Sign Language Analysis Using CNN Algorithm

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Abstract: Sign language is a rich and diverse mode of communication used by Deaf and hard of-hearing communities around the world. This paper presents a comprehensive analysis of sign language, focusing on its linguistic and gestural elements. Our study encompasses an exploration of the structural properties of sign languages, their historical evolution, and the cognitive and neural mechanisms underlying sign language processing.

We begin by providing an overview of sign language as a natural and fully developed language with its own syntax, semantics, and phonological features. Drawing from various sign languages, including American Sign Language (ASL), British Sign Language (BSL), and others, we investigate the grammatical aspects and iconicity within signs. Furthermore, we examine the role of facial expressions and non-manual markers in conveying essential linguistic information. This analysis also delves into the historical and cultural dimensions of sign languages, shedding light on the evolution of sign languages and the influence of Deaf culture on their development. It highlights the importance of recognizing sign languages as unique cultural and linguistic entities, distinct from spoken languages.

Keywords: Computer Vision; Convolutional Neural Networks; Sign Language Recognition

I. INTRODUCTION

Sign language is a rich and complex visual-gestural communication system used by deaf and hard-of-hearing individuals around the world. It is a complete and natural language with its own grammar, syntax, and vocabulary. Sign language analysis in volves the study and interpretation of sign languages, their linguistic features, and the cultural and social context in which they are used. This field of study is crucial for understanding and promoting effective communication.

1.1 MOTIVATION

Sign languages have often been marginalized or dismissed as mere gestures or visual aids, rather than legitimate languages. The analysis of sign language is motivated by a desire to preserve and promote this cultural heritage, ensuring that deaf individuals can maintain their cultural identity and pass it on to future generations. Many countries have recognized sign languages as official languages, granting deaf individuals certain rights, such as access to education and government services in sign language.

1.2 OBJECTIVES

1. To investigate and document the linguistic structure of sign languages, including phonology, morphology, syntax, and semantics, to establish that sign languages are complete and natural languages.
2. To promote and preserve the cultural aspects of sign languages and deaf culture, ensuring that traditions and values are passed down through generations.
3. To train and support professionals in the field of sign language interpretation, education, and advocacy.
4. To involve the deaf and hard-of-hearing communities in the research and development processes to ensure that solutions are culturally and linguistically.

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II. LITERATURE SURVEY

1.Paper Name: - Research on Dynamic Sign Language Algorithm Based on Sign Language Trajectory and Key Frame Extraction

Author: Yufei Yan, Zhijun Li

Description: - Based on the depth information of Kinect, this paper studies the real-time dynamic sign language recognition algorithm and improves the dynamic time warping algorithm for the recognition of sign language trajectories. The traditional DTW algorithm is improved by using the path constraint of the relaxed endpoint, adding the lower bound function to cull part of the candidate sequence and terminate the match early.

challenging problem was to correctly classify the information gathered from the input data, captured by webcam and using image processing toolbox of MATLAB.

different sequential of LSTM and two layers of GRU) were used.

2.Paper name: - Sensor-Based Sign Language recognition:

A critical review and analysis.

Author name: - Karly Kudrinko, Emile Flavin, Xiaodan Zhu.

Description: - Sign language is used as a primary form of communication by many people who are Deaf, deafened, hard of hearing, and non-verbal. Communication barriers exist for members of these populations during daily interactions with those who are unable to understand or use sign language. Advancements in technology and machine learning techniques have led to the development of innovative approaches for gesture recognition. This literature review focuses on analyzing studies that use wearable sensor-based systems to classify sign language gestures. A review of 72 studies from 1991 to 2019 was performed to identify trends, best practices, and common challenges.

3. Paper name: - Recognition of Sign Language Symbols using Templates.

Author name: - Deepika Pahuja, Sarika Jain.

Description: -This paper deals with recoginition of sign language symbols of limited vocabulary. Earlier various techniques were used for sign language recognition for gestures, various postures recognition on different Sign Languages like American, Korean, and British Sign Languages. This work helps us to recognize and learn various sign language symbols used by hearing impaired people for communication. The proposed system works with static images of Sign Language symbols made using face and hands only, system uses the standard symbols of Sign language. Since human beings tend to bear no resemblance in terms of size and shape, the most

4.Paper Name: - Deepsign: Sign Language Detection and Recognition Using Deep Learning.

