Sign Language Generation and Detection using Deep Learning

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ABSTRACT

This study focuses on developing innovative two-way communication systems that allow for seamless interactions between people who use sign language and those who do not. The system uses deep learning techniques, particularly annoying neural networks (CNNs), to enable real-time translation between text, audio and sign language. The main purpose of this project is to bridge communication gaps and to provide access, more efficient and integrated daily interactions for the deaf and hearing at community hearings. In sign language, the difficulty is communicating with people who are not used to it. While existing solutions exist, such as sign language interpreters and mobile applications, they are often unrealistic, expensive or unavailable in real time. Many current technologies offer disposable translations from sign language to text or vice versa, but do not provide integrated two-way communication systems. The aim of our study is to overcome these limitations by designing a comprehensive solution that allows for smooth interaction between sign language users and non-users in real-world scenarios. The recognition module uses CNNs to recognize hand gestures related to sign language and convert them into English text. This function allows those who communicate effectively with non signed voice users by using sign language to convert gestures into real-time readable text. The CNN model is trained with a variety of data records with sign language gestures to ensure high accuracy and robustness in a variety of lighting conditions, hand positions and user variations. Converts voice audio inputs and their corresponding sign language gestures. This feature is particularly advantageous for non-essential voice users who want to communicate with people who rely on sign language. By using deep learning models that include NLP techniques (natural language processing), the system processes input text or language and generates accurate representations of visual sign language. The integration of speech recognition provides even greater accessibility, allowing you to convert spoken language into sign language without the need for manual input. A variety of environments, including educational institutions, employment, medical facilities, and public service centers. By using deep learning and computer vision technology, our research contributes to continuous efforts to improve the inclusion and accessibility of hearing impairment and hearing loss.

Keyword : *Sign Language Generation and Detection, Deep Learning, CNN, Natural Language Processing, Computer Vision*

1. INTRODUCTION

Effective communication is essential in everyday life, but people who rely on sign language often face challenges when interacting with people they don't understand. This communication barrier creates difficulties in accessing critical services, educational and professional opportunities. Many sign language users find it difficult to consult without an interpreter, limiting their ability to participate in society. The motivation behind this project is to treat this problem by developing a real-time, two-way communication system that is translated between sign language, text and language using deep learning techniques. Current translation technology lacks or lacks the accuracy

required for effective communication. Many of the solutions available only convert the spoken or written language in sign language. This means that no seamless, bidirectional translation is provided. To fill this gap, project folding networks (CNNS) and other deep learning models are used to recognize and interpret sign language gestures, and simultaneously create corresponding sign language representations from text or audio input. By creating tools that allow for real translation, we want to make the interaction between sign language and non-users more accessible and natural. In the position of recognizing and converting bark gestures of text and language. The system uses computer vision and machine learning techniques to analyze hand movements and gestures to ensure accurate interpretation. It is designed for a variety of real-world applications, including educational institutions, employment, and public service environments. The scope of this project includes software development, model training with a variety of data records, and thorough testing to improve accuracy and user friendliness. Using advanced technology, this research will help break down barriers to communication and promote a more integrated society where everyone can interact seamlessly independently of language skills.

2. LITERATURE REVIEW

1. Paper Name: Hand Gesture Recognition for Multi-Culture Sign Language using Graph and General Deep Learning Network (2024).
Author Name: Abu Saleh Musa Miah, Md. Al Mehedi Hasan, Yoichi Tomioka, Jungpil Shin.
Description: The paper discusses the importance of Hand Gesture-based Sign Language Recognition (SLR) in facilitating communication between individuals who are hard of hearing and those who do not use sign language. One of the significant challenges highlighted is the lack of a universal sign language, leading to various culturally-specific sign languages, such as Korean, American, and Japanese sign languages. While current SLR systems perform effectively within their cultural contexts, they often struggle when it comes to recognizing and interpreting multiple or mixed cultural sign languages (McSL). To tackle these challenges, the authors present a new end-to-end SLR system called GmTC. This innovative system is specifically designed to translate McSL into text, improving comprehension and interaction between users. The architecture of GmTC employs a combination of two key deep learning modules to extract meaningful features from sign language gestures.

