TRAFFIC SIGN DETECTION

SYSTEM

A Project By: -

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Project Report

Aim: -

The main goal of this object is to create a high accuracy machine learning model that could understand traffic signs automatically. It is one of the main features of a self-driving system (i.e. ADAS). By using a pretrained model, EfficiencyNetV2B0, we achieved amazing results.

Introduction: -

Traffic signs have been made for the safety and security of the citizens on the streets as well as the people driving of riding the vehicles. It is also essential for the uninterrupted flow of traffic. For the self-driving cars, it is essential for the detection of traffic signs in real time. Deep Learning, especially Convolutional Neural Networks (CNNs) is considered one of the most efficient and accurate technology for picture detection.

The project is based on Transfer Learning, which is a technique of using a model trained on a large dataset (ImageNet) to perform a specific task with some changes. This method is less time consuming and has high accuracy.

Methodology: -

3.1 Dataset

The dataset includes illustrations of various traffic signs (Eg: - speed limit, stop, yield, etc.)

Which were used to train the model. The data was split into 2 parts: -

1) Training Set, which includes 80% of the images, and
2) Validation Set, which includes the rest 20% of the images.

3.2 Preprocessing

Resizing: All images are resized to 224x224 pixels so that they could be used as the input of the EfficiencyNetV2 model.

Normalization: Each pixel value has been normalized in order to facilitate smooth training of the model.

Class balancing: In order to address the issue of dataset imbalance, where some images are shown more than others, Class Weights were created. This makes it look for the less frequent classes during training.

3.3 Data Augmentation

In order to be avoid generalization and overfitting, these arguments were set at random times during training:

Rotation= 10%

Zoom= 10%

Contrast= 10%

Translation= Shifting images horizontally or vertically by 10%

Brightness= 10% increase

3.4 Architecture of the model

EfficiencyNetV2B0 was the pretrained model that we used for this project. It is one of the latest pretrained models available with a good balance between performance and training time.

3.5 Training Strategy

The training was done in two stages: -

1) Head Training: - The base MobileNet model was turned off, and only the custom top layers were trained for 20 epochs using the Adam optimizer.
2) Fine Tuning: - The top layers of the base model were unfrozen. The entire model was then fine-tuned for another 20 epochs with a very low learning rate (1e-5) using the RMSprop optimizer.

Results and conclusion: -

The effectiveness was measured by accuracy, precision, recall and the F1-Score measures.

Overall Accuracy: -98.53%

Confusion Matrix: - According to this, this model differentiates between the classes that appear most similar to each other accurately.

The use of Class weight and misclassification has reduced the number of miscalculations. The two staged training process helped it to form a generic image and acquire specific features of traffic signs.

With the help of Transfer Learning and EfficiencyNetV2, an effective Traffic sign detection project was made. The model is very accurate and can handle changes very effectively. In the future, this could be installed in an edge hardware (eg. Raspberry Pi, NVIDIA Jetson Nano etc) for real time application.

References: -

1) EfficiencyNetV2
2) GTSRB- German Traffic Sign Recognition Benchmark