

# Hybrid Framework on Automatic Detection and Recognition of Traffic Display board Signs

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## Abstract

Automatically identifying traffic signs is a challenging and time-consuming process. As the academic community pays more attention to traditional algorithms for vision-based detection, tracking, and classification, three main criteria drive the investigation, they are detection, tracking, and classification. It is capable of performing detection and identification operations to minimize traffic accidents and move towards autonomous cars. A novel method proposed in this paper is based on moment invariants and neural networks for performing detection and recognition with classification, and it also includes automatic detection and identification of traffic signs and traffic board text that uses colour segmentation. Aside from the proposed structure, it is also required to identify the potential graphic road marking with text. This research article contains two algorithms, which are used to accurately classify the board text. The detection through image segmentation and recognition can be done by using the CNN algorithm. Finally, the classification is performed by the SVM framework. Therefore, the proposed framework will be very accurate and reliable with high efficiency, which has been proven in many big dataset applications. The proposed algorithm is tested with various datasets and provided good identification rate compared to the traditional algorithm.

**Keywords:** Machine learning, CNN, SVM

## 1. Introduction

In today's world, autonomous cars must be able to recognise and categorise traffic signs. The field of traffic sign classification and recognition has seen a lot of progress. Each government enacts rules and regulations to ensure the safety of the transportation sector [1]. Ensure safe travel by adhering to all driving rules and regulations. Traffic signs are other forms of visual language such as various signals or messages may be regulated [2].

There are many different types of traffic signs that we may observe alongside roadways. To drive efficiently, one must be aware of the road signs in front of them and react accordingly [3-5]. Fatal things may occur otherwise. Lack of attention or human perception problems prevent drivers from seeing each of the traffic signs present in front of their vehicles. A large number of studies have been performed for automated sign detection and identification to help drivers [6]. Even yet, due to the tremendous potential for practical traffic management system applications, further research study has been required to analyse the problem. Generally, there are three steps in the process of finding and recognizing signs on the road; they are finding, classifying, and recognizing [7-9]. Figure 1 shows some sample input traffic sign symbols.



**Figure 1.** Sample Symbols in Datasets

This image was captured by a video camera placed on top of a car, which is used in the detection process. Traffic signs are probably located inside the ROI of image. Once automated detection and identification of traffic signs have been accomplished, the next step is to classify them. As a visual classifier, each ROI is classified according to its form and color at this step [10]. At the last step, signs are identified as belonging to a particular class. Figure 2 shows the visual road marking with text.



**Figure 2.** Visual Road Marking With Text

Visual road markings, such as traffic signs and traffic lanes help drivers to get all the essential information regarding roadways and road conditions. Traffic signs are an essential component of road infrastructure because they assist with navigation by informing drivers about the present status of the road, whether it is restricted, prohibited, or warned, as well as providing useful information about upcoming turns and changes in direction [11]. Traffic signs are marked with visual characteristics such as shape, color, and pictograms. Driving carelessly and failing to

observe traffic signs may lead to an accident. However, in crowded areas, motorists may choose to disregard traffic signs or fail to see them all at once. In these conditions, a traffic sign recognition system may compensate for drivers' potential inattention by assisting them in obeying traffic signs and decreasing tiredness, making driving safer and simpler [12, 13].

## **2. Organization of The Research**

The rest of this research article is framed as follows: section 3 provides preliminary work of the automatic detection of traffic sign boards. Section 4 discusses about the various machine learning algorithms to accurately detect and classify the sign boards. Section 5 shows some experimental results and its discussion. Section 6 concludes the proposed research work.

## **3. Preliminaries**

Researchers in many countries began studies on how early humans may have used stone tools. Automatic traffic sign detection and identification was begun by Akatsuka et al. [14] Beginning in the early 1990s, De la Escalera et al utilised various edge detection, closed curve, and neural network techniques to carry out the extraction process and target categorization [15]. In 1994, the world's most sophisticated traffic sign detection system was launched by German scientists, Saadna et al. The colour segmentation, form analysis, and statistical pattern recognition methods were utilised to compose the overall system. Researchers have developed a number of practical applications for the development of traffic sign detection system during the past several decades [16].

A. González et al., used the visual appearance of text on traffic panels from street-level images for text detection and identification. In a recent application to intelligent transportation systems, they devised a way to detect traffic panels in street-level pictures and to identify the

information on them (ITS). It first applies blue and white color segmentation before extracting local descriptors [17]. A "bag of visual words" may be used to represent images, and classifiers like Nave Bayes or support vector machines are applied to them.

