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TRAFFIC SIGN DETECTION USING CONVOLUTION NEURAL NETWORK

A NOVEL DEEP LEARNING APPROACH

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Abstract: The accident rate due to negligence of observing traffic signs and not obeying traffic rules has been increasing drastically. By utilization of synthesized training data, which are created from road traffic sign images allows us to overcome the problems of traffic sign detection databases, which vary for countries and regions. This method is used for the generation of a database which consists of synthesized pictures to detect traffic signs under different view-light conditions. With this data set and a perfect Convolutional Neural Network (CNN), we can develop a data driven, traffic sign recognition and detection system which has high detection accuracy and also has high performance ability in training and recognition processes. This ensures less occurrence of accidents and also helps the driver to concentrate on driving rather than observing each and every traffic sign. The purpose of this paper is to provide an efficient method for detection and recognition of traffic signs in India. We proposed methods like neural network and feature extraction which overcome the limitations of existing methods and improve the efficiency in detecting traffic signs and also reduce the road accidents.

***Index terms* – Convolution neural network, Feature extraction, Road accidents, Traffic sign recognition.**

I. INTRODUCTION

Road sign recognition has become a major challenging field in academics as well as in industry. The major application of this systems can be mostly used in the upcoming Artificial Intelligence (AI) world to understand environment and also being one of the most important part in Advance Driver Assistance Systems (ADAS). Majorly, recognition process provides clear visual definition on the fact that every traffic sign may consists of different kinds of shapes, colors and graphics that will represent the environment and road constrains, which enables driver to recognize and prepare, for what he/she may face. Road Signs are not expected to be highly visible to drivers, there may be little confusion between signs or may be some signs are not recognizable by few drivers. This may lead to confusion and more chance for occurrence of accidents. If confusion occurs in recognizing warning signs then it may be dangerous. However, because of different environmental situations, there are few cases where the road signs will get completely perverted, making their appearance challenging for humans and machines.

The difficulties found with the Road sign collection could be eliminated by the utilization of different artificially generated data without must burden on the classifier to recognize. Our paper discusses recognition of sign in two major ways which are classification and extraction. There are many ways in recognizing a signal. The paper [1] uses a modified Hough Transform to determine the coordinates of the road sign, or like in paper [2], where Circular Hough Transform is used to determine the circular prohibitory sign. Methods used in paper [3] and [4] use the information about the shape of the road sign in the detection step, based on the Histogram features and Support Vector Machine classifiers. Using these papers as a reference, the appearance of the sign remains constant in each example. And only the view reference is changed with each sign. The fact is that the pattern of sign is always the same, the only change is the view that a recognition camera or the driver sees and also the environment which makes difficult to recognize, this contribute the different variations in recognition, this can be achieved by updating different conditions of traffic signs in the training set. Our method doesn't require real time data because we used training data set which consists of the photographs that are very similar to the real-world data. The objective of using this data set is to increase our detecting precision as more as possible which should be greater than 90% close to actual observation. So whenever a sign is scanned it may not be same as the real world sign but our method uses CNN to recognize any similarities between them and classifies as the same sign.

II. LITERATURE REVIEW

2.1 DETECTION USING CNN ENSEMBLE.[1]

The method described by Shustanov, P. Yakimov [1] used for Road Sign Detection and Recognition is image processing technique which consist of a group of (CNN) for the recognition called as ensemble.

The recognition rate for the CNN is very high, which makes it more desirable for various computer-based vision tasks. The method used for the execution of CNN is TensorFlow. The members of this paper achieved more than 99 percent of accuracy for circular signs on using German data sets.

2.2 RECOGNITION USING COLOR SEGMENTATION.[2]

Wali etal [2] describes how they have used to implement a novel method for sign recognition. They used advanced ARK-2121 technology which is small computer which they installed this tech on the car. The major techniques in the recognition step of the sign were SVM and HOG. They achieved an accuracy of 91% in detection and about 98% average on the classification process.

