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TRAFFIC SIGN DETECTION METHODS BASED ON MACHINE VISION: REVIEW AND ANALYSES

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ABSTRACT

Traffic signs recognition (TSR) is a crucial a part of some advanced driver-assistance systems (ADASs) and auto driving systems (ADSs). because the first key step of TSR, traffic sign detection (TSD) may be a challenging problem due to differing types , small sizes, complex driving scenes, and occlusions. In recent years, there are an out-sized number of TSD algorithms supported machine vision and pattern recognition. during this paper, a comprehensive review of the literature on TSD is presented. We divide the reviewed detection methods into different categories: color-based methods, shape-based methods, machine-learning-based methods. The methods in each category also are classified into different subcategories for understanding and summarizing the mechanisms of various methods. for a few reviewed methods that lack comparisons on public data-sets, were implemented a part of these methods for comparison. The experimental comparisons and analyses are presented on the reported performance and therefore the performance of our re-implemented methods. Furthermore, future directions and proposals of the TSD research are given to market the event of the TSD.

KEYWORDS: Traffic Sign Detection, MATLAB, AdaBoost, Support Vector Machine (SVM).

I. INTRODUCTION

Computer vision and pattern recognition-based traffic sign detection, tracking and classification methods are studied for several purposes, like Advanced Driver Assistance Systems (ADAS) and Auto Driving Systems (ADS). Traffic sign recognition (TSR) systems requires both detection and classification. For TSR systems, a tracking phase is in between detection and classification for handling video [1]. For TSR, camera and LIDAR are two hottest used sensing devices. during this paper, we review the literature on traffic sign detection supported camera or LIDAR, and do comparison and analysis of the reviewed methods supported the reported performance and therefore the performance of our re-implemented methods.

For a TSR system, traffic sign detection usually is that the first key process. TSD may be a process of detecting and locating signs. Then, the detected traffic signs are utilized. as inputs of the subsequent tracking or classification methods; hence, the accuracy of the traffic sign detection and locating results features a great influence on the subsequent tracking or classification algorithms. Though the structures and appearances of traffic signs are different across the planet, the distinct color and shape characteristics of traffic signs provide important cues to style detection methods.

Within the past decades, many detection methods were designed supported detecting special colors like blue, red and yellow [2]; these methods were commonly used for preliminary reduction of the search space, followed by another detection methods. Shape or edge detection methods also are popular within the detection literature. Different shape detection methods are available to detect circle, squares or polygons.

Shape and edge detection methods also cannot extract the accurate position of a traffic sign. In recent years, with the event of machine learning methods especially deep learning methodologies, the machine learning based detection methods have gradually become the mainstream algorithms. The available traffic sign detection

structures are following: AdaBoost based detection, Support Vector Machine (SVM) based detection [4], and Neural Networks (NN) based detection [5].

These detection structures may have many derivatives with different input features, different training methods or detection systems. The machine learning based detection methods have achieved the-state-of-the-art leads to some aspects.

In some TSR systems, a tracking method is required . The goal of traffic sign tracking is typically designed for enhancing classification performance, ne-positioning or predicting positions for detection within the next frame. After traffic sign detection or tracking, traffic sign recognition is performed to classify the detected traffic signs into correct classes. the most classification methods include binary-tree-based classification, SVM, NN and Sparse Representation Classification (SRC), etc.

The binary-tree-based classification method usually classify traffic signs consistent with the shapes and colours during a coarse-to-ne tree process. As a binary-classification method, SVM classifies traffic signs using one-vs-one or one-vs-others classification process. SRC and NN belong to binary-classification methodology and may recognize multiclass traffic signs directly.