The method of automated identification and recognition of text in traffic signs proposed by Jack Greenhalgh and Majid Mirmehdi is innovative. Search areas within a picture are defined using scene structure, and then traffic sign candidates are located inside those regions. The two primary optimization strategies employed in this task are maximum stable extremal regions and hue, saturation, and value color thresholding. The main goal is to find a large number of candidates. Once this large pool of candidates has been found, each candidate is constrained based on temporal and structural information to create a smaller subset of possible results. A recognition step identifies possible candidate areas and analyses the text inside them. In the course of optical character recognition (OCR), text characters are recognized as texts and are then organized into lines. Temporal integration of text findings over successive frames greatly improves the recognition accuracy [18].

### ***Research Gap***

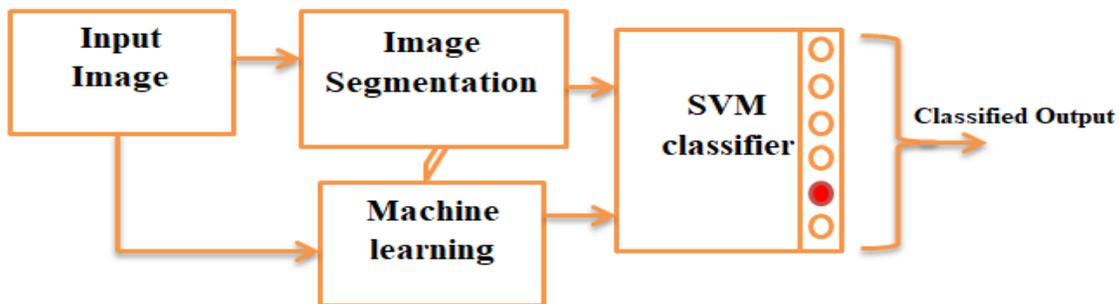
The information on all traffic signs, symbols and board texts on the road will be sent to the driver, who will not have the choice to decide whether to detect and recognize a single sign or symbol. Many of the research fail to classify the board texts in their classification process. Detection and identification in a wide range of meteorological circumstances is not well handled. Snow, fog, hail, and other inclement weather can obscure signboards. It is important to employ a significant percentage of useful automatic detection and classification.

## 4. Methodologies

The suggested framework consists of a segmentation procedure for use with a hybrid machine learning method, as shown in Figure 3. Those specifications have been covered in this section.

### 4.1 Image Segmentation for Traffic Boards

The segmentation is implemented through the utilization of Discrete Wavelet Transformation [DWT]. The technique of dividing an image into segments with the aid of digital image analysis is known as picture segmentation, which contains sets of pixels for image objects [19]. Segmentation seeks to simplify and alter the way the picture is represented, as well as aid in the analysis process. The technique of labeling every pixel in an image such that similar labeled pixels share certain features of the picture is referred to as image segmentation.



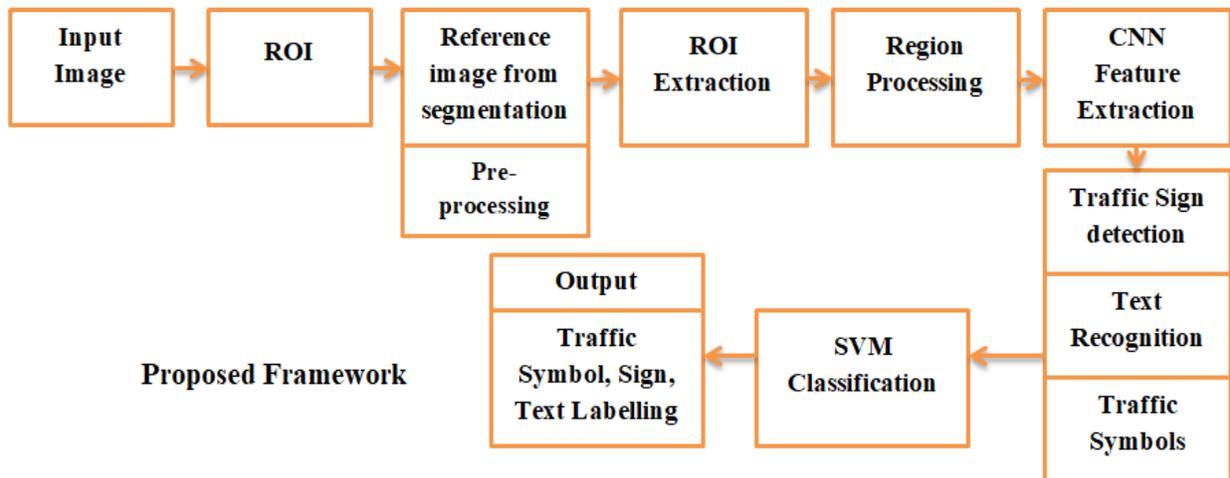
**Figure 3.** Overall Proposed Framework

