International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

TRAFFIC SIGN DETECTION AND RECOGNITION USING FEATURE EXTRACTION FOR AUTONOMOUS VEHICLES

Glory Reuben Maxwell[1], Dr. Dinesh D. Patil[2]

[1]PG Scholar, Dept. of Computer Science and Engineering, SSGBCOET, Bhusawal, Maharashtra, India
[2]Associate Professor & HOD, Dept. of Computer Science and Engineering, SSGBCOET, Bhusawal, Maharashtra,India

---

Abstract – *In the emerging era of automated vehicles, Traffic sign detection is a very useful and effective method for assistance. In the last few decades, there have been many Traffic Sign Detection algorithms based on pattern recognition and machine vision. The traffic sign detection and recognition system should be capable of recognizing and responding the vital information to the driver about the unprecedented environment conditions of the road such as imminent road works, highway work zones and damaged traffic signs automatically. But the traffic sign detection and recognition system deal with the challenges such as different types and small sizes of road traffic signs, complex driving scenarios, and occlusions. The challenge is to identify, detect and recognize the traffic signs by eliminating all the objects in the captured image and to efficiently retrieve only the traffic sign boards even in adverse weather conditions or in the darkness. And to overcome the challenges of wide visibility, illumination, motion artifacts etc. In this paper, I have proposed a methodology for fast detection and recognition of the traffic sign. Our proposed system is divided into two phases. Firstly, traffic detection phase which consists of color segmentation and shape analysis of the captured image resulting in the generation of feature values. To extract the features from the segmented output Histogram of Oriented Gradients (HOG) technique was used. Secondly, In the traffic recognition phase, feature values generated by the previous phase are passed on through convolutional neural networks to classify the traffic sign and then validation is performed with the help of test dataset. The classification accuracy obtained by our proposed system is up to 98%.*

Key Words: Traffic sign detection, traffic sign recognition, color, shape, feature vector, convolutional neural network, classification, histogram of oriented gradients.

1. INTRODUCTION

Traffic sign recognition (TSR) is a technology by which a moving vehicle is able to acknowledge the position of the traffic signs. Image processing techniques are used to detect the traffic signs. The detection methods are going to be generally divided into color based, shape based and Hybrid learning based methods. TSR (Traffic Sign Recognition) systems are used to remind drivers to concentrate on the speed of the vehicle. If drivers and pedestrians pay attention to the vital information, it may result in the occurrence of accidents. With the escalating urge of the perspicacity of the automated vehicles, it is immensely essential to spot and recognize the traffic signs automatically and to transmit the vital information to the driver so that the driver can perform a particular action accordingly. Exploration in this area commenced within the 1980s, for resolving this problem and to make it easier for drivers to read, understand and recognize the road traffic signs. These traffic signs are considered to be of a selected color, shape and size with some symbolic representational meaning in it, so there is a major dissimilarity between the environment and traffic signs of the captured image. Image color and shape-based detection is utilized to locate potential signs in every existing frame. Color segmentation and thresholding are the two methods of Hue Saturation Intensity (HSI) color space which are mainly used to detect the traffic signs. the colors intensity is extracted using Feature extraction technique where features are extracted from each channel of HSI independently to choose out the foremost discriminant features with minimal loss of data, dimensionality reduction.

The TSDR system has established a growing attentiveness in past years. An efficient TSDR system are going to be divided into several phases, starting with pre-processing, detection, tracking, and recognition. Within the pre-processing phase, the foremost goal is to bolster the visual appearance of images. Different approaches are used to minimize the effect of the environment on the test images supported with two important features: color and shape. Traffic sign detection aims to identify regions of interest (ROIs) within which it is imagined to find a traffic sign that is verified after an outsized scale look for candidates within the input image. Circumstances that disturbs the visibility of road signs are temporary due to the illumination factors and inclemency conditions or permanent because of vandalism and bad postage of signs. Traffic signs are affected due to adverse weather conditions such as rain, fog, storm, smog etc. Traffic signs also gets damaged, faded, obscured, partially occluded etc, In our paper, our system is mainly divided into two phases, Initially the detection phase which detects the traffic sign, whereas in the next phase of recognition it determines the traffic sign using feature values.

