American Sign Language Alphabet Classification

A. Problem Statement and Application

An estimated 48 million Americans, or 15% of the population, suffer from hearing loss. There is increasing interest in having A.I. systems take into account the needs of the disabled, particularly those who have hearing impairments [5]. The deaf and hard-of-hearing community uses sign language to communicate and interact with the outside world. Recognition of sign language has long been a significant area of study [1]. However, due to the limited availability of interpreters and the lack of knowledge of sign language among the general population, effective communication becomes challenging. Speaking with people who use sign language in real life might be challenging. Several ASL models in use today only have an accuracy of about 60% because of hand shape, mobility, and occlusions. In American sign language (ASL), proper nouns like names, technical terms, abbreviations, or foreign phrases are often spelt using one of the 26 unique hand movements that represent the letters of the alphabet (from A to Z). ASL is used predominantly in the United States and in many parts of Canada. ASL is accepted by many high schools, colleges, and universities in fulfillment of modern and "foreign" language academic degree requirements across the United States [3]. This project aims for ASL alphabet classification to facilitate better understanding and interaction with the ASL community. The goal of the research is to examine the various deep learning models in order to identify the model that is most optimised for handling the classification challenge. The goal is to develop a reliable and efficient tool for ASL alphabet recognition, which can bridge the communication gap between individuals with hearing impairments and those who do not know sign language. The proposal showcases the importance of the problem, the dataset selection, possible methodology, and the expected results.

B. Dataset Selection

The chosen dataset [8] for this project is the ASL Alphabet dataset, which contains colored images of hand signs representing different ASL alphabet letters. The dataset has images of dimensions 400x400 which have in total 28 classes which are English alphabets from A-Z. The data set contains in total of one hundred and sixty six thousand images which later on will be altered and resized to 256x256 for the models. The dataset provides a diverse collection of hand sign images captured under various conditions, making it suitable for training and evaluating neural network models for ASL alphabet classification.The dataset has been chosen from kaggle. This complete information of the dataset is before trimming and prepossessing the dataset.

C. Methodology

1.Data Prepossessing: Perform necessary prepossessing steps on the dataset to increase the robustness, which includes augmentation techniques like resizing, normalization, and noise addition. The dataset is divided into split is 80% for training , 10% for testing and 10% for validation. 2.Model Selection: Choose the model for ASL alphabet classification where the chosen techniques will extract spatial or sequential information from the images of hand signs. The goal is to use supervised and semi-supervised learning classifications on the ASL alphabets. For Supervised Learning Classification with decision trees, Splitting the dataset into training and testing sets then train the Decision Tree classifier using the prepossessed captions as input features and image labels as the target variable. Tune hyperparameters using techniques like grid search or random search. Evaluate the model's performance on the testing set using evaluation metrics. For Semi-supervised Learning Classification [2] with decision trees, Split data into labeled and unlabeled. Train initial Decision Tree with labeled data. Predict labels for unlabeled data. Combine labeled and predicted labels, train a new Decision Tree iteratively. Evaluate semi-supervised model with labeled testing set and compare performance with supervised model. For Supervised Learning Classification with DNN, Convert the preprocessed captions into numerical representations and build a DNN pipeline using a CNN or RNN model to process the captions and extract features then Train the DNN model using labeled data and optimize hyperparameters. Evaluate the model's performance on the testing set using evaluation metrics. 3.Evaluation and Comparison: Compare the performance of supervised Decision Tree, semi-supervised Decision Tree, and DNN models. Analyze strengths and weaknesses based on classification accuracy, training time. 4.Model Evaluation: Evaluate trained model using metrics on accuracy, precision, and F1 score on the validation set. Analyze potential issues. 5.Optimization and Performance Tuning: Adjust model parameters to increase precision and real-time performance. The analysis of deep learning projects on ASL with accuracy, By comparing the performance of DNN and decision tree models, researchers can gain a better understanding of which approach is more effective in achieving higher accuracy for ASL recognition.

D. Expected output

The project aims to accurately classify images based on labels using the supervised and semi-supervised learning with Decision Trees and Deep Neural Networks. The analysis aids scientists and engineers in image classification and natural language processing, informing algorithm selection.

References

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