Design and Implementation of Sign Board Detection & Recognition for Self-Driving Vehicle

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Abstract: Traffic road sign detection and recognition is important to transport system with a robotic eyes or camera while driving in the road. The sign which is placed at the side of roads to impart information to road users is known as road signs or traffic signs. The application and the difficulty of road sign detection make road sign detection an interesting problem. In terms of application, road sign detection is quite important for the road sign recognition problem, since it is the most important step for a road sign recognition system. This paper presents an overview the traffic road sign detection and recognition, we developed and implemented the procedure to extract the road sign. The main objective of this paper is to design and construct a system which can automatically detect the direction of the road sign and recognize it.

Index Terms – **Road signs, traffic sign detection, traffic sign recognition, autonomous vehicle, image processing, opencv libraries.**

I. INTRODUCTION

The sign which is placed at the side of roads to impart information to users is known as road signs or traffic signs. Traffic sign recognition and detection is an important part of any autonomous vehicle. However, the real challenge lies in the detection and recognition of these traffic sign from the natural image in real time and with accuracy.

One of the many important aspects for a self driving car is the ability for it to detect traffic signs in orders to provide safety and security for the people not only inside the car but also outside of it. It is mostly important for the autonomous vehicles to recognize the traffic signs. There is no complication of adding extra sign boards for this system to detect them. Traffic sign recognition is important for autonomous vehicles and also for manual drivers to avoid accidents. Traffic sign boards on the road sides become hard to look for the drivers and the driver may now and then miss the sign boards on the road. These boards may indicate Humps ahead or No parking or even accident zone etc. Many times as a result of the close traffic movement or the street condition driver may not read anything and regardless of the possibility that he tries to peruse it with a wide eye there is a shot for the driver to lose focus on the road.

All existing traffic sign boards can be detected using image processing techniques and open CV libraries alone. The main advantage of an autonomous car: driving, often tedious and stressful, can be replaced by relaxing things(communication with friends or family, reading/viewing news on the internet, watching a movie, etc.). The accuracy and real time will determine the performance of detection system. Various traffic information such as traffic signs, obstacles and so on can be perceived in

real time. So, automatic traffic sign detection and recognition with image processing technology are considered as crucial technologies of various intelligent vehicle systems. So, we design a system which can automatically detect and recognizes the traffic sign board.

II. PROBLEM STATEMENT

Traffic signs provide valuable information about the road and play a vital role in safe and smooth driving. This is based upon a major approach to detect the direction. This system will play an important role for the detection purpose of specific domains like island, schools, traffic sign, universities, hospitals, offices etc. This propose a high performance detection system suited to fast vehicles or systems with low processing capabilities such as motor-cycles, or small portable recognition systems. Detection and Recognition is one of the most challenging task in the field of computer vision and digital image processing to detect a specific object in a real time environment. It is used to detect and classify road signs from within real-time color images captured by an image-sensor on-board of the vehicle.

To develop a robust hybrid algorithm that can be used in a wide range, to evaluate the system performance with other existing methods and eventually to evaluate the classification algorithm performance. It is about the various existing methods used in detection and recognition of traffic signs, the challenges that occur in dealing with live images. The system attempts to develop such a system which can alert about the approaching road signs early enough to prevent road accidents from happening. But various challenges are faced while developing an automatic road sign recognition system, such as detection phase and recognition phase.

III. PROPOSED APPROACH

Proposed system detects and recognizes the traffic sign board. Specifically, by the middle of this century, we will witness a revolutionary change in how means of transportation will take place. And that's because cars will drive alone from A to B, the driver's role is simply to give orders for the destination. Other activities from the category "Time is Money"(preparation of a presentation, video conference or other things specific to busy business people). Although, safety is important too. Most of the road traffic accidents are caused by the human factor, whether based on fatigue, or failing to adapt to road conditions. Humans are subject to mistake to a much greater extent than the computer, so another great advantage awaiting the authorities from the autonomous cars will be the drastic reduction of the accidents, especially of the victims.

Traffic Sign Detection and Recognition have received an increasing interest. This is due to wide range of applications that a system with this capability provides:-

Highway maintenance : Nowadays, a human operator has to watch a videotape to check the presence and condition of the signs. It is a tedious task because the signs appear from time to time, and because the operator has to pay great attention. The Esprit European project AUTOCAT presents a van developed for the automatic gathering of the traffic sign position.