2. Paper Name: An Efficient Two-Stream Network for Isolated Sign Language Recognition Using Accumulative Video Motion (2022).
Author Name: Hamzah Luqman.
Description: This paper focuses on the significance of sign language as a primary means of communication for individuals with hearing impairments, emphasizing that it relies heavily on hand movements and non-manual gestures. With the rising interest in sign language recognition, the authors propose a new deep learning network designed specifically for recognizing isolated signs effectively, even when only a limited number of sign frames are available. The proposed approach is particularly efficient for recognizing isolated signs, especially static ones. The authors validated their method using two Arabic sign language datasets, KArSL190 and KArSL-502, achieving impressive results. Specifically, their technique outperformed other methods by 15% on the KArSL-190 dataset in a signer-independent mode. Additionally, the approach also surpassed state-of-the-art techniques when evaluated on the Argentinian sign language dataset, LSA64.

3. Paper Name: An Efficient Approach for Interpretation of Indian Sign Language using Machine Learning (2021).
Author Name: Dhivyasri S, Krishnaa Hari K B, Akash M, Sona M.
Description: This paper addresses the challenges faced by individuals with hearing and speech disabilities in communicating with others through sign language, particularly Indian Sign Language (ISL). It highlights that many people find it difficult to interpret sign language gestures because they lack knowledge of their meanings. As a result, communication often requires a translator, making interactions cumbersome for both parties. To improve communication for people with disabilities, the authors propose a system that translates ISL hand gestures representing numbers (1-9), the English alphabet (A-Z), and a few common English words into understandable text, and vice versa. This system aims to facilitate effective communication between sign language users and those who do not understand sign language.

4. Paper Name: Towards Multilingual Sign Language Recognition (2020).
Author Name: Sandrine Tornay Marzieh, Razavi Mathew Magimai Doss.
Description: This paper focuses on the challenges of sign language recognition, particularly regarding the modeling of multichannel information, such as hand shapes and movements. One of the significant issues is that sign languages are often under-resourced, making it difficult to obtain sufficient data for effective recognition systems. The authors note that while previous research has demonstrated the feasibility of estimating hand shape information by pooling resources from various sign languages, a similar approach for modeling hand movement information has not been established. To address this gap, the authors propose a multilingual sign language recognition system that utilizes target sign language independent data to model hand movements effectively. This is achieved by deriving hand movement sub units, allowing for the integration of diverse data sources.

5. Paper Name: Classification Of Sign Language Characters By Applying A Deep Convolutional Neural Network (2020).
Author Name: Md. Mehedi Hasan, Azmain Yakin Srizon, Abu Sayeed And Md. Al Mehedi Hasan.
Description: This paper highlights the importance of sign language recognition, especially considering the large global community of approximately 466 million deaf-mute individuals. The challenge arises from the fact that sign languages vary significantly across different languages and communities, making universal recognition difficult. The authors focus their study on the Sign Language MINST dataset and review previous research that has utilized various classifiers, such as support vector machines, random forests, and multilayer perceptrons, for sign language recognition. Recently, advancements in deep learning have led to the use of shallow convolutional neural networks (CNNs) and Capsule Networks, which have shown promising results in this area. In their research, the authors propose a deep convolutional neural network model specifically designed for the effective identification of sign language alphabets. After implementing their model, they achieved an impressive overall accuracy of 97.62%. When compared to earlier studies, their model demonstrated superior performance, outperforming all previously introduced models for sign language recognition.

3. MOTIVATION

The motivation behind this project stems from barriers to communication between those who use sign language and those who do not exist. Sign language users often face challenges in interacting with the wider community, especially in places where there are no ones being translated for them. This makes it difficult to access services, participate in education, and communicate in daily life. To make communication more integrated. This project will help bridge the gap between sign language users and others, simplify interactions and make them more accessible. The goal is to create tools that can be used in schools, businesses and public spaces to help people communicate effectively regardless of language skills.

4. PROBLEM STATEMENT

Effective communication is a fundamental aspect of human interaction, but those who rely on sign language often face considerable obstacles when dealing with people they don't understand. These challenges limit the ability to participate in daily discussions, access critical services and fully integrate them into society. Despite technological advances, existing translation solutions lack one or more accuracy required for seamless interactions that are insufficient for actual communication. Real-time, two-way communication between sign language users and non-users. The current solution focuses primarily on translation of languages spoken and written in sign language or vice versa, but does not provide an integrated system that supports both functions simultaneously. This gap creates difficulties in accessibility and limits the possibility of those relying on sign language. To address this issue and sign language. Using advanced machine learning and computer vision techniques, the system accurately recognizes and interprets SIND language gestures, while simultaneously generating corresponding sign language expressions from spoken or written input. The focus lies in English sign language, ensuring high accuracy and ease of use in real-world scenarios. Smooth communication between sign language users and non-users. With extensive training and testing of models, the system ensures real processing and high reliability, making it a practical solution for use in educational institutions, employment, health environments and public services. By filling the communication gap, the project seeks to create a more integrated and accessible world for pigeons and hard-hearing communities.

