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Incessant Signs Recognition via Neoteric Classifier Based on Ls-SVM and Naïve Bayes with the Aid of Multi-Features

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***Abstract*—**Over past decades, Indian Sign Language plays an important role for speech and hearing impaired community. This paper focus on novel classification for the detection of sign language efficiently with the use of multi features. The purpose of this paper is to study the existing classification and recognition techniques. And to propose the methodology for better results. From the set of images, features such as edge, texture, histogram and corner features are extracted efficiently using Canny edge detection, Gabor filter, and Harris corner detection. These features are categorized by the hybrid techniques of classification by the contribution of LS-SVM with Naïve Bayes classifier. Initially median filter is utilized for the elimination of noise. The segmentation of image is accomplished by utilizing wavelet transform. Then the recognized sentence will be displayed as a text format in the final outcome. The proposed technique implemented and the practical outcome shows high recognition rate and achieve high accuracy of detection.

***Keywords*—** Canny Edge Detection, Gabor Filter, Harris Corner Detection, LS-SVM, Median Filter, Naïve Bayes, Wavelet Transform.

I. INTRODUCTION

Sign language is the translator of communication between hearing disability people. With the evolution of image processing, various techniques are developed recently in this area. A large amount of the signs in ASL (American Sign Language) are single handed and Indian Sign Language (ISL) is double handed, So ASL is simpler than ISL [1]. Communicating with computers using the people activity is usually utilizing in HCI human computer interaction) applications. One way to integrates the person activity into HCI application are to exploits an already defined groups of the people joint activity that is, gestures [2]. Gestures are used instead of sound to convey among themselves.

Gestures are categories into two types of gesture; first one is static and second is dynamic gesture. The static gesture denoted to confirmed sign of hand and finger orientation and a dynamic gesture incorporates diverse activity and orientation of face expressions, it is mostly utilize to detecting regularly stream of sentences. Sign language recognition (SLR) is belonging to dynamic hand gesture recognition as several gestures can be integrated of larger than one static gesture. In this world, there are multiple numbers of SL (Sign Languages) which are commonly utilized in particular country. The SL is diverge from the other depends on the country culture and spoken language [4]. SL is a visual-gestural language enforced by deaf and hard-hearing human. SL is a utilize 3-D (three dimensional) expanse and the hand activity to denoted meaning. The SL language, it has own syntax and vocabulary, it is whole language is divergent from the other written and spoken languages [5]. Hand gesture recognition approach is utilized as an intermediate to interacting with speech disability people and it interfaces the interaction gap among hearing people and normal people. Computer based detection approach can operates like an intermediate by capture the sign, processing the sign, recognize the sign and explode the result as text [6]. The Deaf and Dumb human depends on sign language translator for the interactions. Although, discover experienced and trained translator for their day to day event throughout life time is a very hard work and also expensive. Since, human-computer communication model show to be a dependable and fixed answer to thus humans [7].The utilize of gestures are always restricted in a the hearing and disability humans, the normal human never try to learn the SL. This causes a large gap in interaction between the hearing-dump and the normal people [8]. Communications is states as interchange of thinking and message either by behavior, speech. The Deaf and dump

human utilize their hands to denote their thinking. Understanding gestures is difficult for normal people. Therefore, these gestures are converted to messages [9]. Deaf human survive entire components of the world. Everywhere the community of deaf people handle, sign language necessarily expanded. In country wise, various languages have been develop as, in Germany developed languages as GSL (German sign language), in America developed as ASL (American Sign Language) and India develop as a ISL (Indian sign language) [10].

A sign language involves the group of manual gestures that use fingers, arms, palms and even human body activity to shown in a numbers, alphabetic letters and words. This category of language enables human who cannot speak or hear to interacting with others humans. Many number of people does not known the each types of language are use deaf and dump people. Therefore, for disability human operating regularly movement turns to be difficult, particularly in public region. Contributed, it is hard and very expensive to develop non-hearing human learn the sign language [11]. The use of gestures in transfer of verbal interaction is very advantageous for the people having no optical interaction. ISL created a try in this direction that corresponds with recognize of various static and indicative alphabetic letters created by hand gestures [12].

Sign Language Recognition (SLR) method provides a strong and dependable via which privates can obtained immediate review on the signs performing by the signers in from of speech or text. SLR techniques have performing very significant work on in gesture-driven HCM system [13]. The communication comprises of the straight organization of graphics objects subsequently as symbols and windows utilizing a signifying instruments. Regardless of whether the contraption of consoles and mouse is a superior advancement, there are still conditions in which these instruments are clashing for HCI [14]. The development of hand motion arbiter's researches effective applications in sign to content transformation strategies, mechanical autonomy, video explanations, assistive framework, gesture based communication Association, virtual reality and video based perception [15]. The procedure of hand signal discovery for the most part comprises of four stages: hand motion picture gathering, motion picture pre-processing utilizing a few strategies, highlight extraction, division and the investigation and characterization stage where the picture is classifications to its resultant motion class [16]

The sign recognition of ISL via neoteric classifier based LS-SVM and Naïve Bayes with the aid of multi-features were addressed here. The outline of this research paper is review as below. Section 2 deals with associated research difficulty. Section 3 discussed about the proposed sign recognition of ISL using neoteric classifier based LS-SVM and Naïve Bayes. Section 4 discussed about the simulation result and performance evaluation of this research and conclusion is stated in section 5.

