International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
©2021 INPRESSCO®, All Rights Reserved
Available at http://inpressco.com/category/ijcet

Research Article

Deep Learning Approaches for Traffic Sign Detection and Recognition

Nikhil S Rajguru and Prof. G. D. Upadhye

Department of Computer Engineering JSPM's Rajashri Shahu College of Engineering

Received 10 Nov 2020, Accepted 10 Dec 2020, Available online 01 Feb 2021, **Special Issue-8 (Feb 2021)**

Abstract

Traffic sign recognition is used to maintain traffic signs, warns the distracted driver, and prevent his/her actions that can lead an accident. A real-time automatic sign detection and recognition can help the driver, significantly increasing his/her safety. Traffic sign recognition also gets an immense interest lately by large scale companies such as Google, Apple and Volkswagen etc. driven by the market needs for intelligent applications such as autonomous driving, driver assistance systems (ADAS), mobile mapping, Mobil eye, Apple, etc. and datasets such as Belgian, German mobile mapping. Hence, in this paper ,we are proposing to do the same with cost efficient manner using Raspberry Pi. We are proposing automated real time system which will capture traffic sign and indicate it at driver dashboard with front obstacle exact distance on monitor. PiCam is used to capture images of traffic sings and is connected to RaspberryPi. Monitor is used to display required output, showing type of sign and distance of collision. This proposal will avoid large number of accidents occurring at bridges and work in progress area due to automated braking system and simultaneous reduce death ratio.

Keywords: *PiCAM, Raspberry Pi, Ultrasonic sensors, Traffic Sign recognition.*

Introduction

According to the world accident report, India has highest number of road accidents. Road accidents have earned India a dubious distinction. With over 130,000 deaths annually, the country has overtaken China and now has the worst road traffic accident rate worldwide. As many as 1, 39, 091 people lost their lives in 4, 40,042 road accidents in the country last year. The statistics released by the National Crime Records Bureau (NCRB) 1, 18, 533 of the victims were male. They include 11,571 pedestrians. The 28 States together accounted for 1, 36, 771 deaths and the seven Union Territories for the remaining. Tamil Nadu tops the list of with 16,175 deaths in 67,757 accidents, followed by Uttar Pradesh with 15,109 deaths in 24,478 accidents. Andhra Pradesh is third with 14,966 deaths in 39,344 accidents and Maharashtra fourth with 13,936 deaths in 45,247 accidents. The Capital city of Delhi accounts for about 1,866 deaths in 6,937 accidents. The states in India like Tamil Nadu, Uttar Pradesh and Andhra Pradesh accounted annually for 15.4, 10.3 and 10.1 of the road accidents in the country. So, it becomes more import to increase security at traffic road to avoid such hazards. We must make vehicle driver more aware about traffic signs and breaking distance. Sometimes driver has all knowledge about traffic signs but while driving they neglect traffic signs which result in accidents.

Sign detection is mainly used to assist the driver and give commands through audio feedback, consequently decreasing the number of accidents. The objective of this work is to formulate a method for traffic light detection and detection of sign boards. With the help of this method, one can accurately detect traffic light colors i.e., red and green, and different signs like forward, turn left, turn right and turn back. Road signs make use of colors as a basis for distinguishing it from other objects. Computer vision is used in the field of intelligent transport systems. Lately, the traffic sign recognition systems have become an integral part of Advanced Driver. Assistance Systems (ADAS). In some cases, vehicle in front of use applies break suddenly due to any reason and we are unable to respond it so fast and front collision occurs. Hence, we have proposed a system using raspberry pi and PiCam with ultrasonic sensor, which will alert driver about traffic signs coming on road and Simultaneously avoid front collision using automatic breaking after vehicle enters in breaking distance zone

Review of Literature

Research and Application of Traffic Sign Detection and Recognition Based on Deep Learning, Now days, with the rapid development of society and economy, automobiles have become almost one of the convenient modes of transport for every house-hold. This makes the road traffic environment more and more

complicated, and people expect to have an intelligent Vision-assisted application that provide drivers with traffic sign information, regulate driver operations, or assist in vehicle control to ensure road safety. As one of the more important functions, traffic sign detection and recognition, has become a hot research direction of researchers at home and abroad. It is mainly the use of vehicle cameras to capture realtime road images, and then to detect and identify the traffic signs encountered on the road, thus providing accurate information to the driving system. However, the road conditions in the actual scene are very complicated. After many years of hard work, researchers have not yet made the recognition system practical, and further research and improvement are still needed. Traditionally, traffic signage has been detected and categorized using standard computer vision methods, but it also takes considerable time to manually process important features of the image. With the development and progress of science and technology, more and more scholars use deep learning technology to solve this problem. The main reason that the deep learning method is widely accepted is that the model can learn the deep features inside the image autonomously from the training samples, especially for many cases that do not know how to design the feature extractor, such as expression recognition, target detection Wait. Based on the application of road traffic sign detection and recognition, this article focuses on the correctness and high efficiency of detection and recognition [1].

