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An Automatic Road Sign Recognizer for an Intelligent Transport System

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*Abstract**:*This paper presents a system for the implementation of “An Automatic Road Sign Recognizer for an Intelligent Transport System”. This system a list of road signs are resized, converted to binary image then line segmentation, single sign segmentation. Then height, 4-poin concavity measurement, centroid and distance of the centroid from the origin of the sign are used as features. A method for accurately locating road signs in real time from a stream of images taken by video camera mounted on an Intelligent Transport System. The process the video stream and extract road sign and the extracted features are used to train a Backpropagation NN.

Keywords:Intelligent Trasnport System (ITS), Region of Interest (ROI), Traffic Sign Recognition (TSR), Image Extract (IE).

I. INTRODUCTION

In traffic environments, Traffic Sign Recognition (TSR) is used to regulate traffic signs, warn the driver, and command or prohibit certain actions. A fast real-time and robust automatic traffic sign detection and recognition can support and disburden the driver, and thus, significantly increase driving safety and comfort. Generally, traffic signs provide the driver various information for safe and efficient navigation. Automatic recognition of traffic signs is, therefore, important for automated intelligent driving vehicle or driver assistance systems. However, identification of traffic signs with respect to various natural background viewing conditions still remains challenging tasks. There has been a surge in recent years of papers describing road sign detection methods. Many of them segment the signs using color and shape. For example, Piccioli et al. [1] use color and a priori information to limit the possible locations of signs in the image. In [2], a redness measure is used to locate stop, yield, and “do not enter” signs. This step is followed by edge detection and shape analysis to identify the sign. Escalera et al., [3], also start with color matching, which they follow with corner detection in which they look for corners in specific relationships that correspond to triangular, rectangular, or circular signs. In their approach to detecting stop signs, Yuille and his colleagues [4] correct for the color of the ambient illumination, locate the boundaries of the signs and map the sign into a frontoparallel position before reading the sign.

The Traffic Sign Recognition Systems usually have developed into two specific phases [5-7]. The first is normally related to the detection of traffic signs in a video sequence or image using image processing. The second one is related to recognition of these detected signs. The detection algorithms normally based on shape or color segmentation. The segmented potential regions are extracted to be input in recognition stage. The efficiency and speed of the detection play important role in the system. To recognize traffic signs, various methods for automatic traffic sign identification have been developed and shown promising results.

II. USED MATERIALS AND METHOD

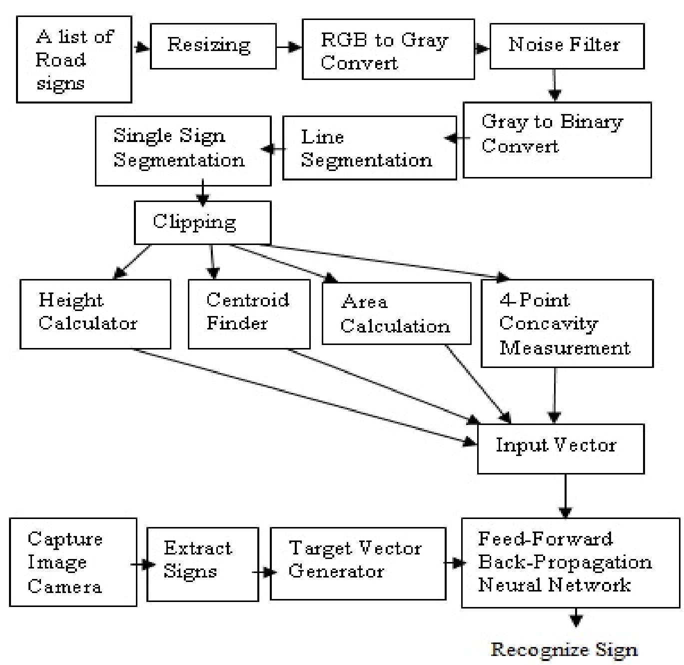

Figure 1. Block diagram of our developed system. Recognize Sign

We have used MATLAB tools to implement the algorithm because MATLAB is a high-performance language for education and research [8]. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation and it also has toolboxes for signal processing, neutral network, image processing, database programs … etc.
The block diagram of our recognition system is given in the following fig. 1

A. Line Segmentation:

In searching the beginning of a line, the system searches the occurrence of a 0 in the bitmap. If there is found one or more 0(s) in the row in consideration, then this row is accepted as the starting row of the line. The process is continued through the consecutive rows in this way until it was found that there is no 0s in a row and the immediate previous row of this row is considered as the ending row of the line. To search the starting column of the line, the system scans the binary file vertically beginning from the starting row and ending at the ending row of the line. In this case, the scanning starts from the starting column of the binary file and continue through the consecutive columns. If the system finds the occurrence of one or more 0's in a column, this column is considered as the starting column of the line.

