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Traffic Sign Detection and Recognition

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ABSTRACT: Important information can be provided to the drivers by the signs on the road like navigation, safety and warning thus computer based system for automatic recognition and detection of road sign grow popular these days. Designing a traffic sign detection and recognition use computer capabilities to aid the transportation systems can be very useful it is also possible to add robotic assistance like cameras that are equipped with an auto detection system for traffic signs on the road. This research paper presents an overview and some technique for traffic sign detection and recognition, in practice we have implemented Blob Analysis as our method for constructing a computerized system that can detect and recognize traffic signs in an autonomous manner from images that are fed to the system. In this paper we will explain how the implemented approach can be reliable and we will demonstrate the process and experimental results found in the process of implementation.

KEYWORDS: recognition of traffic sign,detection of traffic sign, color segmentation, blob analysis.

I.INTRODUCTION

Signs placed along the relative of roads to let drivers know significant information, this signs are called traffic signs or road signs. Traffic signs can be divided into four main types, type one: prohibition, type two: warning, type three: informative, type four: obligation. Depending on the color and the form,Signs of Prohibition are circles with a red borderand a blue or white background. An equilateral triangle with one vertex upwards that is the signs ofwarning.They have are surrounded by a red border and a white background. Each one of the prohibition signs and warning signs, have a yellow background while they are placed in a side of public road. Signs of informative havethe same colors which are blue background with the signs in circles, to indicate obligation. Finally, there are two exceptions:the stop sign, a hexagon and they are yield sign, and their shape is an inverted triangle;to detect and recognition a sign, two properties should been known which they are the shape and color of it.

Detection method of road sign have been increased in recent years researches. Mostly, colors are segmented by using shapes. For example, to limit the possible signs of an image the shape and color is used [2]. Then, by applying the cross-correlation technique, the look and edges of the triangular regions or circular beings are extracted and recognized the signs type. Redness is used in [3] to find and detect yield signs, they used tow signs: “do not enter” and "stop". Besides, they also used shape and edge analysis for detection andidentifying the sign. At the same time, the author in [4]have used another technique, color matching starts with signs and corner detection, where the triangles, rectangles, or circles correspond to the specific corresponding to the previously identifying tables. A neural network used for classification by Yuille and colleagues [5], to detecting stop signs in their approach, corrected the brightness of the ambient light, matched the sign to a pre-parallel place before sign reading, and placedboundaries of signs.

In [6], estimates that about 40% of traffic incidents can be avoided bydecrease drivers' prejudices. Using an automated recognition of road sign system to inform traffic warnings to the driver, including information about the way in front of the car, it is possible to prevent accidents. Usually traffic signs have different shapes like rectangles, octagons, circles and triangles.This helps drivers to drive safely by using this system. Decrease the driver's decision-making burden and increase drivers' awareness of safe driving.

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II.METHODOLOGY

To represent important information to drivers, colors were used forroad signs.Therefore colors can be an important source of information for road signs recognition and detection. Colors can simplify this process because they distinguish the characteristics of traffic signs.In addition, color processing can significantly reduce the amount of fake edge point's produces low-level image processing operations. A mounted camera produces an RGB image for a moving car. This image is not suitable for perception of sign colors in most cases because thecolor of RGB space is formed as a Cartesian coordinate system in which the x, y and z axes are represented by R, G and B, respectively, and the coordinates in the three colors are related to each other; Indicating that any change in environment light intensity affects the RGB system by shifting the color cluster towards theblack corners or white. Color-based detection system is a very important part for simplification of the RGB image detection process which is a method of transforming color space into another form. This depends on the color mark of the RGB color space by converting them into another color space that gives them good detection capabilities to distinguish color information from brightness information. In the literature there are many color spaces, includingYUV color systems and HSB, L * a * b *, HSI, YIQ. Color saturation systems are the most commonly used color tones in road sign recognition.

