



## BRAKE LIGHT DETECTION USING IMAGE PROCESSING TECHNIQUE

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### Abstract

Car driving itself without human intervention is a dream of the World. There are many studies about Intelligent Transport System (ITS) and Unmanned Ground Vehicle (UGV). Interest on unmanned vehicle is increasing. One of the important issues in UGV is detection of signal light, which is necessary when car is on the crossroads and intersection. This proposed system is a perfect system for safety crossing, and also it is cost effective. Therefore, there is a need for developing vision detection system for signal lights and for safe driving. There are many accidents in crossroads and crosswalk; such accidents are caused by careless driving. In this paper we present a new vision algorithm for signal light detection which has real time processing with high detection rate while using low price camera. Using this algorithm, reliability and safety for UGV and drivers will be increasing. This project is aimed at developing a method to detect brake lights of on-road vehicles by segmenting the color images and analyzing the color. The forward-facing images are acquired and processed for suitable color identification after segmentation. This application is suitable for an autonomous (Unmanned) vehicle as well as for the guidance of driver (manned). The system should respond to the information from other vehicles, such as Detection of active Brake lights, which indicate the vehicles intended actions.

### Introduction

In today's world we come across many on-road accidents very often. These accidents basically occur due to the negligence of safe driving. People mix-up their driving attending phone calls, texting, listening songs and many other activities. In such scenarios this technique might be helpful in alerting the driver of the upcoming threat.



Normally in real world whenever vehicles running on road apply brakes the driver captures the active brake lights by the help of his vision. And in response to that he/she slows down the speed or applies brakes of his/her vehicle to avoid accidents. The same logic is applied in our application where images are continuously captured using a simple camera. The human mind processes the continuously captured images and detects any threat in his way; our application processes the images in the same way, to detect the brake lights of other vehicles. As the camera is continuously capturing images, our application shall be running in parallel with it. Each image captured by the camera is continuously processed; if no threat- no action is performed. In case of any threat i.e. any vehicle applies brake, then that image results in detection of active brake lights by this application. And an alert message is displayed to guide the driver of the up-coming threat.

This Technique can also be used in sovereign vehicles, where we can detect the active brake lights of forward facing vehicles and apply brakes automatically.

This technique is simple and effective, where no complex and lavish resources are used and no complex coding is required. All we have to do is just capture an image and segment it and detect whether the Brake lights are active or inactive.

### Literature review

In Image processing lot of work has been done in recognizing and classifying the image for specific applications. (B. S. Anami, D. G. Savakar, 2009) have proposed many methods to identify and recognize the foreign bodies from the group of similar



objects, by using segmentation. (B. S. Anami, D. G. Savakar, 2010) have developed technique to study Influence of Light, Distance and Size on Recognition and Classification of Food Grains' Images. (Basavaraj S Anami and Dayanand G. Savakar, 2011) have proposed Suitability of Feature Extraction Methods in Recognition and Classification of Grains, Fruits and Flowers. From the literature it is observed that, in Vehicles there is no pre-defined feature which can help to monitor the actions of forward facing vehicle which can be helpful to prevent accidents. Due to long driving, drivers may get tired, due to which the concentration towards driving will be decreased, and hence more number of accidents may occur. These problems are solved by implementing additional features such as the use of sensors and many other techniques. In real world we use sensors to detect brake lights to measure distance of forward facing vehicles and many other techniques. All these techniques are effective but are very costly to implement. Spending huge amount of money to just to detect brake lights of forward facing vehicles is not a preferable option.

