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Traffic Sign Detection and Recognition using Convolution Neural Network(CNN)

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Abstract – Traffic Sign Detection and Recognition is an important feature for driver assistance, contributing to safety of drivers, pedestrians and vehicles. In order to focus on driving, drivers sometimes miss out traffic signs on road, or due to bad weather conditions (eg. fog, rain etc.) which could be dangerous for drivers as well as pedestrians. Our Software system would help to detect as well as Identify traffic signs without loosing the focus of drivers while driving. To classify image into respective categories, we build a CNN model (convolution Neural Network). CNN is best for image classification purposes. Tensorflow is used to implement CNN. We are able to implement the model with 99% accuracy. Traffic signs are an essential part of our day to day lives. They contain critical information that ensures the safety of all the people around us. Without traffic signs, all the drivers would be clueless about what might be ahead to them and roads can become a mess. The annual global roach crash statistics say that over 3,280 people die every day in a road accident. These numbers would be much higher in case if there were no traffic signs.

Key Words: convolution neural network, Tensorflow, Traffic Sign Recognition, Machine Learning, Tkinter.

1. INTRODUCTION

Traffic sign recognition system is a crucial research direction in computer vision and a significant section of Advanced Driver Assistance System (ADAS). It can be grouped into two technologies, traffic-sign detection and traffic-sign recognition. The correctness of detection will directly lead to the final identification results. Traffic signs contain necessary messages about vehicle safety and they show the latest traffic conditions, define road rights, forbid and allow some behaviors and driving routes, cue dangerous messages and so on. They can also help drivers identify the condition of the road, so as to determine the driving routes. Traffic signs have some constant characteristics that can be used for detection and classification, among them, color and shape are important attributes that can help drivers obtain road information. The colors used in traffic signs in each country are almost similar, usually consisting of simple colors (red, blue, yellow, etc.) and fixed shapes (circles, triangles, rectangles, etc.). The image of traffic signs is often affected by some external factors such as weather conditions. Therefore, traffic-sign recognition is a challenging subject and also a valuable subject in traffic engineering research. In and, a variety of traffic-sign identification technologies have been developed. In paper, a CNN based on transfer of learning method is put forward. Deep CNN is trained with big data set, and then effective regional convolutional neural network (RCNN) detection is obtained through a spot of standard traffic training examples.

1.1 PHASE 1: DETECTION

In this phase, the image obtained from the camera in the car is preprocessed before the process of detection starts. General preprocessing steps involve converting the obtained RGB image into an HSV image. For detection, the HSV (Hue Saturation Value) color space is preferred over the RGB (Red Green Blue) color space. HSV is more similar to what the human eye actually sees when compared to an RGB image. An RGB image defines colors in terms of three primary colors, whereas HSV has a greater range of colors. An HSV image is also less susceptible to external light changes. The HSV image is equalized to adjust the contrast in the image by modifying the image's histogram. Once the HSV image is obtained, the next steps would be to detect objects based on their color followed by finding out their shape and validating the object to be a traffic sign.

1.1.1 Color based Detection

The first and most important thing we notice in a sign is the color. Once we see the color red, we realize that the board on the side of the road is actually a traffic sign.

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This is the same logic we used while proposing our method of detection. From the captured frames, the proposed algorithm knows to check for a sign based on the color red. If a portion of the image falls under the appropriate threshold of red, that part is checked to see if a sign is available. Once the red threshold is verified, the contours of the red part are found.

1.1.2 Shape Based Detection

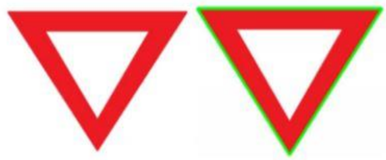
The number of edges is calculated using the contours di. This is done using the Douglas-Peucker algorithm. In this system, we talk about 2 shapes: triangle, circle. Once the number of edges is found using the Douglas-Peucker algorithm, the area of the contour is also found. If the number of edges found is 3, and the area satisfies the minimum condition, it is considered to be a sufficiently large triangle. Similarly, if the number of edges found is greater than or equal to 6, and the area of the contour follows the minimum condition, the contour is considered to be a sufficiently large circle. Once the shapes are found, finding the bounding box is key. The bounding box separates the Region of Interest (ROI) from the rest of the environment. The bounding box usually touches the outer triangle or circle of the detected contour. For a triangular sign, there are two triangles, the outer triangle, which touches the bounding box and the inner triangle which is inside the outer triangle and does not touch the bounding box.

