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A SURF Based Approach for an Intelligent Vehicle/Driver Assistant System

Karthiga P.L.*, S.Md. Mansoor Roomi and Mareeswari M.*****

ABSTRACT

Intelligent transport system (ITS) must be able to analyze and retort to unexpected road conditions such as imminent road works and highway work zone automatically. Recognition of traffic sign is playing a vital role in intelligent transport system, it promises traffic safety by providing the traffic drivers with safety and precaution information about road hazards. A system has been proposed with the threefollowing phases: (i)Traffic board detection, (ii) shape feature extraction and (iii) Classification. The first phase consists of color normalization, color space conversion and shape analysis which is used in various lighting situations to segment a traffic board. A Speeded Up Robust Features (SURF) technique is adopted to extract the features from the segmented output. Finally,the traffic signs are detected by using k-NN classifier. It achieves classification accuracy up to73%.

Index Terms: Intelligent transport system, Road sign detection, YCbCr color space, SURF, k-NN classifier.

1. INTRODUCTION

In driver assistance system (DAS) the most important component is Traffic Sign Recognition (TSR) [6].Robust method for detecting and classifying traffic signs using speed limit and warning information, the TSR guides the driver in safe conditions. Fig 1 shows the difficulties of detecting traffic signs.

Ghica et al. [5] used thresholding based segmentation to detect traffic signs. Yabuki et al. [7] suggested a method to detect the road sign by using the colour distribution of the sign in XYZ colour space. Priese et al. [2] there are modules for the location and path of arrows, a module for the numerals, and another for prohibition signs, speed bounds, and arrows on compulsory signs.

The main objective of the works to provide a better and effective algorithm for identifying the red rimmed circular prohibition and triangular warning signs that could be used for intelligent vehicles. The system has three major steps: Traffic board detection, shape feature extraction, and sign classification.

(a1) (b1) (c1) (d1)

Figure 1: Examples for difûculties facing these task: (a1)Faded traffic signs, (b1) similar background color, (c1)The presence of obstacles in the scene,(d1)Damaged signs.

* P.G. scholar, *Email: plkarthiga@gmail.com*

** Assistant Professor, *Email: smmroomi@tce.edu*

*** Project Associate, Thiagarajar College of Engineering, Madurai, *Email: mareesreema@gmail.com*

2. PROPOSED APPROACH

The proposed method uses the SURF feature and k-NN classifier to efficiently classify 20 different types of trafûc-sign images. It improves the performance under various illumination conditions like over or under illumination. Fig. 2 shows the proposed approach,

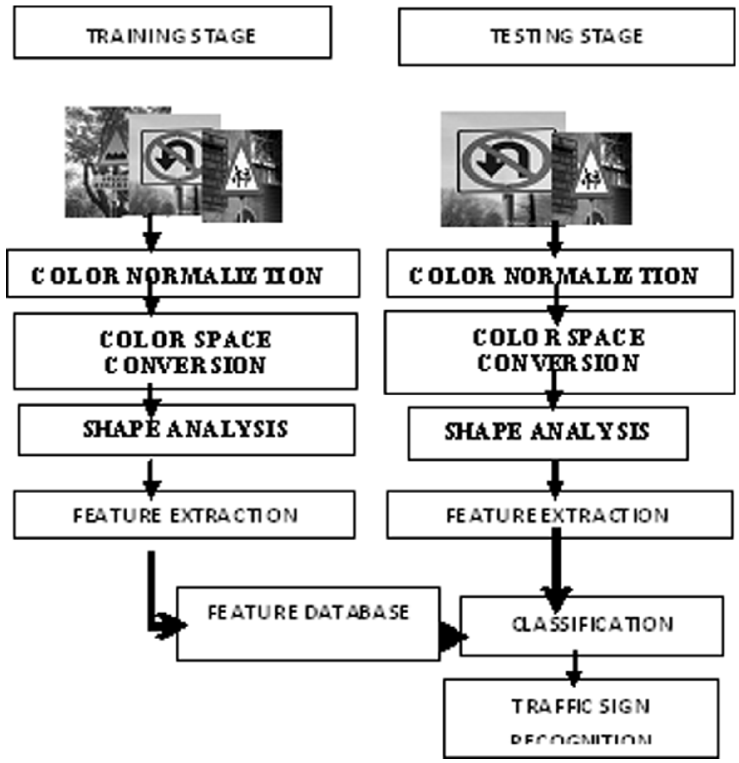

Figure 2:Proposed approach

2.1. Color Normalization

Color image mainly based on the color properties of the captured object. Colors are not a stable features to segment a object, however stability is necessary since professed colors are illuminant independent and do associate with object identity. Previously the colors in images can be matched, they must first be preprocessed to remove the effect of various lighting condition. In color normalization, thevalue of each color band like Red, Green and Bule might be divided by a local RGB average value.