Traffic Light and Sign Detection for Autonomous Land Vehicle Using Raspberry Pi, This work aims to implement traffic light and sign detection using Image processing technique for an autonomous and vehicle. Traffic Sign Recognition system is used to regulate traffic signs, warn a driver and command certain actions. Fast robust and real time automatic traffic sign detection and recognition can support the driver and significantly increase driving safety. Automatic recognition of traffic signs is also important for an automated intelligent driving vehicle or for a driver assistance system. This is a visual based project i.e., the input to the system is video data which is continuously captured from the web cam is interfaced to the Raspberry Pi. Images are pre-processed with several image processing techniques such as; Hue, Saturation and Value (HSV) color space model technique is employed for traffic light detection, for sign detection again HSV color space model and Contour Algorithm has been used. The signs are detected based on Region of Interest (ROI). The ROI is detected based on the features like geometric shape and color of the object in the image containing the traffic Signs [2].

Towards Real-Time Traffic Sign Detection and Classification, Traffic sign recognition plays an important role in driver assistant systems and intelligent autonomous vehicles. Its realtime performance is highly desirable in addition to its recognition performance. This paper aims to deal with real-time traffic sign recognition, i.e., localizing what type of traffic sign appears in which area of an input image at a fast processing time. To achieve this goal, we first propose an extremely fast detection module, which is 20 times faster than the existing best detection module. Our detection module is based on traffic sign proposal extraction and classification built upon a color probability model and a color HOG. Then, we harvest from a convolution neural network to further classify the detected signs into their sub classes within each super class. Experimental results on both German and Chinese roads show that both our detection and classification methods achieve comparable performance with the state-of the-art methods, with significantly improved computational efficiency [3].

Road Sign Recognition System on Raspberry Pi, The paper describes the characteristics of speed signs, requirements and difficulties behind implementing a real-time base system with embedded system, and how to deal with numbers using image processing techniques based on shape and dimension analysis. The paper also shows the techniques used for classification and recognition. Color analysis also plays a specifically important role in many other different applications for road sign detection, this paper points to many problems regarding stability of color detection due to daylight conditions, so absence of color model can led a better solution. In this project lightweight techniques were mainly used due to limitation of real time based application and Raspberry Pi capabilities. Raspberry Pi is the main target for the implementation, as it provides an interface between sensors, database, and image processing results, while also performing functions to manipulate peripheral units (usb dongle, keyboard etc.) [4].

A Survey of Traffic Sign Recognition, Advanced Driver Assistance Systems (ADAS) refer to various hightech invehicle systems that are designed to increase road traffic safety by helping drivers gain better awareness of the road and its potential hazards as well as other drivers around them. The design of traffic sign recognition, one important subsystem of ADAS, has been a challenge problem for many years and hence become an important and active research topic in the area of intelligent transport systems. The realization of a realtime traffic sign recognition system is usually divided into three stages: detection, tracking and classification. This paper introduces the main difficulties in road sign recognition and briefly surveys the state-ofthe-art technologies in this field with further discussions on the potential trend of development of road sign recognition [5].

A Road Sign Detection and the Recognition for Driver Assistance Systems, Explores the effective approach of road sign detection and recognition for Driver Assistance Systems (DAS). In today's world road conditions drastically improved as compared with past decade. Express highways equipped with increased lane size made up with cement concrete. Obviously speed of the vehicle increased. So on driver point of

view there might be chances of neglecting mandatory road sign while driving. This paper illustrates proposed system to help driver about the road sign detection to avoid road accidents. The automatic road-signs recognition is an important part of Driver Assisting Systems which helps driver to increase safety and driving comfort. In this paper an efficient approach for the detection and recognition of the road sign in the road and acquiring the traffic scene images from a moving vehicle is present. In this paper the road sign recognition system is to be divided into two parts, the first part is detection stage which is used to detect the signs from a whole image, and the second part is classification stage that classifies the detected sign in the first part into one of the reference signs which are presents in the dataset. In the detection module segments, the input image in a YCBCR colour space, and then it detects road signs by using the shape filtering method. The classification module present determines the type of detected road signs by using an artificial neural network (ANN). The extensive experimentation has shown that the proposed system approach is robust enough to detect and the recognize road signs under varying lighting, rotation and translation conditions [6].

