Traffic Sign Detection System

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ABSTRACT

The main objective of our project is to design and construct a computer based system which can automatically detect the road signs so as to provide assistance to the user or the machine so that they can take appropriate actions. The proposed approach consists of building a model using convolutional neural networks by extracting traffic signs from an image using color information.

INTRODUCTION

Nowadays, there is a lot of attention being given to the ability of the car to drive itself. One of the many important aspects for a self driving car is the ability for it to detect traffic signs in order to provide safety and security for the people not only inside the car but also outside of it.

The traffic environment consists of different aspects whose main purpose is to regulate flow of traffic, make sure each driver is adhering to the rules so as to provide a safe and secure environment to all the parties concerned.

We have focused our project on the US traffic signs and a few of the traffic signs which we have in our dataset is as shown in the figure below. We used the LISA traffic sign dataset [3]. The dataset consisted of 48 different types of US traffic sings. About 75% of the frames were in gray scale and the rest in color.

The problem we are trying to solve has some advantages such as traffic signs being unique thereby resulting in object variations being small and traffic signs are clearly visible to the driver/system [1]. The other side of the coin is that we have to contend with lighting and weather conditions [1].

In our project we used convolutional neural networks (CNN) to classify the traffic signs and we used color based segmentation to extract/crop signs from images.

Figure: Examples of Traffic signs in the US

METHODS

The entire process of traffic sign detection can be split into the following parts:

1.Extract traffic signs from training images using template matching.

2.Using the extracted traffic signs to train a model based on convolutional neural networks.

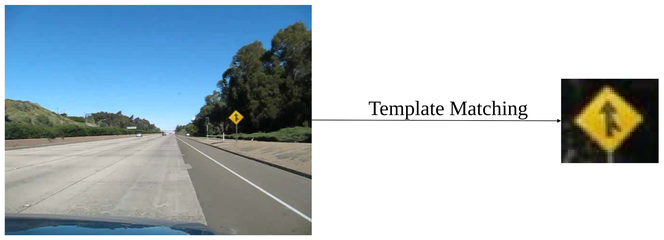
3.The process of predicting a traffic sign from a test image can be further split into four parts.

1. Convert the test image from RBG to HSV.
2. Create 3 binary masks for each test image based on yellow color range, red color range and white color range .
3. From the masks created above extract contours which have a bounding rectangle with area greater than some threshold.
4. Use the trained convolutional neural network to predict the traffic sign in each contour.

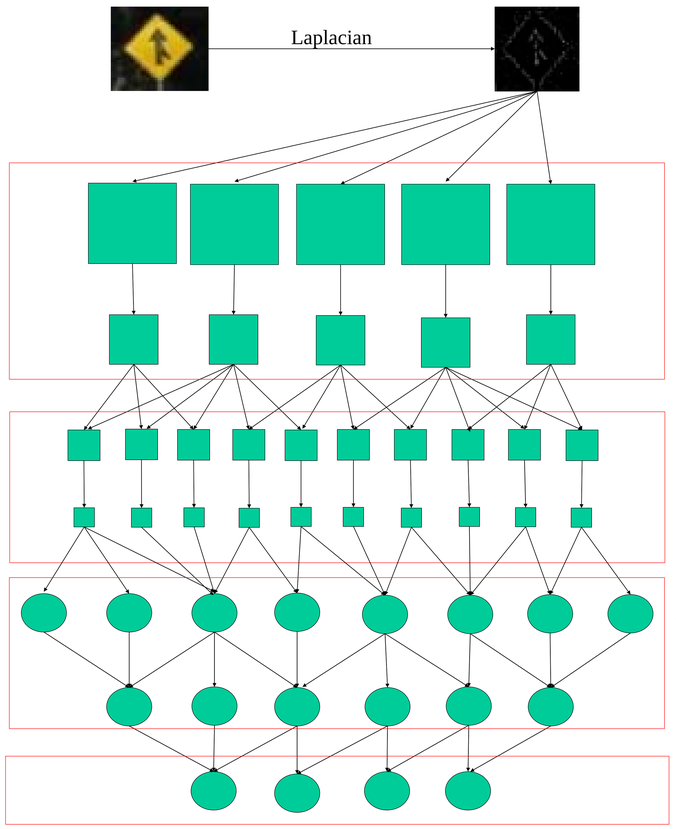
These steps can be explained using the following images.

[1] https://bartlab.org/Dr.%20Jackrit's%20Papers/ney/3.KRS036_Final_Submission.pdf
[2] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.695.3606&rep=rep1&type=pdf
[3] http://cvrr.ucsd.edu/LISA/lisa-traffic-sign-dataset.html

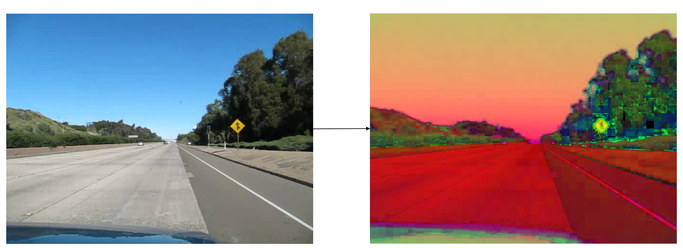
Extracting Traffic signs from training images



Building a CNN model using extracted traffic signs



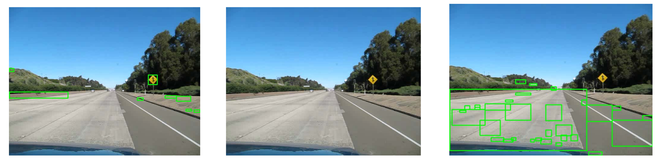
Converting Test Images from RGB to HSV



Creating Binary Masks

Yellow Mask | Red Mask | White Mask

Extracting Contours From Binary Masks



Yellow Contours | Red Contours | White Contours

Predicting Traffic Signs From Contours

RESULTS

The following table shows the Accuracy, Precision, Recall and F1 scores.

Metric	Score
ACCURACY	86.9%
PRECISION	0.8638
RECALL	0.8694
F1 SCORE	0.8633

Metric Table

CONCLUSION

From the following results we can see that the CNN is doing a good job in classifying different types of traffic signs when the extracted signs are cropped perfectly from the image.
Our approach fails to give good results when the extracted signs from test images are cropped incorrectly. Another drawback of our approach is that when the color of the traffic signs vary due to bad weather conditions and poor camera quality the image masks obtained are not perfect and hence the signs are not detected properly.
Future improvements can be made for extracting signs from test images by using advanced segmentation methods