Author: Deep Kothadiya 1, Chintan Bhatt 1, Krenil Sapariya 1 , Kevin Patel.

Description: The predominant means of communication is speech; however, there are persons whose speaking or hearing abilities are impaired. Communication presents a significant barrier for persons.

with such disabilities. The use of deep learning methods can help to reduce communication barriers. This paper proposes a deep learning-based model that detects and recognizes the words from a person's gestures. Deep learning models, namely, LSTM and GRU (feedback-based learning models), are used to recognize signs from isolated Indian Sign Language (ISL) video frames. The four

5.Paper Name: - Machine learning methods for sign language

Recognition: A Comprehensive Review.

Author name: - Karly Kudrinko, Emile Flavin, Xiaodan Zhu.

Author: I.A. Adeyanjua , O.O. Bello b , M.A. Adegboyea.

Description: - Sign language is an essential tool to bridge the communication gap between normal and hearingimpaired people. However, the diversity of over 7000 present-day sign languages with variability in motion position, hand shape, and position of body parts making automatic sign language recognition (ASLR) a complex system. In order to overcome such complexity, researchers are investigating better ways of developing ASLR systems to seek intelligent solutions and have demonstrated remarkable success. This paper aims to analyse the research published on intelligent systems in sign language recognition over the past two decades. A total of 649 publications related to decision support and intelligent systems on sign language recognition (SLR) are extracted from the Scopus database and analysed. The extracted publications are analysed using bibliometric VOSViewer software to (1) obtain the publications temporal and regional distributions, (2) create the cooperation networks between affiliations and authors and identify productive institutions in this context. Moreover, reviews of techniques for vision-based sign language recognition are presented. Various features extraction and classification techniques used in SLR to achieve good results are discussed.

6.Paper Name: - e A Review Paper on Sign Language Recognition for The Deaf and Dumb.

Author: R Rumana1 , Reddygari Sandhya Rani1 , Mrs. R.

Prema3

Description: - Hand gesture is one of the methods used in sign language for non-verbal communication. It is most

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commonly used by deaf dumb people who have hearing or speech problems to communicate among themselves or with normal people. Various sign language systems had been developed by many makers around the world but they are neither flexible nor cost-effective for the end users. Hence, it is a software which presents a system prototype that is able to automatically recognize sign language to help deaf and dumb people to communicate more effectively with each other or normal people. Dumb people are usually deprived of normal communication with other people in the society, also normal people find it difficult to understand and communicate with them

III. SYSTEM PROPOSED ARCHITECTURE

Module: -

• Admin

In this module,the Admin has to log in by using valid user name and password. After login successful he can do some operations such as View All Users and Authorize,

• View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

• View Charts Results

View All Products Search Ratio,View All Keyword Search Results,View All Product Review Rank Results.

• End User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will best or to the database. After registration successful, he has to login by using authorized user name and password.