II. RELATED WORK

In this section, some recent techniques for recognition of ISL are reviewed. Haitham Hasan and S. Abdul-Kareem [17] have described a technique for the recognition of gesture images by the employment of human–computer communication depends on shape evaluation. Here the presence of neural network provided a way for recognizing the hand gestures. A unique multi-layer approach of neural network was constructing for categories by means of back propagation learning algorithm. The primary targets of the static hand motion recognition was to classifications gave hand motion information represented by a few highlights into a few predefined settled number of signal classes. This system represents a recognition algorithm to detecting a group of six static hand gestures, namely: Close, Paste, Open, Maximize, Cut and Minimize. It was gives via three phases, classification, and preprocessing and feature extraction.

Joyeeta Singha and Rabul Hussain Laskar [18] have implemented fusion depends on dynamic independent-air hand gesture detection system to recognize the unique gesture. Diverse clients motion at different velocities for the comparative motion. At the point when separates with different examples of the comparable signal, change because of uniqueness in motion speed not supported to the distinctive score. Along these lines, a two-level speed standardization process by utilizing DTW and Euclidean separation based systems was spoken to. Three highlights in this manner as 'speed', 'introduction between successive focuses' and 'introduction amongst first and each direction focuses' were used for the speed standardization. In any case, in include extraction stages, 44 highlights were looked over the current paper. Utilization of aggregate component gathering could lead to over fitting, data repetition and raising the computational unpredictability because of bigger measurement. In this manner, an exertion was produced to decrease the issues by picked ideal arrangement of highlights utilizing investigation of difference and raising highlights determination procedures.

Subhash Chand Agrawal et al. [19] have discussed about vision-based system for detection of unique sign with the analysis of dynamic and static behavior of Indian sign language (ISL). This technique composed of three phases: preprocessing, feature extraction and classification. In the preprocessing phases, different methods are presented thus as, color segmentation, RER algorithm and face elimination can be accomplish. The important goal of RFR algorithm to remove the redundant frames from the sign video to fast the

recognize work. The second step is feature extraction module, in that step multiple number of feature are extracted. The classification of sign can be performed by using the BKNN (Bayesian K-nearest neighbor) and MSVN (multi-class support vector machine).

Ruben Garcia-Zurdo [20] has described a technique for the recognition for face expression modify in unique ISL decision. Facial gesture pattern results in the change of skin texture by devise crinkle and furrows. Gabor wavelet technique was a common to catch precise textual changes on surfaces. Therefore, a unique approach was developed to model facial expression changes with Gabor wavelet parameters that were chosen from partitioned face areas. These parameters were incorporated with Euclidian distance measure. Multi class SVM classifier was used in this recognition system to identify facial expressions in an isolated facial expression sequences in ISL.

Neha baranwal ET al. [21] have developed a technique using DWPT (Discrete Wavelet Packet Transform) for hand gesture detection. This technique supplies more accurate recurrence determination and more versatility than DWT which sup-port to get the invariant highlights. Dynamic hand gestures were coordinated in a settled foundation and variable light circumstances. These techniques are used for the data confining and removal un-wanted noise. The PCA (Principal Component Analysis) was utilized for dimensionality diminishment and for the extraction of most critical features.

III. PROPOSED METHODOLOGY TO OBSERVE THE SIGN LANGUAGE

Language is the mirror of heart and mind but the deaf and dump people does not have any language other than the Sign Language. This sign language can't be understood by the ordinary people, for this purpose recognition system is used. If they use their signs to express themselves, the recognition system identifies their language. In order to recognize the sign language their gestures and postures are utilized. These gestures and postures are captured and their features are extracted for this process. Once when the features are extracted, they are utilized for classification process. In the existing systems, they have utilized some features for the recognition process. Moreover many existing researches, they have identified single letters like alphabets and numerals. In this paper different features are utilized to provide proper recognized system. This work intended to use the continuous signs in order to identify the sentences for clear-cut perceive of such people's intention.

The important goal of this innovation paper is to recognize posture and gesture for ISL. This can be done in step-by-step process. At first, data acquisition and pre-processing will be performed using a specialized filter to remove noise from the image. After that, segmentation is done by means of Wavelet Transformation. Segmented image is utilized in the next phase that is feature extraction phase. In this work, features such as edge, Texture, histogram, and corner features will be extracted from the image by using the canny edge detection, Gabor filter, and Harris corner detection. After that, by the employment of direct pixel value and hierarchical centroid method, the size of the pixel will be reduced and centroid point will be recognized to split the image. By performing the above process the quality of the image will be improved.

The output from the feature extraction phase will be the extracted features and it will be given as the input for the classification phase. In the classification process, we have utilized LS-SVM in combination with Naïve Bayes.