In the past decade, there are some surveys on TSR. Fu and Huang [7] reviews a part of the TSD methods before 2010; most of the reviewed methods in [7] are out of date. Møgelmose et al. [1] article presents a complete survey for TSD, which covers popular detection methods present before 2012. Gudigar et al. [8] and Saadna and Behloul [9] present reviews for both detection and recognition. These two reviews reported results for detection and lack comprehensive comparisons and summaries of their reviewed detection methods. Furthermore, all previous surveys don't review the LIDAR based methods. Distinguished from these previous surveys, we classify the reviewed methods into categories, re-implement a part of the TSD methods for comprehensive comparisons of those methods, and also review the LIDAR based TSD methods. during this survey, we mainly review the TSD methods in last five years, and provides analyses and future research suggestions.

II. TRAFFIC SIGN

Traffic signs are placed along the roads with the function of informing drivers about the front road conditions, directions, restrictions or text information. Though traffic signs have different structures and appearances in several countries, the foremost essential sorts of traffic signs are prohibitory, danger, mandatory and text-based signs. The prohibitory, danger or mandatory signs often have standard shapes, like circle, triangle and rectangle, and sometimes have standard colors like red, blue and yellow. The text-based signs usually don't have fixed shapes and contain informative text.

Prohibitory Signs

Danger Signs

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Mandatory Signs

Other Signs

Prohibitory Signs

Danger Signs

Mandatory Signs

Other Signs

Regulatory Signs

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Warning Signs

Guide Signs

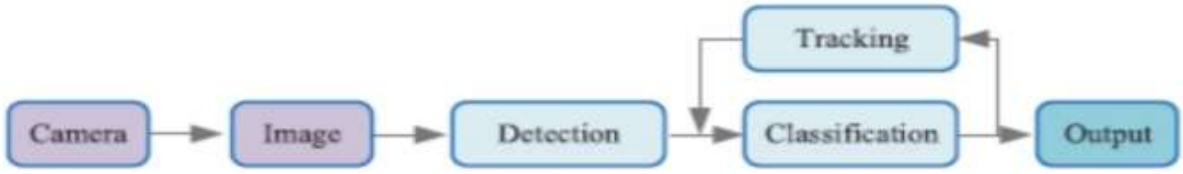
Other Signs

III. MACHINE VISION BASED TSR SYSTEMS AND THEIR APPLICATIONS

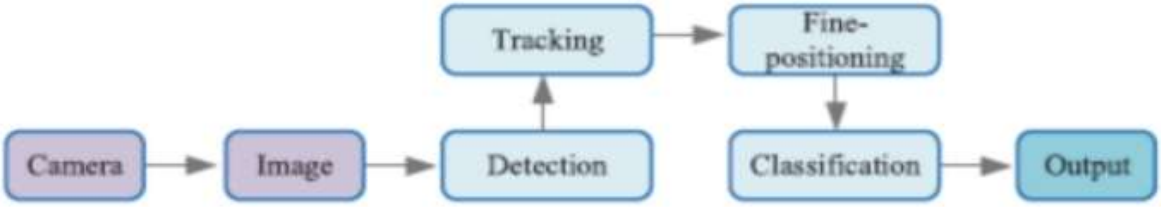
TSR systems are often designed for traffic sign detection, classification and result presentation. For a TSR system, the key stages are detection and classification. The detection stage can detect and locate traffic signs; the detection and localization accuracy largely affects the subsequent processing. Then, the classification stage can classify the detected traffic signs into differing types and output the results of TSR.

In some systems, a tracking stage is required for processing consecutive frames. Some structures of TSR are shown in Fig. 3.1. Fig. 3.1 (a) is that the hottest camera based TSR structure without tracking; this structure can detect and recognize traffic signs during a single frame without using any temporal information from videos. Fig. 3.1 (b) may be a camera based structure with tracking described in [1]; this structure can consecutively confirm the tracking leads to consecutive frames to spice up classification performance. Fig. 3.1 (c) may be a camera based TSR structure with tracking for ne-positioning [14]; during this structure, the tracking results are used for ne-positioning and classification. Fig. 3.1 (d) may be a camera based structure with tracking for position prediction [15]; the multi-ROI tracking process during this structure is employed for position prediction and getting filtered ROIs for classification. Fig. 3.1 (e) may be a common LIDAR and camera based TSR structure [16];the info cloud from laser scanning is employed for traffic sign detection; the detection leads to data clouds are projected into images captured by camera; then, classification is processed with the detected signs within the projected images.