2.3 THE GERMAN TRAFFIC SIGN RECOGNITION.[5]

R. Qian etal [5] describes the analysis and design process of "German Traffic Sign Recognition Benchmark" dataset. The outputs of this project showed that algorithms of machine learning showed very well in recognition of traffic signs. The participants got a very good percentage of 98.98 recognition rate which is as high as human perfection on these datasets.

III. EXSISTING SYSTEM AND ITS DISADVANTAGES

The previous methods used for designing traffic sign recognition model are

1) K-means clustering [8]
2) Lidar and vision based [9]
3) Video streaming [10]

3.1 DISADVANTAGES OF EXSISTING METHODS

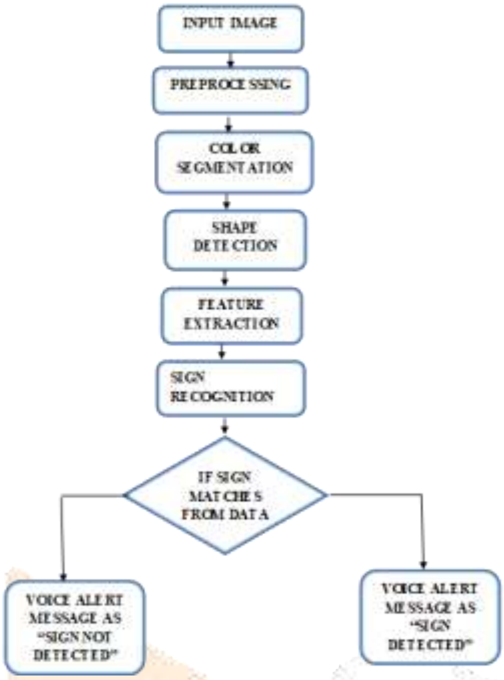
I. False Detection
II. Redundancy (inter pixel redundancy)
III. Less efficiency (compared to our model)
IV. Cost related issues

IV. PROPOSED SYSTEM

The framework we proposed is categorized into three stages: Detection and feature extraction and recognition. The detection stage is just used to find a road sign. At the point when a vehicle is travelling at a specific speed, the camera catches the road sign in nature, and our calculation verifies whether a sign is available in that outline or not available in that perimeter. Distinguishing the traffic sign depends on shape and color. In the feature extraction stage, the proposed calculation characterizes the distinguished road sign. This is accomplished with the assistance of "Convolutional Neural Network" algorithm which classifies the image into sub classes.

4.1 FLOW CHART FOR TRAFFIC SIGN DETECTION MODEL

The flow chart below gives details about various steps involved in designing traffic sign detection model.



STEP 1. INPUT IMAGE

Camera which is placed inside the vehicle records a video which is nothing but a series of photos. Usually there are 24 frames per second. These photos go through the processors for the detection of sign. The camera quality should be very high that it should clearly shows the traffic sign from the minimum distance required. Generally, a camera of more than 8MP is required for this process.

STEP 2. PRE-PROCESSING

The image or videos which is scanned is pre-processed through convolutional neural network. The image which has higher resolution is scaled down to small resolution and RGB image is converted into greyscale format so that the image can be easily processed by the "Convolution Neural Networks". The Neural networks are very similar to the neurons in our brain it senses the image and gives the necessary information to the processor. Below is the figure which shows left or straight sign, it is converted into greyscale and is fed into CNN. It is then sampled and divided into small pieces and the obtained output is compared with the data set which we gave and the corresponding voice output is given. Neural networks are similar to the neurons in our brain it senses the image and gives the necessary information to the processor. The steps which are required for pre-processing in Convolution neural network is lower when compared to other classification algorithms.