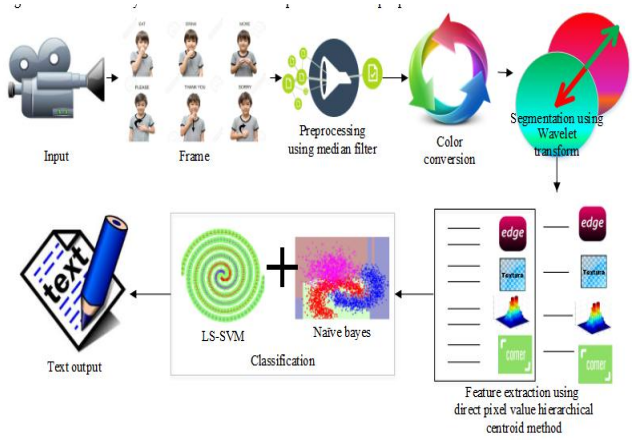


Figure 1 Proposed Method for Incessant Signs Recognition

In order to attain the desirable result, the hybridization of both the techniques is utilized in the training step and in the testing step. The features obtained from the feature extraction phase will be reduced by the Naïve Bayes, testing and training phase will be done by using LS-SVM. Finally the recognized sentence will be displayed as text in the final outcome.

The input video V is changed over into image frame I

with $m \times n$ size and p_{uv} be the number of pixels in the given image.

$$V = \{I_1, I_2, ..., I_{N-1}\} (0 \le k \le N-1) \quad (1)$$

Let I_{inp} be one of the image frame from the video V,

with $m \times n$ size and p_{uv} pixels. At first the image is filtered to remove the noises from it and then the denoise image is converted to gray scale image.

3.1 Pre-processing

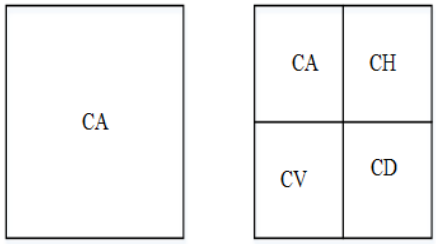
Median filter is regularly utilized for decreasing noise of their strongest opposite to spontaneous type noise and edges conserve attributes. In the centroid filter are performed to entire pixel value categories from the natural neighbourhood into numerical way and afterward change the pixel under thought with the middle pixel esteem. Middle separating resembles utilizing a middle channel, in that each yield pixel is an "average "of the area pixel esteems. The middle channel regularly completes a superior occupation than the mean get out in holding beneficial detail in the pixel. The essential advantages of middle channel over the mean channel are that it is significantly more grounded and grater at preservation edges than mean channel.

3.2 Color conversion

The color conversion is the second phase of pre-processing. Startlingly the RGB images are trans-form to gray scale image by rgb2 gray function available in MATLAB environment. It transforms the true color image RGB to the gray scale intensity image. The function transform RGB images to gray scale by eliminating the shade and sanitation information while belongings the brightness.

3.3Wavelet transform

At first, the input image is subjected to the segmentation process. Wavelets are function to generate from the single function by amplifications and elucidations. The key idea of the wavelet changeover is to indicate any subjective capacity as a superposition of wavelets. Any such superposition breaks down the given trademark into remark-able scale levels wherein each level is besides decayed with a choice custom fitted to that stage.



(a) **(b)**

Figure 2 Image decomposition: (a) original image, (b) decomposed image

Image I_{inp} is additionally decomposed utilizing the wavelet transform and detail coefficients

CA_j at scale j are given by,

$$CA_j(u,v) = I_{inp} * \psi_j(u,v) \quad (2)$$

Where, ψ_j is a wavelet at scale j and * signifies the convolution.

In two-dimensional DWT leads to a decomposition of estimate coefficients at level j in four components: the approximation at level $j+1$, and the details in three orientations (horizontal, vertical, and diagonal).

The accompanying figure3 describes the decomposition steps for image:

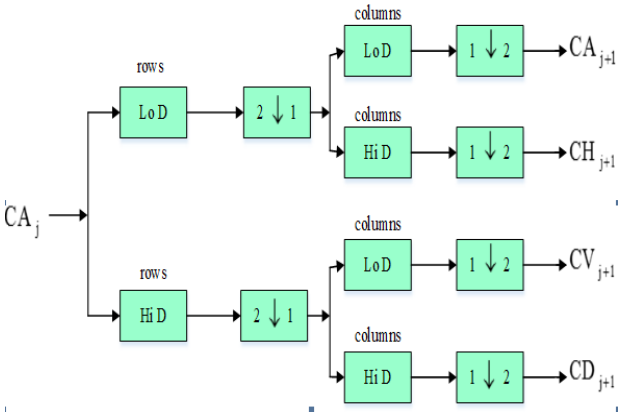


Figure 3 Decomposition Steps

In figure 3 LoD is a decomposition low-pass filter. HiD is a decomposition high-pass filter. LoD and HiD must be the same length.2 1 is a down sample columns keep the even indexed columns, 1 2is a down sample rows
Maintain the even indexed rows.

The discrete wavelet transform (DWT) is indistinguishable to a various leveled sub band framework where the sub-groups are logarithmically dispersed in recurrence and speak to octave-band deterioration. Here we are utilizing db1 wavelet. By applying DWT, the picture is really parceled i.e., disintegrated into four sub-groups and basically sub-inspected as display in Figure 2. The sub-bands marked as CA, CH, CV and CD. Here CH, CV and CD are the finest scale wavelet coefficients while the sub-band CA corresponds to coarse level coef-ficients.CA is details coefficient matrix, CH is horizontal coefficient matrix, CV is vertical coefficient matrix, and CD is diagonal coefficient matrix. After segmentation the image is decomposed in to image.