### 4.2 Intelligent Controller

An additional challenge of video analytic algorithm is that the software will only work with a product made by the same manufacturer. One of the requirements for an intelligent controller is that image detection in automated modes of cars or automobiles are more precise [20].

#### 4.2.1 Image Recognition by CNN

One of the recent research topics in the area of computer vision is the use of convolutional neural networks (CNN). The multi-layer perceptron has been built to understand the distribution law of large data and because of this it has a strong learning and feature expression capacity, which substantially improves image recognition. Figure 4 shows the traffic text board recognition by using the proposed framework.



**Figure 4.** Traffic Text Board Recognition using Proposed Framework

A mathematical or computer model attempts to mimic the structural or functional features of biological neural networks, which is referred to as a built neural network. Computation is carried out by utilizing connectionist approaches employing linked artificial neurons. This CNN process is consisting of image segmentation process and pre-processing for ROI extraction. This region processing may be used to extract features in an adaptable manner. This feature is extracted from a recorded traffic picture and consists of three distinct items as follows:

1. Traffic Sign Detection

## 2. Text Recognition

## 3. Traffic Symbol

An adaptive CNN adjusts its structure in response to the flow of information on and off the network is usually used in most of the situations. For neural networks, the main job is pattern recognition or classification, although recognition, detection, estimation, sequential decision making, and so on are additional responsibilities. Neural networks are seen in both the commercial and scientific community. Neural networks consist of two hidden layers that are concealed inside each layer. The number of hidden layers is six, with four neurons in each one. The neuron count in the output layer is dependent on the number of classes. This is only one example of how a neural network may be set up with which you can learn more about in this article.

### ***4.2.2 SVM Classifier***

The study framework concludes with the creation of the SVM algorithm for reliable categorization of traffic sign boards. The Support Vector Machine (SVM) is another classification approach that separates data into two groups using an N-dimensional hyperplane. Actually, a better way to express this is that SVM is a binary classifier that distinguishes two distinct groups of data by using a subset of samples from the output of CNN approach. It was implemented as a classifier at the conclusion of the identification process, which is used for traffic sign recognition and categorization [21, 22]. The output should be labelling of traffic symbol, sign and text from the traffic sign boards.

## **5. Results & Discussion**

The present applications in the area of traffic sign identification and recognition are still limited by the accuracy of convolution neural network. The lack of traffic sign datasets is the

primary cause of this problem. Deep convolution neural network for traffic sign identification model training and verification requires an enormous quantity of traffic sign data as a foundation. Figure 5 shows some sample input images for recognition process.



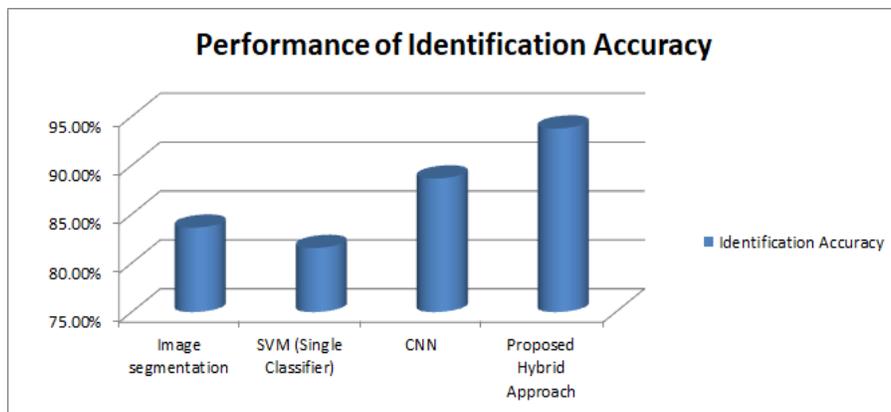
**Figure 5.** Image Recognition by Hybrid Machine Learning

On the other hand, India has open traffic sign databases, which are fewer in number than in underdeveloped nations. While these three data sets were formerly more obscure, more well-known traffic sign databases, which include GTSRB, GTSDDB and KUL in western countries. Traffic sign identification and recognition are conducted by using the datasets obtained from the GTSRB and GTSDDB. Because, they are containing the traffic board signs without texts. We can demonstrate the algorithm's capability by employing a variety of perplexing and difficult-to-identify traffic lights. Table 1 shows how well our suggested framework worked with this dataset.