STEP 3. (RGB) BASED DETECTION

In a sign the most significant thing is the color. Once the red colour is seen it is understood that it is a traffic sign on the road. This same idea is used for our detection process. Based on whatever the frames captured our algorithm is designed to check for a sign depending on the red colour. From the image captured if a part of it is similar to the threshold values of red colour then it is passed for the further steps to recognize if it is a sign or not. Once the threshold of the red is checked the main sign in the red part is to be recognized.

STEP 4. DETECTION BASED ON SHAPE OF THE SIGN

Based on the previous detection method we calculate the number of edges which is implemented using the algorithm of Douglas-Peucker. We majorly concentrate on two shapes which are circle and triangle because they are most repeated shapes of traffic sign. once using Douglas-Peucker algorithm the number of edges and area of interest is found. Now if the edges found is equal or greater than six and if the main part satisfies minimum condition then it is considered as a triangle. And if edges are equal and greater than six and moreover if they satisfy minimum condition then the major part of the image is recognized as circle. After the shapes are recognized the next major step is in detecting the box of the bounding. The bounding box is important because the Region of Interest (ROI) is separated from the environment by the bounding box. Usually the box touches circle or the triangle of the main region. In a triangular sign, it consists of two triangles they are outer triangle and inner triangle. The outer triangle just touches the box of bounding and the one which does not touch is the inner triangle.

STEP 5. RECOGNITION PHASE

When the detection of sign takes place the classification of sign has to be done. By using TensorFlow which is machine learning technique from Google Convolutional Neural Network is designed. In this phase the first thing is to preprocess the image which we received from previous phases. In recognition phase, testing and training of the CNN is considered to be the most significant part. For the testing and training of the data set we utilized "German Traffic Sign Benchmark and the Belgium Traffic Signs". CNN is considered as the brain as it contains the same features and process that a normal brain does or has. Each neuron receives information and is forwarded to the succeeding neuron. CNN has numerous layers the input layer is the 1st one and output layer is the last. Hidden layer is between the first and the last. This method has 6 CNN layers. To prevent overfitting in the middle a perfectly connected hidden layer is present. In this model we used "sequential stack" which was developed by Keras that runs above TensorFlow. There is a "Rectified Linear Unit activation" in all layers. In neural networks the main important activation function is ReLu. The input to fully connected layer is the output of sixth conv layer, which utilizes a level capacity to straighten the yield by then. The final layer consists of Softmax activation and the flattened output is given this layer. To improve the processing speed there is a max pooling layer present just after 2 layers. We use a collection or group if CNN's like here we use three to give more perfect results. The output will be more accurate if we use more CNN's rather than one. Things such as optimizer, loss and metric are to be specified. The loss uses values between 0 and 1 rather than percentages. The optimizer utilizes "Stochastic Gradient Descent with Nesterov momentum". Epochs are used in betterment of the training therefore it improves the perfectness in prediction. Finally, a text to speech module is added to the system where the traffic sign is recognized and the output is produced in the form of voice which helps the driver in the car to easily recognize the signs and avoid accidents

V. RESULTS AND OBSERVATIONS

Sample traffic sign data set used in designing the model. The sample traffic sign data set used is German traffic sign data set

Fig. 5.1. Sample traffic sign data set

5.1. EXPERIMENTAL RESULTS:

Table 5.1. The Detection accuracy of different traffic signs of our model

Detected traffic sign	Probability of detection	Class Number	Recognition time (ms)
STOP	99.86%	14	20 TO 50
NO ENTRY	99.97%	17	20 TO 50
SPEED LIMIT 30 KM/HR	99.69%	1	20 TO 50
GO STRAIGHT OR LEFT	99.99%	37	20 TO 80
DANGEROUS CURVE TO LEFT	99.62%	19	20 TO 80

The below figures represent various traffic sign which are classified under different classes. The probability we obtained is different for different signs. If the distance is increased further then the probability may decrease which in turn reduces the efficiency of predicting the traffic sign.

