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Hand Sign Language Translator for Speech Impaired

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Abstract:- **Lack of speech is a recognized disability that significantly impacts communication abilities. Individuals with this disability employ various methods to interact with others, with sign language being one of the most prevalent and effective forms of communication. Sign language allows deaf and hard of hearing individuals to convey information within their community and beyond. This study focuses on the electronic recognition of sign language, encompassing everything from sign production to text or speech output. The recognition process involves distinguishing between fixed and flexible touch gestures, and this study outlines the steps undertaken. These steps include data acquisition, preprocessing, data augmentation, feature extraction, segmentation, and evaluation of the obtained results. Additionally, this study provides recommendations for future research in this area, serving as a guide for further advancements in sign language recognition.**

Keywords:- *Mediapipe, Sign language recognition [SLR], CNN, Computer Interaction with Humans.*

I. INTRODUCTION

The Sign Language Translator for Speech Impaired using Indian Sign Language is a ground-breaking project aimed at addressing the communication challenges faced by individuals with speech impairments in India. Indian Sign Language (ISL) serves as a vital form of communication for the deaf and speech-impaired community in the country. However, understanding and interpreting ISL poses difficulties for those who do not have knowledge of sign language. This project seeks to develop a program that can accurately translate ISL gestures into spoken or written language, enabling individuals with speech impairments to effectively communicate with the wider community. By leveraging advanced technologies and considering the unique linguistic and cultural aspects of Indian Sign Language, this project aims to enhance inclusivity and accessibility for speech-impaired individuals in various aspects of their lives.

A. Motivation and Background

Sign Language Recognition (SLR) research strives to accurately identify sign language symbols and comprehend their meaning. While prior approaches often treated SLR as Gesture Recognition (GR), sign language encompasses more than isolated gestures. This study aims to transcend isolated gestures by considering the broader context of sign language, incorporating facial expressions, body movements, and temporal dynamics. By developing a comprehensive SLR system, we can enhance communication and inclusivity for the deaf and hard of hearing community. The ultimate objective is to contribute to the advancement of accurate and inclusive communication technologies that cater to the unique needs of sign language users.

B. Sign Language

Sign languages [also known as sign languages] are languages that use visual cues to convey meaning. Sign languages are expressed in sign language as well as non-sign language objects. Sign languages are complete natural languages with their own grammar and dictionary. Sign languages are not universal and are not widely understood, although there are some striking similarities between sign languages. Linguists consider both spoken and signed communications to be natural forms of language, meaning that they both evolved into a vague aging process, one that lasted longer and evolved over time without careful planning. Sign language should not be confused with body language, a form of communication without voice.

