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Methodology for Sign Language Video Interpretation in Hindi Text Language

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ABSTRACT: Hand gestures are a promising interaction modality for a variety of applications, including human-robot interaction, virtual reality, and health care. A robust hand gesture detection and recognition is represented basically by continuously changing different hand shapes and movement by a signer. The proposed system presented in this paper going to recognize the hand gestures of sign language from input video stream of the signer and interprets into corresponding Hindi words and sentences. For this purpose, the proposed system uses the techniques of image processing and synthetic intelligence to fulfill the objective. To carry out this task it uses image processing techniques such as frame extraction, erosion, dilation, edge detection, blur elimination, noise elimination, wavelet transform, image fusion techniques to section shapes in videos. It additionally uses descriptors of elliptical Fourier for feature extraction of shape and also uses analysis for the purpose of the feature set reduction as well as optimization. Extracted features with corresponding Hindi text are stored in the database and compared with given input testing video of the signer by a trained unclear inference system.

KEYWORDS: Sign language; Image processing; Gesture recognition; video processing

I. INTRODUCTION

The task of sign language recognition offers a unique opportunity for the development of motion recognition calculations for human PC interfaces. Specifically, it lets us effortlessly get past simply single motions or signs. Sign language is comprehended as the main characteristic feature that defines a deaf community. The important part of sign language recognition schemes in the public civilization is to ensure that deaf persons have equality of opportunity and full contribution in society. Sign language is basically characterized by continuously changeable unlike hand shapes and movements by a signer. Sign language recognition is interpreting and understanding the information which is embedded in the hand shapes and translating them to meaning complete words. Regular dialect Sign extraction should the hard of hearing deaf people individuals group. By creating communication via gestures acknowledgment framework a listening to disabled person can essentially collaborate with an ordinary person at unique levels in people in general. Logically sign language understanding involves linguistic examination of hands following, hands shapes, hands directions, sign articulation and also with significant linguistic information interconnected with head activities and facial expressions. Sign language is in numerous ways dissimilar from spoken language such as facial and hands terminology, orientations in virtual signing space, and grammatical alterations as explained [2].

Hand gestures recognition is the characteristic method for Human-Machine collaboration and today numerous specialists in the scholarly world and industry are enthused about this heading. It empowers the person to collaborate with machine effortlessly and helpfully without wearing any additional extra device. It can be associated structure motion based correspondence affirmation to robot control and from virtual reality to insightful home systems. Sign language is the straightforward communication method for those who suffer from hearing impairment. The hand gestures are the main section of sign language. Therefore, a sign language can be measured as a group of meaningful and user-friendly hand gestures, movements, and postures. Dynamic hand gesture communiqué is a more regular and humanoid mode of communication with PCs or laptops as compared with static hand gestures [1]. This is because of the fact that hands in the dynamic mode are allowable to move in any direction and curve toward any angle in all reachable coordinates. In another way, static hand gesture communication suffers from a very limited set of possible postures.

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The important issue in sign language recognition associated with speech recognition is to identify instantaneously dissimilar correspondence qualities of an underwriter, for example, hands and head development, outward appearances and body posture. All these features have to be considered concurrently for a good recognition scheme. Tracking the signer in the video where cutter of information is available is the second important issue faced by engineers of sign language recognition system. This is speaking by numerous researchers assigning space. A sign language space can be generated with things such as humans or objects stored in it around a 3D body centered space of the signer. The entities are performed at a certain position and later referenced by directing to space. To define a model for spatial evidence holding the entities created during the sign language dialogue is a major challenge faced by researchers. Recognizing and following hand motions in a grouping of pictures help in removing hand area. In this manner, preparing time will eventually minimize and exactness will be expanded as the elements of that area will represent the hand motion as it were.

In this paper, different image processing techniques and artificial intelligence methods are joined to produce a completely computerized communication via sign language recognition framework. This framework changes over videos of signs by various signers into Hindi language content. The framework can be prepared to handle new signs anytime during operation.

II. RELATED WORK

In the literature review we are going to discuss topical methods over the Sign Language Recognition.

