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SIGN LANGUAGE RECOGNITION SYSTEM USING PYTHON AND OPEN CV

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ABSTRACT

Sign language is a visual language that uses hand gestures, facial expressions, and body language to convey meaning. Sign language is an essential communication tool for the deaf and mute community, but it is not universally understood by the ordinary people. Sign language recognition systems have the potential to bridge this communication gap by translating sign language into text or speech. In recent years, significant progress has been made in developing sign language recognition systems using computer vision and machine learning techniques. This literature survey paper provides an overview of recent advances in sign language recognition systems, including their strengths, limitations, and the techniques and methodologies used. While surveying about the recent study on sign language recognition system that most of the project is based on Deep learning, Machine learning and using convolutional neural network all are based on vision based approach and it is far better than sensor based. There is also some project which is based on sensor based it can be in the form of glove, or other kind of hardware devices. But all projects have some limitation related to accuracy, real time detection and difficulty to predict some letter. Also the algorithm that is used specially in vision based approach commonly is convolutional neural network, support vector machine, etc Some authors used pre-made datasets, while others created their own. By creating their own dataset, the system becomes more accurate, allowing it to recognise the sign faster.

Keywords: Data Collection, Pre-Processing, Training Module, Hand Gesture Recognition.

I. INTRODUCTION

Sign language is a unique form of communication that uses visual cues such as hand gestures, facial expressions, and body language to convey meaning. It is an essential communication tool for the deaf and mute community, and it is estimated that there are more than 70 million deaf people worldwide. However, sign language is not widely understood by the general population, and this can lead to communication barriers and social exclusion for the deaf and mute community. Sign language recognition systems aim to bridge this communication gap by translating sign language into text or speech. These systems have the potential to significantly improve communication between the deaf and mute community and the general population. However, there are still challenges to be addressed, such as the recognition of nonmanual features (such as facial expressions and body language) and the development of systems that can recognize multiple sign languages.

In the field of machine learning and computer vision image based hand gesture recognition is a current active research area In order to make human interaction (HCI) easier and more natural without using additional devices many researchers working on this natural form of human interaction. Therefore, the primary objective of gesture recognition research is to develop systems that can identify and utilize particular human gestures, as an example, to transmit information. For image-based hand gesture interfaces, this requires extremely quick and accurate real-time hand and gesture detection. In this context, sign language recognition, a means of communication for the deaf and dumb people, it is a strong human communication paradigm with numerous potential applications. Creating systems that can identify particular gestures and utilize them to convey information or operate a gadget is one of their key objectives.

The research on human-machine interaction through gesture recognition has led to the use of this technology in a very wide range of applications, such as virtual reality, touch devices, practical diagnostics, gaming systems, and sign language recognition. This is because hand-holding is one of the most significant means of communication in each and every day of human life, and because of the continuous advancements in image and

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video processing technology. Deaf persons have been seen to struggle with social interaction, even though sign language is the most natural way for them to communicate. Similar to how spoken language has a vocabulary of words, sign language has a vocabulary of signs. Grammars in sign languages differ from nation to nation and are neither global nor standardized.

The system must predict and show the text version of the captured images, and the user must be able to capture images of the hand gesture using the web camera. The image goes through a variety of steps in processing, including different computer vision techniques such as image conversion to produce the output utilizing the media-pipe framework. A convolutional neural network is used to train and classify the image, which makes it easier to recognize the sign with the help of hand-landmark. There are various types of sign language across the globe such as American sign language (ASL), Indian sign language(ISL), British sign language (BSL), etc.

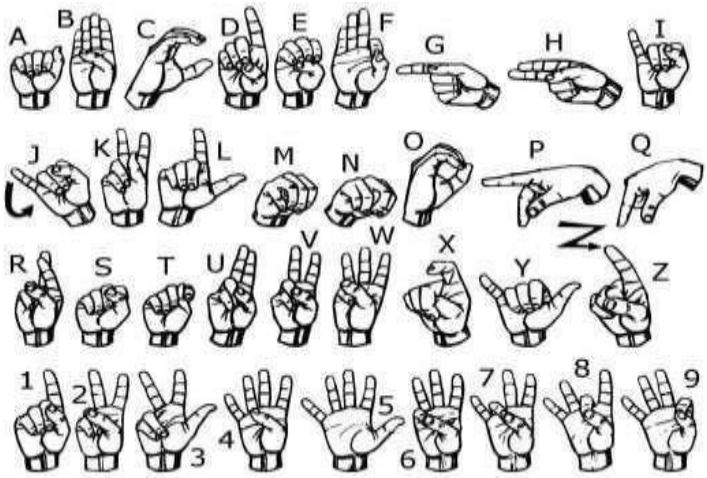

Fig 1: American Sign Language Alphabets and Number

II. LITERATURE SURVEY

Recent advances in computer vision and machine learning have led to significant progress in sign language recognition systems. Sign language recognition systems can be broadly categorized into two categories: vision-based and sensor based.

