Indian Sign Language Detection using Machine Learning

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***Abstract*—Speech impediment is a handicap that limits an individual's capacity to communicate verbally. Every country has its own sign language. Indians utilize Indian Sign Language. As making signs in ISL involves both hands, it is difficult to accurately define and recognize those forms of signals. It is critical to have an independent translator that can process photos and recognize signs very fast at the rate of streaming images. HOG (Histogram of Oriented Gradients) is employed here for object recognition and sign detection. We utilize OpenCV to take images and the Sklearn classification to train the machine from the frames/images which are extracted from the video. This paper/project proposes a Machine Learning-based method for recognizing hand gestures and translating them into text.**

***Index Terms*—Indian Sign Language, independent translator, HOG, Sklearn classification**

I. Introduction

Communication is an essential component of our daily lives in today's world. It is the medium via which we connect with others, share ideas, and express ourselves. Communication, on the other hand, may be challenging for those who are deaf or physically impaired. Although sign language has long been used as a means of communication for the deaf and mute, it usually creates a communication gap between the hearing and speaking populations. Technology has the ability to bridge this communication gap and foster better interpersonal communication. The goal of this research is to look at the use of gestures as a mode of communication for persons who are deaf or physically impaired. The study focuses on Indian Sign Language (ISL), a complex gesture system that combines hand postures to convey phrases and sentences. However, understanding ISL may be difficult for those who are inexperienced with the language, resulting in a communication gap. The paper proposes a real-time translation system that detects and decodes the user's hand motions, which are then translated into text using a camera. This method has the potential to produce a user interface that is simple and easy to use for everyone all of the time.

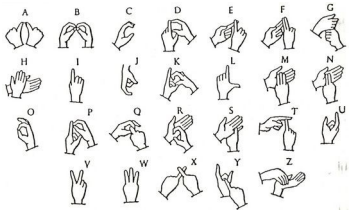

Fig. 1. Indian Sign Language

Although the paper acknowledges that substantial work has been done on identifying American Sign Language (ASL), ISL differs greatly from ASL. ISL, for example, uses two hands to communicate, whereas ASL uses a single hand. This typically leads in feature obscurity due to hand overlapping. Furthermore, the study underlines that a lack of datasets and regional heterogeneity in sign language have restricted attempts at ISL gesture recognition.

The research offers a successful expansion of this concept to words and common phrases, which may not only improve deaf and mute people's communication with the outside world but also provide a boost in building autonomous systems for understanding and assisting them.

The research underlines the relevance of gestures as a form of communication as well as the possibility of technology to assist those who are deaf or physically impaired in communicating with the outside world. The article discusses the goals of the research and suggests a system that might provide a low-cost communication solution. The paper emphasizes the need of developing an easy-to-monitor environment for establishing the model.

II. Literature Survey

Deaf Mute Communication Interpreter- A Review [1]: This paper aims to cover the various prevailing methods of deaf-mute communication interpreter system. The two broad classification of the communication methodologies used by the deaf–mute people are - Wearable Communication Device and Online Learning System. Under Wearable communication method, there are Glove based system, Keypad method and

Handicom Touch-screen. All the above-mentioned three sub-divided methods make use of various sensors, accelerometer, a suitable micro-controller, a text to speech conversion module, a keypad and a touch-screen. The need for an external device to interpret the message between a deaf–mute and non-deaf-mute people can be overcome by the second method i.e online learning system. The Online Learning System has different methods. The five sub-divided methods are- SLIM module, TESSA, Wi-See Technology, SWI_PELE System and Web-Sign Technology.

An Efficient Framework for Indian Sign Language Recognition Using Wavelet Transform [2]:The proposed ISLR system is considered as a pattern recognition technique that has two important modules: feature extraction and classification. The joint use of Discrete Wavelet Transform (DWT) based feature extraction and nearest neighbor classifier is used to recognize the sign language. The experimental results show that the proposed hand gesture recognition system achieves maximum 99.23% classification accuracy while using cosine distance classifier.

Hand Gesture Recognition Using PCA [3]: In this paper authors presented a scheme using a database-driven hand gesture recognition based upon skin color model approach and thresholding approach along with an effective template matching with can be effectively used for human robotics applications and similar other applications. Initially, hand region is segmented by applying skin color model in YCbCr color space. In the next stage thresholding is applied to separate foreground and background. Finally, template-based matching technique is developed using Principal Component Analysis (PCA) for recognition.

