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# A Review on Real-time Traffic Light Detection Methods

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## ABSTRACT

This research paper is conducted to detect crosswalks and traffic lights with small false positive and negative errors. The current reliable traffic light recognition algorithms operate well under way, most of them are mainly designed for detection at a fixed position and effect on autonomous vehicles under real-world conditions is still limited. The paper is presented a camera-based algorithm for the problem. The image processing flow can be divided into three steps, including pre-processing, detection and recognition. In this paper, they proposed a novel vision-based traffic light detection method for driving vehicles, which is fast and robust under different illumination conditions.

**Keywords :** Color Based, Edge Based, Density Based, Background Subtraction, Hough Transform.

## I. INTRODUCTION

Traffic light detection (TLD) in intelligent transportation system (ITS) has been studied widely in recent years but few research on traffic light detection for the visually impaired person to help them cross the road. Mainly two kinds of methods were used for traffic light detection and recognition: active and passive way. Passive traffic light is convenient and with no disturbance to other people. In traffic light detection system for visually impaired person, which can be used in electronic travel aides (ETAs), camera was generally mounted at the user's head. According to the characteristic of traffic light detection and recognition in ETAs, a new method was proposed, fuzzy clustering was used to locate traffic light.

The information of traffic signal can be obtained through wireless communication technology, but it is high cost for installing wireless communication equipment and is difficult to construct the related hardware facilities. In order to simplify the hardware, the image processing technology can be used to recognize traffic lights. This method has several advantages, such as low price, high performance, and easy upgrade. Applying image processing method, traffic lights detection by judging the shape and size of an object, in which the arrow-shaped traffic light was not discussed. Detecting the state of traffic lights and understanding their semantics at interactions is essential for autonomous driving in real-world situations. Some researchers have focused on the vision-based traffic light detection methods by analysing the traffic lights states from the frames captured by the on-board camera automatically.

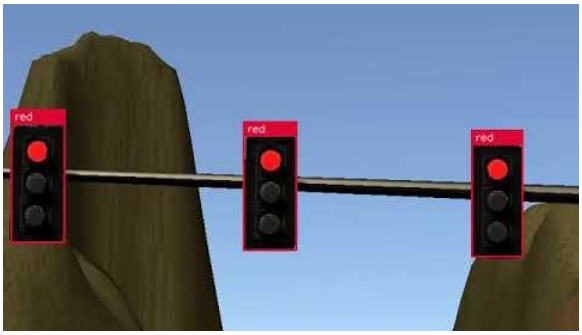


**Figure 1:** Traffic Light Detection

## II. RELATED WORKS

In the paper [8] MASAKO OMACHI, they propose a method of detecting a traffic light from a single scene image taken by an in-vehicle camera. The template matching is one of the most fundamental ones for detecting general object from a scene image. The snap of a traffic light is circle, they can find a traffic light from a scene image by detecting a filled circle of which Color is the one of the traffic lights.

In the paper [5] JONGWON CHOI, they proposed a method of algorithms for detecting crosswalks and traffic lights are designed to run in real time with small computational complexity. For detecting crosswalks, V values of HSV domain image was used. A proposed algorithm for detecting traffic lights is mostly referred to an algorithm using probabilistic template matching.

In the paper [2] ZHANG TIANLEI, they proposed a new approach to detect and recognize traffic lights in vertical arrangement. This approach is designed for autonomous vehicles, so we would use on-vehicle camera to do all processing in real-time.

In paper [4] D.VISHNA PRIYA, they used DAS is used, it provides various environmental information such as traffic signs, speed limits, traffic lights, crosswalks, or any other information like pedestrian or obstacles.

In paper [3] TIN TRUNG DUONG, they proposed the system assist drivers in making decisions and provides co-ordination and notification during abrupt events. The goal is to improve safety. TLD methods can be divided into three categories: learning based, map based or image processing based.

## III. DETECTION METHODS

### A. Color Based Method [6]:

When the traffic light is on, its corresponding Color components much bigger than other Color in RGB Color space. From red, green and yellow Color pixels of traffic lights can be extracted by subtraction between two Color components. When the red traffic light is on R component is bigger than G& B; when the green traffic light is on G component is bigger than R& B; when the yellow traffic light is on R& G component is bigger than B.