Sign inventory : It is basically the same application but in towns and cities. In this case the environment is more difficult than highways. The signs are not always placed perpendicular to the movement of the vehicles, producing a deformed image of the signs; besides, there are occlusions, and other objects with the same colour. There has been little work in this particular environment.

Driver Support System : Traffic sign detection and recognition is one of the less studied subjects in the field of Driver Support Systems. Research groups have been focused on other aspects, more related with the development of an automatic pilot, as the detection of the road borders or the recognition of obstacles in the vehicle's path such as other vehicles or pedestrians. The future Intelligent Vehicles would take some decisions about their speed, trajectory, etc. depending on the signs detected.

Intelligent Autonomous Vehicles: Mobile robots use landmarks as means for their relocalisation. In the case of artificial landmarks, they can be designed as traffic signs. The advantage of this idea is that some precise information is added to the sign, for example, indication the robot the path to follow or some task it has to perform in a particular location.

In this project we use three modules:-

- Main Frame & Contour Module-

  In this module, the main frame used to show the original images of camera and finding contours is like finding white object from black background. So remember, object to be found should be white and background should be black.

- Matching Operations Module-

  This module provides regular matching operations similar to those found in contour frame which is only the main object sign board. In this module, we use Range Of Interest (ROI).

- Corrected Perspective Module-

  This module gives accuracy depends on the changing thresholding values. The Perspective Correction module provides an image transform that corrects for the effects of perspective.

IV. WORK MODULE

Traffic road sign detection and recognition is important to transport system with a robotic eyes or camera while driving in the road. In the traffic road sign detection and recognition, we developed and implemented the procedure to extract the road sign from a natural complex image.

The main objective of this paper is to design and construct a computer based system which can automatically detect the direction of the road sign. This paper is based upon a major approach to detect the direction. In this paper, we will demonstrate the basic idea of how detect the area and extract it. This system will play an important role for the detection purpose of specific domains like island, schools, traffic sign, universities, hospitals, offices etc.

The work is divided into different module part are as:-

- **Main frame & contour module-**
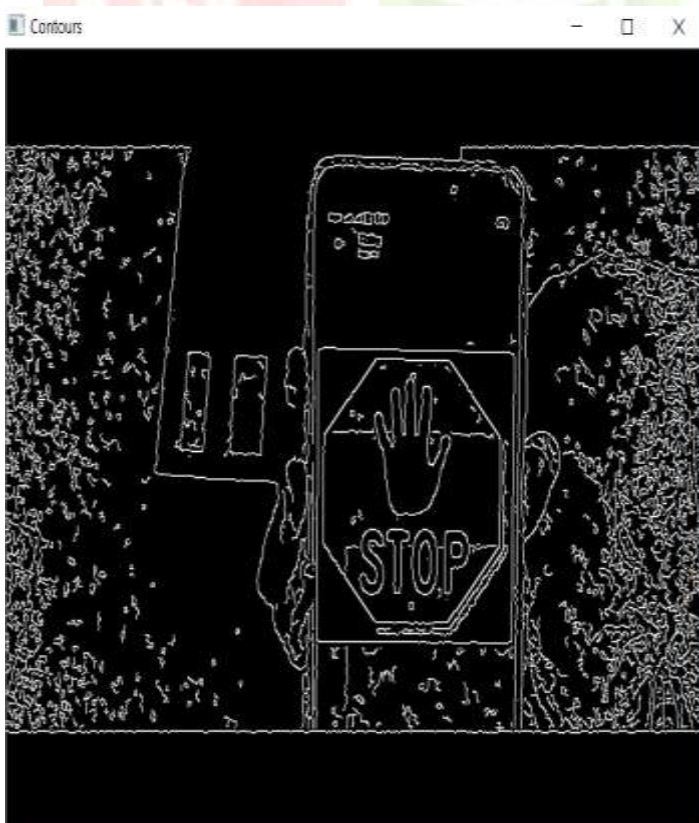
In this module, the main frame used to show the original images of camera and finding contours is like finding white object from black background.

Contours are defined as the line joining all the points along the boundary of an image that are having the same intensity. Contours come handy in shape analysis, finding the size of the object of interest, and object detection. The contours are a useful tool for shape analysis and object detection and recognition. To find the different features of contours, like area, perimeter, centroid, bounding box etc. You will see plenty of functions related to contours.

