Traffic light detection system for an achromate

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Abstract—**A system that recognize traffic light and detect the illumination of signal may be able to contribute to develop ADAS(Advanced Driver Assistance System) for achromate by giving drivers information. In this paper, we propose a method of detection and recognition traffic light in real-time using by vision system. The proposed method is processed with 4 stage. Firstly, we converted RGB color space to HSV color space in ROI region. Secondly, we extracted a coordinate of traffic light as blobs in image by using adaptive thresholding. And then we classified candidate blob of traffic light by using their feature information based on support vector machine. Lastly, we decided a pattern of traffic light. These methods is implemented on the TK-1 board and not only determine whether traffic light or not but also distinguish between traffic signals**

Keywords-traffic light; svm; adaptive thresholding

I. INTRODUCTION

The achromates have a difficulty in detecting the traffic light. So, Road traffic Authority disqualify a people have not the sense of color from getting driver license as specified an eligibility rule of license examination. Therefore A proposed driver assistance system give them to the driving opportunity and the system can be contributed to autonomous vehicle system in the future to prevent traffic accident caused by a careless driver. A kind of driver assistance systems are warning system for the rear parking, lane departure detection system, car to car collision warning system and traffic sign detection system. In this paper, we introduce an algorithm about traffic light detection and distinction using by vision system [1]. Recently, A research related traffic light detection and recognition is both nationally and internationally in active. Chunhe Yu, Chuan Huang, Yao Lang proposed traffic detection algorithm in thresholding method using the pixel density [2]. but the algorithm has a several problem. Because the operation of the algorithm is in entire image, a processing speed of the algorithm is very low e and it is limited in environment. Ying jie, Chen Xiaomin and two teammates suggested the algorithm for traffic light detection by using the shape of traffic light [3]. But the method that used only shape information of them has difficulty in assorting them into traffic light. In this paper, we proposed detection algorithm that can be applied in different environments. Firstly, we configured the ROI (Region Of Interest) of Image with RGB color space. And we convert RGB space to HSV space by using information of pixels in ROI, then we selected to candidate of traffic light by an adaptive thresholding used H, S and V values. After then we made extracted candidate to the blob by labelling schema and classified traffic light among candidates by using their features. Finally, we determined sign of traffic light based on extracted blob and we display in monitor and inform driver to sound an alarm.

II. PROPOSED METHOD

The proposal system for traffic light detection is briefly shown in Fig. 1. It consists of adaptive thresholding with geometrical method, two path scanning with Linked list and classification by using features. The main point of this research is to improve the performance of detection system by adaptive thresholding. Firstly, thresholding image of the input in RGB color space is converted to HSV space. Because traffic light has the most brightness value than other objects. It is a distinct characteristic of traffic light

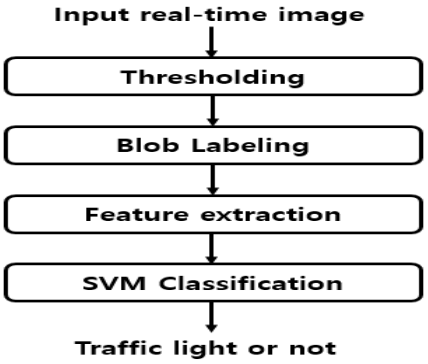

Figure 1. Main flow chart of system

We used combination of saturation and value in HSV color space. The result of combination has always value of above 150 in Fig 2. Also, traffic light has certain color compared to other objects; red, yellow, green and therefore we fixed thresholding with constant value roughly configured.

In Blob Labeling stage, we used binarization method in image with combination of saturation and value to extract

candidate of traffic light. Because traffic light has relatively high brightness value, we selected variable thresholding value obtained by geometric analysis according to surrounding environment. We stored brightness value in ROI image in histogram and we decided thresholding value by using mean and standard deviation of the distribution. Fig 2 is shown the value of traffic light according to brightness distribution of surrounding environment [4].

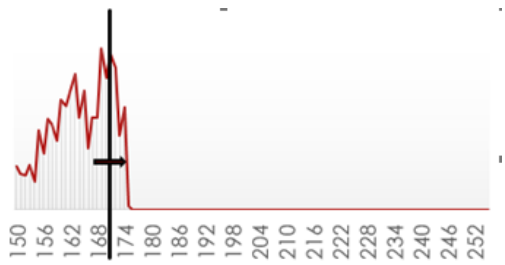

Figure 2. The location of traffic light in brightness distribution.

