HandTalk: Translating Sign Language to Text

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Motivation

The motivation behind developing a machine learning-based sign language detection system stems from the need to bridge communication gaps between deaf or hard-of-hearing individuals and the hearing population. This underrepresentation leads to social and professional barriers for those who rely on sign language as their primary means of communication.

Related Work

A New Benchmark on American Sign Language Recognition using Convolutional Neural Network: This study proposes a novel convolutional neural network (CNN) model to enhance American Sign Language (ASL) recognition accuracy. Evaluated on four publicly available ASL datasets, the model, applied to alphabet and numeral images, achieves a 9% improvement in accuracy over existing methods.

Real-Time Sign Language Detection Using CNN : To detect real-time sign language, a dataset is prepared on which a customized CNN model is trained. In the findings, it was observed that the customized CNN model can achieve the highest 98.6% accuracy.

Deep convolutional neural networks for sign language recognition : To address the lack of mobile selfie sign language datasets, they created one with five subjects performing 200 signs from five angles and various backgrounds, capturing 60 frames per sign. They trained CNNs with three sample sizes and tested on two samples, experimenting with different architectures. Their approach achieved a 92.88% recognition rate.

Timeline

Week 1 (28th August - 3rd September): Gather and preprocess the sign language dataset. Convert images to grayscale and normalize the pixel values. Review relevant literature on sign language recognition and machine learning techniques.

Week 2-3 (4th September - 17th September): Conduct exploratory data analysis (EDA) to understand the dataset. Visualize the data and identify any patterns or trends in the sign language gestures. Perform feature extraction using image processing techniques.

Week 4-7 (18th September - 22nd October): Develop initial models using Logistic Regression, Decision Trees, and Support Vector Machines (SVM). Train models on the dataset and evaluate initial performance. Implement data augmentation techniques to improve model robustness.

Week 8 (30th October - 5th November): Experiment with advanced machine learning algorithms, such as Random Forests and Multi-Layer Perceptron (MLP). Optimize the models through hyperparameter tuning using techniques like Grid Search or Random Search.

Week 9 (5th November - 12th November): Evaluate model performance on the test dataset using metrics such as accuracy, precision, recall, and F1 score. Compare different models to determine the best-performing one.

Week 10-11 (13th November - 20th November): Test the final system and finalize the project report, documenting the methodology, results, and conclusions. Prepare the project presentation and demo for submission.

Individual Tasks

Shubham Sharma:

- Research on Sign Language recognition techniques, relevant ML algorithms and Data Preprocessing,
- Develop and train models using Logistic Regression and Decision Trees.
- Participate in final model system testing and adjustments.
- Contribute to final report and presentation.

Aakash:

- Implement and train advanced ML algorithms like SVM.
- Perform data augmentation to improve model robustness.
- Conduct hyperparameter tuning and optimization.
- Contribute to final report and presentation.

Parveen:

- Conduct EDA and visualize dataset patterns.
- Participate in feature extraction using image processing.
- Evaluate models using accuracy, precision, and recall.
- Comparing and selecting best-performing model.
- Contribute to final report and presentation.

Pourav Surya:

- Implement and train Random Forest and Decision Trees.
- Perform hyperparameter tuning for models.
- Integrate the best model into a real-time interface for sign language conversion.
- Contribute to final report and presentation.

Final Outcome

The goal is to implement a robust machine learning model that accurately converts sign language gestures into corresponding text.

References

1. Deep convolutional neural networks for sign language recognition
2. A New Benchmark on American Sign Language Recognition using Convolutional Neural Network
3. Real-Time Sign Language Detection Using CNN