

Title of the Project: Saudi Sign Language Translator: An AI-Powered Solution for Bridging Communication Barriers

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Abstract:

This research project aims to develop an AI-powered application for translating Saudi Sign Language into text, addressing the communication challenges faced by the deaf community. The project focuses on creating a tool that can recognize and translate static sign language gestures accurately into Arabic text which will help bridge the communication barriers. The methodology involves collecting a dataset of Saudi sign language images and implementing hand detection and gesture recognition to finally translate these into text. The project aims to achieve high accuracy in sign recognition while maintaining real-time processing capabilities. This research specifically addresses the unique challenges of Saudi sign language recognition.

Background and motivation

The deaf community faces significant communication barriers in their daily interactions with hearing individuals. This tool will help the deaf community so that they don't have to rely on sign language interpreters to assist with communication which presents substantial challenges like the availability of sign language interpreters and the lack of automated translation tools. This project addresses this critical gap by using artificial intelligence and computer vision technologies to create an accessible and efficient translation system. The goal is to help deaf people communicate better and feel included while also improving AI for Saudi language and sign language recognition.

Problem statement

The current lack of Saudi Sign Language and automated translation tools creates significant barriers for deaf individuals trying to communicate with hearing people. The challenge lies in developing a system that can accurately recognize and translate a wide range of Saudi signs while being accessible, user-friendly, and practical for everyday use.

Research objectives

1. Develop an AI-powered system for accurate Saudi Sign Language recognition and translation
2. Create a dataset of Saudi Sign Language gestures.

3. Design and develop a user-friendly interface

5. Achieve high accuracy in sign recognition while maintaining real-time processing capabilities

Literature Review

Paper 1: A Saudi Sign Language Recognition System based on Convolutional Neural Networks

This paper addresses the communication barriers that exist between deaf and hearing people because of the lack of sign language knowledge by hearing people and proposes a Sign language recognition system that aims to bridge this gap by translating signs into natural languages using deep learning techniques.

The methodologies used in this research are:

- 1) Data Collection: collected images representing different signs.
- 2) Preprocessing: data augmentation to enhance and generalize the model.
- 3) CNN: for classification of language gestures.

The paper demonstrated that the CNN model has been successful in recognizing Saudi Sign Language gestures with high accuracy. But even with these promising results, it had some limitations: the paper was focused on still images, not full sign language sentences. Also, the system was not extensively tested in real-world scenarios, such as varying lighting conditions. (Al-Obodi & Al-Hanine & Al-Harbi & Al-Dawas & Al-Shargabi, 2020)

Paper 2: Efhamni: A Deep Learning-Based Saudi Sign Language Recognition Application

This research article presents a deep learning-based application specifically designed for Saudi sign language recognition and facilitates communication between deaf individuals and the hearing people. It highlighted the need to improve the technological solutions and

accessibility for the deaf community in Saudi Arabia.

The used methodologies are the following:

- 1) Data Collection: collected images representing different signs (images and videos).
- 2) Preprocessing: data augmentation to enhance and generalize the model. Using computer vision techniques.
- 3) CNN: for classification of language gestures.
- 4) Application Development: a mobile application using the trained model.

The article proved that CNN models are very effective in recognizing Saudi sign language and achieving high accuracy which is making it a very useful tool for bridging communication gaps between deaf and hearing people. One of the limitations of this research is that it needs further evaluation in diverse lighting and background environments. Also, even though the model supports still and dynamic gestures, there is still room for improvement in recognizing continuous sign language sentences. (*Al Khuzayem & Shafi & Aljahdali & Alkhamesie & Alzamzami, 2024*)

Paper 3: Real-Time Arabic Sign Language Recognition Using a Hybrid Deep Learning Model

This study suggests a hybrid deep learning approach to recognize Arabic Sign Language by enhancing accessibility for the deaf community. It preposses developing a system capable of recognizing both static and dynamic gestures using deep learning techniques as a solution to the shortage of sign language interpreters in Saudi Arabia.

