DETECTION, CLASSIFICATION AND RECOGNITION OF ROAD TRAFFIC SIGNS USING COLOR AND SHAPE FEATURES

Gauri A. Tagunde
Student, ME (Information Technology),
Sinhgad College of Engineering, Pune, India
C.O.Banchhor, Nilesh J. Uke
Assistant Professor (Information Technology), Sinhgad College of Engineering, Pune, India

Abstract

This paper discusses the proposed system for detection of road traffic signs from images or real time video, Classification and Recognition. Road traffic signs are detected by analyzing color information, mainly red and blue, contained on the images or video. Following are main modules of a system: Module 1: Pre-Processing, Module 2: RGB to HSV conversion, Module 3: Detection, Module 4: Template Matching. Finally the proposed system produces the detection of traffic sign with its corresponding classification as Danger, Mandatory or Informatory signs, and recognizes that particular sign.

Keywords: Traffic sign detection, Color image analysis, Shape analysis, Feature extraction.

I. Introduction

To provide safe and harmonious flow of traffic, specific rules are provided by every government. Some of these rules are displayed to the driver by means of traffic signs which needs to be interpreted while driving. Road traffic signs reduce the frequency and severity of certain types of crashes, especially right-angle collisions. They are coordinated to provide for continuous movement of traffic at a definite speed along a given route under favorable conditions. The system recognizes the traffic signs by analyzing images / videos taken from camera installed on the car. If an image contains a sign then system gives output as respected sign to the driver.

II. MOTIVATION

The automatic traffic sign recognition system would help reducing the number of traffic accidents & it is essential for any autonomous vehicle project. Traffic signs were designed to contrast easily with the background, so they can be detected by the drivers. Most of the signs have blue or red tint with highly saturated properties & also reflective attributes, since they must be detected in varied weather conditions.

III. LITERATURE SURVEY

Many algorithms and methodologies have been proposed for road traffic sign detection. Tam T. Le has proposes the Support Vector Machine method to retrieve candidate region of traffic sign in real-time video processing in which it utilizes a block of pixels as an input vector [1]. Another method has also been proposed by Hassan Shojania based on thresholding, convolution masks and geometric constraint method but in this they didn't implemented the pictographic recognition stage[2]. Auranuch Lorsakul proposes the system with Neural Network technique with canny edge detection method, in this test sign images including distortion images are provided into the program in order to identify the network generalization. Because the algorithm attempts to detect the circle or ellipse in the test images, this requires more processing time in the much complex background images that have high numbers of the potential area candidates.[3]

IV. EXISTING SYSTEM

The systems can take advantage of GPS (Global Positioning System). It could be always flawless if an updated traffic sign location database would be available. But few cars have GPS installed and traffic sign localization databases are not available for download. Tam T. Le has proposes the Support vector machine method to retrieve candidate region of traffic sign in real-time video processing, which concerns blocks of pixels; therefore, the information of neighbor pixels can help to handle the diversification of both training and testing data. It means that SVMs can return a recall rate better than that of single-pixel-based algorithms. In this approach, instead of deciding whether a pixel has an interested color or not, it chooses blocks of interested color through the results of SVMs. Using feature extraction of a pixel block will help to reduce complexity of the calculation in SVMs because the dimensions of the input vectors, support vectors, and the hyper-plane are only equal to two times of the number of pixels in each block [1].

V. PROPOSED SYSTEM

In this proposed system Detection of road traffic sign is done using color and shape features. It consists of 10 modules and each module play an important role to build complete system.

Following figure shows the modules of proposed system.

