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A REVIEW ON VARIOUS METHODOLOGIES TO RECOGNIZE SIGN LANGUAGE

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Abstract
The main requirement for interaction among differently-abled people with deaf and hard-of-hearing community is only through sign language. Sign language interpreter is required to bridge the gap between the mute people and the normal person. The major challenge is detecting and understanding signs. Many algorithms use object detection technique. Developing technology has the potential in making necessary assistance in recognition of sign language. Sign languages are not universal. This paper analyzes various researched techniques and gives a view about the advancements in machine learning and computational methods.
Keywords : Sign language, Object detection, Machine Learning, Computational methods

I. INTRODUCTION

Sign Language Recognition (SLR) has emerged as a crucial area of research in the field of human computer interaction and accessibility technologies. As societies strive for greater inclusivity, the ability to seamlessly communicate with and understand sign language become increasingly important. This survey paper aims to provide a comprehensive overview of the current state of SLR, exploring various methodologies, challenges, and advancements in the field.

With the growing prevalence of machine learning and computer vision techniques, significant progress has been made in developing robust SLR systems. These systems utilize diverse approaches, including image-based, sensor-based and hybrid methods, each with its own advantages and limitations. Furthermore, the integration of deep learning has led to improved accuracy and efficiency in recognizing signs in real time applications.

By synthesizing the latest findings and innovations in SLR, this survey aims to serve as a valuable resource for researchers, practitioners and developers, fostering further advancements in the field and promoting better communication for the deaf and hard-of-hearing communities.

II. APPROACHES

Centre based systems utilize standard cameras to capture images or videos of sign language gestures. Researches can analyze both static signs and dynamic movements. Videos are typically processed frame by frame, enabling the systems to interpret isolated or continuous signs. This approach is widely used due to its effectiveness in various applications.

Kinect devices capture movement in real-time, providing both visual and depth information. While this adds a layer of detail that 2D cameras cannot achieve, its complexity and higher costs have limited its commercial adoption outside gaming.

Armband and with Electromyography(EMG) to detect muscle activity during signing. The advantage here is that they operate independently of lighting conditions. However, it requires multiple wires for connectivity, which can hinder portability and usability in everyday situations.

Cyber Glove Technology employs sensors on each finger to track hand movements. It often requires additional equipment, like motion trackers, to complete the setup. While effective, it is less practical for casual use in various environments, as it may not capture facial expressions critical to sign language.

The Leap Motion Controller tracks hand and finger movements above the sensor using infrared technology. It offers a more affordable option compared to gloves or Kinect but faces similar challenges, such as the need for proper positioning and the inability to capture full body movements.

Brain-Computer Interface (BCI) is an advance method interprets sign language by analyzing brain wave activity through EEG. It completely eliminates the need for physical gestures, relying on wireless transmission of brain signals. While innovative it involves complex setup and equipment, making it less accessible for everyday use.

Each of these technologies present unique advantages and challenges, influencing their effectiveness and practicality in real-world applications.

III. LITERATURE SURVEY

Ayushi.N.Patani et al.[4]'s paper provides an overview of this sign language interpretation works and brief view of different forms of capturing and recognizing sign language, aiming to offer a systematic solution. Their article paves the way for including the marginalized deaf and mute communities. The main goal is to provide a simple and widely accessible method to facilitate communication with other members of the society.

Suharjito et al.[1] conducted a study on sign language recognition approaches and the methodologies used by researchers. This provides other researchers with insights into better approaches for sign language recognition systems. They compared classification methods from various research groups and tabulated the results of various application systems. The paper compared classification methods such as Hidden Markov Model (HMM), Convolutional Neural Networks (CNN), Kohonen Self-Organizing Map, Simple Support Vector Machine, Multilayer Perceptron, and Naïve Bayes Classifier. The article highlights the limitation that the comparison of methods is still subjective, due to variations in sign language across different countries.

Refat Khan Pathan et al.[8] used "fingerspelling," a dataset with a complex background featuring different environments and scene colors. They proposed a two-layer image processing approach: in the first layer, images are processed as a whole for training, and in the second layer, hand landmarks are extracted. They developed a multi-headed Convolutional Neural Network model that utilized less memory and achieved a slightly lower accuracy of 96.29%. The limitation of their work is that it used a low-range dataset and considered the whole image for processing.

Vjeeta Patil et al.[7] proposed a method where they took the signs of phrases for their research, aiming to recognize signs of sentences used for common phrases. The method can be applied to ASL or any other regional sign languages. Their methodology uses a transfer learning algorithm with TensorFlow object detection. They used both video and static images, creating a dataset of 50 people—both normal and deaf—each performing actions for different sentences. The method achieved an accuracy of 97% and is compatible with other languages. A limitation is the dataset size, which includes only 50 participants.

