMEW), San Jose, CA. 2013. p. 1–4.
- Singh A, Arora S, Shukla P, Mittal A. Indian Sign Language gesture classification as single or double handed gestures. 2015 Third International Conference on Image Information Processing (ICIIP), Waknaghat. 2015. p. 378–81.
- Singh N, Baranwal N, Nandi GC. Implementation and evaluation of DWT and MFCC based ISL gesture recognition. 2014 9th International Conference on Industrial and Information Systems (ICIIS), Gwalior. 2014. p. 1–7.
- 4. Rekha J, Bhattacharya J, Majumder S. Shape, texture and local movement hand gesture features for Indian Sign Language recognition. 3rd International Conference

on Trendz in Information Sciences and Computing (TISC2011), Chennai. 2011. p. 30–5.

- Nagadeepa C, Balaji N, Padmaja V. An Efficient Framework for 2-Dimensional Gesture Based Telugu Character Recognition. 2016 IEEE 6th International Conference on Advanced Computing (IACC), Bhimavaram. 2016. p. 446–50.
- Pan TY, Lo LY, Yeh CW, Li JW, Liu HT, Hu MC. Real-Time Sign Language Recognition in Complex Background Scene Based on a Hierarchical Clustering Classification Method. 2016 IEEE Second International Conference on Multimedia Big Data (BigMM), Taipei. 2016. p. 64–7.
- Savur C, Sahin F. Real-Time American Sign Language Recognition System Using Surface EMG Signal. 2015 IEEE 14th International Conference on Machine Learning and Applications (ICMLA), Miami, FL. 2015. p. 497–502.
- Ghosh DK, Ari S. Static Hand Gesture Recognition using Mixture of Features and SVM Classifier. 2015 Fifth International Conference on Communication Systems and Network Technologies (CSNT), Gwalior. 2015. p. 1094–9.
- Huan L, Bo R. Human gesture recognition based on image sequences. Control Conference (CCC), 2015 34th Chinese, Hangzhou. 2015. p. 8388–92.
- Kuroki K, Zhou Y, Cheng Z, Lu Z, Zhou Y, Jing L. A remote conversation support system for deaf-mute persons based on bimanual gestures recognition using finger-worn devices. 2015 IEEE International Conference on Pervasive Computing and Communication Workshops (PerCom Workshops), St. Louis, MO. 2015. p. 574–8.
- Ni Z, Fu S, Tang B, He H, Huang X. Experimental studies on indoor sign recognition and classification. 2014 IEEE Symposium on Computational Intelligence and Data Mining (CIDM), Orlando, FL. 2014; 489–94.
- Viswanathan DM, Idicula SM. Recognition of hand gestures of English alphabets using HOG method. 2014 International Conference on Data Science and Engineering (ICDSE), Kochi. 2014. p. 219–23.
- Plawiak P, Sosnicki T, Niedzwiecki M, Tabor Z, Rzecki K. Hand Body Language Gesture Recognition Based on Signals From Specialized Glove and Machine Learning Algorithms. IEEE Transactions on Industrial Informatics. 2016 Jun; 12(3):1104–13.
- 14. Huang J, Zhou W, Li H, Li W. Sign language recognition using real-sense. 2015 IEEE China Summit and International Conference on Signal and Information Processing (ChinaSIP), Chengdu. 2015. p. 166–70.
- 15. Aryanie D, Heryadi Y. American sign language-based finger-spelling recognition using k-Nearest Neighbors classifier. 2015 3rd International Conference on Information

and Communication Technology (ICoICT), Nusa Dua. 2015. p. 533–6.

- Wahyono, Jo KH. A comparative study of classification methods for traffic signs recognition. 2014 IEEE International Conference on Industrial Technology (ICIT), Busan. 2014. p. 614–9.
- Sinith MS, Kamal SG, Surendran NS, JPS. Sign Gesture Recongnition using Support Vector Machine. 2012 International Conference on Advances in Computing and Communications (ICACC), Cochin, Kerala. 2012. p. 122–5.