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SURVEY-AN EXPLORATION OF VARIOUS TECHNIQUES FOR SIGN DETECTION IN TRAFFIC PANELS

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ABSTRACT

In Visual Object Detection, traffic sign detection and recognisation is a recurring application domain. The automatic visual recognition and classification of the information contained in the panel could be very useful to assist the driver. Traffic panels instructs the driver assistance on routes by means of iconic symbols and text strings. Based on the color and shape features, the traffic sign is detected and recognized. The various techniques have been used to extract the color and shape features of the traffic sign. This paper provides a survey of the traffic sign detection and recognition, to detail the system for driver assistance to ensure safe journey. A brief review of recent advancement techniques used by researchers has been provided for the detection and the recognisation stages.

Keywords: traffic panel, driver assistance, detection, recognisation.

1. INTRODUCTION

In Visual Object detection, the traffic panel is recurring application to detect and recognize iconic symbol and text strings contained in road panels [1]. Considering the safety and comfort of a driver, the advanced driver systems have included in the traffic sign recognisation [2] [3].There are different types of traffic signs as Information signs, Warning signs, Mandatory signs and prohibited signs are used and these signs helps driver to achieve efficient navigation and safe driving.

The periodical checking of traffic sign state by manually is a tedious task and its prone to human error. To ensure a road safety, computer vision technique is carried out frequently. The road sign can be categorized to three properties by color (blue, red, green and brown), shape (circular, square, triangular and octagonal) and the inner part of the sign [4], which plays a major role in the detection stage in traffic sign detection and recognisation.

In computer visions there still remains a challenging task even for the best computer vision algorithm to identify the traffic signs because of picking up the color, shape and text recognisation. The major problem are changing lighting conditions in outdoor environments, the obstructions of objects between the cameras and the traffic panels [5], partially damaged traffic signs, long exposure of sunlights lead to faded color. The speed and efficiency of the detection and recognisation of the traffic sign plays the important role in the system. The various advanced techniques in detection and recognisation has been developed by researchers and shown the promising results by considering the above mentioned major problems. A brief view of the each recent technique in each stage is discussed.

The paper is organized as follows: section II given an overview of the system, section III discusses Detection stage used to extract the traffic sign based on the shape and color features, section IV discusses the recognisaton stage to classify the traffic sign and the section V concludes the paper.

2. SYSTEM OVERVIEW

The high speed camera shoots the image and it takes to Detection stage [6] and it is normally based on color or shape segmentation algorithms.

The color segmentation is usually a binary mask to separate the interested target objects from the background. The region of interest is determined by the connected components [7].

The shape features are extracted in the binary image to detect the sign by verifying the hypothesis of the sign. The recognisation stage determines the type of traffic sign in the panel and it is addressed by a classification technique or by machine learning techniques.

The Figure-1 shows the different techniques used by different researchers for different stages in Traffic sign detection and recognisation.