Hand Gesture Recognition System For Dumb People [4]: Authors presented the static hand gesture recognition system using digital image processing. For hand gesture feature vector SIFT algorithm is used. The SIFT features have been computed at the edges which are invariant to scaling, rotation, addition of noise.

An Automated System for Indian Sign Language Recognition [5]: In this paper, a method for automatic recognition of signs on the basis of shape-based features is presented. For segmentation of hand region from the images, Otsu's thresholding algorithm is used, that chooses an optimal threshold to minimize the within-class variance of thresholded black and white pixels. Features of segmented hand region are calculated using Hu's invariant moments that are fed to Artificial Neural Network for classification. Performance of the system is evaluated on the basis of Accuracy, Sensitivity, and Specificity.

Hand Gesture Recognition for Sign Language Recognition: A Review [6]: Authors presented various methods of hand gesture and sign language recognition proposed in the past by various researchers. For deaf and dumb people, Sign language is the only way of communication. With the help of sign language, these physically impaired people express their emotions and thoughts to other persons.

Design Issue and Proposed Implementation of Communication Aid for Deaf & Dumb People [7]: In this paper author proposed a system to aid communication of deaf and dumb people communication using Indian sign language (ISL) with normal people where hand gestures will be converted into appropriate text message. The main objective is to design an algorithm to convert dynamic gesture to text at real-time. Finally, after testing is done, the system will be implemented on an android platform and will be available as an application for a smartphone and tablet PC.

Real Time Detection And Recognition Of Indian And American Sign Language Using Sift In [8]: The author proposed a real-time vision-based system for hand gesture recognition for human-computer interaction in many applications. The system can recognize 35 different hand gestures given by Indian and American Sign Language or ISL and ASL at a faster rate with virtuous accuracy. RGB-to-GRAY segmentation technique was used to minimize the chances of false detection. The authors proposed a method of improvised Scale Invariant Feature Transform (SIFT), and the same was used to extract features. The system is modeled using MATLAB. To design and efficient user-friendly hand gesture recognition system, a GUI model has been implemented.

A Review on Feature Extraction for Indian and American Sign Language in [9]: The paper presented the recent research and development of sign language based on manual communication and body language. Sign language recognition system typically elaborate three steps pre-processing, feature extraction, and classification. Classification methods used for recognition are Neural Network(NN), Support Vector Machine(SVM), Hidden Markov Models(HMM), Scale Invariant Feature Transform(SIFT), etc.

SignPro-An Application Suite for Deaf and Dumb in [10]: The author presented an application that helps the deaf and dumb person to communicate with the rest of the world using sign language. The key feature in this system is the real-time gesture-to-text conversion. The processing steps include: gesture extraction, gesture matching and conversion to speech. Gesture extraction involves the use of various image processing techniques such as histogram matching, bounding box computation, skin color segmentation, and region growing. Techniques applicable for Gesture matching include feature point matching and correlation-based matching. The other features in the application include voicing out of text and text-to-gesture conversion.

Offline Signature Verification Using Surf Feature Extraction and Neural Networks Approach [11]: In this paper, offline signature recognition & verification using neural network is proposed, where the signature is captured and presented to the user in an image format.

III. Methodology

A variety of sign actions are thought to be done in order to describe the processing defect. The detection procedure is decided by using these sign activities, which are separated into distinct frames.The HOG features are then identified from each frame data, and the process is repeated. Figure 1 depicts the suggested text processing mechanism. This article