B. Single sign Segmentation:

It is scanned vertically, column-by-column. If a column contains one or more 0's, the column is this column is considered as the starting column position of a sign. The process is continued through the consecutive columns in this way and the process is continued through the consecutive column in this way until it was found that there is no 0s in a column and the immediate previous column of this column is considered as the ending column of the each sign. Figure shows the starting column and ending column of each sign.

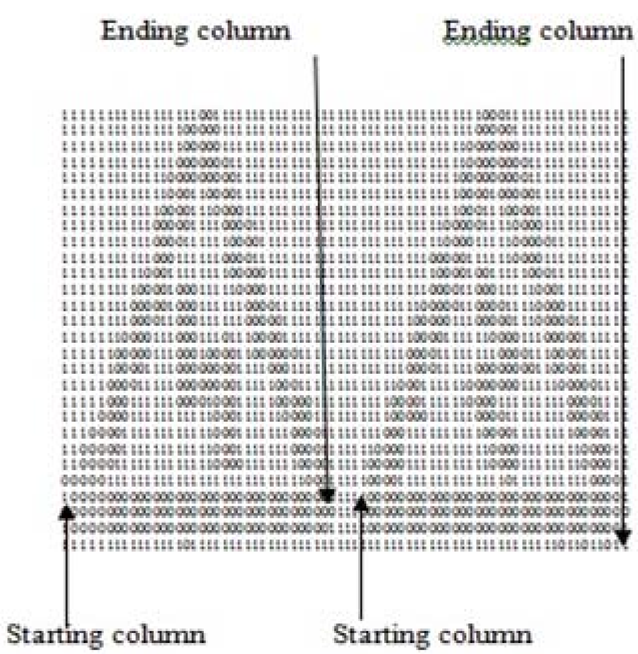

Figure 2. Single Sign Segmentation

C. Average Height of a Sign:

To find the height of a sign from binary image where 0's represent black pixels and 1's represent white pixels, we have used pixel scanning method. Starting from the left most column of top most row, we scan each row of each column. When a 0 (zero) is found, the corresponding row is taken as the first row (Y_{first}). Continuing in this way, we find the last row (Y_{last}) of 0 (zero) of the same column. The height of each column of image is then calculated as

$$Height_{column}(i) = Y_{last}(i) - Y_{first}(i)+1 \quad (1)$$

i, is the column number that contains at least one black pixel (o).

The average height of the binary image is then calculated as

$$Height_{avg}=N/M \quad (2)$$

Where, N is the total number of black pixels (0's) of the image and

M is the total number of columns containing at least one black pixel (0).

D. Area of the Sign:

The area of a sign means the total number of black pixels in the image.

E. Centroid of a Sign:

The centroid of a polyhedron is simply the average of the respective coordinates of all the vertices of the polyhedron. For example, if the coordinates are (x1, y1) (x2, y2) ... (xN, yN), then the centroid wouldbe,
xC=(x1+x2+...+xN)/N
yC=(y1+y2+...+yN)/N

In our system, the centroid of an image is calculated using the following formula:

$$Xc = \frac{\sum_{i=1}^{N} x_i}{area} \quad (3)$$

Where, x_i represents the X-coordinate of each boundary pixel of the image.

$$Yc = \frac{\sum_{l=1}^{N} y_l}{area} \quad (4)$$

Where, y_i represents the Y-coordinate of each boundary pixel of the image and N is the total number of boundary points. The centroid of the image is (Xc,Yc).

F. 4- point Concavity measurement:

The 32×32 binary representation of a sign say sign array is logically divided into 4 equal subarrays. The division of a 32×32 array into four 16×16 subarrays. For each subarray, the element of 8^{th} row and 8^{th} column (marked by black color) is located. If a 0 is reached, then the direction is blocked and it is represented by 0. If no 0 is reached, then the direction is open and it is represented by 1. The overall concavity feature vector is composed of (4×4) 16 elements

G. Extract Sign:

Image extracts from frame various steps. Give below following steps.

a. Input image from frame.