R. Kagalkar [3] presented the review on sign language recognition for the key finding of the comparative analysis of similar techniques and also for technology used in vision-based hand gesture recognition. V. Ekde and R. Kagalkar [4] described review on video content study into text description. Thus this paper presented three necessary contributions to activity recognition from video. Firstly, they introduced a single mechanism for automatically discovering videos activity categories from natural-language descriptions. Secondly, an existing activity recognition scheme is improved abuse object context along with relationships between objects and activities. Finally, shows language process is familiar automatically extracting the requisite data about the relationship between objects and activities from a corpus of general text. F. Shi et al. [5] proposed 3-D multi-scale parts model, which preserved the orders of events. The model has a coarse primitive level spatiotemporal (ST) highlight, and also word covering and occasion content insights. This presented model has higher resolution overlapping parts that can incorporate temporal relations. A. El-Sawah et al. [7] presented a model for tracking of 3-D hand and recognition of dynamic hand gesture. Utilizing various cameras marginally upgrades the precision yet chiefly enhances the accuracy of the information by expanding the working section. The framework handles discontinuous impediment yet does not handle impediment for broadened timeframes. N. H. Dardas and N. D. Georganas [8] proposed a System for bare hand detection and tracking in presence of cluttered background using technique such as skin detection and algorithm of hand posture contour comparison after subtraction of face from image, for hand gestures reorganization via bag-of-features and multiclass support vector machine and build a grammar that used to generate gesture commands for an application control. The proposed scheme in terms of accuracy and speed as the key points extracted represent the detected hand gesture only. A. R. Varkonyi-Koczy and B. Tusor [9] anticipated a hand stance demonstrating and motion displaying with hand motion acknowledgment framework. This recognition system can be used as an interface to make communication (if possible) with the smart environment by simple hand gestures. Their system is able to classify hand gestures that consist of any combination of the previously defined hand postures as well as different simple hand postures. The actual implementation of the Gesture Detector does not take into account the position of the hand, only the shape of it. M. R. Abid et al. [11] extended video and voice recognition framework for element communication via gestures recordings in home intuitive applications. A local part show approach and Bag-of-Features for recognition of basic element signal from the video utilize a thick examining procedure to concentrate entire part highlights neighborhood 3D multiscale and embraced three-dimensional histograms of a slope introduction (3D HOG) descriptor to speak to represent features. The system involves a speech recognition engine, grammar creation, and loading, analysis of a phrase with existing keywords, a speech synthesizer engine initialization and then a robot's valid response. The system does not join dynamic sign language and voice recognition into one application. S. Shiravandi et al. [12] examined a technique for recognition of hand signal from video utilizing dynamic Bayesian systems. The accuracy of the model is increased due to a usage of two networks which are equal with gesture types. When two similar postures are photographed in different directions, they have the different histogram of direction. T. Wenjun et al. [13] presented hand movement directions approach and

