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A REVIEW ON INDIAN TRAFFIC SIGN RECOGNITION METHODS

Divya P[*1] & Sabeena M[2]
PG Scholar, Assistant Professor
[*] Dept. of Electronics and Communication Engineering, College of Engineering Karunagappally, Kollam, India

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ABSTRACT

There is a great demand for Traffic sign recognition in the existing world due to the increase of road accidents. It provided useful information to the driver regarding the meaning of the traffic signs and the traffic rules to be followed. Different methods are used for traffic sign detection and recognition like color segmentation, RGB to HSI model. Recognition includes HOG feature[14], shape context etc. In Deep learning methods, the system consists of mainly three stages, Regions of interest(ROIs) extraction, ROIs refinement and classification, and post processing. In the recent years, there is an increase in the study of Machine learning method for traffic sign recognition in tansportation systems. This paper presents a review of different methods used in Traffic sign recognition.

KEYWORDS: Traffic Sign detection, traffic sign classification, deep learning, convolutional neural network.

1. INTRODUCTION

Indian Traffic signs are designed such that they are easily readable, with highly saturated and contrasting colours. Traffic sign recognition has been studied for years, there still exist many challenges. For example recognition of speed limit sign can inform the driver about the present speed limit and it can also alert the driver if a car is being driven faster than the speed limit. Traffic sign recognition system contains mainly two part, Traffic sign detection and Traffic sign classification. The traffic rules are displayed to the driver by means of traffic signs, which needs to be interpreted while driving. Traffic signs usually have specific colors, so the color based methods are widely used. This appears to be easy as drivers can easily recognize all the signs because the color and shapes of the signs are very different from the natural environment. Many researchers use HSI (Hue, saturation and intensity)color space instead of RGB(Red,green and Blue) and has achieved good performance. Road traffic signs reduce the frequency and severity of certain types of crashes. However, there are some problems while processing the images of signs. Some of the main problems are low camera resolution, imperfect sign state, illumination, and occlusion, weather conditions such as rain, snow .All of these can affect the color analysis and shape extraction of signs. This can be solved by using many traffic sign recognition methods.we have analysis all the technologies and tools used in traffic signs recognition system. Mainly used method for traffic sign recognition is searched for different traffic signs and hence regions of interest (ROI) are calculated by using color and shape features of the sign. These ROI's are then analyzed in the recognition stage.

2. TRAFFIC SIGN DETECTION AND RECOGNITION METHODS

Indian road traffic signs are standardized and pertinent nationwide, these are broadly classified into the following categories[17].

1) Regulatory signs-These signs inform the road users about the laws and regulations they have to follow. Violation of these signs is legal offence. They are circular in shape with red circumference.

2) Compulsory signs-These signs are an extension to regulatory signs and similar to the violation of regulatory signs,violation of these is a legal offence, which makes them most important signs. They are circular in shape and are filled with blue color and white circumference.

3) Warning signs-These signs warn road users of certain hazardous conditions. They are triangular in shape and possess a red circumference. Violation of these is not a legal offence.

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4) Informatory signs - These signs provide information and guidance to road users. They are rectangular and may vary in color, in some cases they might be green with white circumference whereas in others it might be white filled rectangle with blue circumference.

FIgure1:Street view of Traffic sign image samples

2.1.Traffic sign detection

2.1.1.Blurring:

Raw image way include random or AWGN (Additive white guassian noise) like dots due to a less efficient capturing device.Also due to improper illumination,some part of this may have sharp edges and abrupt colour images.Which can affect the entire detection process.So, to reduce noise or to smoothen the image,we need to have a blur like effect.There are two types of blurring which are used.Mediam blur(It reduces salt and paper noise) and Gaussian blur(This can be applied on sharpened edge for smoothing .

