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Automatic Tracking of Traffic Signs Based on HSV

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Abstract: Traffic sign detection and recognition is an important part of driver assistance system, which is used to regulate the traffic signs, warns a driver to prohibit certain action. Real time detection and recognition can support and disburden the driver and it will increase driver safety system. Color segmentation is done using HSV color space along with shape based filtering through the template matching of color detected candidate are used to detect sign from its background. Recognition of traffic signs pattern is done using neural network.

Keywords: YC_bC_r, HIS, HSV, LCH Color space

I. INTRODUCTION

Intelligent Transport system (ITS) is very essential in our day to day life. Large number of accidents occurs due to the violation of traffic rules, and hence Intelligent Transport System is very helpful in prevention of road accidents. Fig 1 shows automated intelligent vehicle using neural network

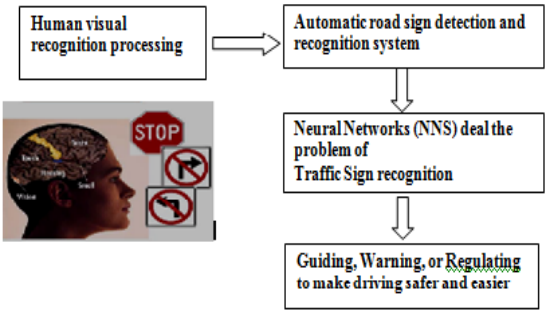

Fig 1: Automated intelligent driving vehicle

Real implantation of traffic sign recognition using intelligent vehicle is proposed in this research paper. In the detection phase, the acquired image is pre-processed, enhanced, and segmented according to the sign properties of color and shape. The classification module determines the type of traffic sign.

II. LITERATURE SURVEY

Detection of traffic signs based on colors is obvious. By using the thresholding techniques we can find the area of traffic sign image which is of color of interest. Depending on environment condition color tends to be unreliable because RGB Color space is sensitive to illumination variation. To overcome this problem color based segmentation is done in other spaces HSV, L*a*b,HSI,YC_bC_r CMYK,CIECA97 are the most popular color space in RGB. In the middle of 1970's HSV color model was developed which rearrange the RGB color model in cylindrical co-ordinates which results in closer to visual perception. In the computer vision HSI model is used.HSI, HSV, HSL are different only in third component [2].Table 1 shows different value of thresholds for traffic signs color.

TABLE I**:** Value of HSV thresholds for the traffic sign color

Color	H	S	V
Red	H≥240 or H≤10	S≥40	V≥30
Yellow	18≤H≤ 45	S≥148	V≥66
Blue	120<H≤175	S≥127.5	V≥20

Different authors use different color space to identify traffic signs. YC_bC_r color space is also used for segmentation, because YC_bC_r colorspace is independent of variable illumination. For the segmentation of the images under varying conditions CIExyz color model along with LCH color space is used. Human perception is very closely related to HSV color space [1]. Captured RGB image is converted into YC_bC_r color difference signals where Y(intensity)=0.299R+0.587G+0.114R,Cb (color difference signals for blue 0.5B-0.169R-0.331G and Cr(color difference signals for red)0 0.5R-0.419G-0.08B.These signals were output to the detection block[3] .shape is one of the important characteristics of traffic signs. Circle rectangle triangle is the different shapes in traffic signs [2].To determine the shape of target area different range of elongation degree, Circular degree, rectangular degree is used. The data in table 2 can solve the problem effectively.

TABLE 2**:** Different shapes corresponding to value range of the shape attribute

Shape	Circular degree C	Rectangular degree R	Elongation degree E
Circle	C≥.75	R>.70	E>0.85
Triangle	0.35<C<0.70	0.4<R<0.75	E>0.80
Rectangle	0.60<C<0.70	R>0.80	E>0.30

When compared to all other color space HSV color space is widely used because it allows some variation in the lighting most notably in the intensity of light.

III. IMAGE PROCESSING STAGES

Video camera captures the images. In the extraction stage traffic signs will be extracted contained in each images, and generates small images called blobs. Each blob will be performed by a Form Recognition Stage to be valuable parameter input. Neural Networks in the Recognition Stage which is the final part, helps in recognition of exact type of traffic signs. Fig 2 shows the system configuration of image processing stages.

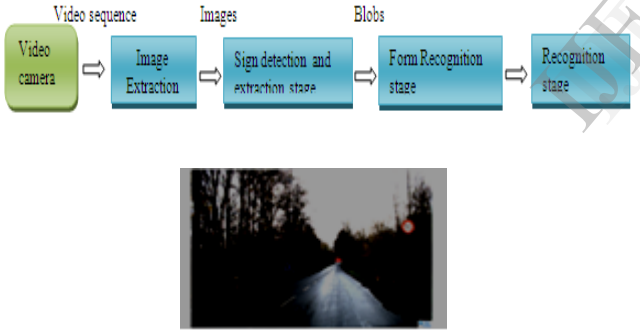

Fig 2: System configurations of image processing stages

IV. METHODOLOGY

In real time camera is mounted in front of the vehicle which will capture the images, these images are sampled according to the particular frame rate. Different filtering techniques were used to avoid the motion blur. HSV color based segmentation used to detect the traffic sign with in the image. The output of detection stage is input to the recognition stage. The main steps are as follows

1) Image extraction from video taken by vehicle Cameras.
2) Image enhancement
3) Color based segmentation
4) Shape based filtering
5) Recognition using neural network