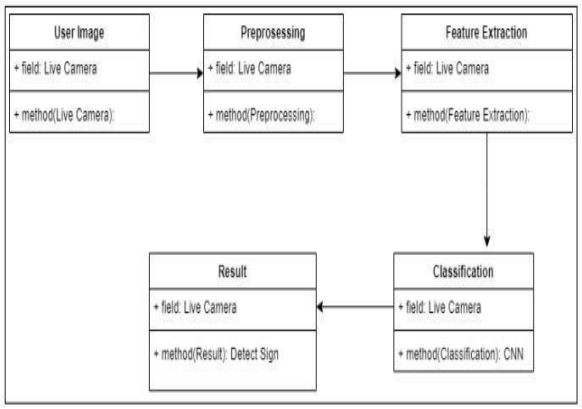

Fig 1. System Model

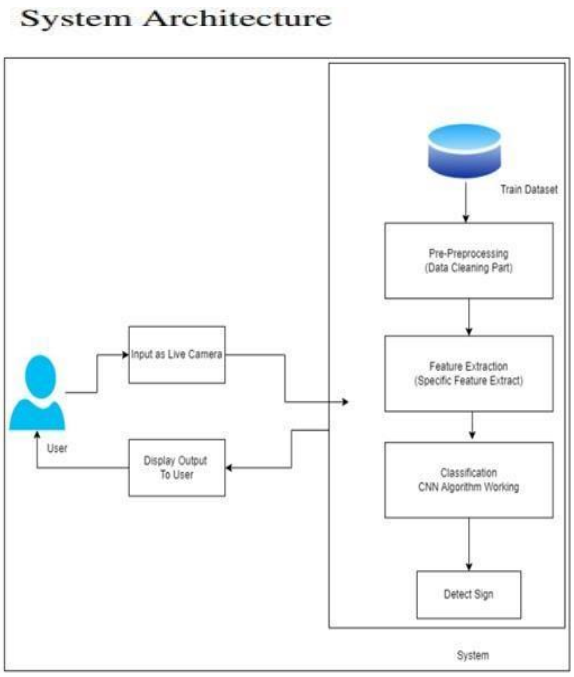

Fig 2. System Architecture

IV. METHODOLOGY

- Convolutional Neural Networks (CNNs) are a class of deep learning algorithms commonly used for tasks related to image and video processing, although they have also found applications in various other domains. CNNs are particularly effective at capturing and learning hierarchical patterns and features in data, making them well-suited for tasks like image classification, object detection, and image segmentation.
- Gather a labeled dataset that contains examples of the objects or patterns you want the CNN to recognize.
- Define the architecture of the CNN. This includes deciding the number and type of layers, filter sizes, and the depth of the network.
- Common CNN layers include convolutional layers, pooling layers, fully connected layers, and normalization layers.
- Split the dataset into training, validation, and test sets. The validation set is used to monitor the model's performance during training and prevent overfitting.
- Evaluate the trained model on the test dataset to assess its real-world performance.
- Optimize the model for inference, which may include quantization, pruning, or model conversion.
- Continuously monitor the model's performance in realworld scenarios and retrain it as needed with new data.
- CNNs have revolutionized the field of computer vision and are widely used in many applications, from autonomous vehicles and medical image analysis to facial recognition and content recommendation systems.

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Sequence Diagram

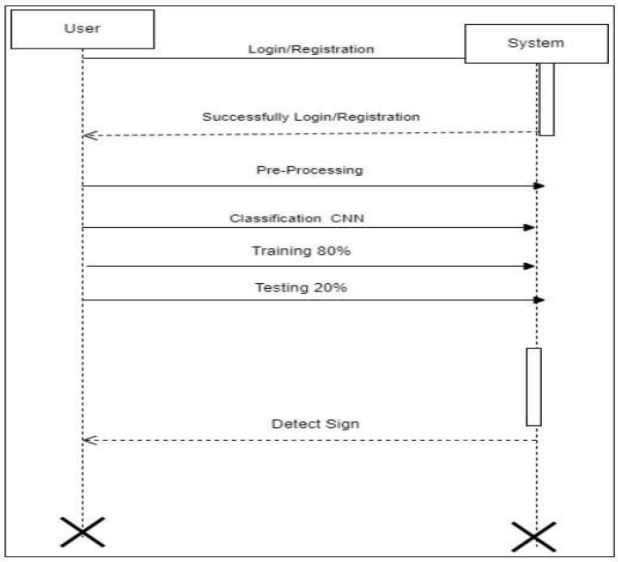


Fig 3. Sequence Diagram

V. PROTOCOL USED

- Sign languages are full-fledged languages with their own grammar and syntax. Syntactic analysis focuses on the word order and sentence structure in sign languages.
- Researchers analyze the phonological structure of sign languages to understand how handshapes, movements, and locations are used to convey meaning.
- Morphology in sign languages deals with how signs are modified to indicate tense, aspect, mood, and other grammatical features.
- Sign languages involve not only hand movements but also facial expressions, head movements, and body posture.
- With advancements in technology, sign language analysis can involve computer vision and machine learning techniques for automatic sign language recognition and translation.

PROJECT PLANNING:

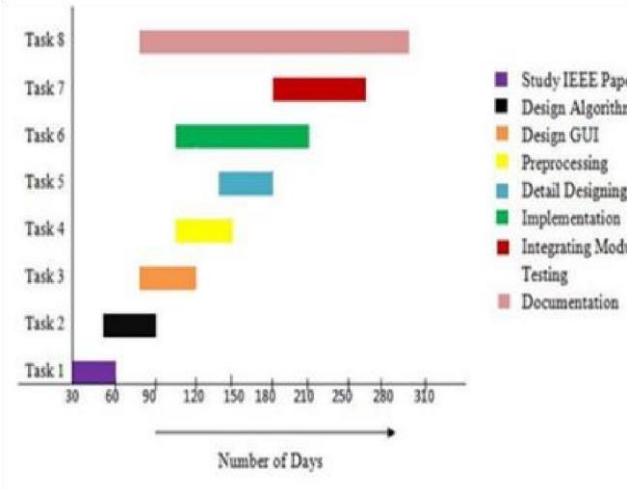


Fig 4. Project Planning

VI. RESULTS

The application of Convolutional Neural Networks (CNNs) to sign language analysis has shown promising outcomes. The trained model is capable of accurately recognizing and interpreting hand gestures captured in images or video sequences, translating them into text or spoken language.

