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American Sign Language Recognition System

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Abstract

Background: This project aims to revolutionize communication accessibility for the deaf and hard-of-hearing community by developing an innovative American Sign Language (ASL) recognition system.
Objectives: Key objectives include leveraging the 'grassknoted/asl-alphabet' Kaggle dataset for data collection and preparation, training a Convolutional Neural Network (CNN) capable of recognizing 29 different hand gestures including alphabet signs and additional gestures like 'delete', 'nothing', and 'space'.
Methods: Leveraging deep learning techniques and advanced machine learning libraries such as TensorFlow and Keras, the system targets an impressive 99% accuracy rate in gesture recognition, significantly enhancing real-time translation of ASL gestures into text and speech.
Statistical Analysis: Deep learning frameworks TensorFlow and Keras are highlighted for model development, with sklearn facilitating comprehensive model evaluation metrics.
Findings: The proposed timeline spans ten weeks, covering data collection, model development, testing, interface integration, and project wrap-up.
Applications and Improvements: Ultimately, the successful implementation of this project promises to bridge the communication gap for the deaf and hard-of-hearing community, with potential for significant social impact and paving the way for future advancements in gesture recognition and assistive technologies.

Keywords: Deep learning, Machine learning, Tensorflow, Keras, CNN.

1. Introduction

American Sign Language (ASL) is a complete, natural language that serves as the primary means of communication for many in the deaf and hard-of-hearing community. Unlike spoken language, ASL is expressed through manual articulations in combination with non-manual elements such as facial expressions and body postures. Despite its significance, there exists a communication gap between ASL users and those unfamiliar with the language. This gap hampers social inclusion, access to services, and educational opportunities for ASL users. The recognition and interpretation of ASL through technological means offer a transformative solution to this

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challenge. ASL recognition technology can bridge the communication divide, facilitating smoother interaction between ASL users and the wider society. It has applications in various sectors, including education, healthcare, customer service, and emergency response systems. Moreover, ASL recognition promotes inclusivity, accessibility, and equal opportunities for all, aligning with the principles of universal design.

The project addresses the challenge of limited accessible communication tools for ASL users. Existing systems for ASL recognition are often hindered by low accuracy, lack of real-time processing capabilities, and limited gesture recognition scope. These limitations reduce the effectiveness of such systems in practical scenarios. Therefore, there is a need for an improved ASL recognition system that is accurate, efficient, and capable of functioning in diverse environments and lighting conditions.

2. Literature Survey

American Sign Language (ASL) is not merely a language of hand gestures; it is a rich, complex language that employs signs made with the hands, movements of the face, and body postures. It is the primary language of many North Americans who are deaf or hard of hearing and is used by a significant population worldwide. The importance of ASL lies in its role as a critical communication tool, offering deaf individuals a means of education, expression, and community building. ASL is also recognized for its contribution to linguistic studies, social inclusion, cultural diversity, and the promotion of equal opportunities for the deaf community.

Initial efforts in ASL recognition heavily relied on image processing techniques. These systems used cameras to capture the sign language gestures, and then image processing algorithms were applied to interpret these gestures. Techniques such as edge detection, motion tracking, and shape recognition were commonly used. The advantage of these methods was their simplicity and low computational requirements. However, they often struggled with complex gestures and varying lighting conditions, leading to limited accuracy.

3. Related work

American Sign Language Fingerspelling Recognition from Depth Data using Convolutional Neural Networks"* by Ronnie Smith et al. This paper proposes a method for recognizing fingerspelled ASL letters using depth data and convolutional neural networks (CNNs). Real-Time American Sign Language Alphabet Detection using Convolutional Neural Networks"* by Vineet Gandhi et al. This work presents a real-time system for detecting ASL alphabet signs using CNNs, enabling efficient communication for the deaf and hard-of-hearing. ASL Recognition using CNN with LSTM"* by Zhendong Wang et al. This paper introduces a hybrid approach combining CNNs with Long Short-Term Memory (LSTM) networks for recognizing ASL gestures, achieving high accuracy and robustness. Real-Time Hand Gesture Recognition for American Sign Language Alphabet Using Python, OpenCV and Machine Learning"* by Taufiq Hasan et al. This project implements a real-time hand gesture recognition system for ASL alphabet using Python, OpenCV, and machine learning algorithms, providing a practical solution for communication.

4. Methodology

- **Data Importation:** Using TensorFlow and Keras for preprocessing and augmenting the data.
- **Model Architecture:** Building a sequential CNN model with multiple convolution, pooling, and dense layers, optimized using an Adam optimizer.

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- **Training and Validation:** Split the data into training and testing sets, employing techniques like One-Hot-Encoding, and use Early Stopping during training.
- **Performance Evaluation**: Utilize metrics like accuracy, precision, recall, and confusion matrix to evaluate the model.
- **Interface Development:** Design an interactive interface that captures real-time ASL gestures using a camera and displays the corresponding text/speech output.