Rachana Patil et al.[5] proposed a method to recognize alphabets in Indian Sign Language. Their method recognizes gestures from photographs using computer vision and machine learning techniques to extract specific features and apply classification to interpret the gestures. For classification, they applied the CNN method with the ReLU function for processing. The validation of the model yielded about 95% accuracy. The system can be enhanced to recognize both normal speech and sign language.

Ashish Sharma et al.[3] aimed to recognize and classify hand gestures with maximum accuracy. Their model uses canny edge detection, ORB, and bag of word techniques. The preprocessed data is fed into several classification algorithms to show effective results. While comparing various classifiers, the MLP classifier with ORB feature extraction technique for the ASL dataset achieved 96.96% accuracy. This can be extended to deep learning techniques. Instead of ASL, the method can be applied to other sign languages like ISL.

E. Padmalatha et al.[2] used gesture images and created a region of interest around the interpreter's hand. They calculated histograms and obtained threshold values to segment the hand. The dataset contains ASL hand gestures for alphabets, numbers, and some phrases. They trained the model with CNN using the Keras module in Python. The training data increased accuracy to 99.4%. The disadvantages include the time required for processing, which can be improved in future stages. Another limitation, according to the authors, is that objects in the background can distort the image, affecting the threshold image. This can be overcome by using images taken from multiple cameras at different angles, providing depth perception of the hand gesture.

IV. PROPOSED METHODOLOGY

The proposed method aims to capture the gestures of sign interpreters, including facial expressions and lip movements, and produce an output with corresponding interpreted text. A camera-based approach will be used to create a dataset, facilitating ease of portability and movement. The suggested method employs a transfer learning algorithm with TensorFlow object detection to recognize sign language. Both static images and videos are captured and pre-processed. The processed images serve as input for recognizing alphabets, numbers, and phrases. These phrases and images can be used for any sign language.

The processing utilizes a classification algorithm to categorize facial expressions with lip movements and hand gestures. The output will result in the generation of words, likely to be generated semantically. For this purpose, a text processing model will be employed. The model supports the recognition of hand gestures and expressions for both deaf and mute individuals, as well as for those who can hear and speak. Figure 1 shows the outline of the proposed methodology.

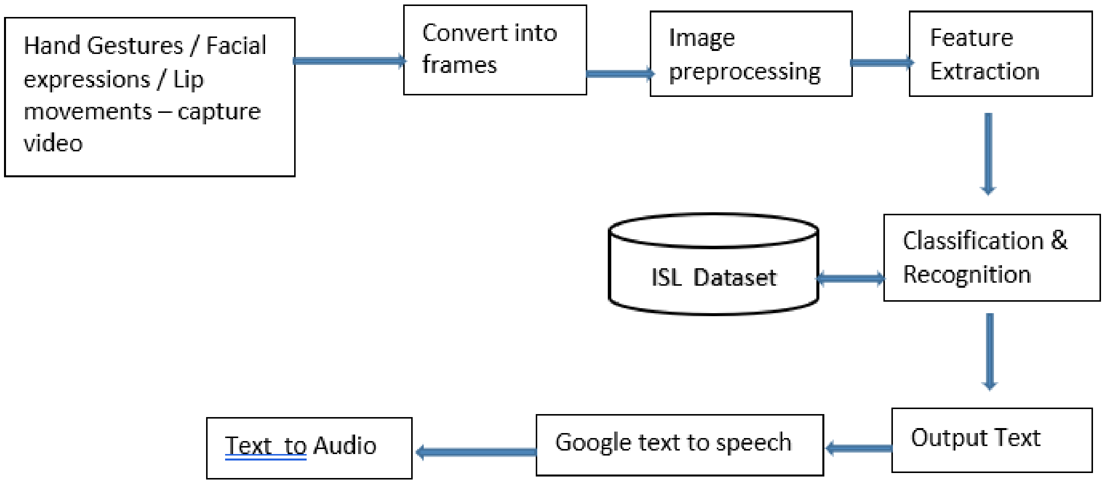

Fig.1. Block Diagram of Automatic Language Translation (Hand gestures & Lip movement)

V. CONCLUSION

This review article provides insight into the various methodologies used for processing hand gesture images and videos. It also discusses different approaches for capturing these images. The proposed methodology, when implemented, could promote inclusivity for isolated and voiceless speech-impaired individuals. It also offers a simple and widely accessible means for them to communicate with other members of society.

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