2.1.2.Colour based detection:

Colour is one of the most powerful attributes for object detection.Traffic Sign detection using color is based on the five typical colors defined in standard traffic signs (red, blue, yellow, white and black).Colour thresholding method[1] is used to segment the image and shape analysis to detect the sign[1].The color and the corners of the shape of the sign were chosen as features to extract the sign from the environment.The effect of light on the color of traffic signs during day and night and concluded that the color of roadside image could get distorted due to light and this may affect the quality of images[3][12].Other method for detection is color learning-using genetic algorithm[4],allowing an invariance localisation to changes in position, scale, rotation, and the presence of other objects of the same colour. Most researchers look for robust color segmentation, paying special attention to non-homogeneous illumination.Colour image information is represented in RGB is an additive colour system based on tri-chromatic theory.Different color spaces available like HSV(Hue,saturation,value)[19],HSL(Hue,saturation,lightness),CMY(Cyan,magenta,yellow),YCbCr,etc...HSV colour space plays are important role in image processing.[10]

2.1.3.Shape based detection:

Shape based method is possible to detect a particular shape information ,like circular,triangle and rectandle, etc...Different methods are used for shape of traffic signs.[10]

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2.1.3.1.Shape detection using edges:
Most of the edge detection techniques depend on the contouror edge information of signs,here detection of signs by using rectangular pattern matching algorithm. The areas detected as signs were defined under one scan window, for detection of rectangular and circular images of traffic sign using rectangular and circular detection algorithm.

2.1.3.2.Shape detection using template matching:
Shape can also be detected using template matching techniques[21].The matching is done by calculating the Hausdroff distance between the image.However, this technique is not suitable for real time applications as it requires many computations between template and ROIs for sign detection.The main advantage of using template approach is that it can be modified to detect any objects [C].Simple template matching (e.g. cross-correlation similarity)

2.1.3.3.Shape detection based on hough transform[8]:
Hough transform[2] is used to detect circles and lines based on curve fitting algorithm. The advantage of using Hough transform(HF) is that it is not sensitive to imperfect data and noise and also manages to detect occluded images. Given the regular geometric information provided by the traffic signs, one of the first attempts to address the problem was to apply Hough transform on the edge map of the region of interest.After extracting straight lines using Canny edges the different segments of proper length and slope may be suitable for use as traffic signs.

2.1.4.Cropped and extract features:
Different methods used for rect and mask extract features from different color shape[13].First the traffic sign is detected then that image is cropped. Finally the image within the bounding box is kept and the rest is discarded.

2.1.5.Detection based on machine learning techniques:
Machine learning algorithms like support vector machines (SVMs)[7] and neural networks (NNs)[18] can be used to extract shapes. SVMs and NNs are used for Traffic sign detection because of their ability to detect shapes accurately. Neural networks are trained for each set of signs. However, addition of more signs implies again training of network and hence manual selection of training samples. SVM's are invariant to rotation, translation and partial occlusions of road signs. MSERs (Maximally Stable Extremal Regions) work on the traffic symbols with white background. Although MSERs are a robust form of sign detection in complex scenes but they are computationally expensive.Machine learning techniques (e.g. suport vector machines,boosting, random forest, etc).

2.2.Traffic sign recognition

2.2.1. Recognition based on template matching:
Template matching is a technique in image processing for finding small parts of an image which match a template image[21].To identify the matching area,We have to compare the template image against the source image by sliding template image over source image.This algorithm stores some sample sign images in database. They calculated the distance between candidate regions came from detection stage and different sizes of template images in database. The template having minimum distance is the matched sign,but this algorithm fails for tilted, rotated and partially hidden traffic signs.

2.2.2. Recognition based on machine learning techniques:
There are many machine learning techniques like SVMs, Neural networks which can be used to recognize signs.SVM[7] has the ability to classify and recognize images with the help of trained data.Mainly used the cascaded structure of support vectors classifiers and HOG features[14] to recognize the signs. The SURF(Speeded up Robust Feature) algorithm was used to match two traffic signs even if they are slightly rotated. The authors in created a SURF database of various traffic signs templates. However, a fast internet connection is needed for better performance of tool.

