Traffic Sign Detection and Recognition

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Abstract - *Classifying traffic signs is an indispensable task for autonomous driving systems. Depending on the country, traffic signs possess a wide variability in their visual appearance making it harder for classification systems to succeed. Either the classifier should be fine-tuned or a bigger collection of images should be used. Nowadays, Intelligent Autonomous Vehicles together with Advanced Driver Assistance Systems (ADAS) deal with the problem of traffic sign recognition. It is a challenging real world computer vision problem due to the different and complex scenarios they are placed into. After images are classified they are made into the groups like highway signs, speed signs, danger signs etc.*

Key Words: Self-Driving Car, traffic sign, recognition and detection, HOG and SVM, MSER and HSV.

1. INTRODUCTION

Traffic sign detection and recognition (TSDR) system has been introduced to reduce traffic safety concerns. A TSDR system detects and recognizes traffic signs from and within images captured by cameras or imaging sensors displaying to the user the user what traffic rules are applicable at that stretch of road. In bad traffic conditions, the driver may not notice traffic signs, due to which accidents occur. In such cases, the TSDR system comes into play. The main objective of the research on TSDR is to improve the efficiency and working speed of the TSDR system. To develop a TSDR system is a difficult job given the continuous changes in the environment and lighting conditions. There are other issues such as partial obscuring, multiple traffic signs appearing at the same time, and blurring and fading of old traffic signs, which can also create problem for the detection purpose and need to be addressed. For application of TSDR system in real-time environment such as self-driving cars, a quick algorithm is required. Also dealing with issues, a recognition system should avoid errors in recognition of non-signs [6].

1.1 Problem Definition

Classifying traffic signs is a very important task for autonomous driving systems as the safety of everyone as well as the passenger depends on it. Depending on the country, traffic signs possess a variety of differences in their visual appearance making it harder for classification systems to succeed as a generalized system is not feasible.

Nowadays, Intelligent Autonomous Vehicles together with Advanced Driver Assistance Systems (ADAS) deal with the problem of traffic sign recognition. It is a challenge as it is a real world computer vision problem due to the different scenarios they are placed into, and not having clear discernable images to work with due to various reasons both natural and manmade. The proposed system will help understand the problem and provide a systematic way of approaching the problem.

1.2 Aims & Objectives

Through this project we aim at understanding the problems faced by the computer models and work a way around it for a better accuracy and more clear classification of the image which in turns helps us understand the various concepts of Machine Learning and Image processing. Making a GUI interphase to test the model using various traffic sign images.

2. LITERATURE SURVEY

The first research on traffic sign recognition was back in 1987; Akatsuka and Imai tried to make a very basic traffic sign recognition system [5]. A system capable of by itself recognize traffic sign and used as an assistance for drivers, telling them about the presence of some specific restriction or danger in speeding or construction work. It can be used to provide the automatic recognition for specific traffic signs. Generally, the procedure of a traffic sign recognition system is divided into two parts, detection and classification.

2.1 Detection

The aim in using traffic sign detection is to locate the regions of interest (ROI) in which a traffic sign is likely to be found. Cropping the excess space is what's required to get the main sign. This technique called as ROI. ROI locates the traffic sign in based on its shape dimensions etc. The traffic signs are cropped which is useful. The background image is removed as it is not an area of interest. By this we assume, that a large part of the image area can be ignored as not required. Traffic signs are designed with set color and shape making them easier to differentiate and recognize.

2.2 Classification

In this part the sign is classified based on the type shape colour and the information the sign is giving. Histogram of oriented gradients (HOG) Features: HOG decomposes an image into small squared cells, computes a histogram of oriented gradients in each cell, normalizes the result using a block-wise pattern, and return a descriptor for each cell [6].

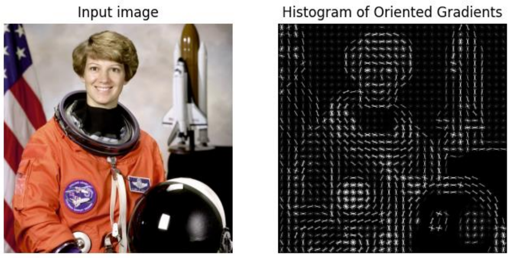

Fig -1: Example of HOG

3. PROPOSED SYSTEM

In this project the aim is to make a general system which can be used across multiple countries for traffic sign recognition. It's simply broken down into a few steps as given in Figure 2 below.

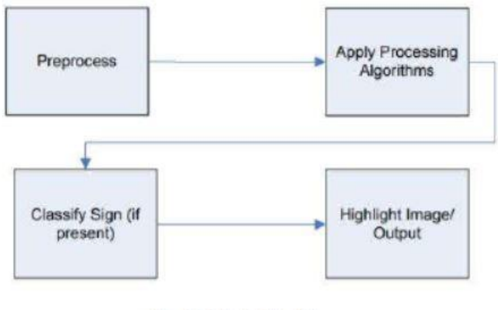

Fig -2: Basic Block Diagram of System

3.1 Detection

Maximally Stable External Regions (MSER) is a method for blob detection in images. The MSER algorithm extracts from an image a number of co-variant regions, called MSERs, an MSER is a sable connected component of some grey - level sets of image. MSER is based on the idea of taking regions which stay nearly the same through a wide range of thresholds.