Fig 1: Sign Language

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C. Block Diagram

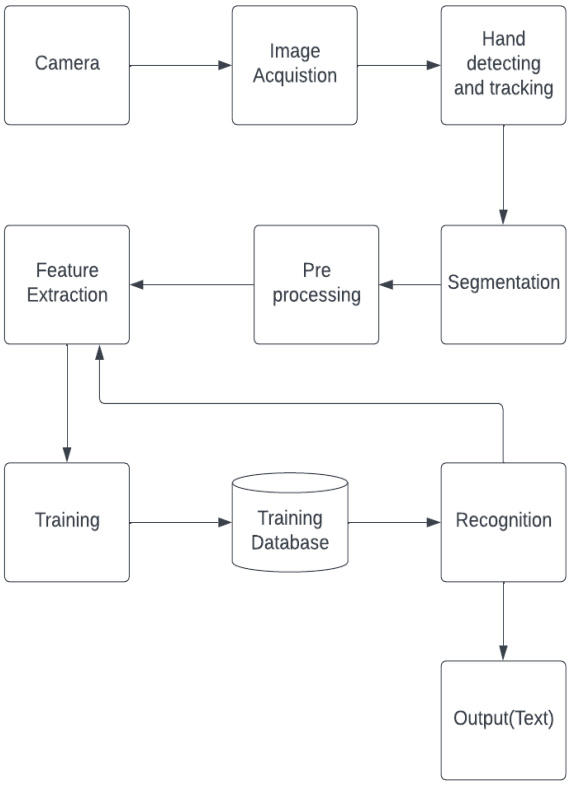

Fig 2 Block Diagram

D. Objective

The objective of this project was to develop a neural network capable of recognizing and distinguishing the alphabet characters in Indian Sign Language (ISL) when presented with a corresponding hand-sign. This project serves as an initial step towards the creation of a potential sign language translator, which can facilitate communication between the deaf and hard of hearing individuals by translating sign language into written and oral language. By bridging this communication gap, such a translator has the potential to greatly enhance the daily interactions and activities of the deaf community, enabling them to better connect and communicate with others.

E. Summary

Improving sign language applications for the deaf is incredibly important as it helps them communicate easily with people who don't understand sign language. Our program aims to take a step towards closing the gap between the deaf community and the general population through sign language. We want to create a system that can recognize the hand movements used to spell characters in Indian Sign Language (ISL). We chose a vision-based system because it provides a simple and reliable way for people to communicate with computers.

In this project, we focused on recognizing the different hand signs for the 26 English alphabets (a to z) and the numbers 1 to 9 in ISL. We used Google's Media-Pipe Framework, which has an advanced model that can detect 21 key points on the palm in 3D. By using this framework, our program aims to improve the accuracy, making it easier for deaf individuals to communicate and connect with others.

II. LITERATURE SURVEY

Sing Language Recognition (SLR) has recently begun to attract the interest of researchers. Here are some related works has been done over past years

- "Sign Language to Text and Speech Translation in Real Time using CNN" (NCAIT Conference Proceedings, 2020): This paper proposes a real-time sign language translation system using CNN. It emphasizes monitoring thresholds and suggests using gloves for accurate predictions.
- "Sign Language Recognition System using TensorFlow Object Detection API" (International Conference on Advanced Network Technologies and Intelligent Computing, 2021): This study focuses on sign language recognition with TensorFlow Object Detection API and CNN. It recommends enlarging the dataset and considering a switch to Keras.
- "SubUNets: End-to-End Hand Shape and Continuous Sign Language Recognition" (ICCV, 2021): This paper presents a sign language recognition system utilizing CNN and SubUNets. It suggests exploring hierarchical SubUNets for improved performance.
- "Sign Language Translator for Deaf and Speech Impaired People using CNN" (12th International Research Conference, 2019): This study aims to recognize static gestures and develop a text-to-speech system. It employs CNN on a Sri Lankan dataset.
- "Sign Language Recognition based on Hand and Body Skeletal Data" (3DTV-Conference, 2018): This paper utilizes CNN on an Argentinian dataset for sign language recognition. It proposes adding more datasets and studying image and optical flow features.
- "Neural Sign Language Translation by Learning Tokenization" (15th IEEE International Conference on Automatic Face and Gesture Recognition, 2020): This study combines CNN and tokenization for sign language translation. It suggests incorporating right hand information and context using 3D-CNNs.

By analysing different methodology, we come-up with one method that, in Indian Sign Language two hands are used for showing signs we have developed that we use Media-Pipe and Convolutional Neural Network to achieve better result.

III. IMPLEMENTATION METHODOLOGY

Media-Pipe Hands utilizes a Machine Learning Pipeline that combines different models to work together. One model focuses on capturing the overall shape of a hand in a complete image and provides a fixed bounding box around the hand. Another model works with a cropped image area determined by the palm detector and accurately determines the 3D key points of the hand.

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To train the model, we need to collect approximately 100 images for each sign. These images are then divided into two sets: a training dataset and a testing dataset, with an 80:20 split. The model is trained using the training dataset images and evaluated using the testing dataset images to ensure its effectiveness.