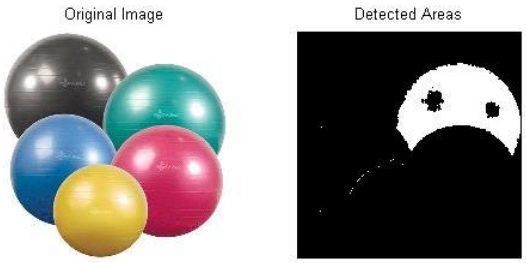


**Figure 2:** Color Detection

### B. Color and edge based method [8]:

The colors of traffic lights depending on the change in the lighting conditions caused by weather, time and other factors. Order to eliminate the slight change in color we convert the color space. It is the normalized RGB is robust under the change in the lighting conditions. So using this convert an RGB image into a normalized RGB one.

**Figure 3:** Color & Edge Detection

### C. HSV based method [1]:

The most significant feature of traffic lights is colour sensitive. However, the Color of traffic lights would vary in different lighting conditions caused by weather, time or other factors while RGB Colour space is sensitive to the light intensity. So the colour space should be converted in order to uniform the drift in colours. HSV colour space is not affected by the lighting changes and hue-component H describes colour. Thus, we first convert image from RGB to HSV.

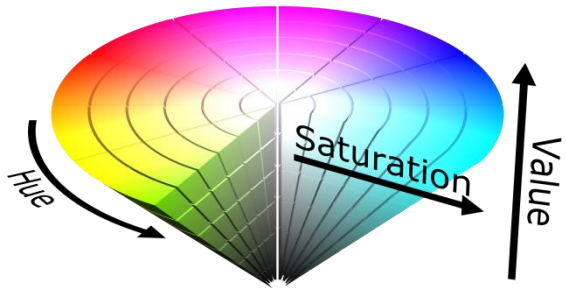


**Figure 4:** HSV Color Model

**D. Adaptive background suppression filter method [2]:**

For most traffic light detection, the sliding window detection approaches usually suffer from large computation and multi-scale problem. In this three types of parameter are used: Arabs: motivation, AdaBSF: model, AdaBSF: optimization. After getting a series of windows by AdaBSF, each window is analysed by more discriminative feature to determine whether it really contains a traffic light instance or not.

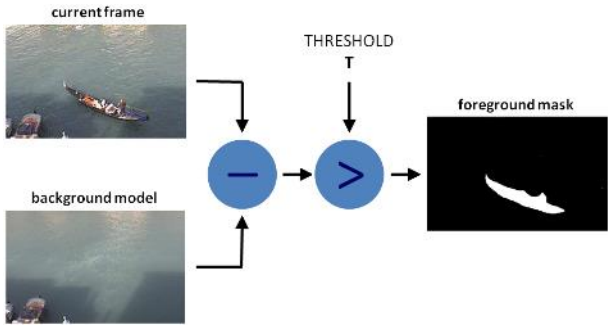


**Figure 5:** Background Subtraction Model

**E. Color density method [3]:**

In Colour density method the states of the blobs are identified. A particular blob can have one of the four states: c=red, yellow, green, and white. The white Color represents other colour that are not quite the same as red, yellow and green. The system map the blob region to the RGB source image to compute ratios of the four pairs: R/B, R/G, G/B AND G/R. Next, a particular blob has four Color densities Dc: red, yellow, green, white. Finally, the blob Colour with the highest density is the state of the blob. However, to prevent the situation where there is too much non-sense Colour information in the blob that is being considered, there are two restrictions.

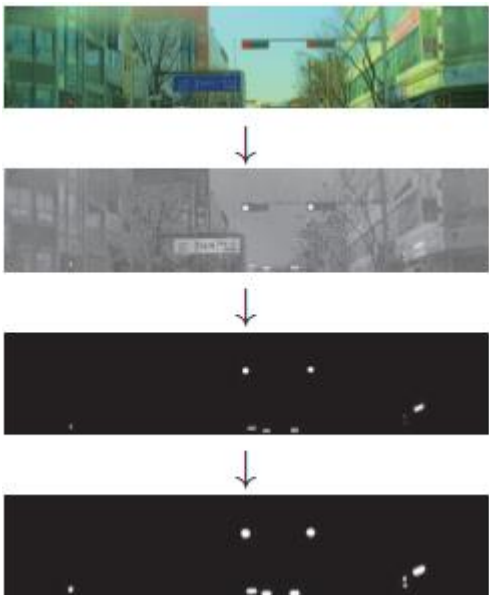

**Figure 6:** Color Density Based Model

**F. Hough Transform [7]**

In automated analysis of digital images, a sub problem often arises of detecting simple shapes, such as straight lines, circles or ellipses. In many cases an edge detector can be used as a pre-processing stage to obtain image points or image pixels that are on the desired curve in the image space. Due to imperfections in either the image data or the edge detector, however, there may be missing points or pixels on the desired curves as well as spatial deviations between the ideal