4.1 Color based segmentation

Mainly there are two class of traffic signs i.e. red traffic sign [warning and compulsory] and blue traffic signs [regulatory and information signs]. Colors are the distinguishing feature of traffic signs hence color based segmentation is done. HSV color segmentation is performed due to human eye has different sensitivity to color and brightness; the illumination variation can be solved by HSV color space. In video streams, HSV color space is used. Red and blue colored objects are separated by thresholding techniques. Binary image is obtained as output. Region properties are used to obtain boundary box. Normally image segmentation algorithm based on HSV Color space because H and S component are not affected by the light intensity. This HSV is a non linear transform of RGB. The color conversion formula from RGB to HSV is as shown in the Fig 3 in which max=max(R,G,B), min=min(R,G,B).In HSV Color map, H stands for Hue color refers to color information. S stands for Saturation refers to dominance of hue in the color, I stands for Intensity, is the illumination factor separated from the intensity.

$$h=\begin{cases} 0^\circ & \text{if max=min} \\ 60^\circ * \frac{g-b}{max-min} + 0^\circ, & \text{if max=r and g}\geq\text{b} \\ 60^\circ * \frac{g-b}{max-min} + 360^\circ, & \text{if max=r and g<b} \\ 60^\circ * \frac{g-b}{max-min} + 120^\circ, & \text{if max=g} \\ 60^\circ * \frac{g-b}{max-min} + 240^\circ, & \text{if max=b} \end{cases}$$

$$S=\begin{cases} 0, & \text{if max=0} \\ \frac{max-min}{max} = 1-\frac{min}{max}, & \text{otherwise} \end{cases}$$

$$V = max$$

Fig 3: Conversion Formula for RGB to HSV

4.2 Shape based filtering

Mainly there are four shapes in traffic signs triangle, circle, rectangle octagon. shape based detection is used to filtering the candidates. By labeling the connected regions, all the pixels were grouped using 8 neighbors. Shape detection is mainly based on a similarity measure between the binary image of the color segmented road sign and the objects of the template database. Both sample and segmented image must have the same dimensions or else resized. First, the road sign is normalized to a size of 50 * 50 pixels by linear interpolation. Secondly, the normalized cross-correlation between the road sign and the templates of the database related to the proper shape is computed. A score list of the best N templates that fall within a fixed range of maximum value is considered. To increase the robustness against uncertainties due to deformation angle of rotation has been

carried out for each sample sign of segmented region, which is rotated from -15 to +15 degree. Cross correlation used for template matching is as shown in the Equation (1)

$$d^2_{f,t} = \sum (f(x,y) - t(x-u, y-v))^2 \text{.....(1)}$$

The term $\sum (f(x,y)^2$ Is considered as constant, then the remaining cross correlation is used for template matching is as shown in the Equation(2)

$$C(u,v) = \sum (f(x,y) - t(x-u, y-v)) \text{.....(2)}$$

When the color segmented image is matched with different templates of data base, if the similarity factor is greater than the threshold value then it is detected as traffic sign.

4.3 Recognition Stage

To confirm the exact traffic sign recognition module is used, multilayered neural networks are mostly widely used in the recognition of traffic signs. From the recognition stage 63 essential training data parameters were extracted and these 63 input layered weights are altered and these parameters are passed hidden layer respectively .When performing the network, the network will identify the input patterns and attempts to produce the associated output patterns. For the corresponding training input patterns output will delivered after the validation. Fig 4 shows MLP structure with 63 input nodes.

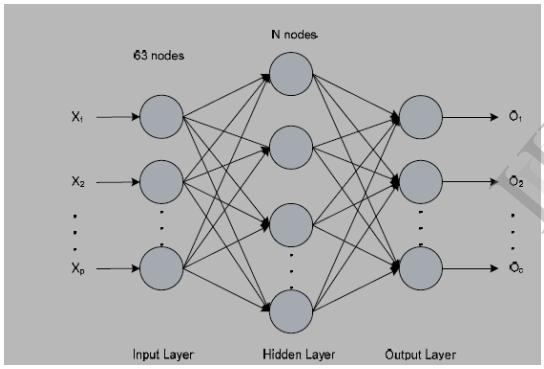

Fig 4: multilayered neural perceptions with 63 input nodes

V. EXPERIMENTAL RESULTS

For the detection of traffic sign mat lab tool is used. Color segmentation on HSV plane is used.

Figure 5 shows test image, figure 6 shows RGB to HSV color segmented image, Figure 7 shows cleaned image, when the color segmented image is matched with different templates of database then it is identified as traffic sign.

Fig 5: Test image

Fig 6: image on HSV Plane

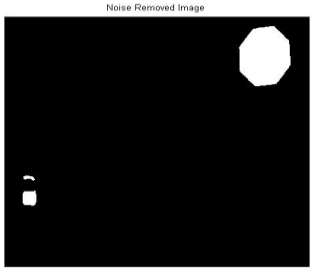

Fig 7: Cleaned image

Fig 8: Detected traffic sign

VI. CONCLUSION AND FUTURE WORK

In this paper HSV color space is used to overcome the illumination variation. Correlation technique is used in template matching which is quite appropriate one. Using the neural network recognition of traffic signs can be done. The first step is to reduce the no of MLP input by pre-processing the traffic sign image. The second step is to search for the best network architecture. When it is implemented in real time the vehicle should move according to the traffic sign. In further recognition can also be done using the techniques PCA,SVM.

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