Fig 5.2. DETECTED TRAFFIC SIGN (SPEED LIMIT 30KM/HR)

The above figure represents "Speed Limit 30 km/hr" traffic sign which is classified under class 1 and the probability we obtained is 99.69% at distance of 10 meters from the webcam. If the distance is increased further then the probability may decrease which in turn reduces the efficiency of predicting the traffic sign.

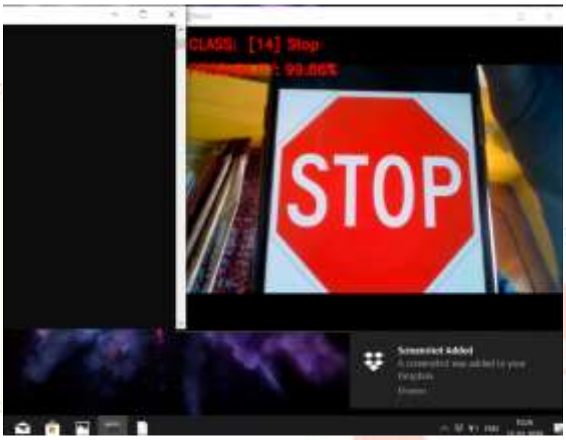


Fig 5.3. DETECTED TRAFFIC SIGN (STOP)

The above figure represents "Stop" traffic sign which is classified under class 14 and the probability we obtained is 99.86% at distance of 10 meters from the webcam. If the distance is increased further then the probability may decrease which in turn reduces the efficiency of predicting the traffic sign.

Fig 5.4. DETECTED TRAFFIC SIGN (DANGEROUS CURVE TO THE LEFT)

The above figure represents "Dangerous Curve to the Left" traffic sign which is classified under class 19 and the probability we obtained is 99.62% at distance of 10 meters from the webcam. If the distance is increased further then the probability may decrease which in turn reduces the efficiency of predicting the traffic sign.

VI. COMPARASION OF EXISTING AND PROPOSED METHOD

Table. 6.1. The Results of existing methods

Parameters	K-means	Lidar and vision based	Video streaming
Method used	K clustering algorithm	Fusion of camera and lidar data	Using video as input and then applying feature extraction
Efficiency	92.6%	95.87%	Around 95%
Recognition time	Takes more time	Takes more time	Takes less time

Table. 6.2. Our model Performance

Parameters	Proposed System
Method used	Convolution neural network
Efficiency	99 to 99%
Recognition time	Takes less time

VII. CONCLUSION

- The model which we proposed will bring us a step closer to achieving the ideal Advanced Driver Assistance System (Autonomous Car) or even a completely driverless system, there is a lot that can be improved.
- For detection of a sign, this paper depends on color and shape of the sign. CNN algorithm is preferred more compared to other algorithms since it provides high efficiency and There is a problem if there is a reflection on the sign which impacts its color. Similarly, if the sign is not proper or cut off, the shape of the sign is impaired, thus resulting in improper detection of the sign which leads to fault detection.
- Another important issue to consider is detection in the night. If the camera used is infrared then there is no problem in detecting signs but in case of noninfrared webcam which may not detect signs accurately which causes high chance of accidents.
- Adding text to speech module in our model makes the driver effortless and makes him to concentrate completely on driving rather than checking for traffic signs. This reduces the occurrence of accidents during night and as well as day time.
- Since we used low GPU (GRAPHICAL PROCESSING UNIT) system, we could not get 100 percent efficiency if the traffic sign is too far away from the system. But we provided a text to speech module which can be equipped in advanced Driver Assistance system.
- The hardware used in this project is very less when compared to other models, which reduces cost and also free from hardware Impairments

VIII. FUTURE SCOPE

Our algorithm is continuous in detecting the signs which leads to detecting signs even there are no signs in the area, which leads to continuous flow of output. This results in false detection or unnecessary detection. This could be improved by increasing the threshold value for detecting sign. The overall performance can also be improved and customized with the help of more datasets from different countries.

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