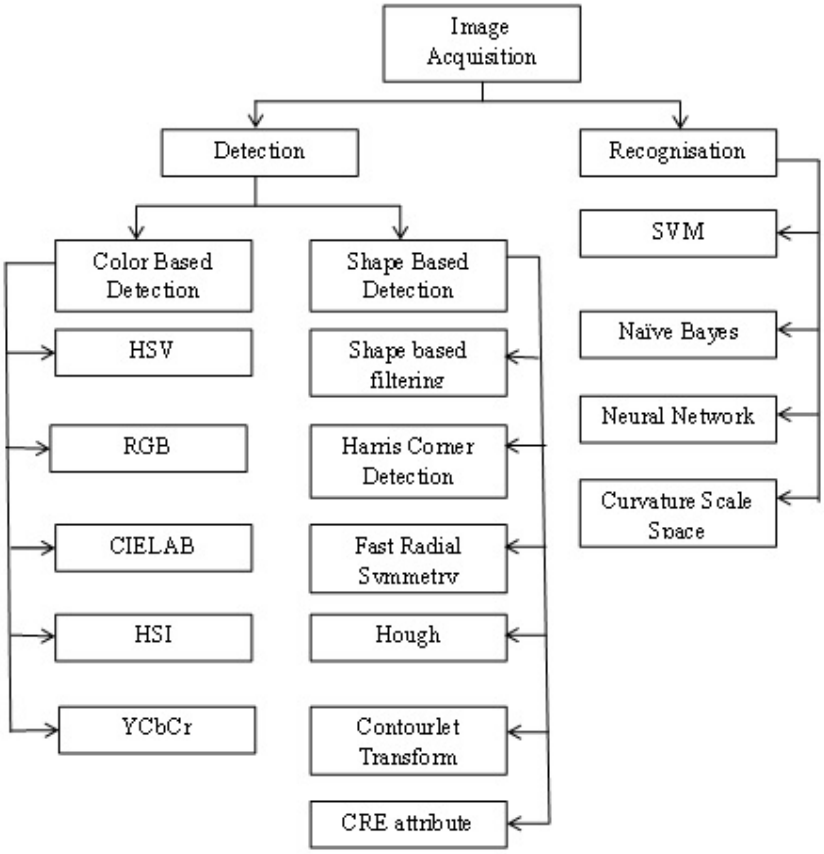

Figure-1. System with different technique for each stage.

3. DETECTION

The sign is detected traditionally by two main approaches exist namely, color based methods and shape based methods. The combination of two methods is also effective in the detection stage

A. Color based detection

Color based segmentation techniques used to get a binary image to extract the traffic sign based on the shape and color features. The candidate objects are selected by thresholding to create a binary image. To locate the candidate objects, different color spaces are used and the most common color space are RGB, YCbCr, HSV, HIS, and CIELAB.

The RGB color space is very fragile regard to influence of lighting variation, so it is further converted to other color spaces [4]. But the RGB color space is used by [8] and [9], and they used adaptive threshold to overcome the combat stabilities due to RGB.

CIELAB color space is based on human color perception and it is device Independent model and the thresholding value can be computed easily. The three binary images is obtained by using the CIELAB color space and these image is send to the morphological opening operation process which is transform of erosion and dilation [2]. The redundant noise is removed and the target objects are enlarged. To find the contours of object an algorithm is employed and the continuous area of the object is represented by each contour. The candidate object is find and the classification process is eliminated.

The color definition of the road signs may affect due to environment changes. The largely invariant nature of HSV even in the illumination changes and it is based on the human color perception, so the RGB is converted into HSV color space [4], [10], [11], [12]. HSV has enhancement ability, specifically in the outdoor environments [4]. Taking the histograms of H, S and V components, red, green and blue color values are determined. To improve the segmentation consistency median filtering and thinning are utilized.

YCbCr color space to solve the illumination variation influence in the RGB color space [13]. The pixel color value is determined by the Cb and Cr planes. To get the binary image, the red and blue color objects are separated using the thresholding techniques. The boundary box properties are obtained by the region properties to determine the region of interest of the candidate objects.

In HSI color space, the hue and saturation components encode the color information and a global threshold is used to select the candidate objects [14]. The noise is eliminated in the binary image by using the median filter. The connected component algorithm is applied to form the region of interest and the boundary box is derived for each region of interest using eight neighbour connectivity.

The comparison of different segmentation techniques based on chromatic and achromatic nature of color space and the best method for normalization is also showed with respect to the illumination and the quality is maintained by the LUT [15] and it stated that there is still need for improvement in achromatic colors to achieve level of performance.

The various phenomena in the environment such as whether condition, distance from the target may have influence in the color segmentation. The colorless approach is followed by some authors [16],[17].

B. Shape based detection

The shape based detection is widely used after the color based segmentation to detect the traffic signs using the shape to eliminate the background outliers with similar color. The shapes have different attributes such as elongovation, rectangularity, circulatory, and distance from centroid ton edge [6]. CRE attribute to determine the shape, the attribute value range of elongation, circular and rectangle degree and they further calculate the number of vertex based on the shape to correct the region.