Towards Reliable Traffic Sign Recognition, Describes robust system architecture for the reliable recognition of circular traffic signs. Our system employs complementing approaches for the different stages of current TSR systems. This introduces the application of local SIFT features for content-based traffic sign detection along with widely applied shape-based approaches. We further add a technique called contracting curve density (CCO) to refine the localization of the detected traffic sign candidates and therefore increase the performance of the subsequent classification module. Finally, the recognition stage based on SIFT and SURF descriptions of the candidates executed by a neural net provides a robust classification of structured image content like traffic signs. By applying these steps we compensate the weaknesses of the utilized approaches, and thus, improve the system's performance [7].

Collision Detection and Avoidance System For Vehicle, Introduce an alarming and response system for moving vehicle using ultrasonic ranging device (URD) which is a combination of a transmitter, a receiver and a single processing device and a microcontroller. The system calculates the minimum safety distance and alarm the driver if distance is low. And if driver doesn't slow down the vehicle then the system will itself apply the brakes and slow the vehicle [8]. Intelligent Transportation System for Accident Prevention and Detection, Provides an intelligent system for two wheeler accident prevention and detection for human life safety. The prevention part involves, Smart Helmet, which automatically checks whether the person is wearing the helmet and has non- alcoholic breath while driving. The relay does not ON the engine if these two conditions are not satisfied. The microcontroller controls the function of relay and thus the ignition. The system also enables detection of an accident at any place and reports about the accident to predefined numbers with GSM module. The Microcontroller continuously records all the parameters of automobile for prevention and detection of accident [9].

A Practical Animal Detection and Collision Avoidance System Using Computer Vision Technique, In this paper, we discussed the necessity of automatic animal detection system and our algorithm for animal detection based on HOG and cascade classifier. The algorithm can detect an animal in different conditions on highways. The proposed system achieves an accuracy of almost 82.5 regarding animal (cow) detection. Estimation of approximate animal distance from the testing vehicle is also done. Though the proposed work has been focused on automatic animal detection in context to Indian highways, it will work in other countries also. The proposed method can easily be extended for detection of other animals too after proper training and testing. The proposed system can be used with other available, efficient pedestrian and vehicle detection systems and can be offered as a complete solution (package) for preventing collisions and loss of human life on highways [10].

A normal human can simply identify any written or typed or scanned text, numbers, etc., but when it comes to a device, it is not easy to find out what accurately that given text or numbers. It will be not easy to identify a handwritten digit for a device. Many machine learning methods used to fix the handwritten digit recognition problem. It is growing in more not easy domains, so its training complexity is also increasing. To beat this complexity problem, many algorithms have been implemented. In this paper, the Convolution Neural Network (CNN) and Particle Swarm Optimization (PSO), those two approaches use for recognition of the isolated handwritten digit. Customized PSO is used to reduce the overall computation time of the proposed system.[11].

In this paper mangoes are graded in four types like Green Mango, Yellow Mango and Red Mango which are based on machine learning method. This system considers RGB values size and shape of mangoes. Following analysis is used to obtain good probability. This helps to train system to identify appropriate maturity of mangoes. This research is conducted on two machine learning method i.e. Naive Byes and SVM (Support Vector Machine)[12].

Proposed System

The system includes two sensors attached to Raspberry Pi. The first sensor is ultrasonic sensor which helps to detect any vehicles or obstacles in front of our vehicle. The second sensor includes Pi Cam which captures images. These images are analysed.To perform the analysis for image,features extraction is done using following steps: Capture input images using pi camera Crop the area of Sign board.

1. Extract parameters like arrows by threshold segmentation(remove noises, Morphological operations).
2. Calculate geometrical properties (Area and perimeter) calculate the roundness value.
3. Classification algorithm to identify Traffic Signs.

Thus deep learning is used to identify the Traffic signal and signify the same.