The used methodologies are the following:

- 1) Data Collection: collected images representing different signs (images and videos).

- 2) Preprocessing: hands landmarks and gestures were extracted using the MediaPipe framework.
- 3) CNN: used for classification of sign language gestures.
- 4) LSTM: used for classification of sign language dynamic gestures.

The findings were promising, achieving 94.40% with CNN for still gestures, and 82.70% with LSTM dynamic gestures. The limitations are that the LSTM model achieved lower accuracy than the CNN model. suggesting that it needs further optimization to achieve better results.

(Noor T & Noor A & Alharbi & Faisal & Alrashidi & Alsaedi & Alharbi & Alsanoosy & Alsaeedi 2024)

Paper 4: Gesture-Based Arabic Sign Language Recognition for Impaired People Using CNN

This study was focused on using deep learning techniques to develop a recognition system for Arabic Sign Language to help bridging the communication gap between deaf and hearing people by taking hand gestures as input, and giving vocalized speech as output.

The used methodologies are the following:

- 1) Data Collection: DG5-V hand gloves were used to capture and create the dataset.
- 2) Preprocessing: images were further processed and enhanced to optimize recognition accuracy
- 3) CNN: used for classification of sign language gestures.

CNN was proven yet again to be reliable in recognized Arabic hand signs with 90% accuracy making it a great choice for real world applications.

The system also showed great performance in translating Arabic hand signs into vocalized speech. One limitation is that the model was trained with the 30 sign letters only, which will restrict its ability to generalize to a broader vocabulary. *(El Rwelli & Shahin & Taloba, 2021)*

Paper 5: Using Deep Learning in Sign Language Translation to Text

This article showed how deep learning methods can be used for translating sign language into text. The research aims to address communication barriers between deaf and hearing people and proposes a deep learning-based translation model.

The used methodologies are the following:

- 1) **literature review:** The researchers conducted literature review of number of studies on sign language translation published and 20 studies were selected based on relevance to the topic.
- 2) CNNs was the most selected model for the studies.
- 3) CTC was used for dynamic gesture recognition.

The study found that CNNs based models are the most effective for still gestures and CTC for dynamic with high accuracy. The limitation is that the proposed system is theoretical and not tested in real-world applications.

References

- Al-Obodi, A. H., Al-Hanine, A. M., Al-Harbi, K. N., Al-Dawas, M. S., & Al-Shargabi, A. A. (2020). A Saudi Sign Language Recognition System based on Convolutional Neural Networks. *Building Services Engineering Research and Technology*, 13(11), 3328–3334. <https://doi.org/10.37624/IJERT/13.11.2020.3328-3334>
- Al Khuzayem, L., Shafi, S., Aljahdali, S., Alkhamesie, R., & Alzamzami, O. (2024). Efhamni: A Deep Learning-Based Saudi Sign Language Recognition Application. *Sensors*, 24(3112). <https://doi.org/10.3390/s24103112>
- Noor, T. H., Noor, A., Alharbi, A. F., Faisal, A., Alrashidi, R., Alsaedi, A. S., Alharbi, G., Alsanoosy, T., & Alsaeedi, A. (2024). Real-Time Arabic Sign Language Recognition Using a Hybrid Deep Learning Model. *Sensors*, 24(3683). <https://doi.org/10.3390/s24113683>
- El Rwelli, R., Shahin, O. R., & Taloba, A. I. (2021). Gesture-Based Arabic Sign Language Recognition for Impaired People Using CNN. *International Journal of Advanced Computer Science and Applications*, 12(12), 574–582. <https://doi.org/10.14569/IJACSA.2021.0121273>
- Samonte, M. J. C., Guingab, C. J. M., Relayo, R. A., Sheng, M. J. C., & Tamayo, J. R. D. (2022). Using Deep Learning in Sign Language Translation to Text. *Proceedings of the International Conference on Industrial Engineering and Operations Management, Istanbul, Turkey*, 4036–4044.