A contour is a closed curve of points or line segments, representing the boundaries of an object in an image. In other words, contours represent the shapes of objects found in an image. If internal detail is visible in an image, the object may produce several associated contours, which are returned in a hierarchical data structure.

Once we find the contours of the objects in an image, we can do things like determine the number of objects in an image, classify the shapes of the objects, or measure the size of the objects. The input to the contour-finding process is a binary image, which we will produce by first applying thresholding and / or edge detection. In the binary image, the objects we wish to detect should be white, while the background of the image should be black.

Contours are *abstract* collections of points and / or line segments corresponding to the shapes of the objects in the image. Thus, they can be manipulated by our programs; we can count the number of contours, use them to categorize the shapes in the object, use them to crop objects from an image, and more. So, let us see how to find contours in an image, and use the contours to determine the number of objects in the image. Since finding contours works on white objects set against a black background, in our thresholding we want to turn off the pixels in the background, while turning on the pixels associated with it. Once we have the contours, we can use them to get the *moments* for the corresponding objects in the image.

The moments of an object are weighted averages of pixel intensities, or functions upon those averages, and the precise details of the mathematics involved is fairly complicated. Luckily, we can easily use moments to determine things like the center of an object, the area inside a contour, and more, without worrying about the mathematics behind the scenes. So remember, object to be found should be white and background should be black.

- **Matching Operation Module-**

This module provides regular matching operations similar to those found in contour frame which is only the main object sign board. In this module, we use Range Of Interest (ROI). It is a method for searching and finding the location of a reference image in a larger image.

OpenCV comes with a function cv2.matchTemplate() for this purpose. It simply slides the reference image over the input image (as in 2D convolution) and compares the reference and patch of input image under the reference image. Several comparison methods are implemented in OpenCV. It returns a grayscale image, where each pixel denotes how much does the neighbourhood of that pixel match with template.

For instance, if we are applying face recognition and we want to detect the eyes of a person, we can provide a random image of an eye as the template and search the source (the face of a person).

In cases where almost identical templates are to be searched, the threshold should be set high.

The idea is to find identical regions of an image that match a template we provide, giving a threshold. The threshold depends on the accuracy with which we want to detect the template in the source image.