$$\frac{r1}{(r1+b1+g1)},\frac{b1}{(r1+b1+g1)},\frac{g1}{(r1+b1+g1)} \tag{1}$$

2.2. Color Space Conversion

To remove all background objects and unimportant information in the image by using color space conversion.The algorithm that has been used for image segmentation. A color space conversion algorithm should be strong enough to work in variety of environmental conditions and be able to generate binary images even when traffic sign colors are attenuated [3][10].

2.2.1. YCbCr color model

YCbCr color model is the basic color model to represent luminance and chrominance of the traffic sign image. The scaling used to change YUV such that Cb is U, but multiplying B’ with a coefficient of 0.5. InYCbCr color model, Cr and Cb are shifted the values are between 0 and 1. The equation becomes:

$$\begin{aligned} Cblue &= ((B1' - Y1')/1.772) + 0.5 \\ Cred &= ((R1' - Y1')/1.402) + 0.5 \end{aligned} \tag{2}$$

In this module to transform RGB to YCbCr comparing all these channels Cr value have high details, hence the threshold is set using Cr and traffic board is detected.

Figure 3: steps for detecting traffic board in an image

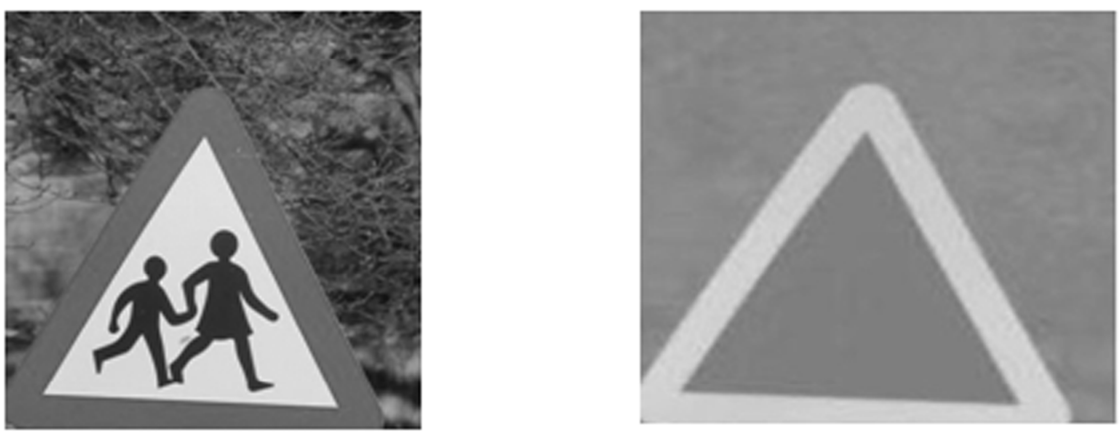

Figure 4: (a) input image and its (b) Cr component of YCbCr color space conversion.

(a1) **(a2)**

(b1) **(b2)**

Figure 5: (a1)original image (a2)Detected Traffic Sign Board image (b1) original image (b2)Detected Traffic Sign Board image

2.3. Shape Analysis

The main task of this module isapplying connected components labeling algorithm to cleaning the binary image from noise and Small objects from an input image and identifying the traffic sign. This module recognized road traffic sign does not varyunder various conditions like scaling, rotation and translation. This means that the significant sign has a fixed size and it is located in a standard position.

(a1) **(a2)** **(b1)** **(b2)**

Figure 6: (a1)original image (a2) Results of shape analysis (b1) original image (b2) Results of shape analysis

2.4. SURF feature extraction.

Compared to other descriptors the SURF provides good feature extraction. Fig.,7 shows the Block diagram of SURF feature extraction,

In SURF descriptor Hessian value is calculated by using these formula,

$$\det(\text{HESSIAN}_{approx}) = D1_{XX}D1yy - (wD1_{xy})^2 \tag{3}$$

where D1xx, D1yy, D1xy is a Gaussian derivative box filter approximation in x direction, y direction and xy direction.

$$\beta = \left|Dyy(9)/Dxy(9)\right|F\left|Lxy(1.2)/Lyy(1.2)\right|F = 0.912\ldots \tag{4}$$

where $|x1|_F$ is the Frobenius norm. β is dependent on the scale size,it turns out that in practice β can approximated using a static constant of 0.9.