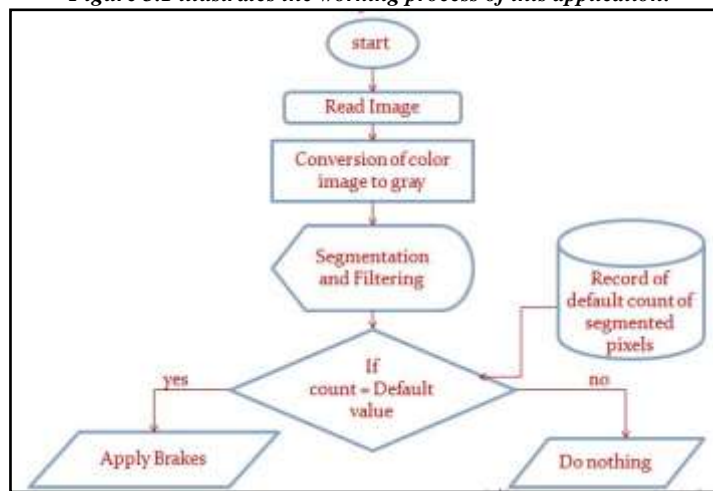
**Proposed system**

The proposed model is framed with two Basic and essential concepts that are high detection rate and cost effective, since we use image processing technique to detect brake light of forward facing vehicles. The concept becomes simple and easy to implement. To implement this technique we don't need any complex resources, all we need is a VGA camera and a circuitry in which the code is integrated.

This technique works on the pixels of an image, which is captured using the above said VGA camera. This technique reduces the cost and has a high detection rate.

**Working principle**

*Figure 3.1 illustrates the working process of this application.*



*Figure 3.1*

**Input**

The first step is to give the input to the application, we give image as our input to the application. A Digital image of the vehicle is given as the input to the detection system where every pixel color code is arranged into corresponding array elements.

*The image given as input is shown in figure 3.2:*



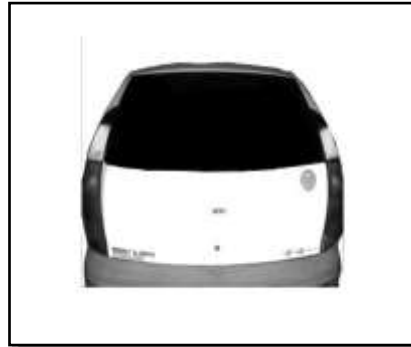
*Figure 3.2*



### Converting color image to Grayscale image

In this step is to convert color image to grayscale image, because in color image red green blue colors have same color frequency from 0 to 255, hence it will create ambiguity in segmentation as it is difficult to differentiate the colors using color code. When a color image is converted to gray scale image then the whole image has same frequency from 0 to 255 hence it is easy to perform segmentation.

*The converted gray scale image is shown in figure 3.3:*

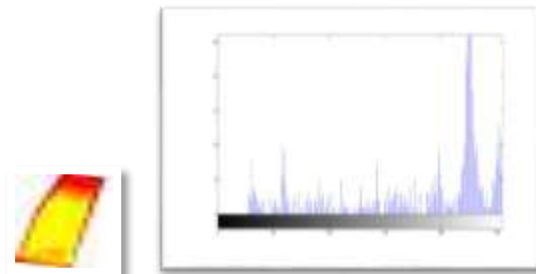


*Figure 3.3*

### Draw a histogram

The Histogram block computes the frequency distribution of the elements in the input. We give only the indicator as input it results in a bar graph where X-axis represents the color code and Y-axis represents the number of pixels. We take the range of color frequency which has the highest peak and that frequency is further given in segmentation process to detect the active brake lights.

*The image if brake light is given as input as shown in figure 3.4*



*Figure 3.4*

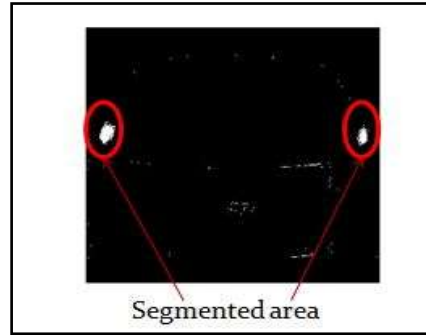
Figure 3.4 illustrates the bar graph, in this graph the highest peak ranges from 220 to 228, this is the value of brake lights which is given for segmentation process.

### Segmentation

Segmentation is the technique of extracting the area of interest from the whole image. Here our area of interest is the active brake lights. An image is stored in two dimensional array variable, where we compare each pixels with the frequency calculated by histogram, i.e. if  $(b(i,j) > 220 \ \&\& \ b(i,j) < 228)$ ; where  $b$  is the gray scale image, if condition satisfies it means the pixels of active brake lights are detected and only that pixels from the image  $b$  is converted to white i.e.  $b(i,j) = 255$ ; and rest of the pixels are converted to black color.