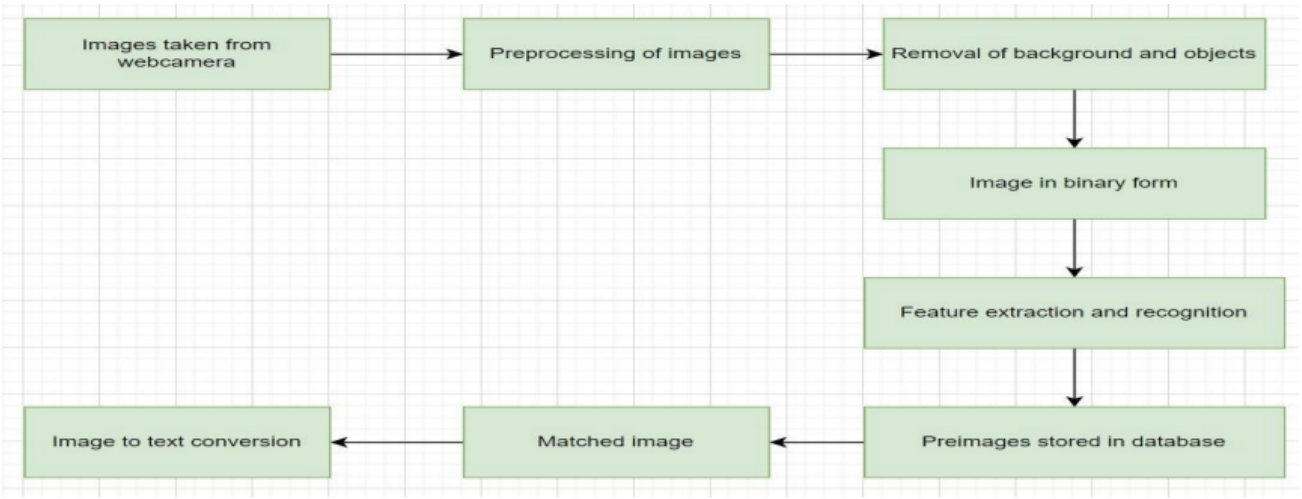

Fig. 2. System design

offers a system in which physically disabled persons are provided a way to communicate with normal people. The photos under consideration are not just single frames, but sets of frames collected from a live video and used for processing. To obtain expected results, features should be extracted, and blurring an image plays an important role in this process. These features are extracted using the HOG (Histogram of Oriented Gradients) algorithm, which is then used to train support vector machines based on this label output, and thus images undergo image processing, feature extraction, and classification. Because the photos are captured by a camera, each frame is analysed using a joint adjacent matching method. The retrieved characteristics are used for classification, and the best frame is matched using sklearn. Steps for additional training and testing are listed below.

1.Taking and processing video: In this step, users' input video is transformed into several frames, and each frame is processed using frame rate.

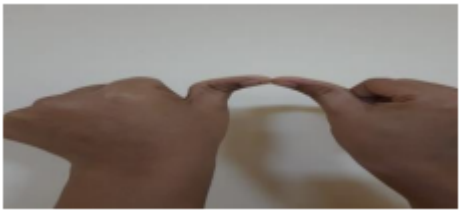

Fig. 3. Gesture for Alphabet 'A'

2.Image Preprocessing: Because a video contains various distortions, such as blur, background pictures, or being shot in a low-light environment, it must be preprocessed in order for the subsequent procedure to be easier. To extract the blur from the gesture frame, nonlinear filtering is performed.

3.Feature Extraction: The HOG algorithm extracts features more easily from a given set of input data.It will identify and

Fig. 4. Gesture for Alphabet 'B'

remove the object from the background by using a feature vector.

4.Classification: Sklearn is used to classify images using characteristics derived from the picture. The characterisation employs pre-recorded video frames.

5.Text Generation: Text will be created using the class labels supplied during training.

6.Indian sign language is employed in the datasets. Samples are taken from several volunteers, and photographs are acquired from every angle and distance from the camera so that different sorts of images may be retrieved and efficient findings can be obtained.

The purpose of this study is to propose a low-cost method for interaction that does not require the use of any hardware devices or gloves. Using such hardware components not only increases the cost, but also reduces the accuracy of image identification. Phase of Feature Extraction To calculate the values of pixels in the resulting image, nearest neighbour interpolation is utilised. To reduce any difficulties caused by an image's lighting situation, these photos are transformed from RGB to grayscale and then binary form. Binary pictures have two potential values: 0 for black and 1 or 255 for white. This is done to make images sharper and clearer. The method of assessing the intensity of an image is known as edge detection. Edges are locations where a variety of attributes may