line/circle/ellipse and the noisy edge points as they are obtained from the edge detector. For these reasons, it is often non-trivial to group the extracted edge features to an appropriate set of lines, circles or ellipses. The purpose of the Hough transform is to address this problem by making it possible to perform groupings of edge points into object candidates by performing an explicit voting procedure over a set of parameterized image objects (Shapiro and Stockman, 304).

The simplest case of Hough transform is detecting straight lines. In general, the straight line y = mx + b can be represented as a point (b, m) in the parameter space. However, vertical lines pose a problem. They would give rise to unbounded values of the slope parameter m. Thus, for computational reasons, Dude and Hart [5] proposed the use of the Hesse normal form r=x cos (theta) +y sin (theta),

Where r is the distance from the origin to the closest point on the straight line, and theta is the angle between the x axis and the line connecting the origin with that closest point.

It is therefore possible to associate with each line of the image a pair theta. The theta plane is sometimes referred to as Hough space for the set of straight lines in two dimensions. This representation makes the Hough transform conceptually very close to the two-dimensional Radon transform. (They can be seen as different ways of looking at the same transform).

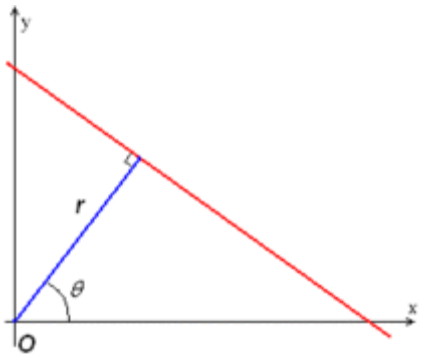


**Figure7:** Hough Transform

Given a single point in the plane, then the set of all straight lines going through that point corresponds to a sinusoidal curve in the (r,θ) plane, which is unique to that point. A set of two or more points that form a straight line will produce sinusoids which cross at the (r,θ) for that line. Thus, the problem of detecting collinear points can be converted to the problem of finding concurrent curves.

## IV. COMPARATIVE ANALYSIS

In this part of the paper describe about the different technique comparative study using its advantages and limitation so we can find the batter among all.

**Table 1.** Comparative Analysis

| No | Method | Advantages | Limitation |
|---|---|---|---|
| 1 | Color Based Method [6] | High detection rate for Bright object. | Not detect when light illumination is low. |
| 2 | Color and Edge Based Method [8] | High detection rate for Bright object and noisy environment . | Sometimes detect noisy region. |
| 3 | HSV Based Method [1] | Works with light shadow | Binary operation are |

| | | | |
|---|---|---|---|
| | | colours. | require. |
| 4 | Adaptive Background Suppression filter method [2] | Detect exact location for Object. | Adaptive background calculation is complex. |
| 5 | Color Density Method [3] | Its works batter For Noisy image. | Detection is not validate for more than two shade of Color. |
| 6 | Hough Transform [7] | Works with Circular Object. | Not detect other shapes. |

As shown in the table the different methods have different advantages some of them are work in light IL luminance where some of are in noisy environment but the Hough transform and color based method have greater advantage then other methods.

## V. CONCLUSION

In conclusion, this paper survey a real-time traffic light detection algorithms. HSV, Colour Thresolding, geometrical information, Hough transform and Color density of an image are used to detect traffic lights. The Color density method recognizes the Color of an object by comparing the densities of each Color belonging to the object. The Hough transform method is robust, only

requires RGB images and has a high detection rate. So the Circular Object in Red Color is only detect in the Hough transform where the other colour based and density based method is work in light illumination area. So In future use of Color based as well as Hough transform based methods combination will give a future direction of research in traffic light detection.

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