The thresholding value is calculated by

$$Threshold\ value = \mu + (\alpha \times \sigma) \quad (1)$$

We configured condition to obtain alpha value according environment in fig 3.

Case 1) whether is comparatively not good.
If (E(I) <= 155)
{ if ($\sigma_I \geq 10$) return (E(I) + 0.5 x σ_I);
else if ($\sigma_I \geq 7$ and $\sigma_I < 10$) return (E(I) + 0.3 x σ_I);
else if ($\sigma_I \geq 5$ and $\sigma_I < 7$) return (E(I) + 0.15 x σ_I);
else return E(I) ; }
Case 2) whether is comparatively good.
If (E(I) > 155),
{ if ($\sigma_I \geq 10$ and $\sigma_I \leq 18$) return (E(I) + 2 x σ_I);
else if ($\sigma_I \geq 18$) return (E(I) + 3 x σ_I);
else return (E(I) + 0.5 x σ_I); }

Figure 3. The condition of alpha value.

The extracted candidates are managed by labelling based on two path scanning algorithm and we implemented as linked list to efficiently manage the blobs.

In feature extraction, we used several features to classify whether traffic light or not.

1) Number of the pixel in blob
2) Blob_height / Blob_width
3) *Pixel Density in blob*
4) *Hue value*
5) *Coordinate x and y of centroid point*

The calculated features is learned to extract SVM (Support vector machine) weight parameters.

Finally, a candidate classified as traffic light is decided whether some kind of signal by using left and right side feature of blob. If classified blob has red component, then we used right side features to determine a right turn signal. On the other hand it has green component, then we used left side feature. The feature is mean of color in each side area.

III. EXPERIMENTAL RESULT

We are carried out a way that controls the vehicle simulations after image processing in TK-1 board while filming with video playback. Vehicle is appeared to fig 4 and we designed by using Arduino RC car acrylic frame.

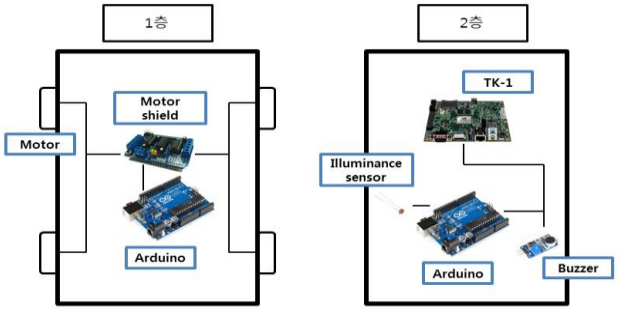

Figure 4. Vehicle for simulations.

The Arduino combined with motor shield control the four motor in the first floor. In the second floor, Arduino control the illumination sensor and buzzer. Also it process the image passed from cam. Our simulation is a little problem because it is progressed by the way to a retake with video playback. The biggest reason about underperforming is affected by the surrounding environment (fluorescent lights, the light of the monitor itself). It leads to occur the noise with wave pattern. As a result, we get the performance of our algorithm in fig 5.

content	Traffic light detection rate		Embedded system	FPS		
result	Daytime	93.83%	95%	GPU	Tk-1	42fps
					cam	31fps
	Cloudy	91.32%		CPU	Tk-1	62fps
	Night time	85.82%			cam	45fps

Figure 5. Result in our algorithms.

In day time we get the 93.83% and 85.82% detection rate in nighttime. Also an operating accuracy of sensor and motor is measured in 95%. The image processing speed in algorithms measured the 62fps in TK-1 board and get the 42fps in case of GPU processing. The lower part fig 6 is implemented our final result [5].

Figure 6. Implementation Results

IV. CONCLUSION

In this paper, we propose a traffic light detection system in various environment on four step and SVM classification. We used illumination sensor to discriminate the day-time, night-time, and cloudy. We make the alarm system to inform the red signal to drivers by using buzzer. When system detected the red signal, it sounds warning in 3-stages. Also Arduino is controlled in 3 stage. In red signal it will be stopped. In other two cases, it has two speeds. The experimental results show that the system can be assisted to the ADAS in the future.

Acknowledgment

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