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Vehicle Recognition Based on Tail Light Detection

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Abstract: During day time numerous approaches have been implemented on vehicle recognition .It is very much easier to recognize vehicles during day time compared to night time .We can capture photo of every part of vehicle during day. But the appearance of vehicles during night time is strikingly different when compared to its daylight counterpart as several attributes come into picture such as surrounding light, color of vehicles, reflection of lights on the body of vehicles, etc. It becomes difficult to recognize or take a picture of every parts of vehicle. When driving in dark conditions, we cannot see the whole body of the vehicle present in front of us due to lack of light conditions, we are only able to see their tail lights and brake lights. So it becomes very much difficult to understand whether it is bus, car or other vehicle present in front. In this paper we try to show a vehicle recognition system which will be able to recognize vehicle at night time environment by locating and segmenting tail light.

Keywords: vehicle recognition, reflection of light, tail light, brake lights, recognition system.

I. INTRODUCTION

If we do a statistical analysis of road accident we can see that most accident is happened during night time. Many Computer Vision techniques have been implemented for aiding road safety and security .But still it is not up to mark. It is happening because the appearance of vehicles during night time is strikingly different when compared to its daylight counterpart as several attributes come into the picture, such as environment lighting, color of vehicles, reflection of light on the body of vehicles, etc. Thus, an entirely different image processing approach is absolutely essential when it comes to dealing with night time road environment. This application targets on segmenting the tail lights of vehicles and classifying them. When vehicles are viewed from behind at night, we can see only red color rear facing brake lights. All vehicles have their own physical and structural features which make them distinctive from each other and the appearance of brake lights is one of those features.

Hence, due to different shapes, sizes and designs of this rear facing lights enables us to determine which type of vehicles it is during night time. This application can play an important role in road traffic police stealth monitoring and may be installed in secluded and rural areas where lighting conditions are scarce. Preferably, the system could be installed on a police vehicle for classifying the preceding vehicles and can be extremely beneficial for stealth missions, surveillance, security enforcement, ticketing vehicle without human interruption, etc.

II. LITERATURE SURVEY

[2]World Wide legislation states that rear automotive lights must be Red and placed symmetrically in pairs at the extremities of the rear of the vehicle. These tail lights must be wired so that they light up whenever the front headlights are activated.Legislation also states that although tail lights and brake lights can be integrated into a single unit,there must be a minimum ratio between they can be easily distinguished. There is no legislation governing the shape of rear automotive lights. Due to the advances in LED technology, light manufactures are departing from conventional break lights. Thus it is important to have a detection method that is shape independent. It has been compulsory for manufactures to include a horizontal bar break light since 1986 in North America and since 1998 in Europe. This is a feature that could possibly be used in future systems,as an aid to detection and as a means to differentiate between tail lights and brake lights.

As rear lights must be red by law, several systems have utilized color to aid vehicle detection. Chern et al [3] detect rear lights by color filtering in RGB space to detect red and white regions. If a white region is surrounded for most of its perimeter by red pixels, it is regarded as a potential rear-light. They note that taillights within 40 meters usually appear as white regions in the image as they are too bright for the image sensor. Their white filter was effective, however the red filter allowed through many different colors, resulting in bright objects such as street lamps being let through the filter. The candidates were paired by considering y-values, area and spacing.

The different techniques commonly employed for vehicle detection under daylight conditions have comprehensively been reviewed before in [2][1]. Although detection of vehicles during night time has been reviewed in the past, a system which actually determines the make of a car hasn't been implemented yet. As mentioned earlier, most of the features engaged in daylight car detection have limited use at dark conditions [2].

Vehicle shadows, vertical and horizontal edges, and corners are almost impossible to detect in darkness, making the rear facing brake lights as the most compelling preceding vehicle features in dark surroundings.

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For lamp detection, it is common to begin with some sort of Thresholding [2]. Thresholding based on Gray scale or brightness is common to start with [2][3]. For color Thresholding, the most common approach is to use the red, green- blue (RGB) color space. Chung-che Wang et. Al [4] proposed a vision- based driver assistance system to enhance the driver safety in the nighttime [5]. The proposed system performs both lame detection and vehicle recognition (as detecting whether the light segmented is that of a vehicle or not) [5]. Ronan O'Malley et. al [2] have discussed the need for a system to avoid or mitigate forward collisions during night time by presenting an algorithm for forward collision detection at night using a visual camera [5].