All the pixels below a given threshold are white and all those above or equal are black.

If we are shown a sequence of threshold images I t with frame t corresponding to threshold t, we would see first a black image, then white spots corresponding to local intensity minima will appear then grow larger.
These white spots will eventually merge, until the whole image is white.

The set of all connected components in the sequence is the set of all extremal regions.

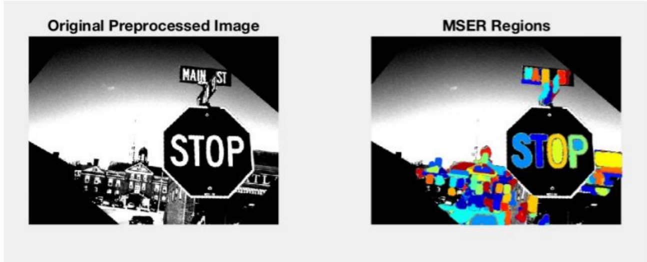

Fig -3: Example of MSER

We first using methods of image pre-processing where in using median filter we clean the salt- and-pepper noise in the image.

Then applying contrast normalization over each of the channel using the formulas, after that blue and red channel intensity normalization will be used.

Next we use the maximally stable external regions (MSER) algorithm to detect binary image for both the red and blue MSER regions.

Then we used HSV and threshold values to help us get a better binary image.

Lastly combining HSV and MSER we get out increased accuracy output which is then contour based cropped and ready to use as into for the SVM classifier.

3.2 Classification

As HOG generates a large number of features, Principal Component Analysis (PCA) a dimensionality-reduction method that is often used to reduce the dimensionality of large data sets, by transforming a large set of variables into a smaller one that still contains most of the information in the large set.

Then SVM Classifier is used. The algorithm outputs an optimal hyperplane which categorizes new examples. In two dimensional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side.

The learning of the hyperplane in linear SVM is done by transforming the problem using some linear algebra.

We first trained the classifier on the dataset, and test it accuracy.

