IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Sign Language Translator

[1]Ansh Pahwa, [2]Arvind Kumar, [3]Aaryan Singh,[4]Aryan Chaudhary
[1]Student, [2]Student, [3]Student,[4]Student
[1]Computer Science and Egineering,
[1]IPEC, Ghaziabad, India

Abstract : Sign language is a language that Deaf people use to communicate with other normal people in the community. Although the sign language is known to hearing-impaired people due to its widespread use among them,it is not known much by other normal people. In this project, we have developed a sign language recognition system for people who do not know sign language,to communicate easily with hearing Impaired people. This project is built to interpret American Sign Language and also provides a complete overview of deep Learning-based methodologies for sign language recognition.

This will benefit deaf and hearing-impaired people by offering them a flexible interpreting alternative when face-to-face inter -preting is not available. And the main purpose of our project is to develop an intelligent system which can act as a translator between normal people and deaf or dumb people ,and can be the communication path between people with speaking deficiency and normal people with both effective and efficient way.

IndexTerms **- American Sign Language, Deep learning, Real-Time gesture to text convertor.**

INTRODUCTION

Very few people understand Sign language. Deaf people are usually deprived of normal communication
most of the time. Sign language is a language that provides visual communication and allows individuals with hearing impairments to communicate with other normal individuals in the community. Hence, the need to develop automated systems capable of translating sign languages into words and sentences is becoming a necessity [8]. And the availability of such translator is really limited, expensive and does not work throughout the life period of a deaf person. So, the solution is that computerized system is most relevant and suitable for translating signs expressed by deaf people into text and voice. The Image Processing method is used for better extraction of features from input images, that should be invariant to background data, translation, scale, shape, rotation, angle, coordinates, movements, etc. Also, Neural Network Model is used to recognize a hand gesture in an image. [3]. Deep Learning is a relatively recent approach to machine learning that involves neural networks with more than one hidden layer. Networks based on deep learning paradigms

fig. 1. Sign Language Hand Gestures

The dataset used, contains a sampled image set of all-American Sign Language (ASL) alphabets Aa-Bb signs and 1-10-digit signs can be observed in Figure (1). The data in its raw form is provided as a pixel-to-pixel intensity [0-255] class-wise distributed XLS files and data preprocessing steps included conversion of the mentioned data to image format using PNG format 64*64 grayscale images. The collected data is separated into training and testing data, 80% data is given for training and 20% data is given for testing. After splitting data, the model is created as sequential network and started fitting process. The fitting process ran through all train data. After, training step, the model and weights and neural network loaded into real-time recognition algorithm. The algorithm consists of two parts that run simultaneously for better accuracy 1) is extracting hands bound feature points, 2) is classifying hand image with convolutional neural network. When there are similar hand signs, the decision will be made according to those steps results.

Machine Learning has a very prevalent subcategory called deep learning, because deep learning gives a high level of performance over the data. Deep learning is used to categorize images to build a convolutional neural network (CNN). The Kera's library in Python issue to build a CNN. Pixels in images are interrelated. Images are seen by computers by pixel value. For example, pixels in images may indicate some pattern. This pixel's value is used by convolution to recognize images. And matrix of pixels multiplies with a filter matrix and calculates the multiplication values by convolution. And then convolution moves to the next pixel and follows the same process as above until it completes all the pixels present in an image.

LITERATURE SURVEY .

Sign language recognition using deep learning has garnered increasing attention in recent years due to its potential to bridge communication gaps and enhance accessibility for individuals who are deaf or hard of hearing. This section provides an overview of key research studies and developments in this field.

"Deep Learning Approaches for Sign Language Recognition" by Hu et al. (2018):
This study explores various deep learning techniques, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), for sign language recognition. The authors investigate the effectiveness of different architectures and feature extraction methods in accurately translating sign language gestures from video inputs.

"Sign Language Recognition Using Machine Learning Techniques: A Survey" by Dhanda et al. (2019):
Dhanda et al. provide a comprehensive survey of machine learning techniques applied to sign language recognition. The paper reviews the literature on both static and dynamic sign
language recognition approaches, including hand-crafted feature-based methods and deep learning-based approaches. The authors discuss the challenges and future directions in this
area of research.

"Transforming Sign Language Recognition with Machine Learning and Computer Vision" by Athitsos et al. (2019):
Athitsos et al. present a novel approach to sign language recognition using machine learning and computer vision techniques. The authors propose a framework that combines hand tracking, hand pose estimation, and sequence modeling to accurately recognize sign language gestures from video
inputs. The study demonstrates promising results in real-world applications.

"Text to Sign Language Translation: A Review" by Bhagwat and Chaudhari (2020):
Bhagwat and Chaudhari provide an overview of text to sign language translation techniques, focusing on both rule-based and data-driven approaches. The paper discusses the challenges associated with translating textual input into sign language gestures and highlights the potential of machine learning-based methods, including LLMs, in addressing these challenges.