Vision-based sign language recognition systems use video cameras to capture the signer's hand gestures, facial expressions, and body language, and then use computer vision techniques to analyze the video and recognize the signs. One of the earliest vision-based sign language recognition systems was developed by Starner et al. (1998), who used computer vision techniques to recognize American Sign Language (ASL) signs. Since then, numerous vision-based sign language recognition systems have been developed, including those based on hand shape recognition (Neff et al., 2017), hand pose estimation (Cao et al., 2018), and deep learning (Pu et al., 2019).

Hand shape recognition systems use features such as hand shape and hand orientation to recognize sign language gestures. Neff et al. (2017) developed a hand shape recognition system that achieved an accuracy of 92% in recognizing ASL signs. Hand pose estimation systems use deep learning techniques to estimate the 3D pose of the signer's hand from a 2D image. Cao et al. (2018) developed a hand pose estimation system that achieved an accuracy of 96% in recognizing ASL signs.

Deep learning techniques have also been used to develop vision-based sign language recognition systems. Pu et al. (2019) developed a sign language recognition system based on convolutional neural networks (CNNs) that achieved an accuracy of 98.3% in recognizing ASL signs.

Sensor-based sign language recognition systems use wearable sensors to capture the motion of the signer's hands, such as accelerometers or gyroscopes. These systems can recognize signs based on the motion patterns of the hands. Sensor based sign language recognition systems have the advantage of being more portable and less affected by environmental factors such as lighting conditions. However, they require the user to wear sensors, which may be uncomfortable or impractical for some users. Sensor-based sign language recognition systems have been used for recognizing ASL signs (Shen et al., 2019) and British Sign Language.

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A. Real-Time Sign Language Recognition Using Deep Learning [1]: The system designed by the authors by using the Roboflow dataset and YOLOv5 (You only look once version 5) family of computer vision models. The proposed model was more successful in extracting necessary features from sign language and recognizing hand gestures than other models. The accuracy was 88.4% with a precision of 76.6% and a recall of 81.2%. This model was able to predict all the alphabet successfully.

B. A CNN based human-computer interface for American Sign Language recognition for hearing-impaired individuals [2]: The authors develop an interface that interprets gestures and hand positions in sign language using a convolutional neural network based on sign language. They used deep learning algorithms and Open CV to access the cameras. The authors have developed a proprietary dataset that helps predict hand poses and improve accuracy. This data set can be used for developing an SLR system. The proposed system can provide solutions in the medical field using deep learning.

C. Real-Time Sign Language Detection using TensorFlow, OpenCV, and Python [3]: The author proposed the Real Time Sign language for hand gesture recognition by using OpenCV and Tensorflow , which is used for classification, perception, comprehension, discovery, prediction, and creation. The proposed system will be utilized in conjunction with a webcam or any other built-in camera capable of detecting and processing signs for recognition. The model is usable by anybody with a basic understanding of technology and so accessible to everyone.

D. Indian Sign Language Recognition using Convolutional Neural Network [4]: The paper published by the authors states the problems faced by deaf and dumb people. The author build a model using a neural network, and the network was able to achieve a validation accuracy of about 95%. Future work should be focused on enhancing the system so that it can also translate from normal language to sign language.

E. Real-time Vernacular Sign Language Recognition using MediaPipe and Machine Learning [5]: The main purpose of this paper is to demonstrate a methodology that simplified Sign Language Recognition using Mediapipe open-source framework and machine learning algorithm. This paper is about developing a machine-learning algorithm that can recognize signs quickly and accurately. The model is lightweight and can be used on smart devices, so it is very practical. Authors used multiple sign language datasets to train the model, and so far it has been very successful. The average accuracy is 99%, which is very good.