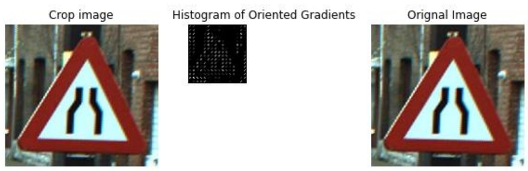

Fig -4: Output of HOG

4. TEST CASES & OUTPUTS

4.1 Test Cases

Accuracy of HOG and SVM	
Test Accuracy	85%
Training Accuracy	92%

Table -1: Accuracy of HOG and SVM

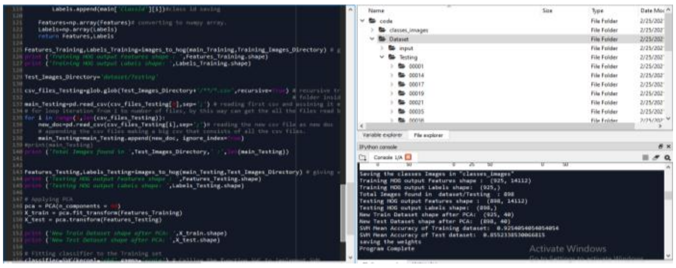

Fig -5: Real Time Testing of Model

4.2 Outputs

4.2.1 Detection

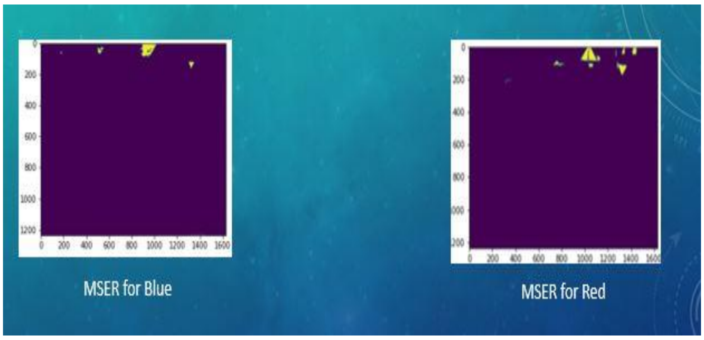

Fig -6: MSER

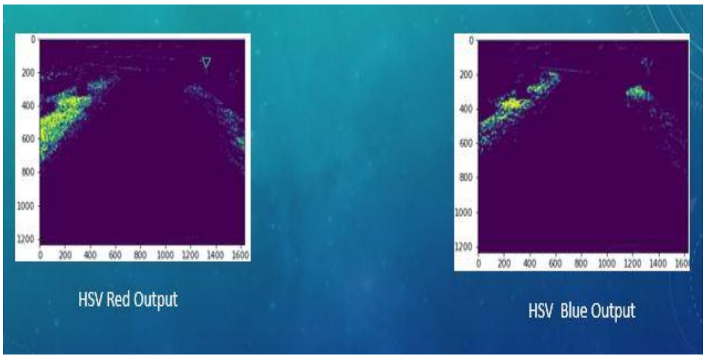

Fig -7: HSV

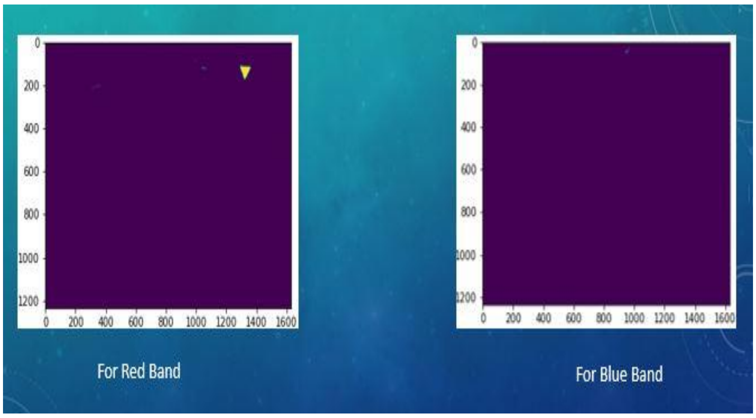

Fig -8: MSER and HSV Combined

4.2.2 Classification

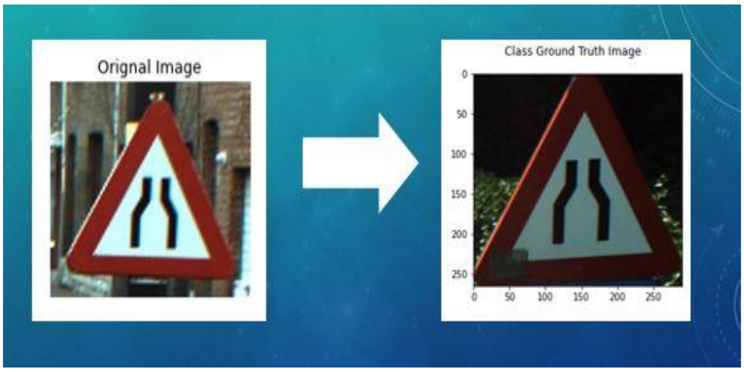

Fig -9: Classification

4.2.3 Final Output & GUI

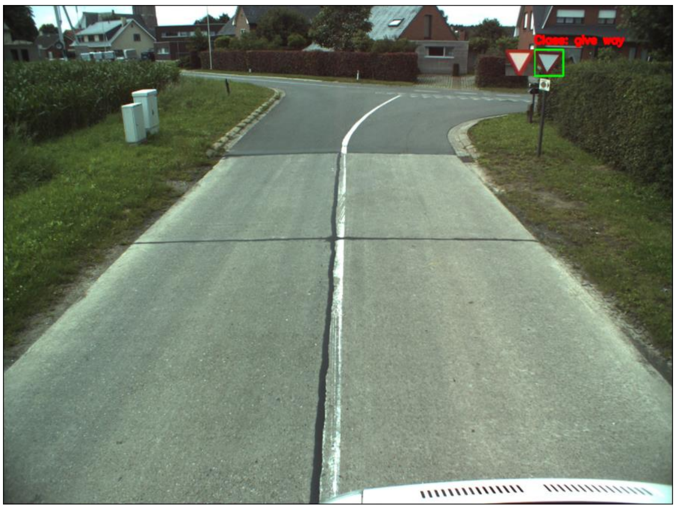

Fig -10: Detection & Classification

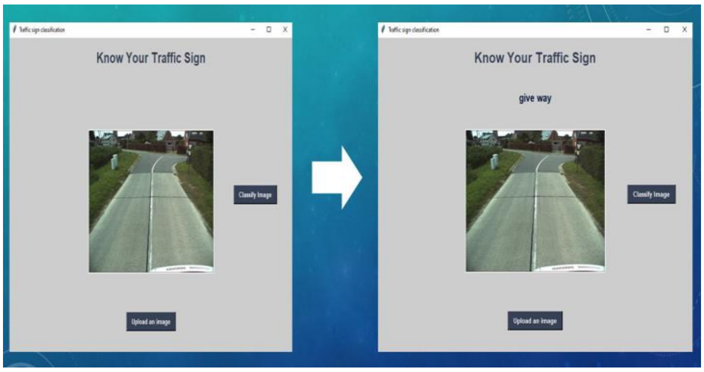

Fig -11: GUI

5. CONCLUSION

Having worked on this project we now get a clear idea of how traffic signs are classified and how the model works to do the same. We also learned various concepts of image preprocessing, computer vision and all the algorithms used for the desired output. We plan to future study this topic deeper and improve on our current model.

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