System Architecture

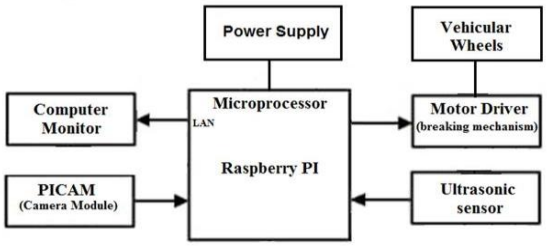

Fig. 1. System Block Diagram

Flow Chart

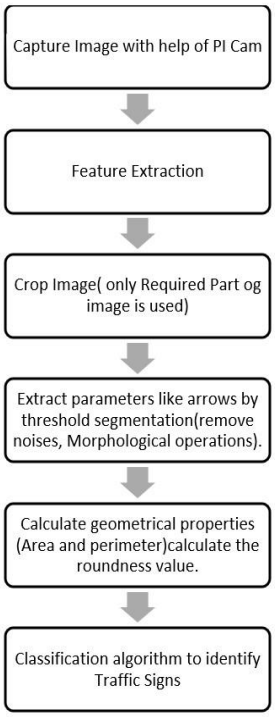

Fig. 2. Flow Chart

Algorithm

A. K-Means Algorithm

Input: a dataset of points P=p1,...,pn, a number of cluster k
Output: centers c1,...,ck implicitly dividing p into k clusters
1) choose k initial centers C= c1,...,ck
2) **while** stopping criterion has not been met
3) **do** assignment Step:
4) **for** i=1,...,N
5) **do** find closest center cK E C to Instance pi
6) **do** find closest center cK E C to Instance pi
7) assign instance pi to set ck
8) update step:
9) **for** i=1,...,k
10) **do** set ci to be center of mass of all points in ci

B. Grayscale Algorithm

Steps:
1. Get the red, green, and blue values of a pixel.
2. Use fancy math to turn those numbers into a single gray
value.
3. Replace the original red, green, and blue values with the
new gray value.
ConversionFactor = 255/(NumberOfShades-1)
AverageValue= (Red + Green +Blue)/3
Gray=Integer((AverageValue/ConversionFactor)+0.5)
*ConversionFactor

System Requirements

A. Software Requirement

1) Raspbian OS.
2) Python.
3) Device Drivers.

B. Hardware Requirement

1) Radio Transmitter and receiver.
2) Picam.
3) Raspberry Pi.
4) Ultrasonic Sensor.
5) LCD display.
6) Motors.
7) Power Supply.
8) Buzzer.

Advantages

1) It will help to reduce the death count due to driver negligence.
2) System can detect a real time moving traffic signs.
3) It can easily be embedded in vehicle controller circuitry.
4) Low cost solution.
5) Effective and real-time supervision can help driver to cautious all the time.
6) It will spread awareness about Traffic signs and driving discipline.
7) It will help to avoid rear or head-on collision

Result and Discussions

A. Results by Deep Learning Method

Fig. 3. shows the output window, which shows stop sign

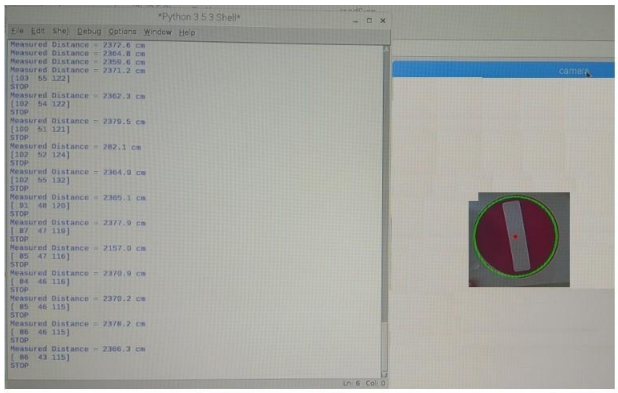

Fig. 3. Stop sign detected output

Fig. 4. shows the output window, which shows right sign. This output shows user need to turn right.

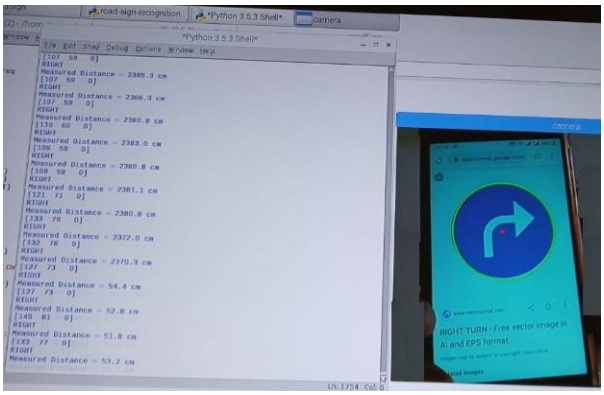

Fig. 4. Right turn sign detected

Fig 5. shows the output window, which shows left sign. This output shows user need to turn left