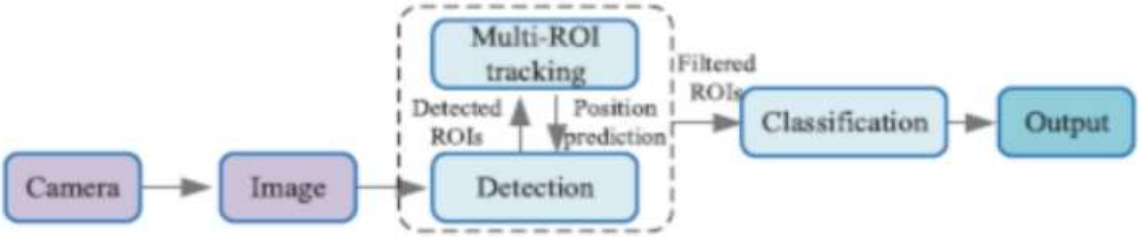
Camera based structure without tracking



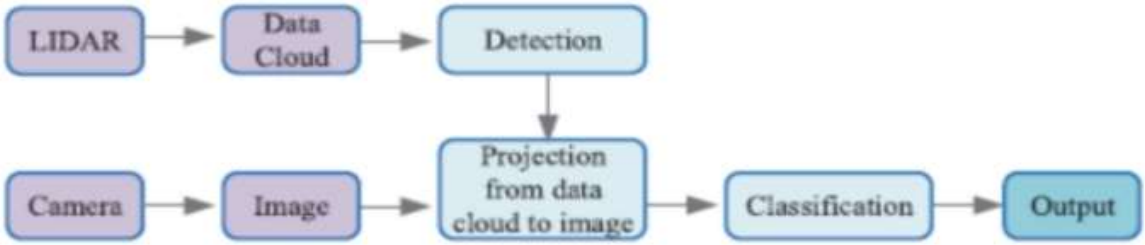
Camera based structure with tracking for consecutive confirm from [1]



Camera based structure with tracking for fine positioning from [14]



Camera based structure with tracking for position predication from [15]



(e) LIDAR and Camera based structure from [16]

Fig-3.1: Different structures of traffic sign recognition systems.

IV. SOFTWARE SPECIFICATION

For simple problems, entering requests at the Matlab prompt within the command window is fast and efficient. However, because the number of commands increases, or whenever a change useful of 1 or more variables with a reevaluation is desired, typing at the Matlab prompt becomes tedious. Matlab allows to put Matlab commands during a simple document , and by telling Matlab to open this file, the stored commands are evaluated one-by-one as if they were just typed in. Those files are called M-files. There are two sorts of M-files:

- Scripts, which don't accept input arguments or return output arguments.