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states of hands methodology from the key edges. Their presented approach is capable of recognizing the dynamic hand gesture. The color-based confront the troublesome job of recognizing protests, for example, the human arm and the face scene. J. Bao et al. [14] proposed a Speeded-Up-Robust Features (SURF) tracking technique for element hand signal or gesture recognition. To recognize a dynamic gesture and to speed up various calculations, the data stream clustering method that supported correlation analysis is developed. They assume that user should stop the video capturing for a while before the meaningful hand gesture starts and after it ends. And the motion trajectory direction is used for the representation of gesture. Z. Yang et al. [15] introduced an HMM-based method for recognition of complex single hand gestures. For their experiments the capture gesture images using a web camera. Features used in the system contain hand location, velocity, size, and shape. Skin color is used to segment hand area from the image to form a hand image sequence. This system not capable of recognizing features to describe the movement of fingers. P. K. Pisharady and M. Saerbeck [16] displayed strong hand signal location furthermore proposed recognition calculation utilizing dynamic distorting of time and estimation of multi-class likelihood. The hierarchical thresholding of the gesture probability has been used to detect gestures and distance of warping. The multi-class probability estimation has been used for gesture classification. The directional features are to be extended to a set of angular features, measuring the angles between various human body links. Ramesh M. Kagalkar and Nagaraj H.N [17] presented New Methodology for Translation of Static Sign Symbol to Words in Kannada Language. The point of gesture-based communication letters in order acknowledgment is to give a simple, productive and precise instrument for programmed interpretation of static sign (dictated by a specific setup of hand) to printed variant in Kannada dialect. The work displayed in this paper objective to build up a framework for programmed interpretation of static motions of letters in the order in Kannada communication through signing. It maps letters, words and articulation of a specific dialect to an arrangement of hand motions empowering an in individual to impart by utilizing hands signals as opposed to by talking. The framework equipped for perceiving gesture-based communication images can be utilized as a method for correspondence with almost deaf individuals. An indication of the hard of hearing individual can be caught, perceived and meant words in Kannada dialect for the advantage of visually impaired individuals. It has been partitioned into two stages firstly; include extraction stage which thus utilizes histogram system, Hough, and Segmentation to concentrate hand from the static sign. Besides characterization stage utilizes the neural system for preparing tests. Great focuses were separated from the sectioned hand utilizing star skeletonization and acknowledgment was performed by separation signature. The proposed technique was tried on the dataset caught in the shut environment with the presumption that the client ought to be in the field of perspective. This study was performed for five distinctive datasets in shifting lighting conditions. The created framework is engaged with a target of lessening the correspondence crevice between ordinary individuals and vocally debilitated. Ramesh M. Kagalkar, Dr. Nagaraj H.N and Dr. S.V Gumaste [18] overview exhibits a synopsis of the troublesome field of static hand motion acknowledgment, that basically comprises of the notoriety of very much characterized signs upheld a stance of the hand. Since individuals tend to differ as far as size and shape the preeminent troublesome downside comprises of the division furthermore the right characterization of the data's accumulated from the info picture, caught by one or extra cameras. The point of this paper is to demonstrate that methods have with achievement been tried and utilized so as to disentangle the issues said higher than yielding a solid and dependable static hand motion acknowledgment framework. Amitkumar Shinde and Ramesh M. Kagalkar[19] The Advanced Marathi Sign Language Recognition using Computer Vision Sign language is a natural language that uses different means of expression for communication in everyday life. As a contrast with other communication via gestures, ISL understanding has less consideration by the analyst. This paper displays an Automatic interpretation framework for the motion of manual letter sets in Marathi communication through signing. It manages pictures of exposed hands, which permits the client to collaborate with the framework actually. The framework gives a chance to hard of hearing persons speak with typical individuals without the need of a translator. They are going to assemble frameworks and strategies for the program acknowledgment of Marathi communication through signing. The initial step of this framework is to make a database of Marathi Sign Language. Hand division is the most pivotal stride in each hand signal acknowledgment framework since in the event that they improve portioned yield, better acknowledgment rates can be accomplished. The proposed framework likewise incorporates productive and vigorous hand division and the following calculation to accomplish better acknowledgment rates. A vast arrangement of tests has been utilized to perceive 43 confined words from the Standard Marathi communication through signing. In proposed framework, they expect to remember some exceptionally essential components of gesture-based communication and to make an interpretation of them to content and the other way around in Marathi dialect. Amitkumar and Ramesh Kagalkar [20] Sign Language Recognition for Deaf User is a Gesture based communication acknowledgment is a standout amongst the most developing fields of examination today and it is the most normal method for correspondence for the general