3.4 Feature Extraction

Feature extraction is a kind of dimensionality reduces. Input ages are to larger for activity, so that process the image in that time reduces the determination of the input image by feature extraction. Feature extraction is states as, changing input data into feature. It is chosen in that direction image information is hold.

In feature extraction process edge, texture and corners are extracted by utilizing canny edge detection, Gabor filter and Harris corner detection respectively. At last histogram features are extracted, which are quickly clarified in beneath sections.

3.4.1 Edge features

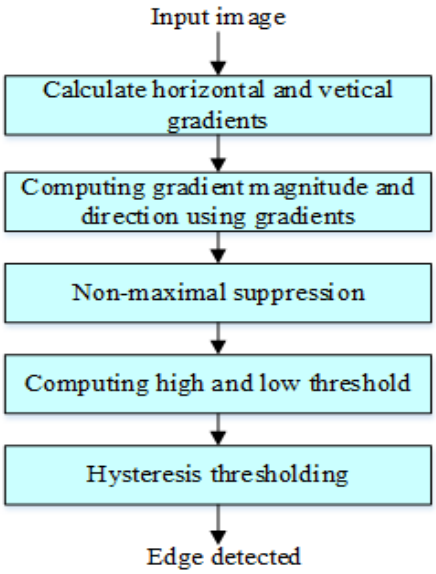


Figure 4 Steps of Edge Detection

The canny edge detection algorithm is done by five steps. In the initial step the horizontal (G_u) and vertical (G_v) gradient of each pixel in an image is computing. In the second phase of size and way of the each pixel in the image is measured. In the third step all non-maxima's are made as zero that is suppression the non-maxima's therefore the step is called Non-Maximal Suppression. In the fourth step the high and low thresholds are measured utilizing the histogram of the gradient size of the image. In the fifth step to get the best possible edge map hysteresis thresholding is utilized which will link between the frail and solid edges. The weak edges are considered over if and only if it is connected to one of the solid edges or else it is dispensed with from the edge map. The solid edge is the one whose pixel is more than the high threshold and weak edge is one whose pixel value lays amongst high and low threshold.

3.4.2 Texture features

Gabor filters are utilized to extract texture feature at each pixel of input image. Brief Gabor filters are utilized for space invariant pressure photographs and curved line strains. The lengthy Gabor filters out for grey stage traits and directly line strains. The filter out may be seen as sinusoidal plane of element frequency and orientation, balanced by way of a Gaussian envelope. It isolated by many filtered image which restricted frequency and patterns in intensity is change. It is considered to be reasonable to recognize the texture. The conversion is considered as wavelet transform of which the main wavelet is Gabor function. The Gabor wavelet change of an image is

$$g(u,v) = \sum_s \sum_t f(u-s, v-t)\psi(s,t) \quad (3)$$

In spatial area, a Gabor filter is

$$\psi(u,v) = \exp\left\{-\frac{1}{2}\left[\frac{\tilde{u}}{\sigma_u} + \frac{\tilde{v}}{\sigma_v}\right]\right\}\cos(2\pi f\tilde{u}) \quad (4)$$

Where f is central frequency and σ_u, σ_v are correspondingly the constant of space of u, v Gaussian casing. After the combining the changed virtual and real parts, in order to enhance the size of changed image, the texture features characterizing the image were expelled.

3.4.3 Corner features

Calculation of Harris corner feature score

Then the input image pixels go through the line buffers and create a 3x3 window. Here the block RAM resource utilized to build line buffer. Partial derivative is taken to calculate horizontal and vertical image gradients. In parallel the multiplier array calculates the elements of matrix Mat those are $G_u, G_v, G_u \times G_v$.

$ind(a,b)$: The intensity of pixel at row a and column b

Calculate $G_u(...)$ and $G_v(\ldots)$ the partial derivatives of $ind(\,)$ in a and a direction both the image.

$$G_u = \left(\frac{\partial ind(a,b)}{\partial u}\right), \quad G_v = \left(\frac{\partial ind(a,b)}{\partial v}\right) \quad (5)$$

Where, $\partial u = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$ and $\partial v = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$

$$Mat = \begin{bmatrix} \sum_{a,b}^{W} G_u^2 & \sum_{a,b}^{W} G_u \times G_v \\ \sum_{a,b}^{W} G_u \times G_v & \sum_{a,b}^{W} G_v^2 \end{bmatrix} \quad (6)$$

Where W is range of window and a , b are index of pixels. The approximation formula is employed to calculate Harris score and then compared to threshold value. Here R gives the approximation formula.

$$R = Det(Mat) - k * Trace(Mat)^2 \quad (7)$$

Where value of k is in between 0.04-0.06.

Threshold operator

This is utilized to eliminate feature points in the local area. If the threshold value is less than the value of R, then middle pixel of window is termed as corner element. Like this all corner elements in image are detected. Here based on the image type, the number of corners detected varies. If the large number of corners is detected then there is a need of non-maximum suppression block to avoid confusion in further processing.

Find N best corner feature elements

Depending on the image type we decide the upper and lower threshold value. But sometimes it may happen that the detected corner feature element value does not match any of the threshold value and not within the range. Then at this time the threshold value is multiplied by 2 or divided by 2.

Feature matching

The intensity of pixel plays important role to match corner candidates of both stereo pair images.

$$\left| Ind_L(a,b) - Ind_R(a,b) \right|$$

This is how the Harris corner detection algorithm used for the equivalent the stereo pair images.