*The result of this segmentation process is shown in figure 3.5:*

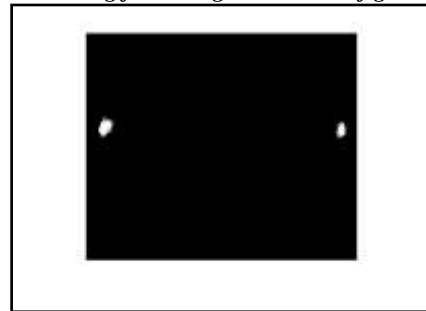


*Figure 3.5*

### Filtering

Filtering is a process of removing noise from the image. Hence, applying low pass filter we get rid of noise. In an image if a group of white pixels is less than or equal to the given value then all the pixels are converted to black it returns a filtered image.

*The resulting final image is shown in figure 3.6:*



*Figure 3.6*

### Output

In the final step the count of white pixels from the output of filtering process is stored in the database, which is later used for comparison with other samples of similar vehicle. If the sample image consists of active brake lights, comparison of the count will be successfully matched and an alert message is displayed to the user as shown in figure 3.7.



*Figure 3.7*



If sample image contains inactive brake lights then no pixels are converted into white in the segmentation process hence no action is taken.

## Algorithm for the proposed model

### Step 1: Reading input

- The input for our Application is images captured from a simple camera.
- The images can be RGB or Black and White.
- The images must be captured from a fixed distance.

### Step 2: Conversion of RGB images to Gray scale images.

- Conversion is essential since RGB images can create ambiguity while segmentation.

### Step 3: Segmentation

- Segmentation is done to extract the interested part of the image i.e Active Brake lights.
- Only active brake lights pixels are done converted to white color and remaining black.
- By doing segmentation we get the active brake lights pixels hence brake lights are detected, if brakes are not applied we will get full black image.

### Step 4: Filtering

- Filtering process is implemented to remove the noise from the image
- Filtering is done to remove the unwanted pixels from the image.

## Experimental results

### Samples of different vehicles



Figure 5.1

Figure 5.2



Figure 5.3

Figure 5.4



Figure 5.5

Figure 5.6

The following are the results that were produced during the process to find the accuracy in regard with the counterfeit details

Vehicles	No. of Samples	Accuracy (%)
Vehicle1	50	83
Vehicle2	55	75
Vehicle3	50	80

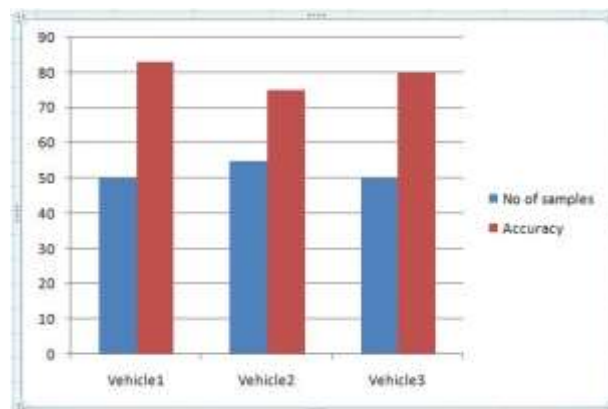


Figure 5.7

The proposed model has been verified for accuracy with 100-150 samples, which include images of different vehicles. And we have observed 80% accuracy during the verification process.

**Conclusion**

This testimony has detailed the development and implementation of an algorithm to detect Brake lights from images taken from camera. From this project we conclude that this particular application is capable of recognizing the brake light signals produced by the vehicles. It also displays a message to depict the action to be performed after recognizing the signal .Thus reducing the manual work of driving and the chances of road accidents. A succession of tests is then applied to filter out false positives before sampling the image to obtain the data. As a final test the ‘data’ in the guide sections is verified. The algorithm has been designed to be robust against a wide number of samples.

**References**

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### BOOKS

1. *An Introduction to Digital Image Processing with Matlab*
2. *MATLAB® Getting Started Guide R2012b*

### LINKS

- ❖ <http://www.mathworks.in/>
- ❖ [http://www.mathworks.in/academia/student\\_center/tutorials/launchpad.html](http://www.mathworks.in/academia/student_center/tutorials/launchpad.html)
- ❖ <http://users.ece.gatech.edu/bonnie/book/TUTORIAL/tutorial.html>
- ❖ <http://www.cyclismo.org/tutorial/matlab/>
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