$$hd_{blue} = e^{\frac{-(H-170)}{30}^{2}}, hd_{red} = e^{\frac{-H^2}{20^2}} + e^{\frac{-(H-255)}{20^2}^{2}} \quad (1)$$

$$sd = e^{\frac{-(S-255)}{115^2}^{2}} (2)$$

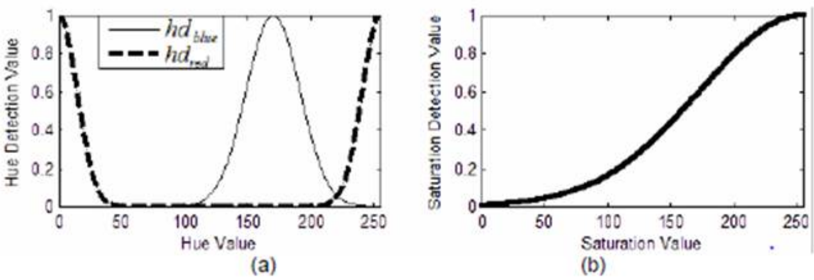

Fig. 1(a) Functions forblue image areas and detection of red;
(b) Color saturated areas function for detection

As mentioned, the detection and recognition of road signs despite by wide use of colors, butshapes analysis are also an important method to use. Many research groups use the shape of road signs and it have been proventhat it can be sufficient to detect them. Recognition of standard color and shapes flaws among countries, using shape analysishas the advantages of not depending on colors only. Another point should be mentioned in this argument is varying of reflectance properties bythe fact that colors vary as daylight. This leads shape detection and recognition to be a good alternative when it is difficult to extract color information such as in twilight and night time.

$$H = \begin{cases} undefined, & MAX = MIN \\ 60 \times \frac{G-B}{MAX-MIN}, & (MAX = R) \wedge (G \geq B) \\ 60 \times \frac{G-B}{MAX-MIN} + 360, & (MAX = R) \wedge (G < B) \\ 60 \times \frac{B-R}{MAX-MIN} + 120, & MAX = G \\ 60 \times \frac{R-G}{MAX-MIN} + 240, & MAX = B \end{cases} \quad (3)$$

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$$S = \begin{cases} 0, & MAX = 0 \\ 1 - & otherwise \end{cases} \quad (4)$$

$$V = MAX \quad (5)$$

$$hd_{blue} = \begin{cases} 1 - \frac{|R-G|}{MAX - MIN}, & (MAX = B) \wedge (MAX - MIN \geq th) \\ 0, & itherwise \end{cases} \quad (6)$$

$$hd_{red} = \begin{cases} 1 - \frac{|G-B|}{MAX - MIN}, & (MAX = R) \wedge (MAX - MIN \geq th) \\ 0, & itherwise \end{cases} \quad (7)$$

To identify traffic signs and routes using shapes may face some difficulties and certain features including figure-based road sign detection. Objects like traffic signs can exist on the stage like carswindows, and mailboxes. Road signs may have been damaged or clogged by other objects. The distance betweenthe sign variesand the camerascannot capture the right size of the signso they may appear unstable. Sign will not be recognized when it is too small. If the viewing angle is not overhead, feature ratio can also change. From color variations or daylight variations,shapes not affected [1]. Study with shapes requires a mapping algorithm and robust edge detection. As shown in figure (1), the traffic signs have significant shapes and color, in this paper we used color and shapes based methods for traffic signs recognition anddetection.

Type	Shape	Colors	Examples
1	Circle	Red, Blue, White, Black	
2	Upper Triangle	Blue, Yellow, White, Black	
3	Lower Triangle	Red, White, Black	
4	Octagon	Red, White	
5	Square	Blue, White	
6	Rectangle	Yellow, Black	

Fig. 2 Shape and color based traffic sign detection.

III.TRAFFIC SIGN DETECTION

Visual object detection in large, potentially cluttered scenes is always a very difficult task. Detection of traffic signs is a good example of such a challenge. A successful detector should be able to efficiently address several application-specific problems, e.g. a large and diverse gamut of signs to be captured, insufficient figure background contrast of signs that are seen in adverse illumination, or blur caused by the vibrations of the camera. However, in many aspects road sign detection resembles other, more general visual object detection problems. Therefore, when addressing it, the same, common, fundamental questions need to be answered.