3.4.4 Histogram features

A histogram of the image $f_1(x,y)$ can be characterized as

$$H_i = \sum_{x,y} I_{seg}(f_1(x,y) = i), i = 0,...,n-1 \quad (8)$$

$$I(A)\begin{cases} 1 & A \text{ is true} \\ 0 & A \text{ is false} \end{cases} \quad (9)$$

This histogram comprises data regarding the dissemination of the restricted smaller scale designs in this manner as edges corner across all images. So, it can be exploits to statistically explaining image attributes. The entire image is similarly isolated into small regions $R_1, R_2, ...R_m$ to extract histograms. The features extracted from each sub-division are joining into single; specially improve feature histogram characterized as

$$H_{i,j} = \sum_{x,y} I\{f_1(x,y) = 1\} \pm (x,y) \in R_j \quad (10)$$

Where $i = 0,...,n-1, \quad j = 0,...,m-1.$

3.4.5 Direct pixel value and hierarchical centroid method

Feature extraction techniques exploits as a part of this project are direct pixel value and hierarchical centroid.

In direct pixel value function extraction technique, unique picture was resized to m×n pixels and after that the picture matrix was converted into one dimensional array.

Hierarchical centroid, which makes use of the centroid technique for locating the centroid of the photograph, via the centroid photo is apportioned into two one of a kind zones, left and right zones. Iteratively this approach became in line with-formed at most seven times then we obtained features out the image. The last outcomes of the extraction task is regarding of functions, normally is known as attribute vector and function vector represent the image. After feature extraction the I_{seg} image is changed in to I_{fet} image.

3.5 Classification

The feature extracted I_{fet} image is set as an input for classification process. In the classification process, we have utilized LS-SVM in combination with Naïve Bayes. In order to attain the desirable result, the hybridization of both the techniques is utilized in the Training step and in the testing step. The features obtained from the feature extraction phase will be reduced by the Naïve bayes, testing and training phase will be done by using LS-SVM. The features obtained from the feature extraction phase will be tested with the database in training phase and the recognized sentence will be displayed as a text format in the final outcome.

3.5.1 Naïve Bayes

The Naïve Bayesian classifier is constructing absolutely in light of Bayes' hypothesis with freedom suspicions among indicators. A Gullible Bayesian variant is clear to work, without a mind boggling iterative parameter estimation which makes it particularly advantageous for to a great degree enormous datasets. Despite its straightforwardness, the Innocent Bayesian classifier frequently improves and is broadly utilized in light of the fact that it regularly beats more noteworthy cutting edge order systems.

Bayes theorem supplies a direction of measuring the posterior probability, $P(c \mid x)$ from $P(c)$, $P(x)$ and $P(x \mid c)$. Naive Bayes classifier concludes that the impacts of the value of a predictor (x) on a provided class (c) are independent of the values of other predictors. This assumption is called class conditional independence.

$$P(c \mid x) = \frac{P(x \mid c)P(c)}{P(x)} \quad (11)$$

$$P(c|x) = P(x_1|c) \times P(x_2|c) \times ... \times P(x_n|c) \times P(c) \quad (12)$$

Where,

$P(c|x)$, is the posterior probability of class (target) given predictor (attribute).

$P(c)$, is the prior probability of class.

$P(x|c)$, is the likelihood which is the probability of predictor given class.

$P(x)$, is the prior probability of predictor.

Numerical predictors

Numerical variables need to be changed over to their express inverse numbers previously building their recurrence tables. The option is utilizing the conveyance of the numerical variable to have a decent wagered of the frequency. The opportunity density characteristic for the distribution is explains through two argument this is S.D and mean.

The frame probability is

$$\sum \frac{1}{\sqrt{2\pi}std} \frac{x - mean}{2 \times (std)^2} \quad (13)$$

Where the mean value is

$$mean = \frac{1}{n} \sum_{i=1}^{n} x_i \quad (14)$$

And the standard deviation is

$$std\sigma = \left[\frac{1}{n-1} \sum_{i=1}^{n} (x_i - m)^2 \right]^{0.5} \quad (15)$$

The Naïve Bayes probability value is

$$\sum_{i=1}^{n} \frac{1}{\sqrt{2\pi\sigma}} e \frac{x_i - m}{2\sigma^2} \quad (16)$$

3.5.2LS-SVM

An LS-SVM is a two-class classifier building from addition of a kernel function $K(\cdot\cdot)$

$$f(x) = \sum_{i=1}^{N} \alpha_i t_i K(x, x_i) + d \quad (17)$$

Where t_i is the ideal output, $\sum_{i=1}^{N} \alpha_i t_i = 0$ and $\alpha_i > 0$. The vectors x_i are support vectors and obtained from the training set by a development procedure. The predicated outcomes are 1 or -1; possible on whether the according to the SVM is in class1 or class 0, appropriately. For classification, a class decision based on whether the value, $f(x)$ is above or below a threshold.

The kernel $K(\cdot\cdot)$ is strained to have several attributes, so that $K(\cdot\cdot)$ can be denoted as

$$K(x, y) = b(x)^t b(y) \quad (18)$$

Where, $b(x)$ is a mapping from the enter space to a maybe boundless dimensional territory. The piece is should have been amazing semi-specific. The Mercer condition ensures that the edge idea is huge, and the streamlining of the LS-SVM is restricted.