The contourlet transform technique is used [4] to extract the shape features and it is a successful approach for compression and enhancement of image and the contour edges of the target image is extracted by the shape features. Hough transform technique is common approach in computer vision which is used to find the arbitrary shapes in an image [12], [14],[18], [19] [20].

Hough transform extract the shape on the selected color range using HSV [12]. Hough transform is divided into hough circle transform and hough line transform. The hough circle transform is used detect all the circles by appling it on the edge map and the hough line transform`to obtain all the lines in the image. After the lines found the polygon detection algorithm is used to detect the triangle and square shapes, where the angles close to 90 degree is square and 60 degree is triangle. The affine transform and perspective are applied for normalization on the extracted potential traffic sign. The regular polygon detector used to detect the rectangular signs.

Shape based filtering is used for shape detection on the binary image by the similarity measure [13]. The road sign is normalized by linear interpolation. The proper shape is computed by the normalized cross relation between the objects of the template database and the road sign and for the best N templates, a score list constructed. Angle of rotation is performed for each sample sign and the greatest similarity factor for the angle value is found by similarity coefficient. The cross correlation of template matching is computed by the squared Euclidean distance. The similarity between the template feature and the image is found by the following equation

$$C(u, v) = \Sigma f(x, y)\, t(x-u, y-v) \quad (1)$$

The shape is detected if the similarity measure for the match is higher than the threshold value.

Harris corner detection algorithm finds the triangular and square shapes and the shapes fast radial symmetry transform (FRST) identify the circular shapes [21].RSD, STVUE and BCT is compared to verify the extracted red rim and they shows that RSD is detection rate is 93% which is the best speed compared to the other two [22].

4. RECOGNISATION

The recognisation stage determines the type of sign in the detected image. SVM used often for solving the binary classification problems and the regression is also applied by it [23],[24],[25]. Hog descriptors represents the the regions of interest for the better classification and are fed into the Support Vector Machines (SVMs)in order to be recognized [14] [26]. The optimal hyperplane is computed by SVM to separate the data. S. Lafuente-Arroyo, et, al., used support vector machine to analyse the image and decides after checking if there is a keep-clear sign in it. The Geographical Information System (GIS) database includes the keep –clear sign and the management module compare the data in GIS with the council database to reposition or repair the sign.

The shift descriptor is used to recognise the symbol, numbers and single characters [5] and the HMM is used to find the whole word. The different elements in the panel is separated by vertical edges and horizontal edges of the image and it leads to extract the foreground objects correctly. The same authors [27] used blue and white color masks for the segmentation and to detect a traffic panel BOVW approach is applied on each frame. The comparison of different descriptor is shown and the three descriptor namely SIFT, Hue Histogram and TCH achieve better panel detection for different panels. The SVM and Naive Bayes are compared to choose for the better classification and the Naive Bayes computation time is less than SVM. The system choose the TCH for recognise the symbol and the Naive Bayes for classification.

Curvature Scale Space (CSS) analyses the closed contours shape inflection points and describes the object shape [28]. The comparison made between the database and the pictogram inside of each signs. The recognisation rate of CSS is showed as 80.1 % .

Neural Network does not transform the image into another representation and the classification depends on the correlation between the network (assumed to be chosen from the beginning) and the neural weights [12] [29]. The computation time for the template matching is avoided. The two hidden layer and 25 input feature of each image are used for the classification, which is in the four feed forward back propogation neural network [13]. The log sigmoid activation function is used in the hidden layer

and the competitive layer is the output layer, where the traffic sign to be identified.

5. CONCLUSIONS

Traffic sign detection and recognisation becomes most significant for Driver Assistance system to ensure a safe journey. The changing lighting conditions in outdoor environments made difficult in the detection phase to identify the signal. This review paper discusses the various techniques used recently for the detection and recognisation of signs contained in the traffic panel. However, there exists some potential drawbacks which can be resolved by constructing more effective techniques.

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