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population with listening to issues. A hand signal acknowledgment framework can give a chance to hard of hearing persons to correspond with typical individuals without the need of a mediator or middle of the road. They manufactured a frameworks and techniques for the programmed acknowledgment of Marathi gesture based communication. Through that they instruct classes with the deciding objective of setting up the nearly deaf sign customer in Marathi. The framework requires hand to be appropriately adjusted to the camera and does not require any exceptional shading markers, glove or wearable sensors. An extensive arrangement of tests has been utilized as a part of proposed framework to perceive confined words from the standard Marathi communication via gestures which are taken before camera by distinctive hard of hearing sign client. In proposed framework, authors expect to perceive some exceptionally fundamental components of communication via gestures and to make an interpretation of them to content and the other way around. Amit Kumar and Ramesh Kagalkar [21] In later year's gesture-based communication acknowledgment has turned in a standout amongst the most developing fields of examination and it is the most characteristic method of correspondence for the individuals with listening to issues. A hand signal acknowledgment framework can give a chance to hard of hearing persons speak with typical individuals without the need of a translator or middle. They were constructed a framework and techniques for the programmed acknowledgment of the Marathi communication via gestures. Through that, they are giving instructing classes to the reason for preparing the hard of hearing sign client in Marathi. The framework does oblige hand to be appropriately adjusted to the camera and does not require any wearable sensors. A substantial arrangement of tests has been utilized as a part of the proposed framework to perceive confined words from the standard Marathi communication through signing, which are taken before the camera with distinctive hard of hearing sign client. In proposed framework, authors mean to perceive some extremely essential components of gesture-based communication and to make an interpretation of them to content and the other way around. The proposed framework utilizes 46 Marathi letters in order for acknowledgment.

III. EXISTING SYSTEM

A. *Existing System:*

As the existence of computers in everyday simple operations of our routines increases, it becomes necessary to create human–computer interaction more sensitive to those who are not used to technical language or who are not absorbed in technological advances. The part of gesture-based communication acknowledgment frameworks in the general public is to guarantee that hard of hearing individuals have the correspondence of chance and full cooperation in the public society. By developing sign language detection system a hearing impaired person is able to easily interact with a normal person at different levels in the society.

Sign language recognition systems are more complex as compared to speech (voice) recognition. Because sign recognition is used to recognize different communication attributes of a signer at the same time such as hands and at the same time head movement, facial expressions and at the same time body pose. All these attributes have to be considering simultaneously for a good recognition system. Tracking the signer in a video where cutter of information is available is the second important issue faced by engineers of sign language recognition system. This is addressed by a lot of researchers as signing space. Every language, natural or reproduction, has words and sentences. Therefore, any system for sign language recognition must be capable of both words and sentences recognition. In order to come within reach of the problem of translating signs into text, it is essential to create a database of videos of dissimilar signs by multiple signers.

B. *Objective*

Every language, natural or artificial, has words and sentences. Hence, any sign language recognition system has to be capable of recognizing both words and sentences. In order to move towards the problem of translating signs into text, it is essential to create a new database of videos with different signs by many signers.
The main objectives of this study are illustrated as:

- To make system that converts videos of signs by different signers into Hindi text.
- To get better results for video of gesturers.
- To give better acknowledgment rates for various gesturers under various conditions.

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- To get more accuracy from classification technique.

IV. PROPOSED ALGORITHM

This paper proposed a system to familiar with gestures of sign language from a video stream of the signer. The developed scheme converts words and sentences of Indian sign language into text in Hindi. The authority of image processing techniques and artificial intelligence techniques has used to attain the objective. To achieve much better performance, various image processing techniques are used which can be listed as: frame differencing based tracking, edge detection, image fusion, image segmentation, dilation, erosion, techniques to section shapes in our videos.

