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American Sign Language Recognition System: Enhancing Communication Accessibility for Individuals with Hearing Disabilities

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Abstract*: The Sign language is a visual language used by the people with the speech and hearing disabilities for communication in their daily conversation activities. It is completely an optical communication language through its native grammar, be unlike fundamentally from that of oral languages. In this research paper, presented an optimal approach, whose major objective is to accomplish the transliteration of 24 static sign language alphabets and numbers of American Sign Language into humanoid or machine decipherable English manuscript. Pre-processing operations of the signed input gesture are done in the first phase. In the next phase, the various region properties of pre-processed gesture image is computed. In the final phase, based on the properties calculated of earlier phase, the transliteration of signed gesture into text has been carried out. This paper also presents the statistical result evaluation with the comparative graphical depiction of existing techniques and proposed technique*

Keywords: American Sign Language, Gesture Recognition, ASL Alphabets, ASL Numbers, Preprocessing, Region Properties

I. INTRODUCTION

The sign language (SL) is made by specifications of hand and facial idioms to express their views and thoughts of speech and hearing disabled persons with the normal(speech and hearing) people. Most of the normal persons may not clearly understand the sign language. Therefore, there is a massive communication gap between the deaf communities with the general public. There is an inevitability of technology support for speech impairment people as human translators are highly impossible to patronage speech impaired persons in their daily activities in all the time. By the advancement in science and technology, we can think of designing an approach that can interpret gesture signs into humanoid or machine decipherable text. This smoothens the conversation between normal and impaired people .

There are more than 120 distinctive sign lingos are used by speech impaired community of various nations throughout the universe such as American Sign Language (ASL), Indian Sign Language, Australian Sign Language, Italian Sign Language, Sri Lankan Sign Language, and many more. Over and above 70 million people in the universe and about 10 million people in India are using sign language as their prime medium of communication.

ASL is most widely used SL in the world and fourth most usable linguistic in North America. Not only in United States, ASL is also used in Canada, Mexico, West Africa, and Asia. More than 20 other nations including Jamaica, Panama, Thai, Malaysia in which English is the major communication language uses ASL for their hearing impaired community communication. Nearly two million hard of hearing people of USA and Canada are using ASL as their primary basis of communication ,cumulative by means of postures of the body and expressions of the face.

As ASL is seen as precise and genuine language, it hasplentiful variations, like other languages do, such as French and Spanish. ASL is an outstanding form of interaction and favorable to an enormous portion of the speech impairment population. Its foundation, existing conditions, prospect hopes, and global impact are quite amazing and eye- opening.

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ASL provides a set of 26 gesture signs named as anAmerican Manual Alphabet that can be cast-off to spell out many of the English words available.

The 19 various hand shapes of ASL are cast-off to make 26 American Manual Alphabets. An identical hand shape with diverse orientations is used for 'K' and 'P' letters signs. In ASL, also offers a set of 10 numeric gestures to sign the numbers '0' to '9'. ASL doesn't comprises built-in ASLequivalents signs for accurate nouns and technical terms [4]. Along with ASL Alphabets and Numbers, there are thousands of hand and facial gesture signs are available to sign the various English words as well. The set of 26 gesture signs of English Alphabets (A-Z) and 10 Numbers (0-9) are shown in Fig. 1

Fig.1. ASL Alphabets and Number gestures

II. DATA COLLECTION

Data collection is a part of research work in all the research arenas comprising sciences, social science, technology, humanity, and business as well. In data collection procedure, methods may vary by discipline, the prominence on guaranteeing precise and authentic collection leftovers the identical. Irrespective of the discipline of the study, clear-cut collection of data is an essential stage to stabilizing the integrity of the research. The openly existing data collections are restricted both in mass and class. A ceremonial progression of data collection is vital as it ratifies that the data congregated are both definite and truthful. The ensuing conclusions be contingent on arguments signified in the outcomes are valid.

ASL static gestures and video gestures can be referred and analyzed from the website of American Sign Language University (ASLU) for ASL Alphabets, Numbers, and Video Gestures. Creating large annotated ASL database for training and testing purpose is time consuming. However, in this research work, an effort has been put in creation of plenty of ASL Gestures and Video Gestures set of own in various background (plain and complex, uniform and non-uniform), location (indoor and outdoor), time (day and night), and light illumination (natural and artificial) by different signers for cognition (training) and recognition (testing) of American SLR system.