1.1 Detection Phase

This is the first phase of the system, in which firstly image procurement is executed and color segmentation as well as shape analysis is performed resulting in the extraction of

feature values of the road traffic sign. This phase generates an output of feature values which acts as an input for the recognition phase.

1.2 Recognition Phase

Later on, in this recognition phase feature values are inputs forwarded from the detection phase. These feature values are then classified using convolutional neural network to recognize the traffic sign. The output of CNN is then processed for validation and generates a result of traffic sign.

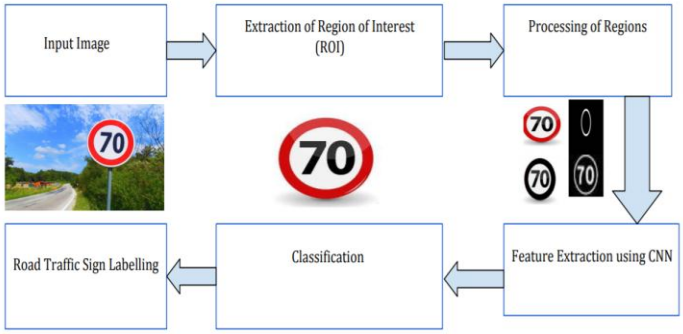

Fig-1: Processing Image

2. RELATED WORKS

There are many research within the literature managing Road Traffic Sign Recognition (TSR) problems. Initially, the primary effort on programmed road traffic sign detection was presented in the year 1984 in Japan. Different researchers introduced several methods afterwards, to develop an efficient traffic sign detection and recognition system and to chop back all of the problems. The effective TSDR is fragmented into numerous phases, starting with preprocessing, then detection, followed by tracking, and lastly recognition. Following are some papers that has been analyzed and been surveyed.

Nadra Ben Romdhane and group [1], They presented the additional computer vision-based system for vigorous TSDR and tracking. An intelligent automotive uses an awfully important reinforce for driver's abetment. Primarily, the color segmentation technique is implemented to generate candidate sign regions. Then, HoG features is drawn out to convert the detected signs to its corresponding feature vector. SVM classifier uses these feature vectors as an input to determine the classes of the traffic sign. Eventually, the method to track is implemented with the help of an optical flow to form sure never-ending capture of the recognized sign during the hastening of the processing time. The tactic affords high precision rates under various challenging conditions.

Zhe Zhu and team [2] discussed an approach on traffic sign detection and classification within the wild. Two contributions are made to the matter in wild wider roads. Firstly, an oversized traffic-sign benchmark was created from 100000 Ten cent Street View panoramas. It generates one lakh images containing 30,000 sign instances. These samples contain a huge distinction in climate and luminance. Each traffic-sign of the benchmark is categorized within a category label, bounding box and also pixel mask. Later on, it illustrates how a robust endways convolutional neural network must synchronously recognize and classify the numerous signs. The Image processing technique using convolutional neural network results in goal objects which resides at an oversized segment of the image, these kind of similar networks does not function properly for the aimed objects inhabited only at little fraction of an image. Experimental results display the high efficiency and performance related to the network. The standard, ASCII file and CNN model are applied in this proposed model.

Shu-Chun Huang and team [3], they proposed a system with two subsystems techniques are involved in the determination of traffic signs: detection and recognition. Initially, the color extraction is used to neglect the irrelevant details of the picture. Hierarchical grouping and image segmentation are performed to point out the road traffic sign region. Finally, in the recognition subsystem, to carry out the grouping of traffic signs convolution neural network technique is implemented. Real scene images are used for the evaluative tests. The analysis and evaluation were provided by the authors.