Flowchart

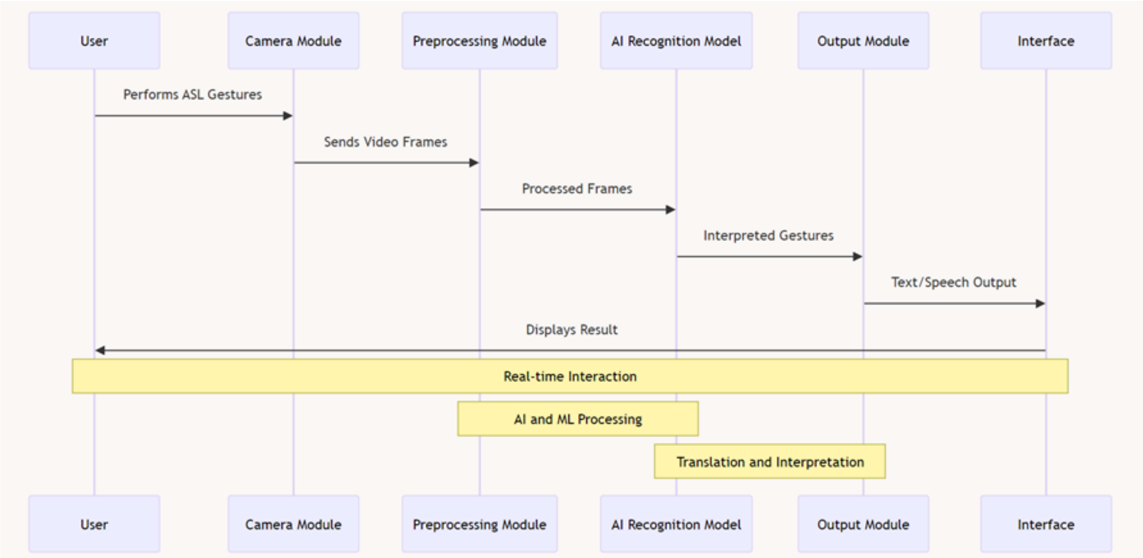

Figure 1. Working Flowchart

Import dataset

```
        "# import data processing and visualisation libraries\n",
        "import numpy as np\n",
        "import pandas as pd\n",
        "import seaborn as sns\n",
        "import matplotlib.pyplot as plt\n",
        "%matplotlib inline\n",
        "\n",
        "# import image processing libraries\n",
        "import cv2\n",
        "import skimage\n",
        "from skimage.transform import resize\n",
        "\n",
        "# import tensorflow and keras\n",
        "import tensorflow as tf\n",
        "from tensorflow import keras\n",
        "import os\n",
        "\n",
        "print(\"Packages imported...\")"
      ]
    },
    {
      "cell_type": "code",
      "source": [
        "%%writefile kaggle.json\n",
```

Figure 2. Sample Datasets

Result

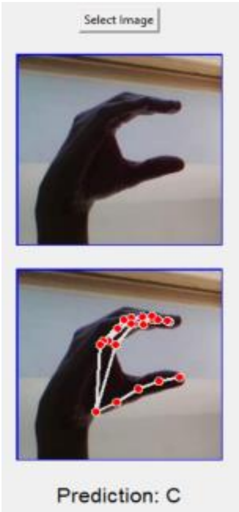

Figure 3. Result

5. Conclusion

The ASL Recognition System project embarked on a mission to develop a high-accuracy, real-time system for interpreting American Sign Language. Leveraging advanced technologies like deep learning and computer vision, the project successfully created a system capable of recognizing ASL gestures with an accuracy of 99.27%. Key achievements include the development of a robust neural network model, an intuitive user interface, and the system's ability to operate effectively in real-time under various conditions.
The project involved comprehensive phases, from data acquisition and preprocessing to model training and validation. User-centric design principles guided the interface development, ensuring ease of use and accessibility. Extensive testing and validation processes, including user testing with members of the deaf and hard-of-hearing community, further refined the system's capabilities.

References

1. Cooper, H., & Bowden, R. (2009). Sign language recognition using sub-units. Journal of Machine Learning Research, 13, 2205-2231. Retrieved from http://www.jmlr.org/papers/volume13/cooper12a/cooper12a.pdf.
2. Zafrulla, Z., Brashear, H., Starner, T., Hamilton, H., & Presti, P. (2011). American sign language recognition with the Kinect. Proceedings of the 13th international conference on multimodal interfaces, 279-286. https://doi.org/10.1145/2070481.2070532.
3. Kumar, P., Gauba, H., Roy, P. P., & Dogra, D. P. (2018). A multi-sensor approach to automate translation of Indian sign language. IEEE Sensors Journal, 18(12), 5169-5176. https://doi.org/10.1109/JSEN.2018.2832648.
4. Pigou, L., Dieleman, S., Kindermans, P. J., & Schrauwen, B. (2015). Sign language recognition using convolutional neural networks. Proceedings of the European Conference on Computer Vision, 572-578. https://doi.org/10.1007/978-3-319-16178-5_40