The goal of matching operation is match the source image with the output/outcome/resulted image. It is used to find the template in an image. For that we need two images i.e., Source image and Template image. It is very important module to match images on traffic sign board.
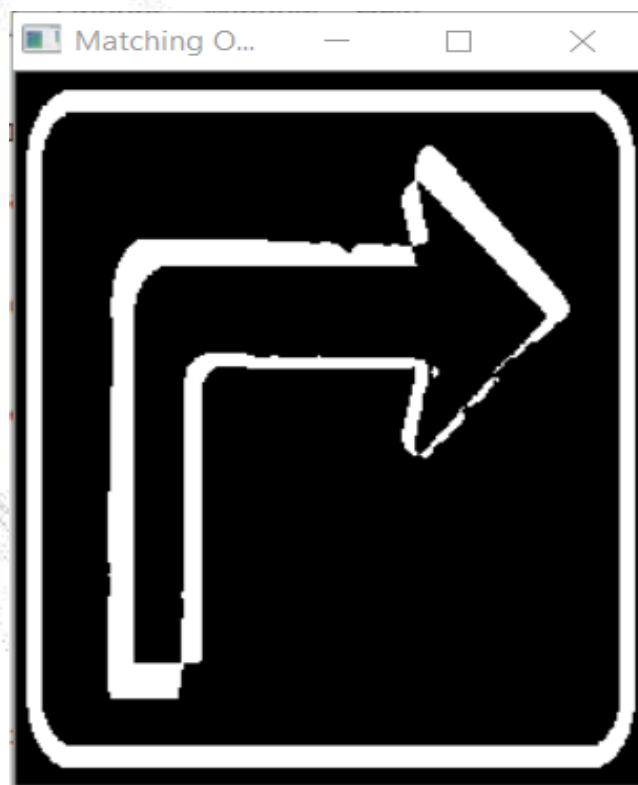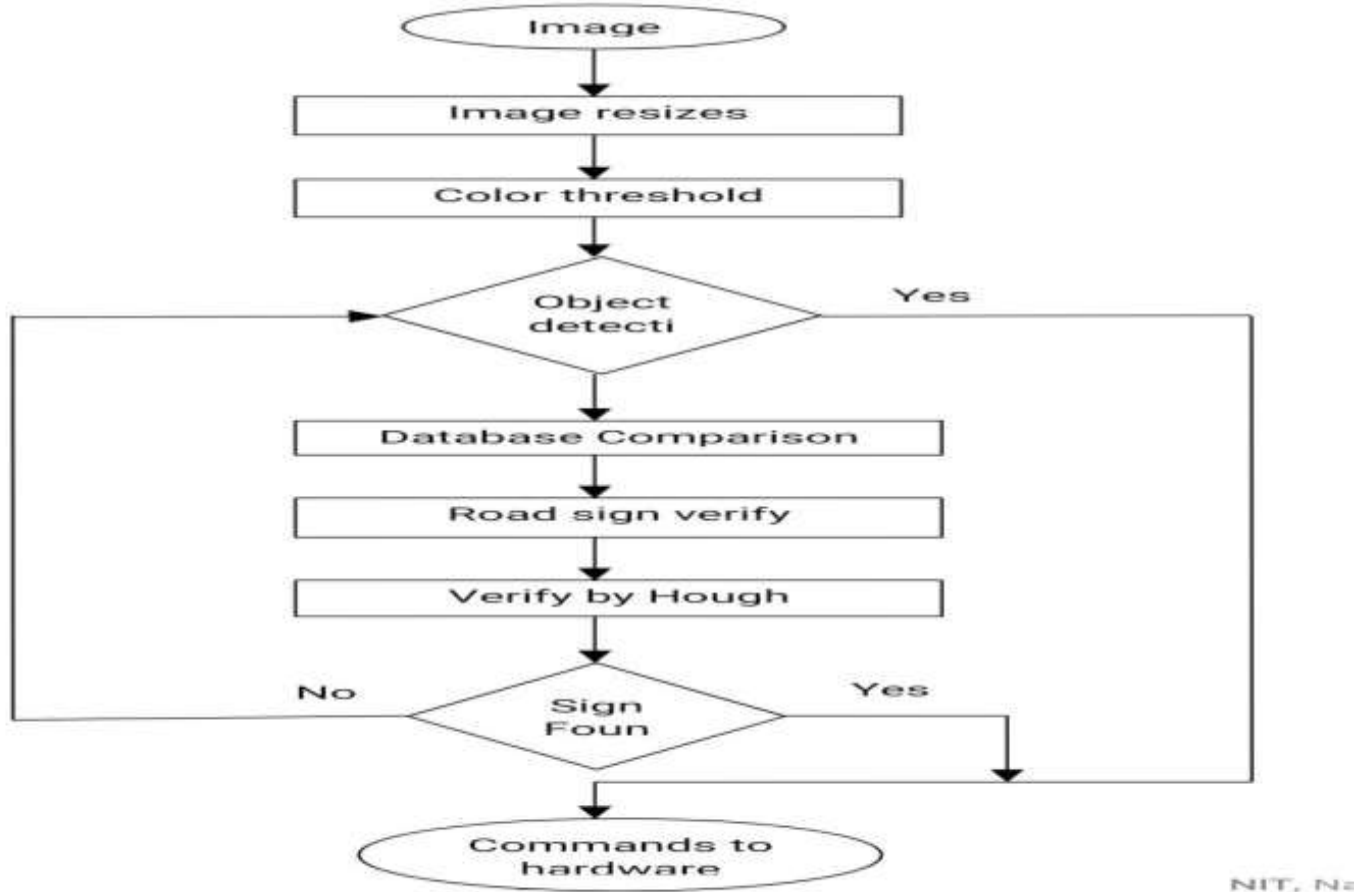
Fig.- System architecture of sign board detection and recognition for self-driving vehicle

- **Corrected Perspective Module-**

This module gives accuracy depends on the changing thresholding values. The Perspective Correction module provides an image transform that corrects for the effects of perspective which is very important for sign board detection and recognition for autonomous vehicle.