A. *Proposed Architecture Diagram:*

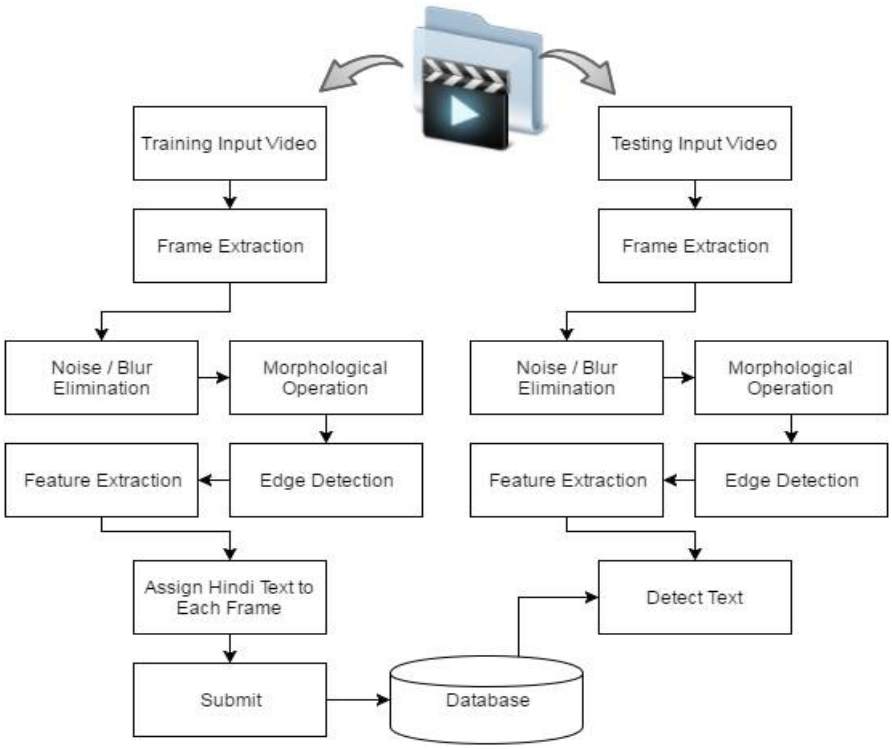

Fig.1. Proposed Architecture

B. *Architecture Overview:*

The proposed system consists of two major module Training and Testing is shown in fig 1.

1. Training Section

The training section is used to train videos and stored on a database with its features which need for video testing. This section is handled by the admin who is accountable for data training. In training section user gives sign video as input to a system, then a video is processed by means of frame extraction. These frames are nothing but images since the video is a set of continuous images. This process in performed by extracting images with particular time interval such that frame obtained after every second etc.

Step 1:

$$V = \sum_{i=0}^{n} f_i(x, y)$$

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where, $V \rightarrow inputVideo$, f_i is a frame at i[th] location, $f(x,y)$ denotes input image.

After that convert RBG (Red, Green, and Blue) colour extracted frames in step 1 into Grayscale images/frames by eliminating the hue and saturation information and retaining the luminance. The RGB image represented in the form of intensity function as:

$In_{RGB} = (F_R, F_G, F_B)$

Where, $F_R(x,y)$ denote intensity at pixel (x,y) in the red channel, $F_G(x,y)$ denote intensity at pixel (x,y) in the green channel, $F_B(x,y)$ denote intensity at pixel (x,y) in the blue channel.
Image transformation can be done as:

$$In_y = 0.333F_R + 0.5F_G + 0.1666F_B$$

Next, every is image processed out using edge detection, filtering, segmentation, and feature extraction. Image filtering process converts a colour image into grey by removing noise pixel values from it using Gaussian Filtering technique. It uses Gaussian function

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Where, x is the distance from the origin in the horizontal axis, y is the distance from the origin in the vertical axis, σ is slandered deviation.

Edge detection is applied to identify shape existing in the image. Canny fused Wavelet based video object division have ended up being an irreplaceable part of accomplishing better division since it joins the fundamental characteristics of watchful administrator and two-dimensional wavelet change. In segmenting videos dilation and erosion are used in combination to produce a binary gradient image before applying discrete wavelet transform. Apply Image segmentation by performing edge detection algorithm is proposed based on morphology, a canny edge detector, and wavelet transform.

Step 1. Image is smooth by convolution function as:

$$f_s(x,y) = G(x,y) * f(x,y)$$

Step 2. Calculate the gradient magnitude as:

$$M(x,y) = \sqrt{g_x^2 + g_y^2}$$

Step 3. Calculate the direction (angle) as:

$$\alpha(x,y) = \arctan\left(\frac{g_y}{g_x}\right)$$

Where, $g_x = \frac{\partial f_s}{\partial x}$ and $g_y = \frac{\partial f_s}{\partial y}$

Step 4. Compute direction ∂x from $\alpha(x,y)$ and find points closest to $M(x,y)$ along direction

Step 5. If $M(x,y)$is less than at least one of the neighbor then compute suppression

$g_N(x,y) = M(x,y) = 0$

Step 6. Else $g_N(x,y) = M(x,y)$

Step 7. Reduce false edge points using Hysteresis thresholding as:

$g_{NH}(x,y) = g_N(x,y) \geq T_H$

$g_{NL}(x,y) = g_N(x,y) \geq T_L$

And

$g_{NL}(x,y) = g_{NL}(x,y) - g_{NH}(x,y)$

Step 8. If all non-valid pixel in $g_{NH}(x,y)$ have been visited then set 0 to all pixel in $g_{NL}(x,y)$ that are never marked as valid.

