Traffic Sign Detection and Regularization Report

1. Introduction

This project focuses on the classification of traffic signs using the German Traffic Sign Recognition Benchmark (GTSRB) dataset. The objective was to build a convolutional neural network (CNN) that can classify traffic sign images into their respective categories. We further explored the impact of regularization techniques to improve model performance and reduce overfitting.

2. Dataset Description

The dataset used is the FullIJCNN2013 version of GTSRB, which includes 43 traffic sign classes. The dataset was divided into a training set (987 images) and a validation set (226 images). Each image belongs to one of the 43 predefined traffic sign categories.

3. Data Preprocessing

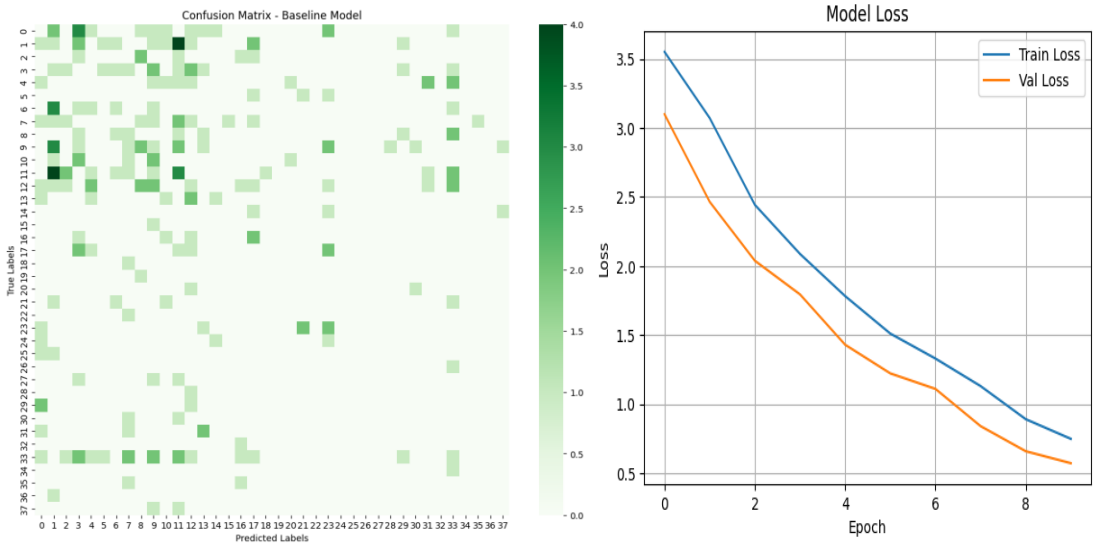
Images were resized to 64x64 pixels for uniformity. Pixel values were normalized to a 0-1 range. To improve generalization, data augmentation techniques such as rotation, zoom, and horizontal flipping were applied.

4. Baseline Model Architecture

A convolutional neural network was constructed with multiple Conv2D and MaxPooling2D layers, followed by fully connected Dense layers. The model was compiled using the Adam optimizer and categorical cross-entropy loss function.

5. Baseline Model Evaluation

The baseline model achieved a validation accuracy of approximately 85.8%. However, the classification report and confusion matrix indicated poor generalization, with many classes receiving 0 precision, recall, and F1-score.

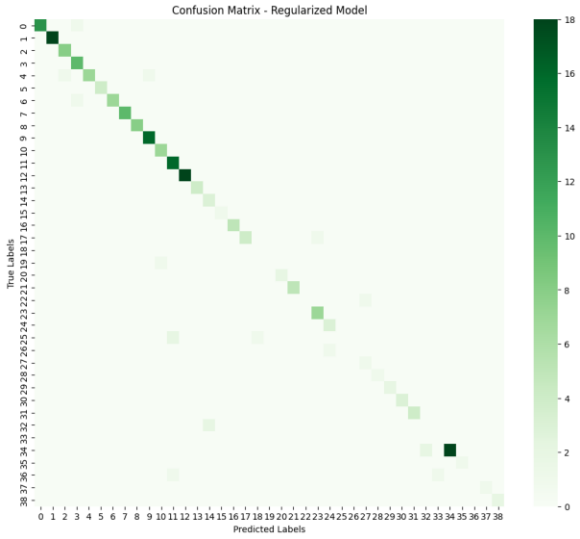


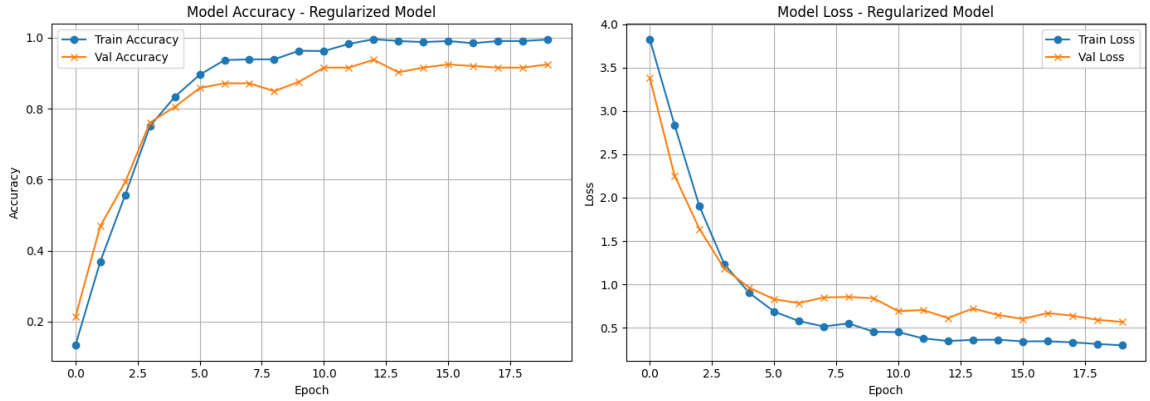
6. Regularized Model

To address overfitting, regularization techniques such as Dropout and L2 regularization were applied. The updated model architecture included Dropout layers and kernel regularizes in convolutional layers.

7. Regularized Model Evaluation

The regularized model significantly improved generalization, achieving a validation accuracy of 92%. The confusion matrix and classification report showed strong performance across most classes, with many achieving 100% precision and recall.





8. Conclusion

The project successfully demonstrated the effectiveness of CNNs in classifying traffic signs. Initial baseline results were limited due to overfitting, but with the introduction of regularization techniques, performance improved dramatically. Future work may include using transfer learning and expanding the dataset for even better results.

GitHub link:

https://github.com/HazalAtis/Traffic-Sign-Classification