1.1.3 Sign Validation

Once the bounding box is found, the sign must be validated. The image on which a threshold filter has been applied is first inverted where the inner triangle which was previously black is now white and the outer triangle which was previously white is now black. If the white triangle touches the boundary, then it is not a sign, and if it does not touch the outer triangle and the boundary box, it is considered to be a traffic sign. This is resized to 48x48 and set to the next phase. To indicate where the sign is, a green contour is drawn around the detected sign. As seen in Fig., the detected sign is highlighted with a green border.

(a) (b)

Fig. 1. (a) Image with threshold filter applied and (b) Inversion of image with threshold filter applied

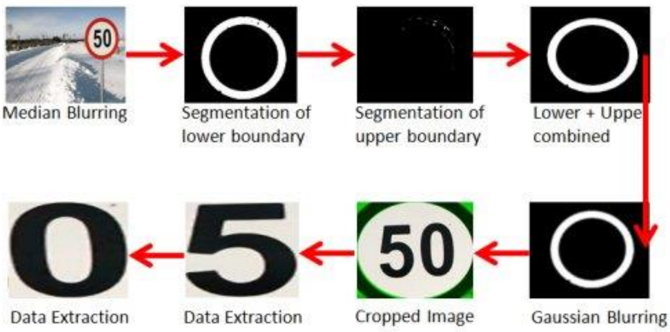


(a) (b)

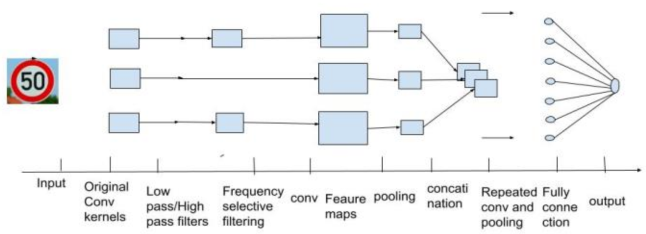
Fig. 2. (a) Original Image and (b) Sign Detected Image

1.2 PHASE 2: RECOGNITION

Once the sign is detected, the sign must also be classified. With the help of Google's open source machine learning framework, TensorFlow, a convolutional neural network can be implemented. In our implementation of the recognition phase, the first step was to take the detected sign from the previous phase and perform basic preprocessing on the image. Training and testing of the CNN is the most important part of this phase. We used the German Traffic Sign Benchmark and the Belgium Traffic Signs data set for training and testing. A convolutional neural network is very similar to the brain in the sense that it also has neurons which in turn have weights and biases. Each neuron receives an input on which it performs some operation and the output is passed as the input to the next neuron. A convolutional neural network can have many layers, the first always being the input layer and the last the output layer. Anything else in between is called a hidden layer. This paper proposes a feed-forward network with six convolutional layers. This also has fully connected hidden layers with dropout layers in between to prevent overfitting. The model proposed in this paper makes use of the sequential stack provided by Keras, which is an open source high level neural network library that is capable of running on top of TensorFlow. All the layers of the proposed CNN have Rectified Linear Unit (ReLu) activation. ReLu activation is considered to be the most popular activation function for neural networks. The output of the 6th convolutional layer is fed to a fully connected layer, which uses a flatten function to flatten the output at that point. The flattened output is given to the final layer which uses SoftMax activation. A max pooling layer is also added after every two convolutional layers to improve the speed of processing. We do not use just one CNN but an ensemble of CNNs. We have 3 CNNs whose aggregate determines the final result. This provides a much more accurate result than just a single CNN. The loss, optimizer and metrics of the model must be mentioned. The loss of the model is set to categorical cross entropy which means that the loss of the model is calculated as a value in between 0 and 1 instead of using percentages. The optimizer uses Stochastic Gradient Descent with Nesterov momentum. The metric used is accuracy. To improve the training of the machine, epochs with a backward pass are used. Epochs increase the accuracy of the prediction.