Jian-He Shi and team's work [4] deals with an automated TSDR approach uses the videos recorded from an in-vehicle dash cam. It is reinforced with image processing; vertex bisector transforms and bilateral Chinese transformation techniques. The pictures taken by the dash cam are refined with the visual representation of situated gradients to come up with the feature vectors, observed by SVMs to identify the various traffic signs. The bilateral Chinese transform and bisector and vertex transform are accustomed extract the road traffic signs from pictures. Eventually, then the neural network is arrogated to spot the road traffic signs data. Experiments are estimated with actual real-world traffic scenarios and the outcomes are illustrated the effectuality of the suggested system.

Xinyu Zhang and group [5] discusses a comprehensive review on technology and application of intelligent driving supported seeing. During this study, the software architecture of the autonomous vehicle supported the driving perspicacity is used to acquire various types of visual sensors. The target segment is extracted by using the image segmentation algorithm; therefore, the segmentation of the ROI is run. The feature calculation obtained by using inputs results, whereas in the subsequent segmentation region the obstacle examination is completed. Once the driving data is computed and finished, the visual sensors upsurge or decrement few or more or modify the installation location or visual sensor model, which depicts how effective is the decision making of the intellectual driving force, make the

multiple vision sensors transforms to the necessities of assorted intelligent driving hardware test platforms.

3. CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Networks or CNNs are powerful neural networks that can easily extract features from images and help in object detection, face recognition and many other advanced vision applications. Convolutional Neural Network (ConvNet/CNN) which is a Deep Learning algorithm can take in an input image, assigns weights to various objects in the input image and is capable of segregating one object from the other. CNN are majorly used in image recognition and processing precisely designed for process pixel data. CNN are based on the principle of local receptive fields, shared weighted and pooling or down sampling. All convolutional operations are actually cross-sectional. Convolutional neural networks are purely neural networks which makes the usage of convolution instead of general matrix multiplication in minimum one of the present layers. Each convolutional layer consists of many filters often called as kernel weights used for detection of various features. In the case of traffic sign detection and recognition, features might be the traffic sign colors, edges, etc. Later on, the layers detect more high features and the final layer assigns a classification to the traffic sign. One kernel filter extract on the basis of edges while another filter might extract a particular color whereas another one will detect the unwanted noise within the image.

Feature extraction is a method of dimensionality lessening by a primary set of newly generated data which is decreased to more controllable clusters for rectification. Feature extraction phase mainly integrates convolution layer with pooling layer, in this instance subordinate the layers pair of a fully connected layer to assemblage. CNN is a category of erudite and feed forward neural network system which has been beneficially functional to discover visual representation. CNN's consumption is a spread of multilayer perceptrons envisioned to entail insignificant preprocessing. CNN comprises of a necessary data and a capitulate layer, similarly several hidden layers consists of convolutional layers, pooling layers, standardization layers and completely associated layers. CNN system describes the later equipped GTSRB dataset. During the composition of the dataset, the CNN is used to describe the relevant information about specified classes. A CNN design is formed by using a mound of unambiguous layers which alters the knowledge capacity into a productive size over a variance volume. The square structure of CNN is the intermediate layer of convolution. The given layers constraints consist of many learnable channels, which have a small amount responsive field.

