TRAFFIC SIGN RECOGNITION using ARTIFICIAL NEURAL NETWORK

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Abstract

To understand Neural Network and applying the concepts to model the dataset of Traffic Signs, and henceforth recognizing the test images using the trained model. The approach follows an efficient image recognition using properly trained artificial neural network implementation.

Problem Statement

To identify and recognize varied Traffic signs affected by impact of nature (dust or distortions) or illumination using Artificial Neural Network model to improve recognition capabilities and analyzing the accuracy and metrics on different parameters.

Introduction

Traffic Sign Recognition gains its importance and motivation as:

- It is still a challenging task to recognize Traffic signs in various natural background viewing conditions of weather and illumination.
- Moreover, traffic sign recognition has computational difficulties with the performance of system in real time.

The project aims at efficient recognition of traffic signs using properly trained implementation of neural network. Initial phase of understanding involved exploring machine learning and its several techniques. As the widely stated, **Machine learning** is a subfield of computer science that evolved from the study of pattern recognition and computational **learning** theory in artificial intelligence. It can be applied in several ways such as regression, classification or prediction. This project directly deals with classification and identification of a test image from one of the trained Traffic sign images. It involves extracting the unique features from the data of interest (Set of traffic signs pre-classified, also known as supervised data) which could be used in mapping the dataset trough the neural network model and henceforth identifying the test images.

Literature Survey

1. Robust Method for Road Sign Detection and Recognition Piccioli et al., *Image and Vision Computing 14*, pp.208-223., 1996
2. Using Color to Detect, Localize and Identify Informational Signs Yuille et al., *Proc. International Conference on Computer Vision ICCV98*, Bombay, India, pp. 628-633., 1998
3. The German Traffic Sign Recognition Benchmark Johannes Stallkamp et al., *International Joint Conference on Neural Networks, 2011*

Metrics Used

1. Accuracy
2. Precision
3. Recall
4. F1-score
5. Support
6. Confusion Matrix

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Methodology

I. Data Set Identification

The Datasets used in this project:
1. German Traffic Sign Recognition Benchmark, GTSRB dataset (39,209 images in 43 classes)
2. Belgium Traffic Sign Dataset (7125 images in 63 classes)

II. Feature Extraction

This dataset was processed using Caffe for feature extraction.**BVLC GoogLeNet** model will be loaded into caffe to get required image feature vectors. Also, three datasets of pre extracted feature vectors(Hue, HOG and Haar) of GTSC dataset will also be considered for analysis.

III. Training the Model

Scikit-learn package in python was used to apply the Multi-Layer Perceptron. For this MLP, L-BFGS algorithm was used for implementation.

IV. Testing the Model

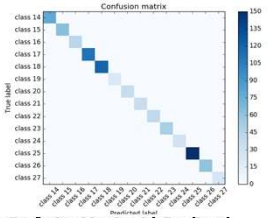
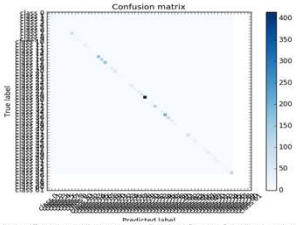
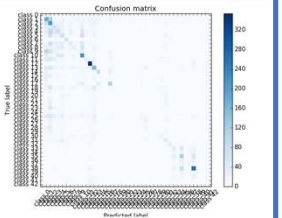
The test set is given to model and corresponding classification of the image is stored as vector of test outputs and validated.

V. Analysis of the Model

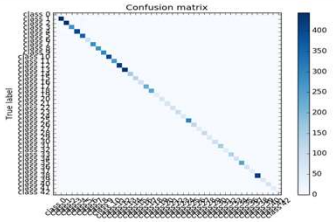
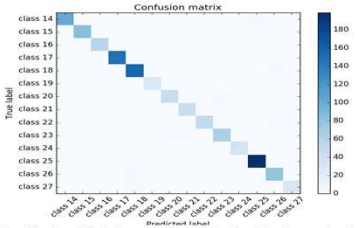
Analysing model for its accuracy.

Observations

Dataset 1 : GTSC caffe extracted {Training (3135,4097) , Testing (855,4097)}
Dataset 2 : BTSC Caffe Extraced { Training (4575,4097) , Testing (2520,4097) }
Dataset 3 : GTSC Hue Feature Set { Training (30061,256) , Testing (7842,256) }

Dataset 1	Dataset 2	Dataset 3
 Fig. Confusion Matrix with Predicted outputs on horizontal and True outputs on vertical axes with 14 different classes.	 Fig. Confusion Matrix with Predicted outputs on horizontal and True outputs on vertical axes with 62 different classes for predictions.	 Fig. Confusion Matrix with Predicted outp horizontal and True outputs on vertical ax 43 classes for prediction.
Precision = 1 Recall = 1 F1-score = 1 Support = 855	Precision = 0.94 Recall =0.92 F1-score=0.92 Support = 2520	Precision = 0.26 Recall = 0.29 F1-score = 0.25 Support = 7842
Accuracy = 99.87	Accuracy = 92.063	Accuracy = 29.09

Dataset 4 : GTSC HOG Feature Set { Training (35288,1568) , Testing (7842,1568) }
Dataset 5 : GTSC Haar Feature Set { Training (3135,11584) , Testing (1140,11584) }

Dataset 4	Dataset 5
 Fig. Confusion Matrix with Predicted outputs on horizontal and True outputs on vertical axes with 43 different classes.	 Fig. Confusion Matrix with Predicted outputs on horizontal and True outputs on vertical axes with 14 different classes.
Precision = 0.99 Recall = 0.99 F1-score = 0.99 Support = 7842	Precision = 0.98 Recall = 0.98 F1-score = 0.98 Support = 1140
Accuracy = 99.05	Accuracy = 98.42

Summary and Conclusion

1. Traffic Signs can be classified if the feature extraction is carried out properly.
2. Hue Feature is not a good sole feature to extract uniqueness for classification modelling.
3. Choice of feature for extraction can help overcome the bad quality of image.
4. For greater accuracy, both the training data must be good and parameters in the model must be rightly set.
5. Number of hidden layer nodes depend on the data to be trained and tested.

References

1. Mohammad Badrul Alam Miah. Article: A Real Time Road Sign Recognition using Neural Network. *International Journal of Computer Applications* 114(13):1-5, March 2015.
2. C.Y. Fang, C.S. Fuh, P.S. Yen, S. Cherng, S.W. Chen, An automatic road sign recognition system based on a computational model of human recognition processing, Computer Vision and Image Understanding, Volume 96, Issue 2, November 2004, Pages 237-268, ISSN 1077-3142
3. J. Stallkamp, M. Schlipsing, J. Salmen, and C. Igel. The German Traffic Sign Recognition Benchmark: A multi-class classification competition. In Proceedings of the IEEE International Joint Conference on Neural Networks, pages 1453–1460. 2011.