Step 9. For Morphological operation applies Dilation and Erosion.

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- Dilation process enlarges (expands) the image $A \oplus B$
  Where, A is any gray scale shape, B is symmetric structuring element.
- Whereas Erosion process shrinks the image $A \circ B = (A \ominus B) \oplus B$

The feature extraction using SIFT process is bound to view shape of the image. During feature extraction process, seek invariance parameters so that the extraction process does not vary according to specified circumstances. That is, systems utilized for highlight extraction should discover shapes dependable and powerfully regardless of changes in illumination levels, position, orientation, and size of the article in a video. Filter components are elements (keypoints) separated from pictures to help in stable coordinating between various perspectives of the same item, picture grouping, and object recognition. The removed key points are invariant to scale, introduction and incompletely invariant to illumination changes, and are exceedingly particular of the picture. Accordingly, the SIFT is embraced in this paper for the bare hand shape recognition. After all this process, images of video with corresponding extracted features and their assign text are stored in the database.

2. Testing Section

This module tests the video of sign learner and gets the result only if at slightest one video is trained. In this phase, all process on images is performed same as in training phases such as filtering, edge detection, segmentation and feature extraction. The last process of the system is a classification of different signs in the form of text description in Hindi language corresponding to the correctly classified sign. For this purpose of sign language recognition system, the proposed system has deployed a fuzzy inference mechanism. In this mechanism, if-else conditions are used to detect corresponding text of the video.

V. RESULTS AND DISCUSSIONS

A. *Database:*

In order to evaluate Hindi text extraction process from sign videos, at least 100 sign videos are used to train and store into database. In the introduced situation, the testing video is beforehand prepared so that the exhibited tests as of already include some motions with entirely comparable features to get the best result.

Id	Number of Video Frames	Text
1	3	नौकर
2	5	अपना ख्याल रखें
3	10	मैं कक्षा में पाने के लिए बस ले लिया
4	20	हाई मैं वापस आ गया। अधिक सांकेतिक भाषा के साथ आप तैयार आशा जानने के लिए
5	6	आपसे मिलकर अच्छा लगा

Table. 1. Data set

B. *Results:*

While training each frame is assign by tag or Hindi text as per sign in that frame. For result analysis, this paper considers the training section and testing section. Some results are predicted using the dependent fuzzy technique. For the dependent system, accurate results are above 90% because database consists of the video that gives as testing. Videos are divided into frames and those frames are used for sign detection and after detection of sign from each frame, the final statement in the Hindi language is generated. Some of the outputs detected from videos are shown in table 1. In this input video text is the original text for that video and output text is the predicted text from implementation.

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Input: मैं कक्षा में पाने के लिए बस ले लिया Output: मैं कक्षा में पाने लिए बस ले लिया

Input: अपना ख्याल रखें Output: ख्याल रखें

Input: आपसे मिलकर अच्छा लगा Output: आपसे मिलकर अच्छा लगा

Input: अध्यापक Output: अध्यापक


Table. 2. Predicted Output

VI. CONCLUSION AND FUTURE WORK

This paper presents a methodology for recognition of dynamic sign language video into Hindi text language which may be words or sentences. This paper uses the techniques of image processing and synthetic intelligence to get accurate outcome. For implementation of this methodology, it uses image processing techniques such as image/frame differencing, erosion, dilation, edge detection, blur elimination, noise elimination, wavelet transform, image fusion techniques to section shapes in sign videos. It also uses SIFT feature extraction technique and most important analysis for set of features reduction as well as optimization. In future we will work on Hindi text simulation.

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BIOGRAPHY

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