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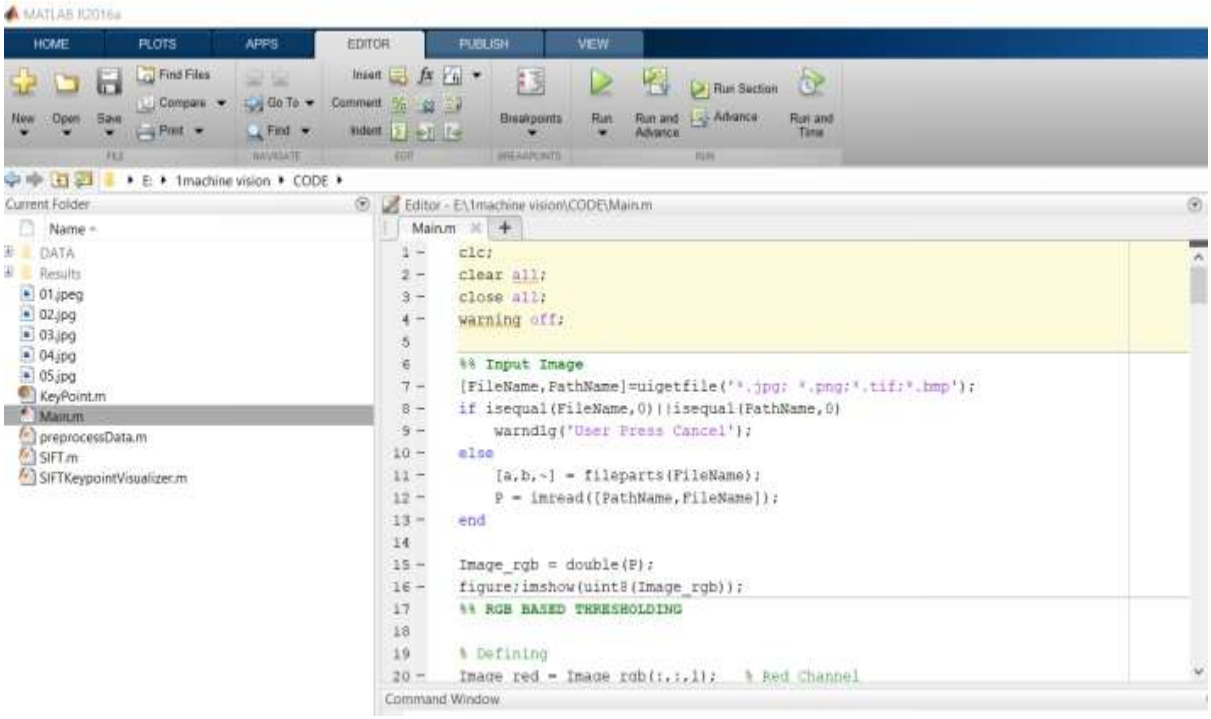
- Functions, which may accept input arguments and return output arguments. Internal variables are local to the function. the sole difference within the syntax of a Script-file and a Function-file is that the first line.

Matlab 7.0 and above.

V. IMPLEMENTATION AND SNAPSHOTS



In above snapshot, we have implanted the traffic sign detection algorithm on MATLAB.

Fig-5.1: Input Image

The basic input image that is submitted will be processed such that it can be readily used by any available classifier for traffic sign detection.