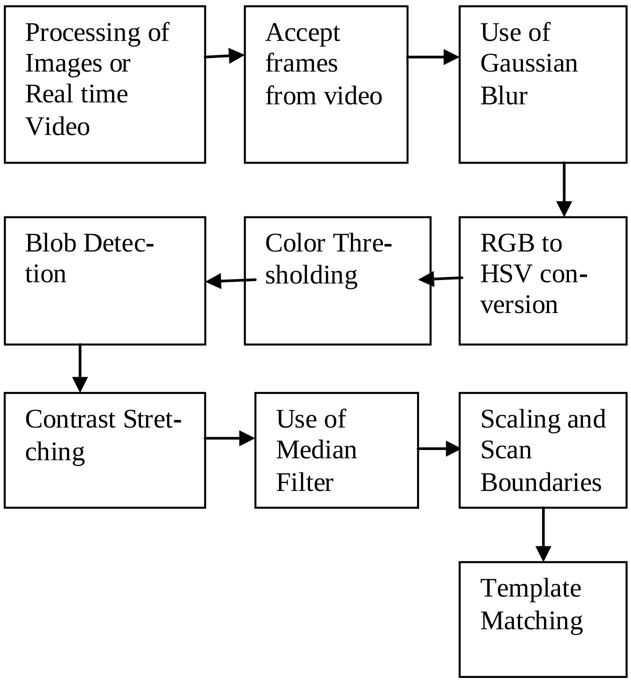


Fig.1. Framework of Proposed System

Module 1: Pre- Processing of an image or video

Following steps are used for pre-processing

1. **Processing of Images or Real time Video:**
   Proposed system is designed to detect the road traffic signs from an images or the real time video which is captured by Web camera.

2. **Accept frames from video:**
   In the case of detecting the road traffic signs from a real time video, it accepts the frames from the captured video after some time interval which is set as per the need.

3. **Use of Gaussian Blur**
   Gaussian blur is the result of blurring or smoothing an image by a Gaussian function, which is as below

$$\mathrm{f(x)} = ae - \frac{(x-b)2}{2c2}$$

For some real constants a, b, c > 0, and e ≈ 2.718281828

It is widely used effect in graphics software, to reduce image noise and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen. Gaussian smoothing is also used as a pre-processing stage in computer vision algorithms in order to enhance image structures at different scales. Applying a Gaussian blur has the effect of reducing the image's high-frequency components. The Gaussian blur is a type of image-blurring filter that uses a Gaussian function for calculating the transformation to apply to each pixel in the image. The equation of a Gaussian function in one dimension is

$$G(x) = \frac{1}{\sqrt{2}\pi\sigma 2} e - \frac{x2}{2\sigma 2}$$

in two dimensions, it is the product of two such Gaussians, one in each dimension:

$$G(x,y) = \frac{1}{2\pi\sigma 2} e - \frac{x2+y2}{2\sigma 2}$$

Where x is the distance from the origin in the horizontal axis, y is the distance from the origin in the vertical axis, and σ is the standard deviation of the Gaussian distribution. When applied in two dimensions, this formula produces a surface whose contours are concentric circles with a Gaussian distribution from the center point. Values from this distribution are used to build a convolution matrix which is applied to the original image. Each pixel's new value is set to a weighted average of that pixel's neighborhood. The original pixel's value receives the heaviest weight (having the highest Gaussian value) and neighboring pixels receive smaller weights as their distance to the original pixel increases. This results in a blur that preserves boundaries and edges better than other. The Discretisation is typically achieved by sampling the Gaussian filter kernel at discrete points, normally at positions corresponding to the midpoints of each pixel. When converting the Gaussian's continuous values into the discrete values needed for a kernel, the sum of the values will be different from 1. This will cause a darkening or brightening of the image. The values can be normalized by dividing each term in the kernel by the sum of all terms in the kernel.

Module 2: RGB to HSV conversion

RGB color space is the combination of 3 primary colors of light: Red, Green and Blue which is mostly used by most computer devises. Commonly used color space that corresponds more naturally to human perception is the HSV color space, whose three components are hue, saturation and value. The HSV color space allows decoupling the color, saturation and intensity information, which can be very useful to find sign colors for all the pixels where a (R, G, B) channel is maximum, the hue is determined by the difference of the other two channels, divided by the difference of the maximum and minimum value of the three channels. The result is a value between -1 and 1, which is shifted according to the (R, G, B) channel of the maximum. To avoid pixels where the color is not well defined is set to 0, all values where the difference between MAX and MIN is below a threshold value.

Module 3: Detection of traffic sign.

Following are the steps for detection.

1. **Color Thresholding**
   Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images. During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled "object" if its value is between two thresholds; and threshold outside, which is the opposite of threshold inside . Typically, an object pixel is given a value of “1” while a background pixel is given a value of “0.” Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's labels. Colour images can also be thresholded. One approach is to designate a separate threshold for each of the RGB components of the image and then combine them with an AND operation.