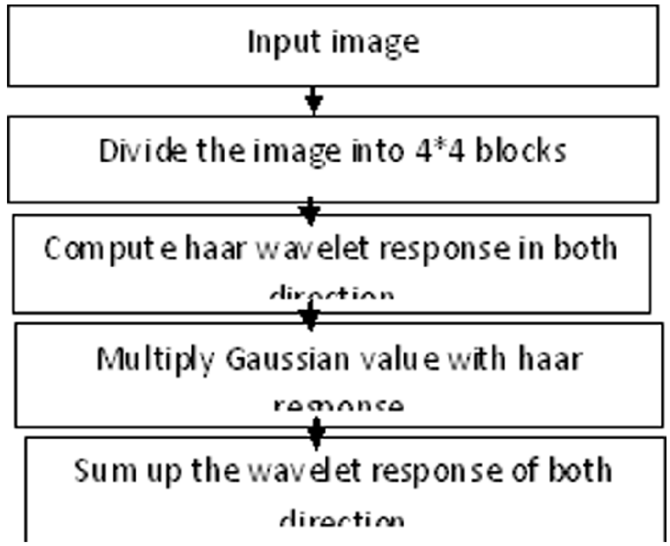

Figure7: Block diagram of SURF feature extraction

(a) (b) (a1) (b1)

Figure 8: (a1) Original image(a2)SURF feature extracted image
(b1)Original image(b2)SURF feature extracted image

2.5. k-Nearest Neighbor Classifier

The *k*-NN is a simplest algorithm among all machine learning algorithms. The main principle in k-Nearest Neighbor approach is toclassify the new sample into a particular class v depending upon the k samples in

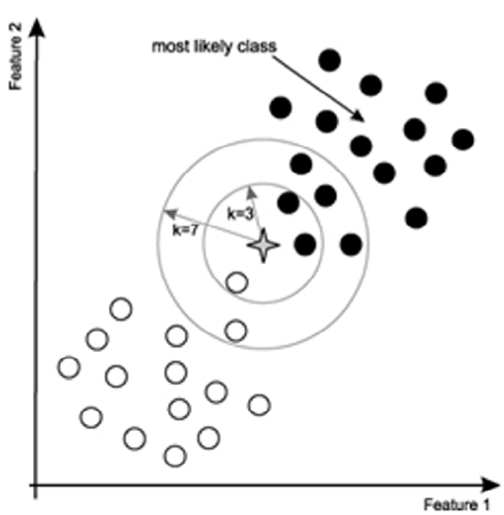

Figure 9:

the training set where variable x is analogous to u and to use these k samples .If f is a smooth function, a suitablesuggestion is to look for samples in training data that are near it (in terms of the self-determining variables) and then to compute v from the values of y for these samples.

The Euclidean distance between the points x and u is

$$d(x,u) = \sqrt{\sum_{i=1}^{n} (xi - yi)^2} \tag{5}$$

In the proposed approach traffic signs must be classified by using k-NN classifier. In this approach, k = 18 different classes like(school zone,oneway,,speed breaker etc..,).

3. EXPERIMENTAL RESULTS

In this section, experimentation of the proposed methodology has been presented. From the experimental analysis it is observed that the projected method works better results for traffic sign recognition. The proposed methodology is done for 18 different classes like(pedestrian, crossing,speed breaker, school zone etc..,). It recognize what type of traffic sign present in the given image and it also provide better ROI segmentation using YCbCr color space conversion.Traffic sign feature extraction is done by using SURF and finally classified by using k-NN classifier.Graphical User Interface (GUI) results as shown in Figures.

Figure 10: Results of 50 km speed limit sign image

Figure 11: Results of school zone image

Figure 12: Results of left trun prohibited image

Figure 13: Results of speed breaker image

CONCLUSION

This method provides better and effective algorithm for detect traffic signs and provides better results in various condition such as low resolution, high resolution, shadow image and bad weather condition. The proposed scheme comprises three major parts. In first phase the YCbCr conversion is used to detect and segment the traffic board from traffic scene image. Then SURF is used for featureextraction. Finallythe feature vector of road signs are classified by using k-NN classifier. It provides better algorithm for scale, rotation and illumination invariant condition.

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