- What is the object of interest? Is it unambiguously defined or has variable appearance?
- How to learn the object, if the model is not available? Is it possible to obtain a sufficient amount of training data?
- What makes the target object distinctive? How to extract its discriminative features?
- How to efficiently manage false positives and false negatives of the detector in runtime?
- How to efficiently scan a large region of the input image in search of the target object candidates?

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In the case of traffic signs, the choice of the detection strategy largely depends on how broad class of signs is targeted. When a single type of sign is focused on, it is relatively easy to develop a fast and robust detector as the target object is uniquely or nearly uniquely defined. On account of this fact, the detector can operate on a dedicated discriminative feature representation that can be derived from real-life sign images or their Highway Code prototypes. The task becomes much more complicated when multiple diverse road signs are to be detected, which is the case in most practical applications. Usually, taking the real-time performance requirement into account, the existing TSR systems of this kind cannot offer a general-purpose detection algorithm capable of handling the entire traffic sign diversity in a uniform way. They must strike a balance between the flexibility of the solution and its computational efficiency. Therefore, they usually specialize in detecting only narrow sign categories that exhibit many common appearance characteristics. For example detection on the European prohibition signs is facilitated by the fact that all of them have a circular shape with red rim, white interior and possibly some black symbols in it.

Apart from ensuring a flexibility of the detector and its high discriminative power in real-life traffic scenarios, several other issues need to be addressed. First, it must be decided how to efficiently scan potentially large regions of the scene with the detector and how to optimally reduce these search regions at no or little cost in the detection rate. Second, if the detector operates through dense image scanning, it is necessary to ensure that no multiple, redundant, i.e. nearly entirely overlapping hypotheses are generated around the true target locations and scales. Third, the invariance issues must be addressed. Ideally, although it is almost always neglected, the road sign detector should be pose-invariant in order to enable robust pictogram recognition even when the target appears distorted in the image. To achieve insensitivity to lightning changes, it should also be able to discriminate a sign from the background even when its colours look pale, e.g. as a result of shade or faded dye on the sign's surface. Other challenges involve dealing with motion blur, occlusions and other temporal aspects of the detection.

Partially because the crucial pieces of information colour and shape of the signs, are not fully and simultaneously exploited. As a result, the TSR systems that are currently released on the market specialize in detecting only certain types of traffic signs which have similar appearance and are therefore easier to learn.

IV.RECOGNITION OF TRAFFIC SIGN

Traffic signs recognition is a hard multi-class problem. In practice, handling the entire gamut of pictograms is never considered in TSR. This would be impractical as the total number of signs is huge, they differ from country to country, and some of them are extremely rare. Therefore, the common approach adopted is to focus on a relatively narrow category of the most relevant signs within one country. This reduces the complexity of the classification task and is hence more suitable for in-vehicle application. In addition, very traffic signs are not standardized in terms of color, shape, and icons they contain. A good example is the directional sign that can vary according to size, shape, and background color of the plate. These marks also include variable font characters as well as various symbols such as arrows. With such great appearance variability, only very coarse class definitions make sense, but this kind of categorization is of little practical use. Alternatively, the contained textual information, if present, may be focused on. However, fast and reliable recognition of these kinds of patterns is not possible in low-resolution and noisy imagery captured with a wide-angle camera and therefore requires more advanced hardware, e.g. an additional telephoto lens.

Recognition of road sign involves two important tasks, each of which requires special attention: extracting attributes and classification. In many object recognition problems, the feature extraction step is considered more important. A distinctive display of an object provides a mapping from the high dimensional original image field to the low dimensional feature field where the different class models are more clearly separated from each other. With such a mapping available, even a simple classifier design will offer satisfactory performance. In the case of TSR, a major difficulty at this level seems to be a joint modelling of colour and shape of traffic signs, which are these features that make them appear so distinctive to the driver, even in high visual clutter and in adverse lightning and weather conditions. Note that neither of these cues alone guarantees a sign to appear sufficiently distinguishable from the background in the entire spectrum of possible traffic situations. For example, in the street scenes there are many circular structures and straight edge segments with appropriate slope that could potentially constitute signs' contours. Only in presence of appropriately arranged, highly contrasting colours the true sign boundaries can be readily

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distinguished from those belonging to the other, accidental objects. Another challenging problem regarding the feature extraction step is ensuring that such features are robust to various types of image transformations which often occur in realistic traffic scenarios: adverse illumination, geometric distortion, shadows, motion blur or partial occlusions.