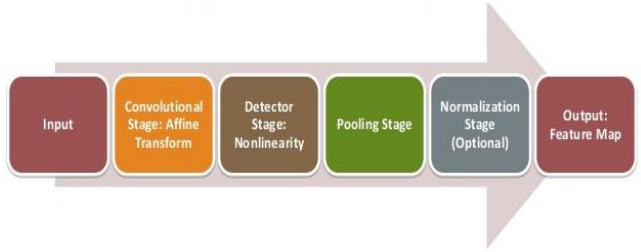

Fig -2: Typical CNN Layer

4. PROPOSED METHODOLOGY

The goal of this research is to propose an efficient and high performing system suited for fast autonomous vehicles or systems with low computational complexity and processing capabilities. The challenge is to identify, detect and recognize the traffic signs by eliminating all the objects in the captured image and to efficiently retrieve only the traffic sign boards even in adverse weather conditions or in the darkness. And to overcome the challenges of wide visibility, illumination, partial occlusions, motion artifacts etc. In our proposed methodology our system is separated by two phases. In the pre-phase, the onboard dash camera captures the image from the vehicle in motion. The image procurement is performed to eliminate the unwanted noise in the captured image. Color segmentation is the process of filtering and identification of multiple color segments of the region. Segmentation is implemented using color space including hue, saturation and intensity. Color thresholding is performed resulting in region grouping to generate region properties. Shape analysis is the process of analyzing and identifying different geometrical structure like circle, triangle, square etc. and classify them on the basis of the geometry. In our system, Histogram of Oriented Gradients (HOG) is used which is a feature descriptor to extract features from the captured image data. Largely used in computer perception function of detection of an object from the image. HOG descriptor focusses on the shape or the formation of the object. Based on the extracted output of color segmentation and shape analysis a set of values are produced which gets compared with the dataset.

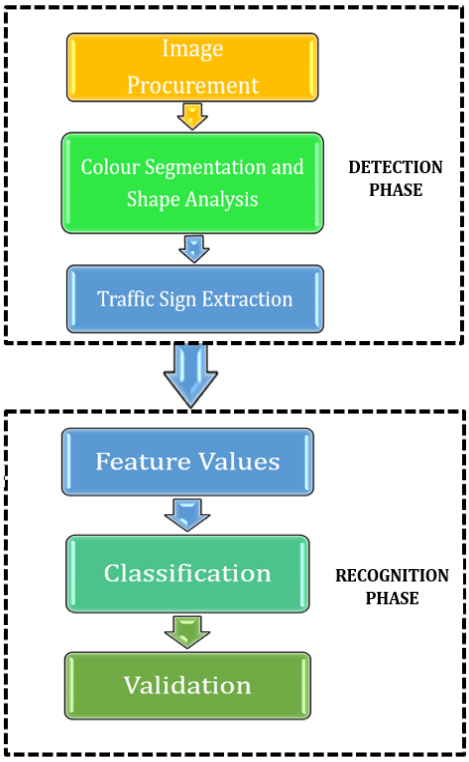

Fig-3: Proposed Methodology

Traffic signs are extracted based on features like size, color, shape etc. which later passes on to the next and final stage of recognition which intakes the feature values of the previous phase as the input and by using Convolutional Neural Network (CNN) it classifies the feature values to uniquely identify the traffic signs. The important stage comprises gaining data or condition of road before identifying the traffic sign. System computation lags behind by transferring the assimilated data to the main control system. CNN is exploited to distinguish the road traffic signs by supposing separation and transferring the relative data to the vehicle's driver. Traffic signs may be secluded into numerous classes and into each classification classes, moreover segregated into different subclasses with relative conformist appearance and shape. Traffic sign system is divided into two stages task consisting of first stage as detection of the traffic sign from the captured image and the second stage comprises of recognition step that uniquely identifies and determine the traffic road signs into a certain class. The steps for detection, classification and recognition are given below. Traffic signs generated by the classification undergoes the validation process to determine and recognize the traffic sign uniquely, and provides the assistance to the vehicle's driver and ensures the safety of the passengers. Given above flowgraph depicted in figure 3 describes the systematic flow of the proposed system.

- Traverse the Dataset
- Build a Convolutional Neural Network Model
- Perform Training on dataset
- Check Validation of the model
- Perform test on the model with the help of test dataset

In the previous related research, the outcome efficiency in identifying the traffic sign is 94.8% accurate. The performance measures of the two methods are depicted in figure 4. We note that the proposed method gives an improvement of 3.5% in recall rate, 6% in the precision rate and 3.2% increase rate in accuracy.