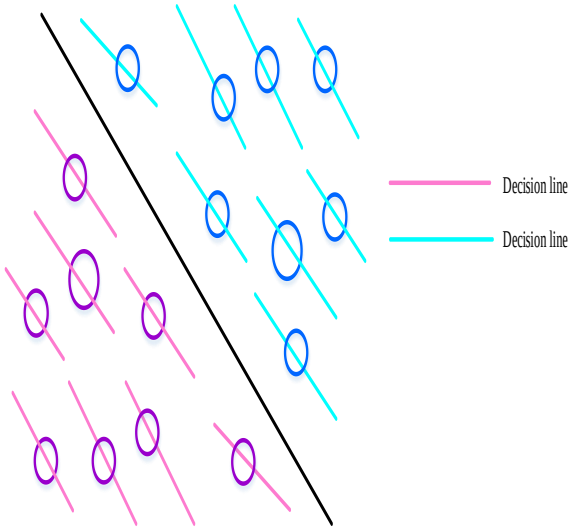


Figure 5 Classification Of LS-SVM

The optimization case relies upon a maximum margin idea, see Figure 5. For a divisible statistics set, the framework puts a hyper plane in an exorbitant dimensional zone so that the hyper plane has greatest edge. The records factors from the preparation set duplicity on the breaking points are the help vectors in Eq. (17). The point of convergence, at that point, of the LS-SVM instruction methodology is to demonstrate restrict, as opposed to a traditional GMM UBM which might version the opportunity distributions of the two classes.

IV. SIMULATION RESULTS

The important goal of this innovation approach is to recognize the sign language using Neoteric classifier based on LS-SVM with Naïve bayes classification. The proposed methodology is implemented in the MATLAB platform.

4.1 Performance evaluation

Here a video file is given as input.The size of the input video is146 kb is of .mp4 type. The video have 640 widths and 360 heights and 0.03 lengths. This video is converted in to 98 frames. After that the video file is converted into 98frame. I_{inp} , be one of the image frame from the video V . The input frame is given below in figure 6.

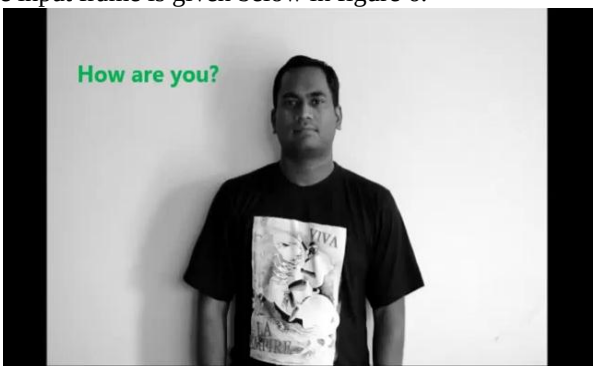


Figure 6 Input Frame

The first step in this proposed approach is preprocessing. Here the frame contains some noise and it is removed by the utilization of median filter. The frame after the removal of noise is shown below in fig 7.

Figure 7 Preprocessed Images

The second step in this proposed approach is color conversion.The RGB images were transform to gray scale image. It is provided following figure 8.

Figure 8 Gray scale image

The third step in this innovation system is segmentation. In the segmentation process the grayscale image is decomposed using the wavelet transform. After segmentation the I_{inp} image is decomposed in to I_{seg} image is given below in figure 9

Figure 9 Decomposed Image

The fourth step in this proposed approach is feature extraction. After feature extraction the I_{seg} image is changed in to I_{fet} image.

The edge feature are extracted by using the canny edge detection is given below in fig 10

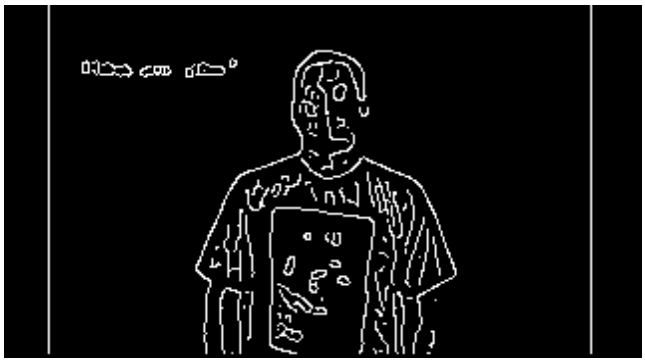


Figure 10 Edge Detected Image

In the feature extraction phase the texture feature are extracted using Gabor filter is given below in figure 11

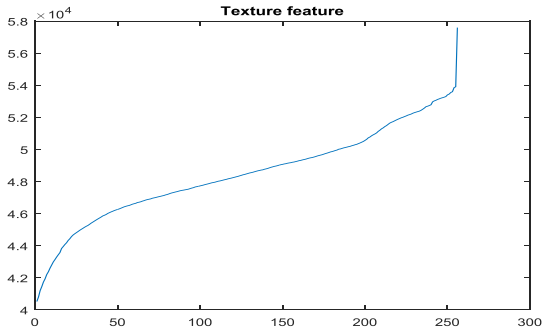


Figure 11 Texture Feature

In the feature extraction phase the Corner feature are extracted using Harris corner detection is given below in fig 12

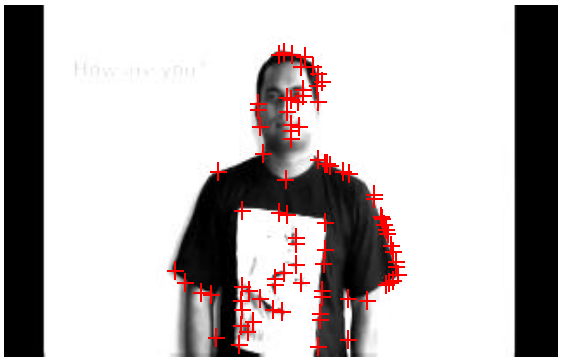


Figure 12 Detect Corner-Harris

In the feature extraction phase the histogram features are extracted is shown in figure 13. The histogram features are extracted for classification process.