At the classifier design step, assuming that discriminative sign features are identified, the major difficulty is handling a large number of pictograms, frequently very similar to one another. Often a satisfactory separation of multiple classes at the feature representation level is not possible. In that case a discriminative power of the classifier can be increased by further transformations of the feature space, as is done for instance in the case of multi-class Support Vector Machines. Another possibility is to combine different classifiers into trees or ensembles, e.g. via bagging or boosting, in which each classifier partially contributes to the ultimate decision. However, care should be taken to maintain balance between the classifier's complexity and its computational efficiency, especially when matching with many dozens of sign prototypes is involved.

V. RESULT

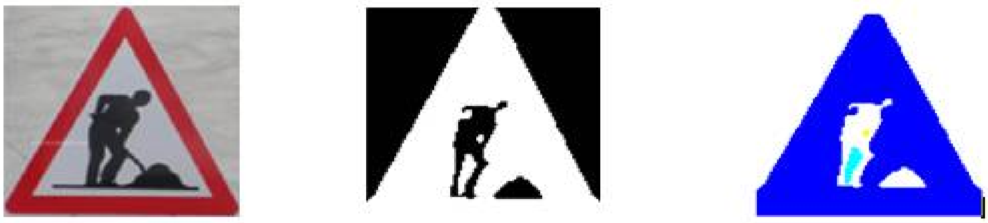
Road traffic signs usually classified depending on two main basics, shape and color. They are positioned and designed in such a way to be noticed easily while driving. Firstly the input video should be converting to frames to be processed. Then in the first step of blob detection which called blob extraction, the original image is converted to grayscale image then to binary image using quantization process.

Quantization of color images is a process that used to reduce the number of distinct colors used in an image, but it should be considered that the new processed image visually should be similar as it could be to the original one. The original images with its corresponding gray scaled and binary image are shown in figure 3

A B C

Fig. 3 Original image with its corresponding grayscale and binary image

Then then the binary image is processed, first it will be inverted then all connected components (objects) that have fewer than specific number of pixels will be removed. Then the binary image is scanned, the scan process start from upper-left and continued to the right and from top to bottom until the entire image is scanned. This process help tracing region boundaries in binary image, each shape is saved in a unique RGB colored image called blob. Figure 4 shows the detected sign in both colored and processed binary image with extracted blob of a traffic sign.



A B C

Fig. 4 detected sign using blob detection method

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Luminosity	Present Signs	Detected Signs	Detection Rate	Overall Detection
Low	218	203	93.1%	94.0%
Normal	344	336	97.7%	
Excessive	17	5	29.4%	

Table. 1 Sign Detection Results

For detection and recognition of a traffic sign, a previously defined dataset are requires. This dataset in our case are images captured for number of traffic signs. The mentioned process is repeated for every frame of selected video also for images in the dataset. Each frame is processed and extracted blob are saved in new image, then those blobs are compared with dataset blobs. After extraction of sign, it converted to colored image and a message box is shown with sign name as shown in figure 5.

A B

Fig. 5 detection and recognition of a traffic sign.

Class	Detection Rate	Classification Rate	Global Rate
Danger	93.1%	94.0%	87.5%
Information	97.1%	91.4%	88.8%
Obligation	94.0%	92.1%	86.7%
Prohibition	95.6%	79.4%	75.6%

Table. 2For each sign classresults classification and detection

VI.CONCLUSION

This paper presented to traffic sign detection and recognition we used blob analysis method and based on the (MATLAB)program platform. Blob analysis algorithmdepended on the color and shape for detection. Then in the first step of blob detection which called blob extraction, the original image is converted to grayscale image then to binary image using quantization process.This process help tracing region boundaries in binary image, each shape is saved in a unique RGB colored image called blob.

After many trying, we have run our program many times, have tried with different inputs, we are working on a complete quail program.Depending on simulation result this method can successfully detect and recognize traffic sings accurately recognize traffic signs with fast response and it can be used for real time detection.

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