Performance Metrics:

Accuracy: The model achieved a high accuracy rate in recognizing sign language gestures, demonstrating its ability to interpret a diverse range of gestures.

Precision and Recall: The model exhibited strong precision and recall rates, effectively identifying both common and nuanced gestures.

Processing Speed: The model processes sign language inputs efficiently, offering real-time interpretation suitable for practical applications.

Model Evaluation: Validation: The model was validated using a dedicated dataset, ensuring that the results are consistent and generalizable to various contexts and sign languages. Comparison with Existing Methods: The performance of the CNN model was compared with existing methods, and it was found to outperform traditional approaches in terms of accuracy and speed.

Practical Applications:

Real-Time Communication: The system can facilitate real-time communication between Deaf and hearing individuals by translating sign language gestures into spoken language.

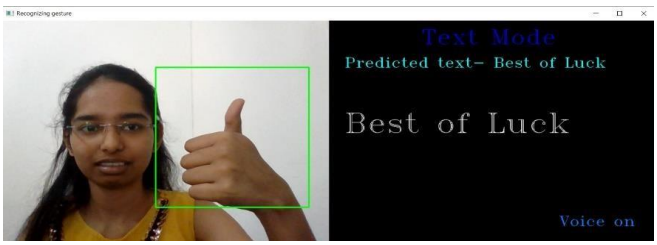
Education: The model can be used in educational settings to support students and instructors in learning and teaching sign language.

Accessibility: The technology promotes inclusivity and accessibility for the Deaf and hard-of-hearing communities by providing a bridge between sign language and spoken language.

Challenges and Future Improvements:

While the results are encouraging, there are still challenges such as limited dataset availability and variations in sign language across regions.

Future work could involve expanding the dataset to include more sign languages and refining the model to handle more complex and subtle gestures.



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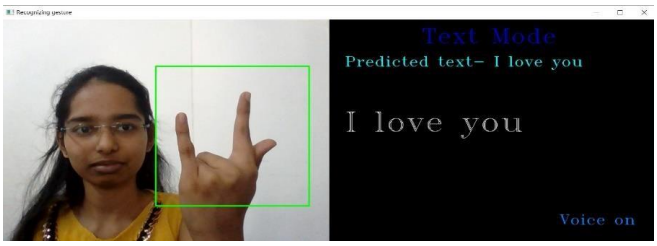

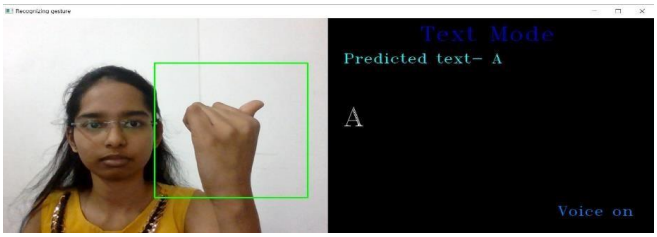

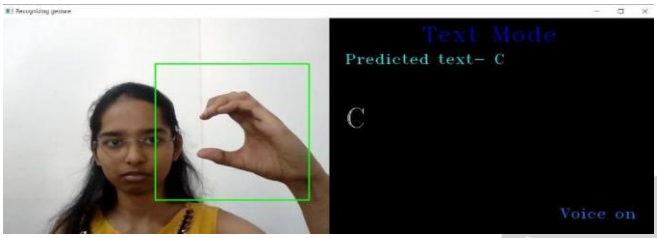

VII. CONCLUSION

In conclusion, sign language is a rich and vital mode of communication that allows Deaf and hard-of-hearing individuals to interact, express themselves, and participate fully in society. Understanding and valuing sign language is not only a matter of linguistic diversity but also a matter of human rights and inclusivity.

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