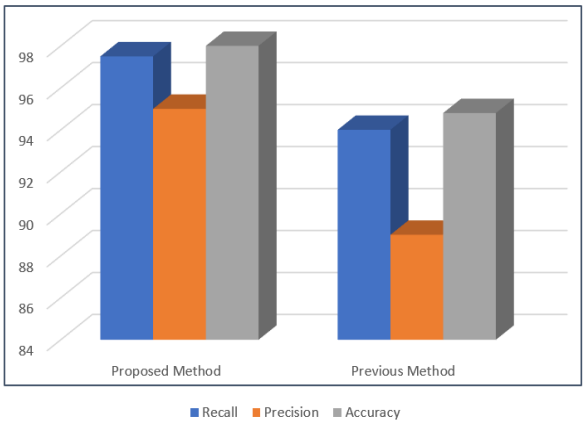

Fig-4: Comparative Evaluation of the two methods

5. CONCLUSION

In our proposed system, I have used two major phases which consists of detection and recognition of the road traffic signs. The proposed system uses very easy and precise detection phase which detects the traffic signs on the basis of shape and color feature. By using color space, color segmentation is implemented whereas for shape analysis HOG feature is used. The output from both segments is combined together, which gives the rough overview of the traffic sign. Further, in recognition phase extracted feature values will be classified using CNN and is validated using the test dataset. Due to large dataset the computational time of the system is more. To overcome this issue, someone can classify the datasets by not only focusing on red color. RGB thresholding implementation fails in low contrast situations and low illumination. When the light source is behind the sign, its shadow makes the signs red pixels harder to detect and segment. For example, if there are multiple red color signs in the same captured image it may be tedious process of computation for the system to identify. In future research can arrange and classify the dataset according to the color. The researcher can also focus on blue and green color rather than only focusing on red color. The shape classification can be improved by adding more linearly independent features. Detection rate may be improved by retraining the detector with negative images that contain features which caused false positives during testing. After implementation of our system I have received better performance values than compared to the previous method. Accuracy of 98% along with 97.5% recall rate and 95% precision rate. In future, various machine learning techniques along with data science can be used to generate the accurate traffic signs. Hybrid machine learning techniques can be used to lower computational time as well as time complexity to recognize the traffic sign.

ACKNOWLEDGEMENT

The completion of this paper would not have been possible without the support and guidance of my respected HOD and guide Dr. Dinesh D. Patil. He has been a constant of motivation and has encouraged me to pursue this project. With my deep sense of gratitude, I thank my respected faculties for always supporting me in my project. This research paper provides me an opportunity to put in the knowledge of advanced technology. I would like to give thanks to all the mentioned and non-mentioned authors of the reference. I thereby take the privilege opportunity to thank my Dr. Dinesh D. Patil, my friends and family members whose helps and guidance made this study possible.

REFERENCES

[1] Nadra Ben Romdhane, Hazar Mliki, Mohamed Hammami, "An improved traffic signs recognition and tracking method for driver assistance system", IEEE/ACIS 15th International Conference on Computer and Information Science (ICIS), June 2016. doi:10.1109/ICIS.2016.7550772

[2] Zhe Zhu, Dun Liang, Songhai Zhang, Xiaolei Huang, Baoli Li, Shimin Hu, "Traffic-Sign Detection and Classification

in the Wild " IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp 2110-2118, June 2016, doi: 10.1109/CVPR.2016.232.

[3] Shu-Chun Huang ,Huei-Yung Lin ,Chin-Chen Chang ,"An In-Car Camera System for Traffic Sign Detection and Recognition", Joint 17th World Congress of International Fuzzy Systems Association and 9th International Conference on Soft Computing and Intelligent Systems (IFSA-SCIS), June 2017, doi: 10.1109/IFSA-SCIS.2017.8023239

[4] Jian-He Shi, Huei-Yung Lin, " A Vision System for Traffic Sign Detection and Recognition", IEEE 26th International Symposium on Industrial Electronics (ISIE), pp 1597-1601, June 2017, doi: 10.1109/ISIE.2017.8001485.

[5] Xinyu Zhang, Hongbo Gao, Guotao Xie, Buyun Gao1, Deyi Li, "Technology and application of intelligent driving based on visual perception ", CAAI Trans. Intell. Technol., 2017, Vol. 2, Iss. 3, pp. 126–132, Sept. 2017, doi: 10.1049/trit.2017.0015.