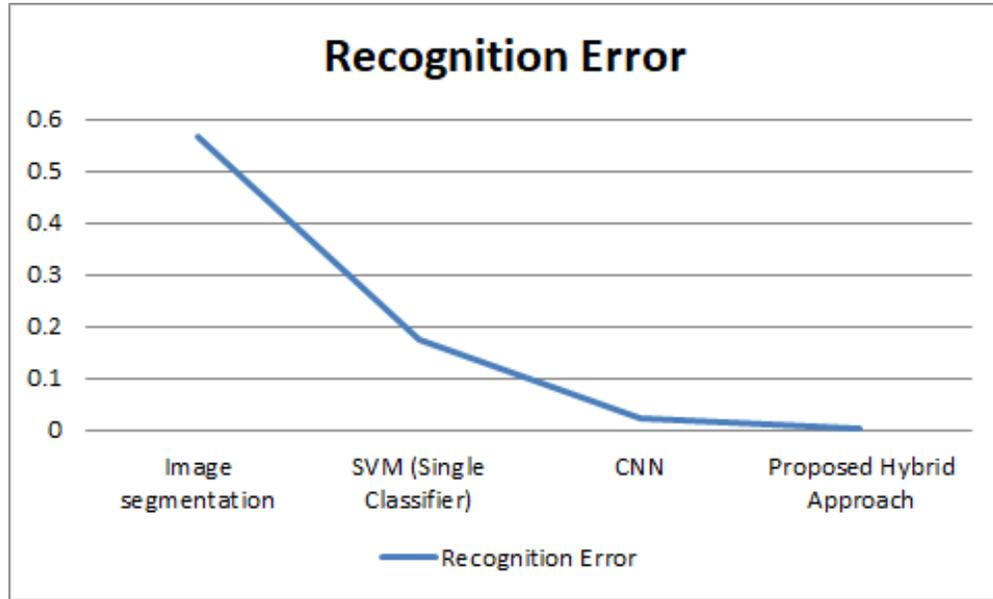
**Table 1.** Overall Performance Computation by Various Methods

S.No	Model	Identification items	Missing items	Identification Accuracy	Computation speed	Recognition error
1	Image segmentation	Traffic symbol alone	Text and Road Marking text	83.64%	High	0.567
2	SVM (Single classifier)	Traffic symbol or text	Text and road marking text	81.56%	High	0.175
3	CNN Method	Traffic Symbol with text	Visual road marking text	88.67%	Low	0.023
4	Proposed hybrid Approach	Traffic symbol with text + Visual road marking with text	At par distance Recognition	93.78%	Moderate	0.003

The proposed system is facing a problem of at par distance recognition. The image recognition results are varying based on the distance between vehicle and traffic symbol pole. There are several types of complicated traffic signs included in these two datasets by including ones that include tilt, uneven illumination, signs with distractions, occlusion, and other such backgrounds, as well as real geographic maps [23]. The comparison of various algorithms is done with the proposed framework as shown in figure 6 and 7.



**Figure 6.** Overall Performance Measures by Different Algorithms



**Figure 7.** Performance Measures of Recognition Error

This technique is both precise and quick, which is appropriate for training the data sets with huge quantities of items. While all other classifiers performed well in comparison, the proposed hybrid classifier performed the best with an accuracy that was lower than the low recognition rate that was achieved by comparing it to the pure image segmentation method.

## 6. Conclusion

The structure that we've described thus far is notably superior to traditional methods. In addition, it allows for greater computational performance because it can identify a larger number of detected items on the road. It also provides accurate and reliable identification results. Additionally, the recognition rate is minimized or practically non-existent. The framework we have proposed consists of an SVM algorithm for final identification classification that yields

superior accuracy when compared to traditional single-classifier techniques. Regardless, the proposed framework leverages less poor-quality measures. Our suggested architecture will consider the effects of lower quality and fuzzy pictures, bad weather, changing lighting conditions, inaccurate text on traffic signs, and improved processing power in the future. Further, the traffic road signs are in various countries across the globe, representing work to be done in the future. It handles a method of enhancing accuracy while minimizing the classification errors very well [24, 25].

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