2. SYSTEM ARCHITECTURE:



TRAFFIC SIGN CLASSIFIER GUI

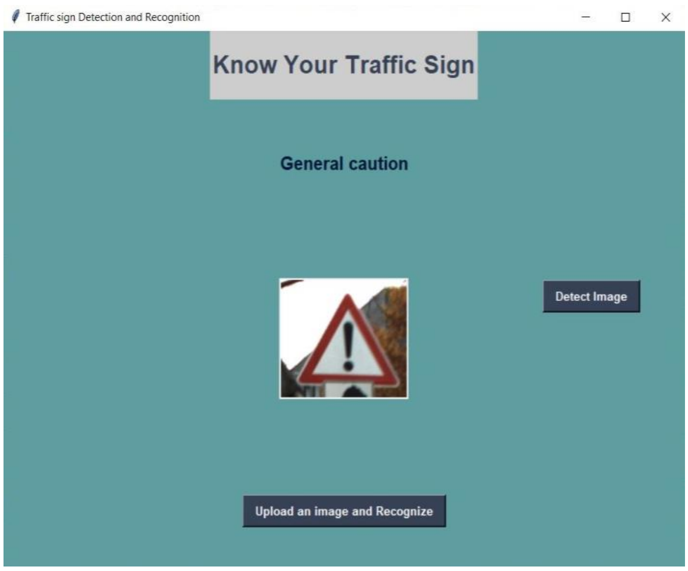
We are going to build a graphical user interface for our traffic signs classifier with Tkinter. Tkinter is a GUI toolkit in the standard python library. We will make a new file in the project folder and save it as gui.py and we can run the code by typing python gui.py in the command line.

In this file, we have first loaded the trained model 'traffic_classifier.h5' using Keras. And then we build the GUI for uploading the image and a button is used to classify which calls the classify() function. The classify() function is useful for converting the image into the dimension of shape (1, 30, 30, 3). This is because to predict the traffic sign we have to provide the same dimension we have used when building the model.then we predict the class, the model.predict_classes(image) returns us a number between (0-42) which represents the class it belongs to. We use the dictionary to get the information about the class.

3. ADVANTAGE:

1. Traffic control signals provide for an orderly movement of traffic.
2. Manufacturers are emphasizing the development of safety equipment with an aim to reducing the number of accidents caused by driver distraction and to reduce the seriousness of such accidents.
3. Good signs on streets and highways is vital for safety, since in addition to regulating traffic, it informs the driver of the condition of the roads.
4. They intercept heavy traffic to allow other traffic to cross the road intersection safety.

4. RESULT:



5. FUTURE SCOPE:

While the model proposed in this system does bring us a step closer to achieving the ideal Advanced Driver Assistance System or even a completely driverless system, there is a lot that can be improved. Forv identification of a sign, this system depends on color and shape of the sign. This is a problem if there is a reflection on the sign which impacts its color. Similarly, if the sign is chipped or cut off, the shape of the sign is impaired, thus resulting in no detection of the sign. Another important issue to consider is detection in the night. If the camera is not able to capture the environment in the night due to the darkness, the sign cannot be detected and classified. A text to speech module can also be added to this application. In the current application, the driver would have to read the text printed on the classified sign, but with the help of a voice module, more comfort is guaranteed. The overall performance could also be improved and customized with the help of more datasets and from different countries.

6. CONCLUSION:

•A traffic sign recognition method on account of deep learning is proposed, which mainly aims at circular traffic signs.
• By using image preprocessing, traffic sign detection, recognition and classification, this method can effectively detect and identify traffic signs.

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