"Advancements in Natural Language Processing: Applications in Sign Language Translation" by Kim et al. (2021):
Kim et al. review recent advancements in natural language processing (NLP) and their applications in sign language translation. The paper discusses the integration of NLP techniques, such as language modeling and sequence-to-sequence translation, with computer vision methods for text to sign language translation. The authors highlight the role of LLMs in improving translation accuracy and fluency. Overall, the literature survey highlights the growing interest in leveraging machine learning techniques, including deep learning, for testing language translation. While
Significant progress ha been made , challenges such as handling linguistic variations, ensuring accuracy in translation, and addressing."

GOAL OBJECTIVE

The global objective of the proposed research on "sign language translator using deep learning "is to develop an advanced system capable of accurately translating textual information into sign language gestures in real time. This system aims to bridge communication gaps between individuals who primarily use text-based communication gaps and those who rely on sign language, particularly benefiting the deaf and hard of hearing community. Through the integration of cutting-edge machine learning techniques, the research seeks to achieve the following overarching goals.

- Enhance Accessibility: By enabling seamless translation of sign language, the system aims to improve accessibility to information and communication for individuals with hearing impairments. It strives to empower users by providing them with equal access to digital content and communication platforms.
- Foster Inclusivity: The development of a robust sign language Translation system promotes inclusivity by facilitating effective communication and interaction between individuals from diverse linguistic backgrounds. By breaking down communication barriers, the system promotes understanding and empathy. And inclusivity in both online and offline environments.
- Ensure Accuracy and Efficiency: The research aims to design and implement a high-precision recognition system that accurately translates inputs into corresponding sign language gestures. Through rigorous training, optimization, and evaluation processes, the system endeavors to achieve a high level of accuracy and efficiency in real-time translation, minimizing errors and enhancing user experience.
- Adaptability and Scalability: The system aims to be adaptable and scalable, capable of accommodating various languages, dialects, and sign language systems. By leveraging the capabilities of deep learning techniques, it seeks to continuously improve its performance through iterative learning and adaptation to evolving linguistic patterns and user needs.
- Promote Technological Innovation: By exploring the intersection of natural language processing, machine learning, and sign language recognition, the research aims to drive technological innovation in the field of accessibility and assistive technology. It seeks to inspire further research and development efforts aimed at harnessing the potential of AI-driven solutions to address societal challenges and promote social inclusion.

Overall, the global objective of the research is to contribute to the advancement of technology-driven solutions that empower individuals with hearing impairments, promote inclusive communication environments, and foster greater accessibility and inclusivity in society. Through interdisciplinary collaboration and innovative methodologies, the research aims to make meaningful contributions towards building a more inclusive and equitable world for all.

RESEARCH METHODOLOGY

The methodology section outlines the plan and method that how the study is conducted. This includes Universe of the study, sample of the study, Data and Sources of Data, study's variables and analytical framework. The details are as follows;

The methodology for implementing Text to Sign Language using deep learning (Convolutional Neural Network) in machine learning involves several key steps. Initially, a diverse dataset comprising textual input and corresponding sign language gestures is collected and annotated with accurate alignments. This dataset undergoes preprocessing to handle linguistic variations, including tokenization and augmentation to encompass various sign languages and dialects.

This dataset uses transfer learning techniques to adapt its understanding to the task of text to sign language translation. The model architecture incorporates mechanisms for attention and alignment to capture semantic and syntactic correspondences between text and sign language. Feature extraction techniques are employed to extract linguistic features from textual input and represent sign language gestures, including hand movements and facial expressions. The trained model is evaluated on a separate validation dataset using metrics such as accuracy and F1 score, with qualitative analysis conducted through human evaluation. Finally, the model is integrated into a user-friendly interface for real-time input and display of sign language gestures, ensuring compatibility with various platforms and devices. Continuous improvement and maintenance mechanisms are established to monitor and update the system-based user feedback and

on this dataset using transfer learning techniques to adapt its understanding to the task of text to sign language translation. The model architecture incorporates mechanisms for attention and alignment to capture semantic and syntactic correspondences between text and sign language. Feature extraction techniques are employed to extract linguistic features from textual input and represent sign language gestures, including hand movements and facial expressions. The trained model is evaluated on a separate validation dataset using metrics such as accuracy and F1 score, with qualitative analysis conducted through human evaluation. Finally, the model is integrated into a user-friendly interface for real-time input and display of sign language gestures, ensuring compatibility with various platforms and devices. Continuous improvement and maintenance mechanisms are established to monitor and update the system-based user feedback and

TECHNOLOGY USED

Cameras and Sensors: To capture sign language gestures, cameras and/or sensors can be used. These devices capture the movements and expressions of the signer, which are then processed by software.

Computer Vision: Computer vision techniques can be used to analyze the video or sensor data captured from the signer. This can include gesture recognition, facial expression analysis, and body pose estimation.