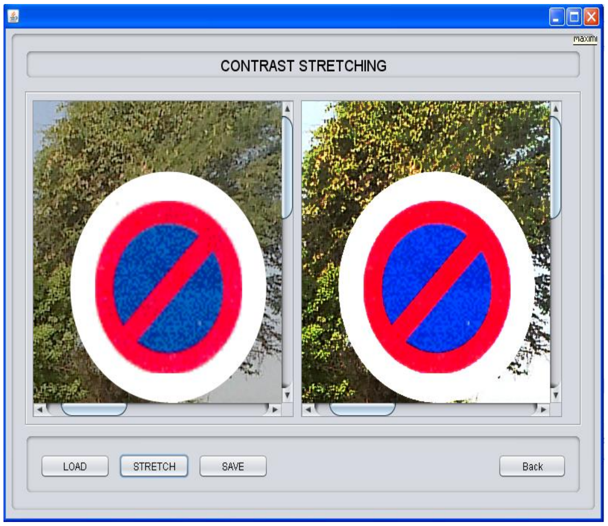
2. **Blob Detection**
   Blob detection refers to visual modules that used for detecting points and/or regions in the image that differ in properties like brightness or color compared to the surrounding. The blob analysis takes an image is represented as a matrix with a certain number of pixels on a certain number of lines. When the image is grayscale, every one of those pixels has a value which indicates the brightness of the image at that point. When this grayscale image is converted to a black and white image, where every pixel above a certain threshold is white and under that threshold is black, then generated a black and white image with the white area's being the blobs. Following sequence of actions are involved [14].
   A. Check the first line of the image and find groups of one or more white pixels. These are the blobs on a certain line, called line blobs. Number each of these groups.
   B. Repeat this sequence on the next line. While collecting the line blobs, check the line blobs on the line which are checked before this current line and see if these blobs overlap each other.
   C. If so merge these line blobs as one blob i.e. Give the current line blob the same number or id as the line blob(s) on the other line.
   D. Repeat this for every line and have a collection of blobs.

3. **Contrast Stretching**
   Contrast stretching (often called normalization) is a simple image enhancement technique that attempts to improve the contrast in an image by `stretching' the range of intensity values it contains to span a desired range of values. It can only apply a linear scaling function to the image pixel values. As a result the `enhancement' is less harsh. Before the stretching can be performed it is necessary to specify the upper and lower pixel value limits over which the image is to be normalized. Often these limits will just be the minimum and maximum pixel values that the image type concerned allows. For example for 8-bit gray level images the lower and upper limits might be 0 and 255. Call the lower and the upper limits a and b respectively.
   The simplest sort of normalization then scans the image to find the lowest and highest pixel values currently present in the image.

   Call these c and d. Then each pixel P is scaled using the following function:

   Values below 0 are set to 0 and values about 255 are set to 255.

$$Pout = (Pin - C)\left(\frac{b-a}{d-c}\right) + a$$



4. **Use of Median Filter**
   In signal processing it is necessary to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, used to remove noise. It is pre-processing step to improve the result of later processing eg: edge detection on an image. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the “window”, which slides, entry by entry, over the entire signal. For 1D signal, the most obvious window is just the first few preceding and following entries, whereas for 2D signals such as images, more complex window patterns are possible. If the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median.

5. **Scaling and Scan Boundaries**
   Image scaling is the process of resizing a digital image. Scaling is a non-trivial process that involves a trade-off between efficiency, smoothness and sharpness. As the size of an image is increased, so the pixels which comprise the image become increasingly visible, making the image appears "soft". Conversely, reducing an image will tend to enhance its smoothness and apparent sharpness. To locate the particular sign exactly, boundary scanning is done with the help of colors. This scan includes right to left, left to right, top to bottom, and bottom to top of an image.

Module 4: Template Matching

Finally In this module we are comparing resultant image with the image which is stored in database. After comparison if the match is found then corresponding Detected sign with its Classification and Recognition is displayed.

VI. Conclusion

This paper provides approach for detecting road traffic signs with quality output. Correct traffic sign detection is essential for accurate classification because if particular sign is not detected properly it cannot produce proper result. Still research is going on more results will be presented in the next paper.

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Biographies

1. GAURI A. TAGUNDE Completed her B.E. Degree in Computer Branch from Smt. Kashibai Navale College of Engineering , Vadgaon(Bk), Pune., India in 2008 and pursuing M.E in Information Technology Branch from Sinhgad College of Engineering ,Pune, India. Gauri A. Tagunde may be reached at gtagunde@gmail.com