III. LITERATURE SURVEY

Limited efforts have been attempted in recognition of gestures made by finger spelling but with confines of recognition rate and time. A classification approach for sign language recognition is proposed . This system recognizes 24 ASL alphabets gestures and yields 86.67% of success rate. A real time ASL recognition system of 26 English alphabets with

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complex background and mixed lighting condition was presented using Edge Oriented Histogram by using 10 Mega pixel web camera with maximum of 1 meter distance and this offers 88.26% of success rate. Matheesha Fernando et al., presented a system for recognition. Among

50 ASL signed gestures, 5 signed gestures by every 10 signers (A, B, C, D, V Signed gestures) were considered.

The total of 8 signs (A, B, C, D, L, P, V, and Y) were warehoused and cast-off as masters containing the recognizing 5 and 3 other signed gestures. 12 signed gestures were unsuccessful to recognize evidently in usual background which provides a recognition rate of 76% using Hu moment classification. An ASL Recognition System presented using Self Organizing Map. 7 different gestures

(B, C, H, I, L, O, Y) of ASL of 10 different sets in real time environment with plain background and a set from the internet was used for testing and obtain the recognition rate of 92%. In 2011, an ASL Recognition method is established which uses Cartesian Genetic Programming to identify the gestures of 26 ASL English alphabet. This uses 26 gestures for training and a new set of 26 gestures recognition purposes. The recognition results of above 90% accurate.

New feature extraction techniques are proposed to recognition of static ASL signs of numbers 0 to 9 in plain background and obtained 74.69%, 82.92%, 87.94, and 98.17% of recognition rates using Statistical Measures Technique, Orientation Histogram Technique, COHST (Combined Orientation Histogram and Statistical Technique), and Wavelet Features Technique respectively. An Open-Finger Distance Feature Measurement and Neural Network Classification Technique is used to recognize the ASL Numbers and obtained 92.09% of recognition rate.

In 2014, an ASL detection system has been designed by detecting human skin color using HSV color model and edge detection technique with morphological operations. A total of 100 gestures are tested and 65% of the total gestures were recognized properly. Sruthi Upendran et al., proposed an ASL interpreter which recognizes 24 static ASL alphabets in to textual form and further to speech using principle Component Analysis (PCA) and K-Nearest Neighbor (KNN) algorithm and obtained 77.29% recognition rate. A human computer interaction system for recognition of an ASL gesture 'P' in a plain background using gray scale thresholding and edge detection technique. They have taken only one gesture for consideration.

An ASL recognition framework using MAdaline Neural Network classification technique has been designed to recognize the standardized ASL consisting 26 American manual alphabets from A to Z. A novel technique to recognize the 26 static ASL gestures (A-Z) using polygon approximation and Douglas - Peucker algorithm. This technique recognizes the open and closed finger gestures efficiently and results 79.92% accuracy .

The space, size, illumination and rotation invariant alphabet recognition approach of ASL is evolved using SIFT algorithm. This approach is designed work well for both standard ASL database and homemade ASL database. A quantitative attempt is made to recognize real time gestures as well. A dynamic simple and complex background hand gesture recognition (HGR) integrated system is developed using Gaussian and canny filters with flood fill algorithm. Alphabets A to L are considered for recognition and yield 84% and 58% accuracy in simple and complex background respectively

IV. METHODOLOGY

Pre-processing Operations:

The first phase of the proposed approach involves pre-processing operations on the signed input gesture. This phase aims to enhance the quality of the input gesture image Fig.2 to facilitate accurate analysis and recognition. The following pre-processing operations are performed:

1) Image Resizing:

The input gesture image is resized to a standard size to ensure uniformity and consistency in the subsequent analysis.

2) Noise Reduction:

Techniques such as Gaussian blurring and median filtering are applied to reduce noise and smooth out irregularities in the gesture image.

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3) Contrast Enhancement:

Histogram equalization and contrast stretching methods are utilized to enhance the contrast of the gesture image, thereby improving the visibility of important features.

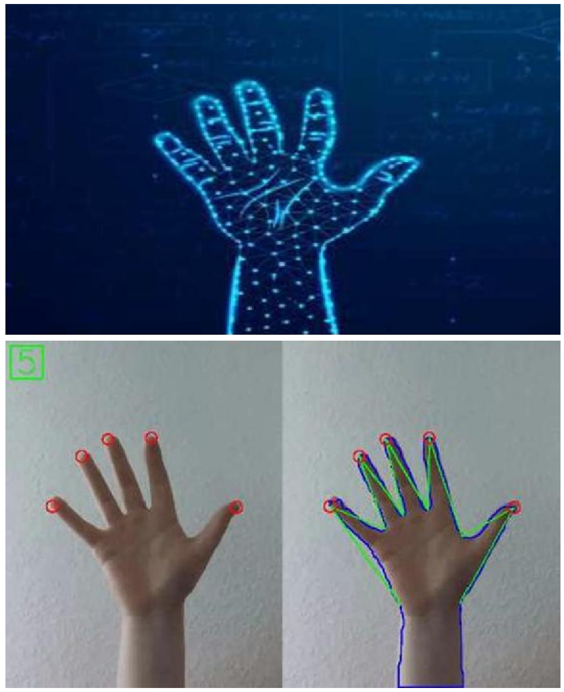

Fig.2.Gesture Identification

B. Feature Extraction:

In the second phase, various region properties of the pre- processed gesture image are computed to extract relevant features. These features serve as discriminative characteristics for distinguishing between different sign language alphabets and numbers. The following feature extraction techniques are employed:

1) Contour Detection:

The contours of the gesture image are detected using edge detection algorithms such as Canny edge detection.