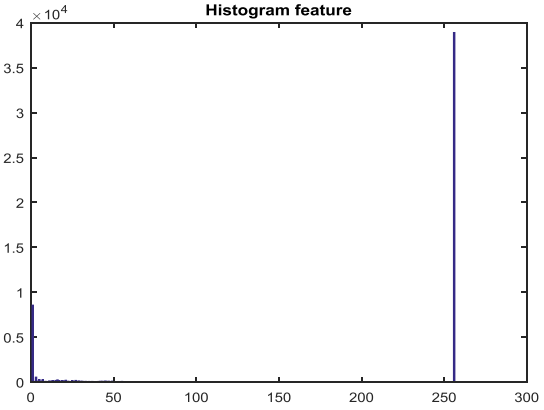


Figure 13 Histogram Feature

The feature extracted I_{fet} image is set as an input for classification process. In the classification process, we have utilized LS-SVM in combination with Naïve Bayes. The features obtained from the feature extraction phase will be reduced by the Naïve bayes, testing and training phase will be done by using LS-SVM. The output text is given below in figure 14.

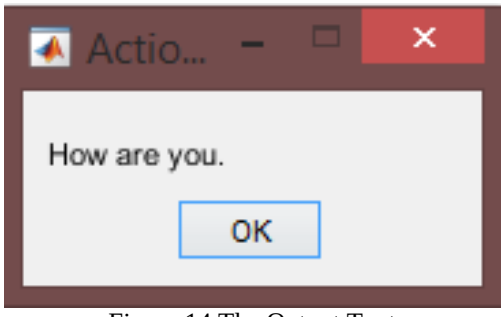


Figure 14 The Output Text

The results for various input videos is shown below in figure 14,15,16,17.

Result for sample video 1 is shown below in fig 15.

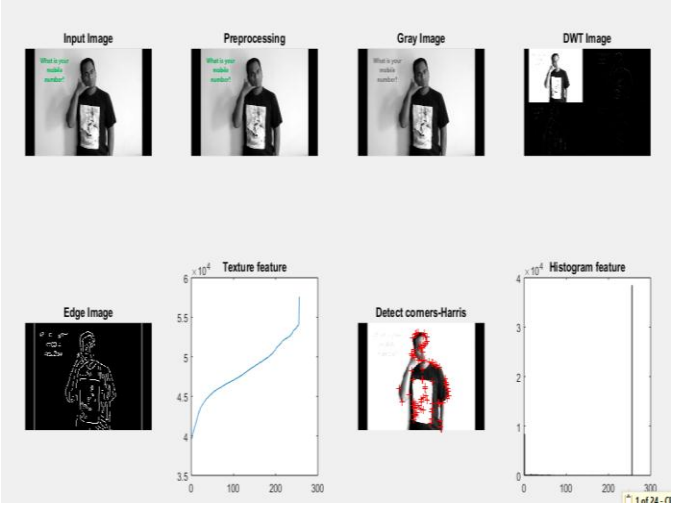


Figure 15 Results for Sample Video 1

Result for sample video 2 is shown below in fig 16.

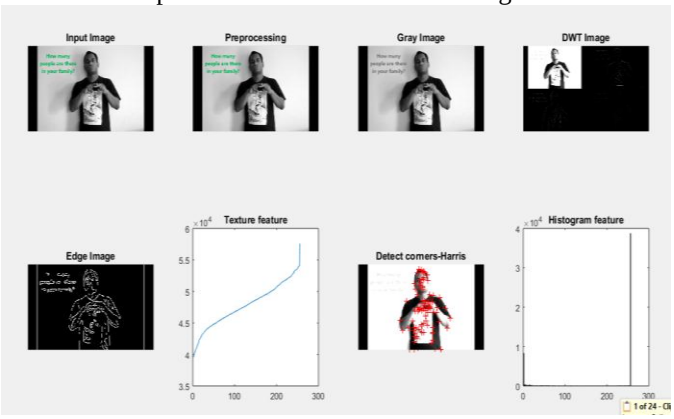


Figure 16 Result For Sample Video 2

Result for sample video 3 is shown below in fig 17.