It gives closeness of a thresholding value to a standard or known value. To determine if a value is accurate compare it to the accepted value. As these values can be anything which has been developed. This corrected perspective is very important for giving accuracy point of view. It gives accurate result of any image which the camera will captured for the sign board detection and recognition.

With the accuracy and real time results, the proposed system has potential to be used in autonomous vehicle. In this way it provide accuracy for images which is perfect for giving

Traffic sign are an integral part of our road infrastructure. They provide critical information, sometimes compelling recommendations for road users.

Traditionally, standard computer vision methods were employed to detect and recognize traffic signs, but these required considerable and time-consuming manual work to handcraft important features in images. Instead, by applying deep learning to this problem, we create a model that reliably classifies traffic signs, learning to identify the most appropriate features for this problem by itself. In this we can create a deep learning architecture that can identify traffic signs with close to the accuracy.

V. EXPERIMENTAL RESULT AND DISCUSSION

Snapshot of designed system is given below which shows interface of various modules of system along with their functionalities. Experimentation is carried out by using a road sign board images. All the experiments are carried out in Image Processing and open CV libraries. With the live footage, the system was able to detect the sign and recognize it.

This system can provide multiple active features like real-time traffic sign detection using powerful cameras, obstacle detection and more often highly automated cars. The experimental result of road sign detection and recognition are as:-1) The results of road sign detection 2) The recognition result. It helps researchers because it is time effective one. As a whole, this method can reach the need of real time and accuracy for the detection and recognition of traffic signs. The overall experimental result as shown as below:-

Fig.- Snapshot of Self-driving Vehicle with its components   Fig.- Snapshot of Self-driving working module
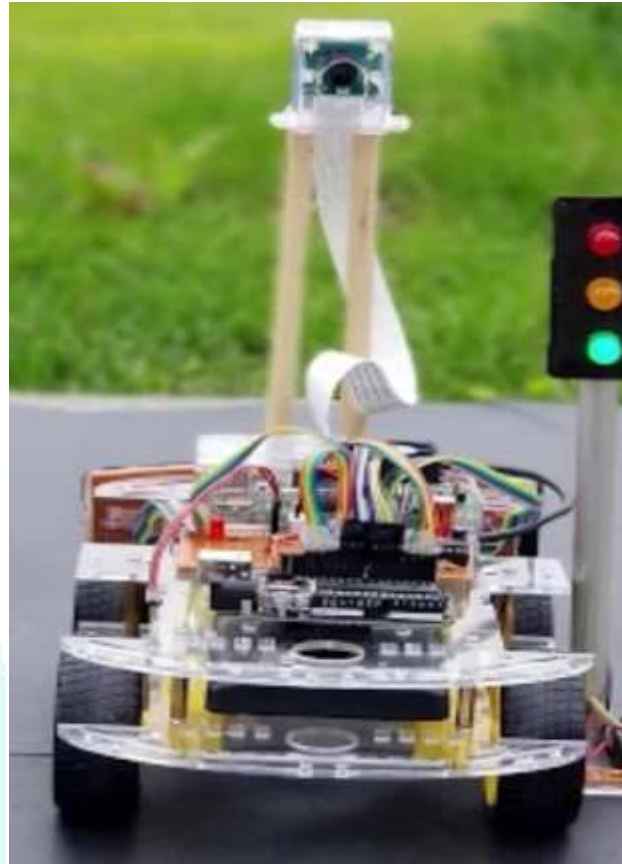
Fig.- Snapshot of Automatic Self-driving Vehicle

VI. CONCLUSION

It presents the conclusion of this dissertation and the future work that can be carried out on the basis of the present work. The conclusion summarizes the overall work that has been carried out in this dissertation.

Road signs which are designed for human eyes are easily detectable & recognizable. It is used to reduce the processing time. The detection accuracy can be increased. It is reliable & more efficient. It is fast & robust. It reduces the number of accidents & false-positives which can appear in camera sign detection. It is used to keep control of vehicle speed from the speed limit boards or even to go slow at school zones or pedestrian crossing zones. All existing traffic sign boards can be detected using image processing techniques & open CV libraries alone.

VII. FUTURE WORK

1) The detection and recognition procedure is performed in a real time.
2) It also can be used to automatically take actions regarding the traffic signs that appear.
3) It will navigates from google map.
4) It will uses the Auto Breaking System (ABS) for obstacle.

VIII. REFERENCES

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