[6] Zhe Zhu ; Jiaming Lu ; Ralph R. Martin ; Shimin Hu ,"An Optimization Approach for Localization Refinement of Candidate Traffic Signs", IEEE Transactions on Intelligent Transportation Systems ,Volume: 18 , Issue: 11, pp. 30006-3016 Nov. 2017, doi: 10.1109/TITS.2017.2665647

[7] Yatham Sai Sangram Reddy, Devareddy Karthik, Nikunj Rana, M Jasmine Pemeena Priyadarsini, G. K Rajini and Shaik Naseera, "Traffic signs recognition for driving assistance", IOP Conference Series: Materials Science and Engineering, pp. 1-8 November 2017, doi: 10.1088/1757-899X/263/5/052046.

[8] Zhuo Zhang, Xiaolong Zhou(B), Sixian Chan, Shengyong Chen, and Honghai Liu, "Faster R-CNN for Small Traffic Sign Detection ", Computer Vision: Second CCF Chinese Conference, CCCV 2017, Tianjin, China, October 11–14, 2017, Proceedings, Part III (pp.155-165), December 2017.

[9] Hairo Nizam Mohd Shah, Mohd Zamzuri Ab Rashid, Zalina Kamis, Mohd Shahrieel Mohd Aras, Nursabillilah Mohd Ali, Faizil Wasbari, Tengku Muhammad Mahfuz Tengku Anuar, "Sign Detection Vision Based Mobile Robot Platform", Indonesian Journal of Electrical Engineering and Computer Science Vol. 7, No. 2, pp. 524 - 532, August 2017.

[10] Rongqiang Qian , Bailing Zhang, Yong Yue, Zhao Wang, Frans Coenen "Robust chinese traffic sign detection and recognition with deep convolutional neural network", The 2015 11th International Conference on Natural Computation, Paper No- 7378092, pp 791-796, August 2015

[11] Vahid Balali, Mani Golparvar-Fard "Evaluation of Multiclass traffic sign Detection and Classification methods for U.S. Roadways Asset Inventory Management" Journal of Civil Engineering, Vol.30 issue 2, March 2016.

[12] E. Peng, F. Chen and X. Song, "ICCSIP 2016. Communications in Computer and Information Science," in Traffic Sign Detection with Convolutional Neural Networks, Singapore, 2017.

[13] Z. Zuo, K. Yu, Q. Zhou, X. Wang and T. Li, "Traffic Signs Detection Based on Faster R-CNN," 2017 IEEE 37th International Conference on Distributed Computing Systems Workshops, 2017.

[14] Monika Deswal, Neetu Sharma, " A Fast HSV Image Color and Texture Detection and Image Conversion Algorithm", International Journal of Science and Research (IJSR), Volume 3 Issue 6, Paper No 02014482, 1279-1284, June 2014

[15] Suresha M, Harisha Naik T,"A Survey on Image Analysis based on Texture", International Journals of Advanced Research in Computer Science and Software Engineering, Volume-7, Issue-6, pp.686-695, June 2017

[16] Suganthi,A, SenthilMurugan, M, "An Integrated Approach for Texture Analysis in Image," International Journal of Informative & Futuristic Research,2347-1697, Vol. 4, pp. 7170-7178, 2017.

[17] Lotfi Abdi and Aref Meddeb, "Deep Learning Traffic Sign Detection, Recognition and Augmentation", SAC '17: Proceedings of the Symposium on Applied Computing ,pp. 131 -136, April 2017.

[18] Qi Li, Gongbo Liang, yongyi gong," A geometric framework for stop sign detection", IEEE ChinaSIP ,Paper No - 7230403,pp. 258-262 , July 2015, doi: 10.1109/ChinaSIP.2015.7230403

[19] Qingsong, X., Juan, S., Tiantian, L.: A detection and recognition method for prohibition traffic signs. In: 2010 International Conference on Image Analysis and Signal Processing (IASP), pp. 583–586. IEEE (2010).

BIOGRAPHIES

Glory Reuben Maxwell received her B.E. degree from St. Peter's Institute of Higher Education and Research, Chennai in 2018 and is pursuing her M.Tech Computer Science and Engineering at Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal.

Dr. Dinesh D. Patil is working as Associate Professor and Head of Department with 13 years of Experience at Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal. He finished his PhD in the year 2020.