III. METHODOLOGY

The entire algorithm for vehicle recognition is based on image processing. The proposed system uses MATLAB as a platform on which image processing algorithm has been developed and tested. As an image acquisition devise, camera is used. These are the following processes can be carried out for making the required application.

3.1 HARDWARE REQUIREMENT

Camera is the first and the most important hardware in this system used for image acquisition purpose. Proper selection of hardware is important for the effective working of the system. A good resolution camera will be implemented for this project which will capture the vehicle images on night. The camera can be mounted internally on the vehicle, behind the rear view mirror or we can put somewhere so that images can be capture wherever necessary.

3.2 IMAGE COLLECTION

The second task in this image processing algorithm is to get the live video feed from the camera connected. This live video feed has further been converted into sequence of frames andthese frames are used in order to apply further image processing algorithm. Then converts these video feed into image array.

Conditionally, ROI (Region of Interest) can also be applied for capturing specified area of the frame. The input video is of the form mpeg,avi etc. Camera fitted in the car captures the front vehicles.The captured video is converted into number of frames. The numbers of frames are based on the format of the video.

3.3 CONVERT THE IMAGE TO BINARY IMAGE

The collected images are having different colors. So if we do binarization, it converts RGB fames into the binary image. It converts the input image to a binary image. The output image BW replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black). It helps in identify important body parts of the vehicle for the system and we can easily spot the part having greater luminance.

3.4 REMOVAL OF NOISE AND DILATION

For removing the noise in the binary image, we calculate the weight of the object. Morphological operation employed here for reduce the noise. In Morphological Operation the technique such as erosion and dilation used. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries.

The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring elements used to process the image. Erosion is the processes of removing the noise in the input binary frame. Dilation is the process of reconstructing the interesting region that can be eliminated during the time of noise removal. So after this process we got an image having only required part of the vehicle i.e. we only got the image of the tail light.

3.5 TAIL LIGHT EDGE DETECTION

The noise free input frame are subjected into the edge detection .The Edge Detection block finds the edges in an input image by approximating the gradient magnitude of the image. For edge detection, we use the canny edge detector. The canny Edge Detection block finds edges by looking for the local maxima of the gradient of the input image.

It calculates the gradient using the derivative of the Gaussian filter. The Canny method uses two thresholds to detect strong and weak edges. It includes the weak edges in the output only ifthey are connected to strong edges. As a result, the method is more robust to noise, and more likely to detect true weak edges.

The Canny method applies two thresholds to gradients .A high threshold for low edge sensitivity and a low threshold for high edge sensitivity. Edge starts with the low sensitivity result and then grows it to include connected edge pixels from the high sensitivity results this helps fill in gaps in the detected edges. In this case,the contour functions determine the number contours to display based on the minimum and maximum data values.

3.6 TAIL LIGHT PAIRING

Pairing is done based on the size, and intensity of the light objects. In lamp pairing symmetry is check by the comparison of the aspect ratios of the light candidates. This is done to get objects of different shapes but similar size and position to be paired.Here similar lamp that is tail lights are to be paired and identified.

3.7 DISTANCE MEASURING

After pairing, try to find the centroid position of the two rear light .Then detect the x, y coordinate of the two centroid position .Using matlab code we locate the centroid position .

```
s = region props(image, 'centroid');
centroids= cat(1,s.Centroid);

hold on
plot(centroids(:,1), centroids(:,2), 'b*')
```

hold off
After this using distance formula we calculate the distance between these two points
Distance = $\sqrt{(x2-x1)^2+(y2-y1)^2}$

3.8 MAINTAIN DATABASE

Next we try to make a database by collecting the distances of taillights pairs of different vehicles. We basically try to find distances between taillights of car, bus, truck etc. We collect these distances and make a database. This database will help in future to recognize vehicles .We can compare target vehicle with this database and can say about the target vehicle whether it is bus, car, truck or other vehicle.

IV. CONCLUSION

In this paper we have tried to find a distance between symmetric tail lights of a vehicle. We have succeeded in finding the distances between the tail light of vehicles. We have used some mathematical formula to find the distances in matlab platform.

After finding distances of tail lights of all type of vehicles we will use these distances as a reference to compare vehicles. In future by this automatic vehicle recognition system we can check whether it is bus ,car or other vehicle and will be able to recognize the type of vehicle in front present at night time environment.

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