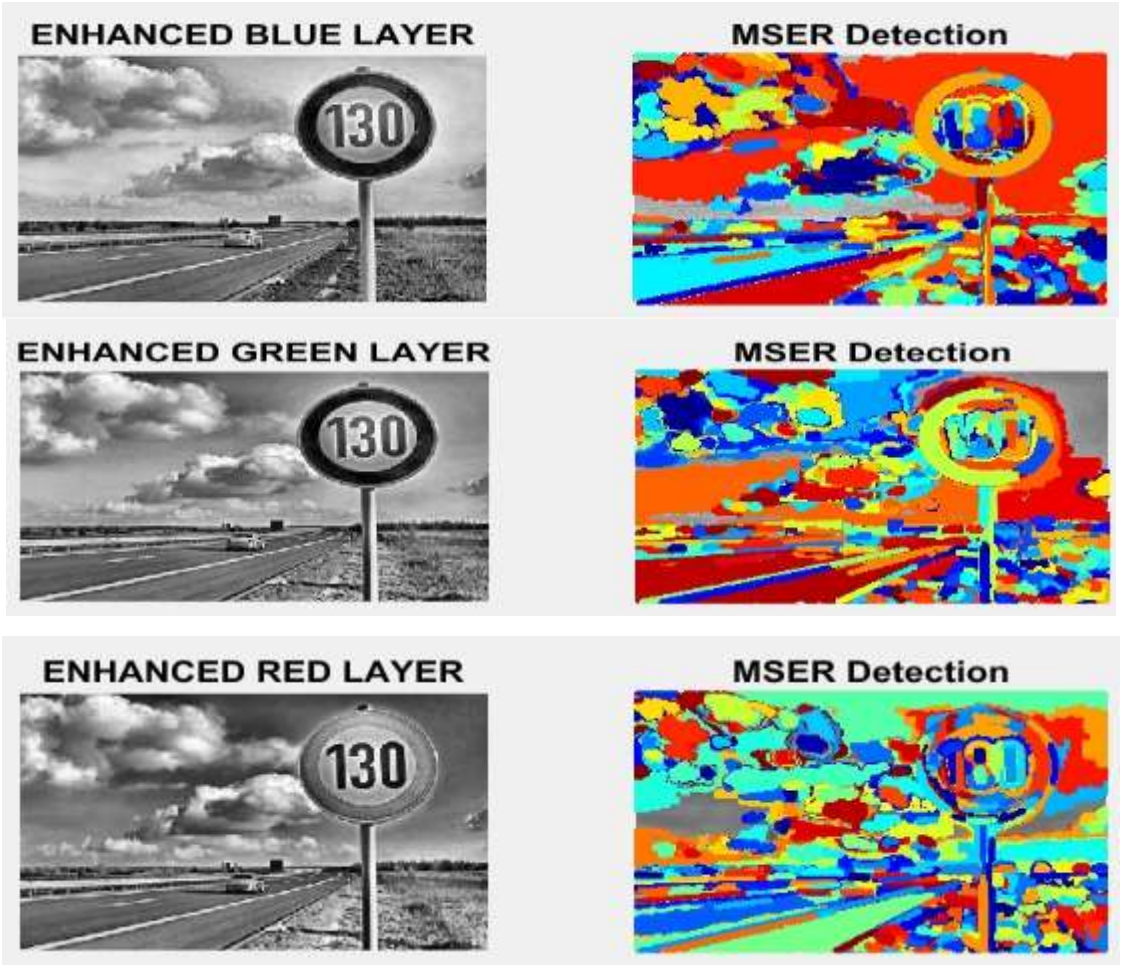


Fig-5.2: Final Output Image

This is final output image that can be used by classifiers for detection.

VI. CONCLUSIONS

In this review, we divide the traffic sign detection methods into categories: color based methods, shape based methods, color and shape based methods, and machine learning based methods. Conclusions and perspectives are given during this section.

The color based methods are often fast and comparatively simple. Though most of the previous color based detection methods are out of date, they're still important ways to extract ROIs for the subsequent fine detection process. Building robust color enhancement methods or color extraction methods for other detection methods is an assisted thanks to achieve fast detection in real applications. The shape based methods haven't been widely studied in recent years. counting on edge detection, most shape based methods are often not suitable for detecting traffic signs with small size or vague edges, yet have potential on traffic sign extraction in some applications.

The color and shape based methods like MSERs based methods and HCRE based methods are able to do high performance for ROI extraction; these methods usually need an honest color enhancement process. In future, robust color enhancement and extraction methodologies could also be developed to further improve the performance of those methods.

The machine learning methods have achieved the-state-of the-art results. When handling high resolution images and little vague traffic signs, some machine learning methods are still hard to stay an honest balance of the consuming time and accuracy. an outsized portion of those methods need some assisted methods to realize fast and accurate detection.

Mobile laser scanning technology has experienced significant growth in recent five years, and has been a key solution in many ADAS systems. There are many methods published using different laser scanning devices and their own dataset. it's hard to match the performance of those methods. The previous TSD methods tested on some public datasets for traffic sign detection have reported high performance.

The previous TSD methods and public datasets mainly involved the challenging problems of small sizes, occlusions, complex driving scenes, rotation in or out the plane, illumination changes, etc. These variations belong to classical TSD problems and are researched for several years. Rare methods focused on the traffic sign detection problem in the dark which has some difficulties to deal, like headlight reflection, street lighting and dark illumination. Extreme weather features a great impact on the standard of the pictures captured by cameras. Extreme weather like heavy fog, heavy rain and heavy snow were also not considered in previous methods. In future, new methods and new datasets which will handle night and extreme weather are needed to enhance the power of camera based TSD methods to affect these conditions.