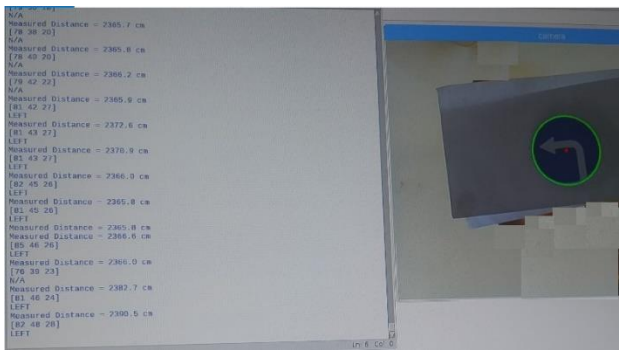

Fig. 5. Left turn sign detected

B. Comparison Between PQFT and Deep Learning

Traffic Sign Detection is compared with a method PQFT based on phase spectrum of quaternion Fourier transform. This method can only detect the saliency of static image,paper considers that the HSV color space is close to the human eye color perception, hue (H) can accurately reflects the color types, low sensitivity to external light conditions change, and using the intensity (V) of the frame difference to represent the motion information. Therefore, the HSV color space and motion information were adopted to construct quaternion, which effectively realize traffic sign detection. Fig 6. shows the comparison between Two Methods

METHOD	PQFT	Deep Learning
Total Frame Numbers	300	300
Frame Number Containing Traffic Signal	43	43
Correct Numbers	39	42
Number of Wrong Detection	3	1
Number of Leak Detection	1	0
Accuracy	**90.1%**	**98%**

Fig. 6. Comparison between PQFT and Deep Learning Method

X.

Conclusion

Proposed system will detect the sign board and Alert the driver with respective alert but if driver has neglected the Sign board alert the automated braking will be activated by Raspberry Pi. On the other hand, system will continuously track front vehicle distance using ultrasonic sensor, and breaks will be applied according to distance.

References

[1] D. Priyanka, K. Dharani, C. Anirudh, K. Akshay, M. P. Sunil and S. A. Hariprasad,"Traffic light and sign detection for autonomous land vehicle using Raspberry Pi", International Conference on Inventive Computing and Informatics (ICICI), Coimbatore, pp. 160-164, 2017.

[2] Y. Yang, H. Luo, H. Xu and F. Wu, "Towards Real-Time Traffic Sign Detection and Classification", IEEE Transactions on Intelligent Transportation Systems, vol. 17, no. 7, pp. 2022-2031, July 2016.

[3] C. Wang, "Research and Application of Traffic Sign Detection and Recognition Based on Deep Learning", International Conference on Robots & Intelligent System (ICRIS), Changsha, pp. 150-152, 2018.

[4] "OpenCV Documentation", Web. http://opencv.org/, [Accessed November 10th, 2015].

[5] "Raspberry Pi Foundation", Web. https://www.raspberrypi.org/ [Accessed October 29th, 2015].

[7] A. J. Kale and R. C. Mahajan, "A road sign detection and the recognition for Driver Assistance Systems", International Conference on Energy Systems and Applications, Pune, pp. 69-74, 2015.

[8] B. Hoferlin and K. Zimmermann, "Towards reliable traffic sign recognition", IEEE Intelligent Vehicles Symposium, Xi'an, pp. 324-329, 2009.

[9] S. Agrawal and S. W. Varade, "Collision detection and avoidance system for vehicle", 2nd International Conference on Communication and Electronics Systems (ICCES), Coimbatore, pp. 476-477, 2017.

[10] Dr.D.Selvathi, P.Pavithra, T.Preethi, "Intelligent Transportation System for Accident Prevention and Detection", International Conference on Intelligent Computing and Control Systems (ICICCS), pp. 1–10,2017.

[11] G.D.Upadhye, P.Barhate, "Classifying Handwritten Digit Recognition Using CNN and PSO", IJRTE,ISSN: 2277-3878, Volume-8 Issue-2, July 2019.

[12] G.D.Upadhye, D.Pise, "Grading of Harvested Mangoes Quality and Maturity Based on Machine Learning Techniques", IEEE International conference on smart city and Emerging Technology,2018.

[13] C. Li, W. Song, L. Xiao, Y. Hu and X. Pan, "Salient traffic sign video detection based on hypercomplex frequency domain", Proceedings of the 33rd Chinese Control Conference, Nanjing, 2014.