F. Convolutional Neural Network Hand Gesture Recognition for American Sign Language [6]: Paper focuses on natural language and in particular on sign language recognition. The authors used the American Sign Language dataset which is publicly available by Turkey Ankara Ayrancı Anadolu High School, which comprises approximately 205 images per class. thus the testing accuracy is 87.50 %, the validation accuracy is 86.30%, and the training accuracy is 91.37%. and the system can predict the sign of 0 to 9 digits performed by the users.

G. Sign Language Recognition [7]: Sign language is primarily used by deaf (mute community) and mute people to exchange information in their communities and with others. Sign Language Recognition (SLR) recognizes a hand gesture capture and continues until text or speech is generated for the corresponding hand gesture. Computer vision is a field of artificial intelligence focused on problems related to images and videos. Combining CNNs and computer vision can solve complex problems. To develop a practical and meaningful system that can understand sign language and translate it into appropriate text. Our system still has many flaws. The system can recognize hand gestures for digits 0-9 and alphabets A-Z, but not body gestures or other dynamic gestures. I'm sure it can be improved and optimized in the future.

Sr. no	Title	Author	Technology	Advantages	Disadvantages
[1]	**Real-Time Sign Language Recognition Using Deep Learning [2022]**	Sanket Bankar, Tushar Kadam, Vedant Korhale, Mrs. A. A. Kulkarni	Roboflow Dataset, YOLOv5	This model was able to predict all the alphabet successfully.	Difficult to understand
[2]	**A CNN based human**	Ahmed Kasapbasi	CNN(Convol-	The model gives	Background

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	computer interface for American Sign Language recognition for hearing impaired individuals [2022]	Ahmed Eltayeb Ahmed Elbushra Omar Al-Hardanee Arif Yilmaz	utional Neural Networks), Open CV	95.50% accuracy .	issue while prediction so it requires right background.
[3]	**Real-Time Sign Language Detection using TensorFlow, OpenCV, and Python [2022]**	Prashant Verma , Khushboo Badli	Tensorflow, OpenCV, CNN	It extract the feature of an captured image using tensorflow.	Limitation: Low light intensity. unmanaged background
[4]	**Real-time Vernacular Sign Language Recognition using MediaPipe and Machine Learning. [2021]**	Arpita Haldera , Akshit Tayadeb	Mediapipe Framework SVM(Support Vector Machine)	This model can be adapted to any regional language, saving costs and can achieve maximum accuracy. It Detects complex gestures accurately	Difficult for commercial use.
[5]	**Indian Sign Language Recognition using Convolutional Neural Network [2021]**	Rachana Patil1, Vivek Patil , Abhishek Bahuguna, and Mr. Gaurav Datkhile	CNN(convolutional neural network)	This model Recognizes the formed sign and translate them into text and speech with appropriate content.	Variability in sign language gestures.
[6]	**Convolutional Neural Network Hand Gesture Recognition for American Sign Language [2021]**	Shruti Chavan, Xinrui Yu , Jafar Saniie	CNN(convolutional neural network)	The dataset's picture preparation reduces the complexity of the processing and storage.	It only predict digits between 0 to 9.
[7]	**Sign Language Recognition [2021]**	Satwik Ram Kodandaram., Sunil GI, N.Pavan Kumar	Django Rest Framework, CNN (Convolutional neural Network)	It has high accuracy.	System doesn't cover dynamic body gesture

III. CONCLUSION

Based on the literature survey on sign language recognition systems, several conclusions can be drawn. Firstly, there has been a significant amount of research conducted in this field, with different approaches and techniques proposed for recognizing sign language. These include computer vision-based approaches, wearable sensor-based approaches, and deep learning-based approaches.

Secondly, the performance of sign language recognition systems has greatly improved in recent years, with many achieving high accuracy rates. However, there are still some challenges that need to be addressed, such as handling variations in sign language gestures due to factors like hand orientation, lighting conditions, and background clutter. Thirdly, there is a need for standardized datasets for training and evaluating sign language recognition systems. This would allow for fair comparisons between different approaches and enable researchers to benchmark their results against others. Finally, there is a growing interest in developing sign language recognition systems that can be used in real-world applications, such as in education, communication, and accessibility for people with hearing impairments. Overall, the literature survey indicates that sign language recognition systems have great potential for improving the quality of life for people with hearing impairments and promoting inclusivity in society.

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