5. METHODOLOGY

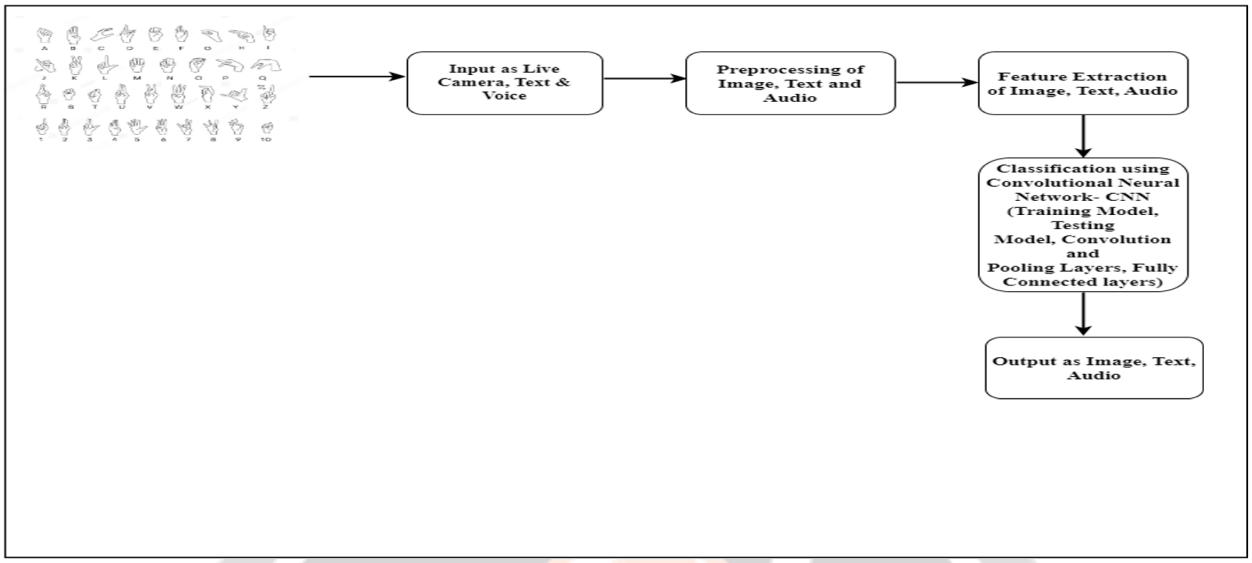

Fig -1: System Architecture

System architecture for sign language and recognition projects promotes communication between sign language users and others. You use entries with live cameras, text or audio, and then processed to clean and form the data. Major features such as hand shapes and important patterns of text and audio are then extracted. Recognizes gestures. Finally, the system outputs translations in various formats, text or audio, enabling effective communication for the user. Using CNN ensures accurate recognition and makes your system efficient and versatile.

Hardware Requirements:

- Processor: Intel i5
- RAM: 8 GB
- Hard Disk: 500 GB

Software Requirements:

- Python 3.8
- TensorFlow
- Keras
- OpenCV
- NumPy
- Matplotlib

6. DATA FLOW DIAGRAMS

Data flow diagrams (DFD) represent the different stages of sign language recognition systems. At DFD level-0, the system is displayed at a high level. Here, it is processed to create an output that allows for synthetic, text, language, and other inputs to be text or audio. DFD Level 1 is more detailed and shows that the input data is analyzed using a folding network (CNN) to produce output. DFD Level 2 provides the most detailed breakthrough indicates that after receiving input, preprocessing, characteristic extraction, and classification using CNN are exposed to the generation of the final result It's there. These diagrams explain the step-by-step process of the system from output to output, gradually increasing the level of detail.