Machine Learning: Machine learning models, such as deep learning models, can be trained to recognize sign language gestures and translate them into text or spoken language. These models require a large amount of annotated data for training.

Natural Language Processing (NLP): NLP techniques can be used to process the translated text and generate coherent sentences or responses. This can include tasks such as language translation, text summarization, and sentiment analysis.

Gesture Recognition Software: Specialized software can be used to recognize and interpret sign language gestures. This software may use a combination of computer vision, machine learning, and NLP techniques.

User Interfaces: The translated text or spoken language can be displayed to the user through a graphical user interface (GUI) or a speech synthesis system. This allows the user to interact with the system and receive feedback in real-time.

RESULTS AND DISCUSSION

The development of a sign language translation system using deep learning(Convultional Neural Network) represents a significant step towards enhancing accessibility and inclusivity for individuals who are deaf or hard of hearing.

By leveraging advanced natural language processing techniques, this research has demonstrated the feasibility of accurately translating textual information into sign language gestures in real-time.Through rigorous training and fine-tuning of machine learning models, we have achieved promising results in terms of accuracy and efficiency in text to sign language translation. The integration of CNN models has enabled the system to capture linguistic nuances and variations, facilitating more natural and comprehensible sign language output.

Moving forward, continued research and development efforts are essential to further improve the performance and usability of the system. Collaboration with stakeholders from the deaf and hard of hearing community will be crucial in ensuring that the system meets their needs and preferences effectively. Furthermore, ongoing advancements in machine learning techniques and sign language research present opportunities for continual refinement and innovation in this field. By staying abreast of these developments and embracing interdisciplinary collaboration, we can continue to push the boundaries of accessibility and inclusivity through technology-driven solutions.

In conclusion, the text to sign language recognition system holds great potential to empower individuals with hearing impairments, promote inclusive communication environments, and foster greater accessibility in society. Through collective efforts and a commitment to harnessing the power of technology for social good, we can work towards building a more inclusive and equitable world for all.

Acknowledgment

We extend our sincere gratitude to the deaf and hard of hearing community, researchers, collaborators, data annotators, developers of open-source tools, advisors, funding agencies, and institutions. Your contributions, insights, and support have been invaluable in the development of this research project on sign language translator using deep learning.Thank you for your dedication and commitment to advancing accessibility and inclusivity through technology.

References

[1] Brill R. 1986. The Conference of Educational Administrators Serving the Deaf: A History. Washington, DC: Gallaudet University Press.

[2] Y. Lecun, L. Bottou, Y. Bengio and P. Haffner, "Gradient based learning applied to document recognition," in Proceedings of the IEEE, vol. 86, no. 11, pp. 2278-2324, Nov.1998, doi: 10.1109/5.726791.

[3] M. Sandler, A. Howard, M. Zhu, A. Zhmoginov and L. Chen, "MobileNetV2: Inverted Residuals and Linear Bottlenecks," 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2018, pp. 4510-4520, doi: 10.1109/CVPR.2018.00474.

[4] L. K. Hansen and P. Salamon, "Neural network ensembles," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 12, no. 10, pp. 993-1001, Oct. 1990, doi: 10.1109/34.58871.

[5] Kang, Byeongkeun, Subarna Tripathi, and Truong Q. Nguyen. "Real- time sign language fingerspelling recognition using convolutional neural networks from depth map." arXiv preprint arXiv: 1509.03001 (2015).

[6] Suganya, R., and T. Meeradevi. "Design of a communication aid for physically challenged." In Electronics and Communication Systems(ICECS), 2015 2nd International Conference on, pp. 818-822. IEEE,2015.

[7] Sruthi Upendran, Thamizharasi. A," American Sign Language Interpreter System for Deaf and Dumb Individuals", 2014 International Conference on Control, Instrumentation, Communication and Computa.

[8] David H. Wolpert, Stacked generalization, Neural Networks, Volume 5, Issue 2, 1992, Pages 241-259, ISSN 0893-6080, https://doi.org/10.1016/S0893-6080(05)80023-1.

[9] Y. Liu, X. Yao, Ensemble learning via negative correlation, Neural Networks, Volume 12, Issue 10,1999, Pages 1399-1404, ISSN 08936080, https://doi.org/10.1016/S0893- 6080(99)00073-8.

[10] MacKay D.J.C. (1995) Developments in Probabilistic Modelling with Neural Networks — Ensemble Learning. In: Kappen B., Gielen S.(eds) Neural Networks: Artificial Intelligence and Industrial Applications. Springer, London. https://doi.org/10.1007/978-1-447 HYPERLINK "https://doi.org/10.1007/978-1-44713087-1_37"1 HYPERLINK "https://doi.org/10.1007/978-1-44713087-1_37"3087-1_37

[11] Polikar R. (2012) Ensemble Learning. In: Zhang C., MaY. (eds) Ensemble Machine Learning. Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-9326-7_1