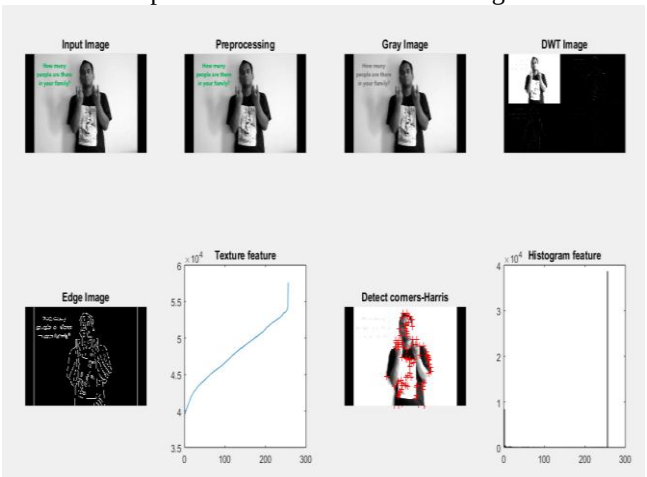


Figure 17 result for sample video 3

Processing time for different video files is shown below in table 1. Based on the number of frames the processing time varies. For more number of frames, the processing duration is high and for fewer number of frame, the processing duration is low.

Table 1 Processing time for different video files

Sr. no	File	File size	File length	No. of frames	Processing time (sec)
1	Do you go to office	200KB	00.00.04	137	29.190377
2	Do you have money	122KB	00.00.02	83	16.523261
3	Do you watch TV	226KB	00.00.05	152	31.131556
4	Good question	130KB	00.00.03	90	17.706682
5	How are you	146KB	00.00.03	98	18.826170

The processing time for different video is shown below in figure 18.

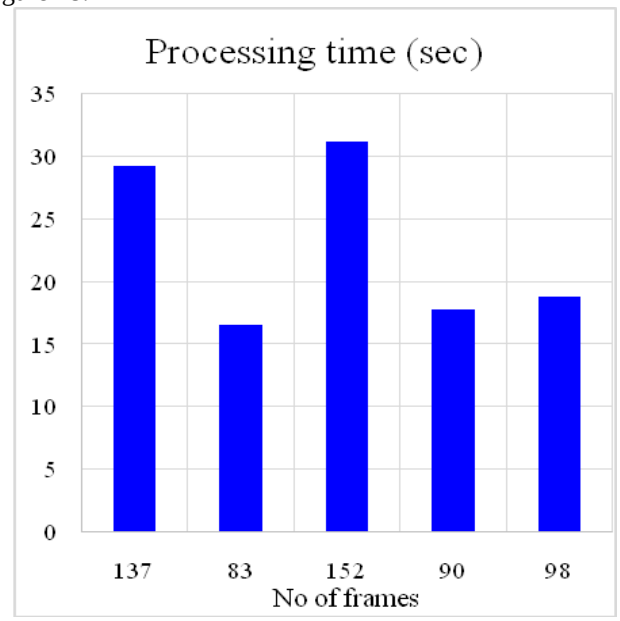


Figure 18 Processing Time for Different Video

4.2 Comparison result

Accuracy: The classification accuracy is determined of utility of a technique. It is based on the number of proper classified samples, and is determined using the below equation.

$$\text{Accuracy}(\%) = \frac{\text{No of correctly classified samples}}{\text{Total no of samples}} \times 100 \quad (19)$$

The accuracy rate is must always be high for obtaining efficient result. The accuracy rate is compared with the existing approach is display the following table 2.

Table: 2Comparisonswith Existing Approach

SR.NO	CLASSIFIER	ACCURACY
1.	MSVM	95.3%
2.	KNN	97.10%
3.	SVM	98.75%
4.	LS-SVM with NB	100%

The accuracy rate of the proposed LS-SVM with Naïve bayes is compared with existing technique like MSVM, KNN, and SVM in figure 19.It is proved that our proposed method achieves high accuracy rate.

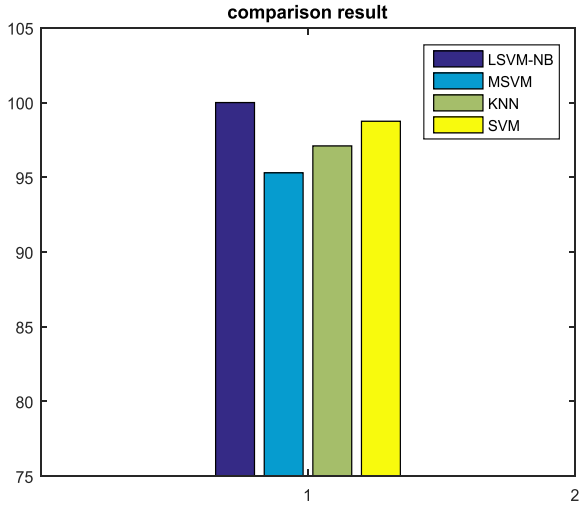


Figure 19 Comparisons for Accuracy Rate

V. CONCLUSION

Incessant sign language recognition via neoteric classifier based on LS-SVM with Naïve Bayesis presented in this paper. In the first phase noise is removed by a median filter and in the second steps, segmentation is complete with the aid of Wavelet Transformation. Image features such as edge, Texture, histogram, and corner features are extracted for the subsequent process in the third phase. Here, feature extraction is done by the employment of direct pixel value and hierarchical centroid method. In the classification process, we have utilized LS-SVM in combination with Naïve Bayes for training and testing phase. The features obtained from the feature extraction phase are tested using the database in training phase and the recognized sentence is displayed as text in the final outcome. Experimental results

demonstrate that our proposed continuous sign language recognition provides better accuracy of 100%.

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