2) Region of Interest (ROI) Identification

Regions of interest containing significant gesture components are identified based on contour properties such as area, perimeter, and centroid.

3) Shape Analysis:

Geometric properties of the identified ROIs, such as aspect ratio, circularity, and convexity, are analyzed to characterize the shape of the gestures.

C. Transliteration :

In the final phase, based on the extracted features and properties of the pre-processed gesture image, the transliteration of signed gestures into text is carried out. The transliteration process involves mapping the identified gestures to their corresponding English alphabet or numerical representation. The following steps are involved in the transliteration process:

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1) Feature Matching:

The extracted features of the gesture image are compared with a predefined database of gesture features to determine the closest match.

2) Alphabet/Number Assignment:

Each identified gesture is assigned its corresponding English alphabet or numerical value based on the closest match obtained through feature matching.

3) Text Generation:

The assigned alphabets and numbers are combined to generate the transliterated text corresponding to the signed gesture sequence.

D. Statistical Result Evaluation :

To evaluate the effectiveness and performance of the proposed approach, statistical analysis is conducted, comparing the results obtained with existing techniques. Various metrics such as accuracy, precision, recall, and F1 score are calculated to assess the transliteration accuracy and robustness of the proposed method. The evaluation results are presented using comparative graphical depictions to provide insights into the comparative performance of the proposed technique.

V. CONCLUSION

The proposed approach consists of three main phases: pre-processing operations, feature extraction, and transliteration. In the pre-processing phase, various operations such as image resizing, noise reduction, and contrast enhancement were applied to enhance the quality of the input gesture images. Subsequently, in the feature extraction phase, region properties of the pre-processed gesture images were computed to extract discriminative features for gesture recognition. Finally, in the transliteration phase, the identified gestures were mapped to their corresponding English alphabet or numerical representation based on feature matching and assignment algorithms.

The effectiveness of the proposed approach was evaluated through statistical result evaluation, where the transliteration accuracy and performance were compared with existing techniques. The results demonstrated the efficacy of the proposed method in accurately transliterating sign language gestures into text, thus enabling seamless communication for individuals with speech and hearing disabilities.

In conclusion, the proposed approach presents a promising solution for bridging the communication gap between individuals with speech and hearing disabilities and the broader community. By leveraging advanced image processing and machine learning techniques, our approach facilitates efficient and accurate transliteration of sign language gestures, thereby empowering individuals with disabilities to engage in daily conversation activities with greater ease and accessibility.

VI. FUTURE PERSPECTIVE

This research work can be extended to recognize the rotation and distance invariant ASL Alphabets gestures, numbers gestures and other complex gestures in different background (plain and complex), location (indoor and outdoor), lighting conditions (day and night light) in real time environment. This research work can also be extended to recognize English words and sentences which needs video processing.

In conclusion, future research and development efforts in the field of sign language recognition hold great potential for advancing accessibility, inclusivity, and empowerment for individuals with speech and hearing disabilities. By leveraging advancements in technology and interdisciplinary collaborations, we can continue to innovate and create solutions that break down barriers to communication and foster greater social inclusion.

REFERENCES

[1]. B M Chethana Kumara, H S Nagendraswamy and R Lekha Chinmayi, "Spatial Relationship Based Features for Indian Sign Language Recognition", International Journal of Computing, Communications & Instrumentation Engineering, Vol. 3, Issue 2, ISSN 2349- 1469, 2016.

[2]. Srinath S, Ganesh Krishna Sharma, "Classification approach for Sign Language Recognition", International Conference on Signal, Image Processing, Communication & Automation, 2017.

[3]. Shivashankara S, Srinath S, " American Sign Language Recognition System: An Optimal Approach ", International Journal of Image, Graphics and Signal Processing(IJIGSP), Vol.10, No.8, pp. 18-30, 2018.DOI: 10.5815/ijigsp.2018.08.03

[4]. Shivashankara S, Srinath S, "A Review on Vision Based American Sign Language Recognition, its Techniques, and Outcomes", 7 th IEEE International Conference on Communication Systems and Network Technologies (CSNT-2017), pp.293-299, 2017

[5]. Helen Cooper, Brian Holt, Richard Bowden, "Sign Language Recognition" Matheesha Fernando, Janaka Wijayanayaka, "Low cost approach for Real Time Sign Language Recognition", 8 th International Conference on Industrial and Information Systems, pp.637-642, 2013

[6]. Asha Thalange, Dr. S. K. Dixit, "COHST and Wavelet Features Based Static ASL Numbers Recognition", 2 nd International Conference on Intelligent Computing, Communication & Convergence (Elsevier), pp.455-460, 2016

[7]. Dr. Roger Sapsford, Victor Jupp, "Data Collection and Analysis", 2nd Edition, Sage Publishing Ltd, 2006.

[8]. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 2nd Edition, Prentice Hall, 2008

[9]. Suchin Adhan and Chuchart Pintavirooj, "Alphabetic Hand Sign Interpretation using Geometric Invariance", IEEE International Conference on Biomedical Engineering, 2014.