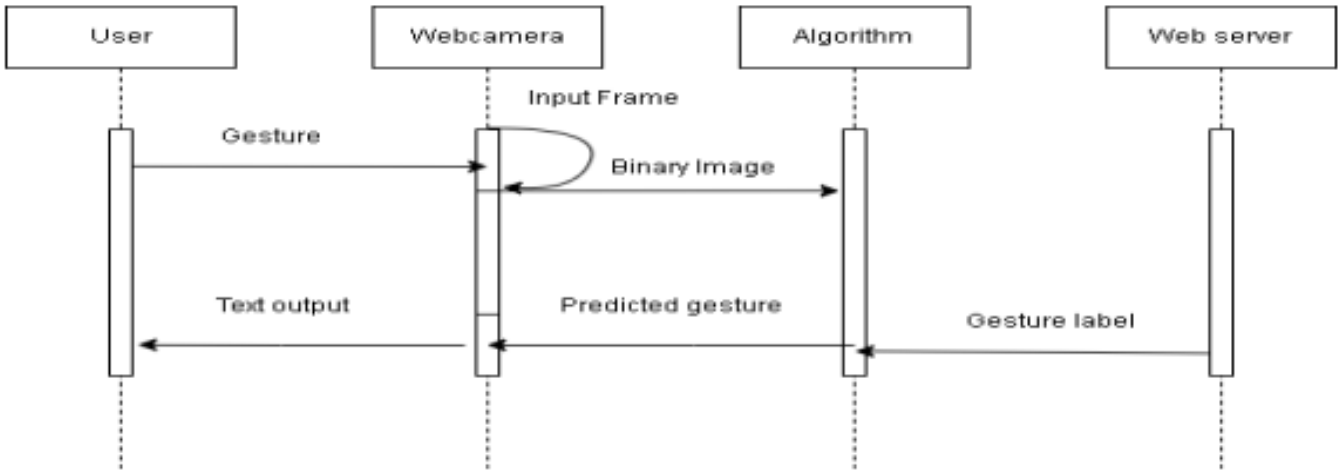

Fig. 5. Sequence Diagram

be obtained and used for detection. To acquire the optimum edge detection solution, the Canny edge detection technique is applied. In this situation, we used the histogram technique, the Hough transform, OTSU's segmentation algorithm, and edge detection. Classification Phase In neural networks, the output layer classification phase consists of 214 output neurons, as well as network architecture, network formation, and network training. The neural network classification employs 256 instances as its input vector. Supervised learning is used in conjunction with a feed forward back propagation network.

IV. Sequence Diagram

A sequence diagram demonstrates the relationship and order of operations between processes in a system. A sequence diagram displays item interactions in chronological order.

V. Results

Recognition system depends on how the data is being processed. It checks for accuracy at which a gesture can be recognized. Here user input plays a vital role where users show the gesture to the webcam in a certain distance and at different angles, the webcam captures the hand gesture as an input for the hand sign gesture image. Results become more efficient when the gesture captured during the training phase has enough datasets using which the gesture is being recognized and converted into text form. While taking a gesture as input, the user must make sure that background contains no objects or distortion inorder to get the result as expected and with proper accuracy.

VI. Future scope

For further development, it will be necessary to look at more complex mathematical image processing methods. It also features methods for calculating lighting offsets and adjustments based on user operating conditions. This uses brand-new mathematical detecting algorithms. More research and the purchase of hardware components like infrared cameras or two side-by-side webcams can fix the problem.

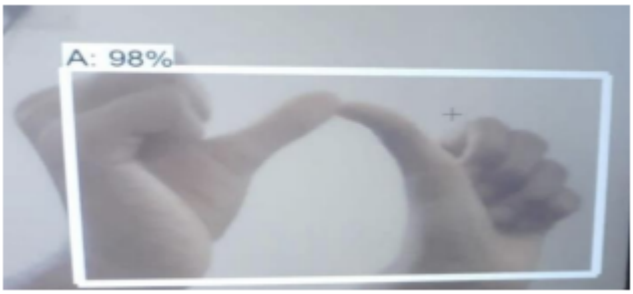

Fig. 6. Outcome

VII. Conclusion

The study presents a real-time system for sign language identification that achieves high recognition accuracy with minimal processing cost. The system uses an improved feature extraction approach. To reduce false detections, the system segments images into RGB-to-GRAY and then utilises an improvised Scale Invariant Feature Transform (SIFT) to extract features. For user-friendly interaction, a GUI model is put into practise. The system can generate grammatically correct words using 35 different hand gestures from Indian and American Sign Language (ISL and ASL). The proposed method improves retrieval accuracy by generating fewer descriptive features with fewer processing frames than conventional processing systems. The interface's practical adaptation for blind and visually impaired people is limited by its simplicity and suitability for use in real-world scenarios. The authors aim to develop a system that can provide a summary without consideration to the signer. This technology uses hand gesture to text conversion, which reduces the number of hardware components while facilitating simple and useful human-computer interaction. Helping those in need and maintaining social relevance are the major objectives. Additionally, the paper reviews recent studies on feature extraction and sign language recognition, and it describes a programme that enables sign

language communication for those who are deaf or dumb. Another article suggests utilising Surf feature extraction with neural networks to create an offline signature verification system.

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