Fig -2: Data Flow Diagram Level-0

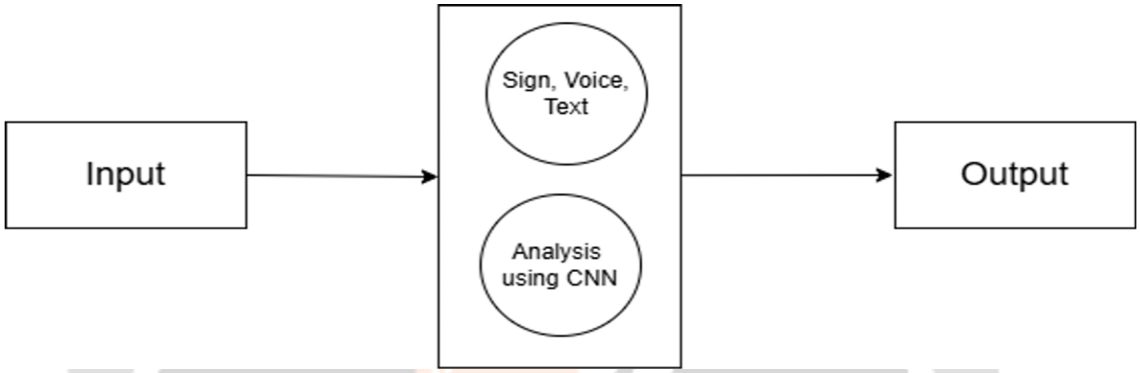

Fig -3: Data Flow Diagram Level-1

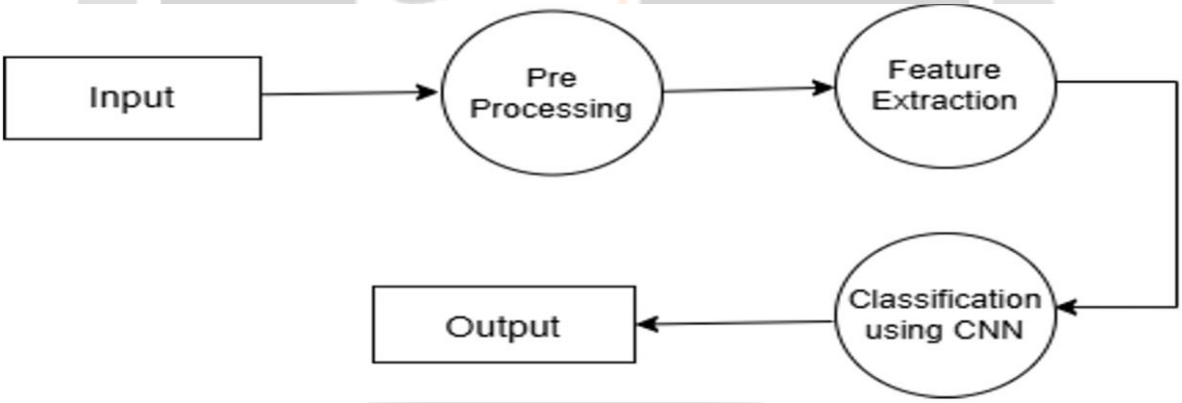

Fig -4: Data Flow Diagram Level-2

7. CONCLUSION

Sign language is a tool to reduce the communication gap between deaf and ordinary people. This system above illustrates a methodology aimed at enabling two-way communication. This method proposed here facilitates the conversion of language instructions. This overcomes the requirements of the translator as the conversion is used in real time. The system looks like the voices of the deaf. This project is a step to helping someone specially challenged. This can be further improved by being compatible with friendly, efficient, portable and compatible users that caters to more and more characters and dynamic characters. This can be further improvised to make it compatible with the integrated flock of mobile phones.

8. REFERENCES

[1] Abu Saleh Musa Miah, Md. Al Mehedi Hasan, Yoichi Tomioka, Jungpil Shin, "Hand Gesture Recognition For Multi-culture Sign Language Using Graph And General Deep Learning Network", IEEE (Feb 2024)

[2] Hamzah Luqman, "An Efficient Two-stream Network For Isolated Sign Language Recognition Using Accumulative Video Motion", IEEE (Sep 2022).

[3] Dhivyasri S, Krishnaa Hari K B, Akash M, Sona M, "An Efficient Approach For Interpretation Of Indian Sign Language Using Machine Learning", (IEEE, 2021).

[4] Sandrine Tornay Marzieh, Razavi Mathew Magimai.-Doss, "Towards Multilingual Sign Language Recognition", (IEEE, 2020).

[5] Md. Mehedi Hasan, Azmain Yakin Srizon, Abu Sayeed And Md. Al Mehedi Hasan, "Classification Of Sign Language Characters By Applying A Deep Convolutional Neural Network", ICAICT (Nov 2020).