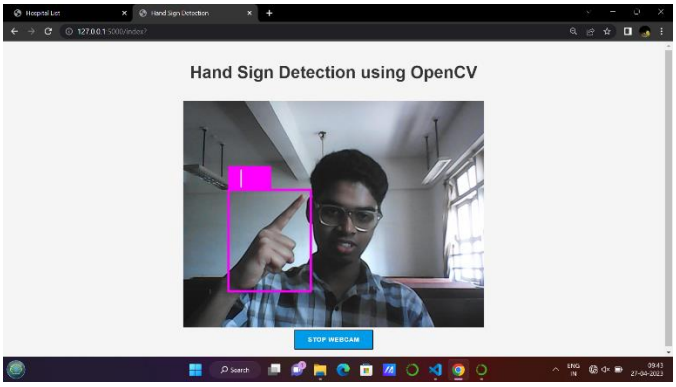
Once the model is trained, we create a website where individuals can display their hand sign, and the result will be shown in text form. This allows for easy communication and understanding between sign language users and those who don't understand sign language.

To achieve this, we utilize the CNN algorithm, which is a powerful recognition algorithm widely used in pattern recognition and image processing. CNN has many advantages, including a simple structure, fewer training parameters, and adaptability to various situations.

By implementing Media-Pipe Hands and using the CNN algorithm, we can develop a website that accurately interprets sign language, making communication more accessible and inclusive for all.

IV. RESULT

This sign language receiver can detect hand and produce co-ordinators and will be able to recognize letters (A-Z) and numbers (1-9). All signs will appear in real time.



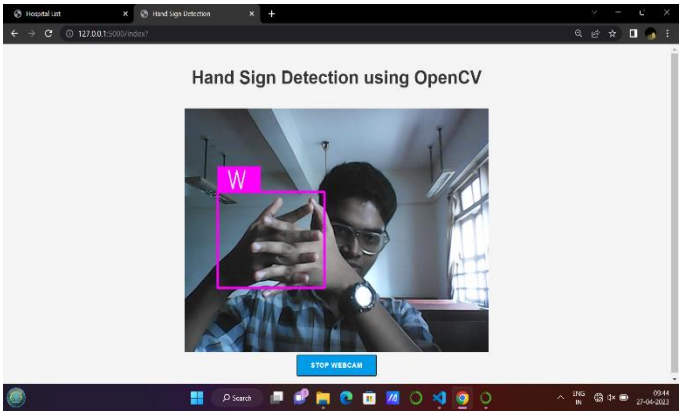


Fig 3 & 4: Output

V. CONCLUSION

Our sign language recognition system, powered by Media-Pipe and CNN, achieves an accuracy of 95% on the test dataset. In real-time scenarios, the system operates at an average accuracy of 80 to 85% with a fast speed of 20 frames per second (fps). We are continuously working to enhance the real-time accuracy by exploring different background subtraction methods. Our aim is to ensure accurate and reliable sign language interpretation for effective communication.

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APPENDIX

➢ *Media-Pipe Framework*

Mediapipe Hands is a reliable hand and finger tracking device solution. It uses machine learning (ML) to understand 21 3D local hand marks from just one frame. Although modern methods depend largely on the powerful desktop locations for discovery, our approach benefits real-time performance on mobile phones, even scales to many

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hands. We hope to give you this handy idea working on extensive research and development society will result in cases of misuse, to promote new applications and new research methods. Mediapipe Hands uses an integrated ML pipe of the many models working together: The palm detection model which works on the full image and returns the direct-directed hand binding box. Hand gesture model applicable to image-cut region defined by a palm detector once returns 3D hand key points with high reliability. This strategy is similar to the one used in our Mediapipe Face Mesh solution, using a face detector and a face detector a landmark model.

- *Convolution Neural network*

CNNs use a variation of multilayer perceptrons designed to require minimal preprocessing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics. Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field. The receptive fields of different neurons partially overlap such that they cover the entire visual field. CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage. They have applications in image and video recognition, recommender systems, image classification, medical image analysis, and natural language processing.