VII. REFERENCES

[1] A. Mogelmose, M. M. Trivedi, and T. B. Moeslund, ``Vision-based traffic sign detection and analysis for intelligent driver assistance systems: Perspectives and survey," IEEE Trans. Intell. Transp. Syst., vol. 13, no. 4, pp. 14841497, Dec. 2012.

[2] H. Gómez-Moreno, S. Maldonado-Bascón, P. Gil-Jiménez, and S. Lafuente-Arroyo, ``Goal evaluation of segmentation algorithms for traffic sign recognition," IEEE Trans. Intell. Transp. Syst., vol. 11, no. 4, pp. 917930, Dec. 2010.

[3] P. Viola and M. J. Jones, ``Robust real-time face detection," Int. J. Comput. Vis., vol. 57, no. 2, pp. 137154, 2004.

[4] N. Dalal and B. Triggs, ``Histograms of oriented gradients for human detection," in Proc. CVPR, San Diego, CA, USA, Jun. 2005, pp. 886893.

[5] R. Girshick, J. Donahue, T. Darrell, and J. Malik, ``Rich feature hierarchies for accurate object detection and semantic segmentation," in Proc. CVPR, Columbus, OH, USA, Jun. 2014, pp. 580587.

[6] S. Houben, J. Stallkamp, J. Salmen, M. Schlipsing, and C. Igel, ``Detection of traffic signs in real-world images: The German trafc sign detection benchmark," in Proc. Int. Joint Conf. Neural Netw., Dallas, TX, USA, Aug. 2013, pp. 18.

[7] M.-Y. Fu and Y.-S. Huang, ``A survey of trafc sign recognition," in Proc. ICWAPR, Qingdao, China, Jul. 2010, pp. 119124.

[8] A. Gudigar, S. Chokkadi, and U. Raghavendra, ``A review on automatic detection and recognition of trafc sign," Multi. Tools Appli., vol. 75, no. 1, pp. 333364, Jan. 2016.

[9] Y. Saadna and A. Behloul, ``An overview of trafc sign detection and classification methods," Int. J. Multimedia Inf. Retr., vol. 6, no. 3, pp. 193210, Sep. 2017.

[10] Z. Zhu, D. Liang, S. Zhang, X. Huang, B. Li, and S. Hu, ``Traffic-sign detection and classification in the wild," in Proc. CVPR, Las Vegas, NV, USA, Jun. 2016, pp. 21102118.

[11] A. Mogelmose, D. Liu, and M. M. Trivedi, ``Detection of U.S. traffic signs," IEEE Trans. Intell. Transp. Syst., vol. 16, no. 6, pp. 31163125, Sep. 2015.

[12] M. Costa, A. Simone, V. Vignali, C. Lantieri, and N. Palena, ``Fixation distance and fixation duration to vertical road signs," Appl. Ergonomics, vol. 69, pp. 4857, May 2018.

[13] T. Ben-Bassat and D. Shinar, ``The effect of context and drivers' age on highway traffic signs comprehension," Transp. Res. F, Traffic Psychol. Behav., vol. 33, pp. 117127, Aug. 2015.

[14] M. Meuter, C. Nunn, S. M. Gormer, S. Müller-Schneiders, and A. Kummert, ``A decision fusion and reasoning module for a traffic sign recognition system," IEEE Trans. Intell. Transp. Syst., vol. 12, no. 4, pp. 11261134, Dec. 2011.

[15] M. Boumediene, J.-P. Lauffenburger, J. Daniel, C. Cudel, and A. Ouamri, ``Multi-ROI association and tracking with belief functions: Application to traffic sign recognition," IEEE Trans. Intell. Transp. Syst., vol. 15, no. 6, pp. 24702479, Dec. 2014.