CS 554 : Introduction to Machine Learning and Artificial Neural Networks 2022 Spring

PROJECT PROPOSAL

Title: Traffic Sign Recognition

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Project Description: One of the most important factors for ensuring the safe drive is accurate detection of traffic signs. There are chances that drivers may be suffering from tiredness or drowsiness which can lead to misinterpretation of the signs or prevent drivers from obeying the road signs. With the advent of autonomous vehicles, these situations that come from the consciousness of the driver are not a problem. Hence, deep learning algorithms are used to make sense of these signs in autonomous driving systems. However, in the real world, a lot of challenges are faced such as disturbance in traffic signs, decolorization, lens blur or the weather conditions. In this study, we will focus on automated traffic sign detection systems and investigate the effect of challenging conditions in algorithmic performance. In the area of Traffic Sign Recognition, several methods have been proposed in the literature such as Convolutional Neural Networks, Support Vector Machines. Even with the latest Traffic Sign Classification methods being proven for very high accuracies[1], there is still some room to improve for researchers.

In this project, the aim is to compare and design combine several deep learning and machine learning techniques like SVM, CNN and LSTM, in order to improve the accuracy of the Traffic Sign Recognition challenge.

Approach to tackle the problem: For accurate traffic sign recognition, a clean dataset and creating an efficient model structure are significant issues. While loading the dataset on our model, we have to make them similar dimensions. We need to interpolate the images to a single dimension. We can make the dataset consistent by rotating or distorting the images. We should convert RGB images to HSV color space because HSV is more robust towards external lighting changes. Moreover, After loading the datasets, we have to split them into train, validate and test sets. However, if we directly split them, our model will not be trained on all the traffic signs as the dataset is not randomized. For improving the accuracy of the Traffic Sign Detection problem, an algorithm will be modeled to combine machine learning and deep learning classifiers in literature.

Dataset:

- German Traffic Sign Recognition Benchmarks (GTSRB)
  It is a 10 hours video created in Germany. The dataset was reduced to 51,480 images of the 43 classes. All the images in the dataset have 32*32 size and the total dataset is

divided into training data and testing data.Total 39,209 images are present as training data and 12,630 images as test data.

- Belgium KUL Belgium Traffic Signs dataset:
  Belgium KUL Belgium Traffic Signs dataset is a dataset for classification where each image represents a sign with 10% offset. They are cropped according to the ground truth information to obtain only the Regions of Interests (RoIs). The original dataset is divided into 62 classes with 4,561 images for training and 2,528 images for testing.

- LISA Traffic Sign dataset
  LISA Traffic Sign dataset contains videos and annotated frames of US traffic signs. It has two versions, one with pictures only and one with both pictures and videos. Traffic signs belong to 47 different classes and 7855annotations on 6610 frames. Size of the picture ranges from 640x480 to 1024x522 pixels. Some images are in gray scale where as other are in color

Algorithms:

Convolutional Neural Networks(CNN):

Convolutional Neural Networks(CNN) is a deep neural network and advanced version of Multi-Layer Perceptron. Multi-Layer Perceptrons have fully connected architecture meaning that all neurons in one layer are connected to neurons on the next layer. The approach is adjusting the weights on the network to deal with overfitting problems. In Convolutional Neural Networks layers are sparsely connected rather than fully connected which reduces the number of learned parameters. Both methods can be used for traffic sign recognition but in general Convolutional Neural Network has better performance than MLP.

Long-Short Term Memory(LSTM):

LSTM is a type of recurrent neural network architecture used in the field of deep learning. LSTM can be used for image recognition, natural language processing and speech recognition.

Support Vector Machines(SVM):

SVM is a supervised learning machine learning model used for both classification and regression problems.The main objective in SVM is to maximize the distance between decision boundaries(margin). Samples on the training set that are closest to the decision boundary are the support vectors. The choice of the type of decision boundary has a key role on performance of the classifier.

References and Papers For Literature Review:

[1] T. Guofeng, C. Huairong, L. Yong and Z. Kai, "Traffic sign recognition based on SVM and convolutional neural network," *2017 12th IEEE Conference on Industrial Electronics and Applications (ICIEA)*, 2017, pp. 2066-2071

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