3. DEEP LEARNING BASED METHODS

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In 1980's deep learning was first theorized. Deep learning is a machine learning approach and these are composed of multiple processing layers.Large amount of labeled data and substantial computing powers are required for deep learning. The neural networks (NNs) has the power that it lies in their ability to approximate any continuous function.. The commonly used activation functions are, sigmoid and the Rectified Linear Unit (ReLU). A n-layer NN having an input layer and $n-1$ hidden layers. Deep neural network (DNN) has been widely used in computer vision. This is a powerful tool for uncovering the nonlinear information hidden in the data.In 1988 the birth of Convolutional neural networks (CNN) or ConvNets. Neural Network does not transform the image into another representation and the classification depends on the correlation between the network and the neural weights. Deep learning approaches significantly improve the final results of traffic sign recognition.

In deep learning algorithms contains Deep Neural Network(DNN), Convolutional neural network(CNN)[17][22] and Recurent Neural Network(RNN).Deep neural networks used for providing lift for classification and forecasting models. Convolutional neural network providing feature extraction and classification of images. Recurrent neural network used for sequence of events, language models, time series etc…A deep machine learning process consists of two main phases: training and inferring.

4. ANALYSIS OF TRAFFIC SIGN DETECTION AND RECOGNITION

In Traffic sign recognition method, Deep learning based method is better, because high computation speed. Deep Learning is an area of machine learning which overcomes machine learning limitations. The deep learning model can learn directly from dataset like images, voice or text. A CNN architecture is in the simplest case a list of Layers that transform the image volume into an output volume (e.g. holding the class scores) .There are a few distinct types of Layers ,like CONV/FC/RELU/POOL. Each Layer accepts an input 3D volume and transforms it to an output 3D volume through a differentiable function. Each Layer may or may not have parameters, like CONV/FC do, RELU/POOL don't. Each Layer may or may not have additional hyperparameters, like CONV/FC/POOL do, RELU doesn't .

Table1.An analysis of Traffic Sign Detection and Recognition

Year	Authors	Detection Algorithm	Recognition Algorithm
1997	Escasera and salichs	Colour thersholding[1]	Neural Network(NN)
2003	Benallal and Meunier	Colour segmentation[3][10]	-
2003	Escasera	Genetic Algoritm[4]	Bayesian generative modeling(BGM)[4,5]
2005	Claus Bahlmann	Adaboost Algorithm[5]	Bayesian generative modeling(BGM)[4,5]
2007	Mourtarde	Shape detection through Hough transform[2]	Neural Network(NN)
2009	Mourtarde	Colour segmentation[3]	Support vector machine(SVM)[7]
2012	Oruklu	Colour segmentation[3]	Template Matching and Neural Network[21]
2014	Yi yang	Color probability model[14]	HOG Featrure context and Shape context[14]
2015	Karunalithika	Opencv library is used for detection[15]	Mobile base applications[15]
2016	Rihab Hamida	Colour segmentation based on Xilinx system generator[16]	Simulink model based on Xilinx system gererator[16]
2016	Arun Nandawal	Colour segmentation[3]	Neural Network(NN)
2016	Abdul Alim	Colour based method	Neural Network(NN)
2016	W.Devapriya	HSV colour model[19]	KELM classifier(NN)[19]
2017	S.Visalini	Convolutionaql Neural	Convolutionaql Neural

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		Network(CNN)[17]	Network(CNN)[17]
2018	Amal bouti	Convolutionaql Neural Network(CNN)[17]	Convolutionaql Neural Network(CNN)[17,22]

5. CONCLUSION

In this paper, we have provided an extensive review of the Traffic Sign Recognition methods. Many authors have worked on Traffic sign recognition systems under controlled environments and certain specified datasets but with uncontrolled conditions less work has been focused. Table illustrates the various sign detection and recognition methods used by researchers from the last 20 years. It provide a detailed summarize on different methods of Traffic Sign Recognition. which can provide valuable in-sight in to this important research area and encourage new research, like Deep learning method for Indian traffic sign detection and classification. Recent research focused on both symbol-based and text-based signs. Deep Neural Networks based approaches give more effective results for Traffic sign Recognition.

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