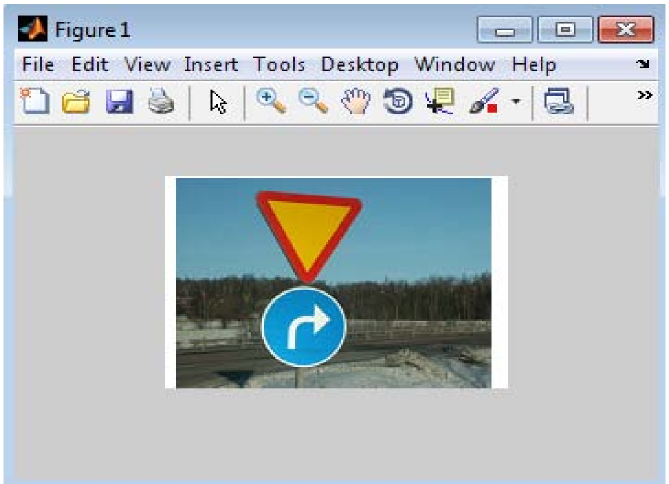

Figure 3. Input images from file

b. Color segmentation.

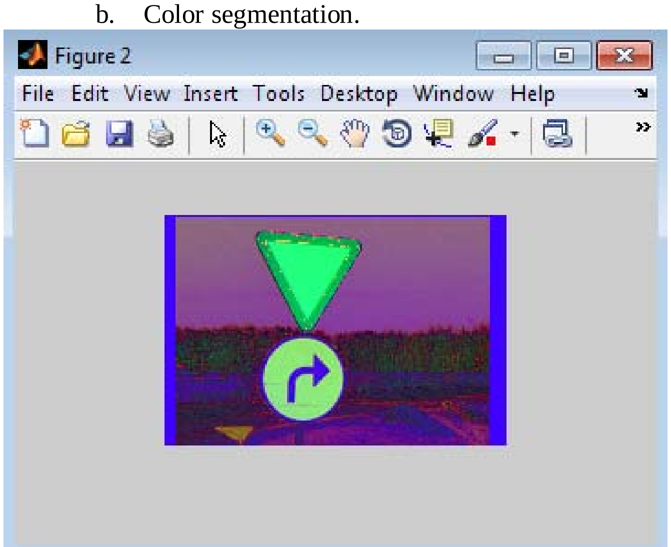

Figure4. After colour segmentation

c. Detect edges with edge detector algorithm.
d. Mark the bounding boxes of the objects.

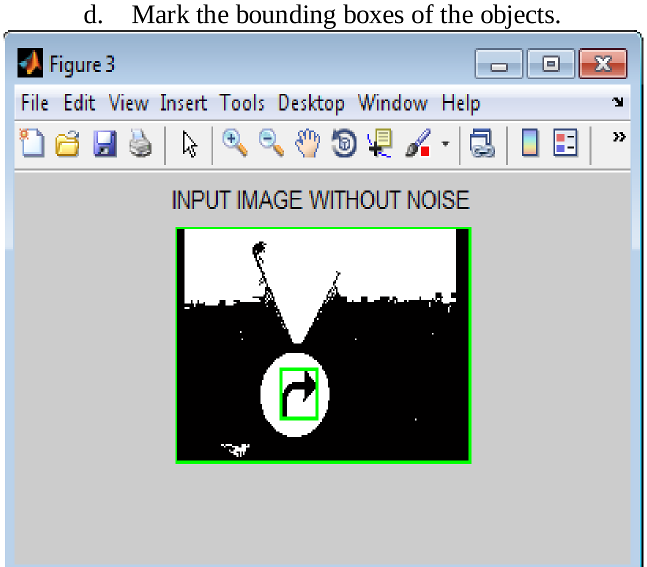

Figure 5. Detect object and bounding boxes of the objects.

e. Remove objects whose highest pixel locates below row 310 of the original images, setting the origin (0,0) of the coordinate system to the upper-left corner.
f. Remove objects with height/width ratios not in the range.
g. Check existence of the corners of each object.
a) Find the pixel with the smallest row number. When there are many such pixels, choose the pixel with the smallest column number.
b) Find the red pixels with the smallest and the largest column numbers. If there are multiple choices, choose those with the largest row numbers.
c) Mark locations of these three pixels in the imaginary nine equal regions, set-ting their corresponding containing regions by 1.
d) Remove the object if these pixels do not form any of the patterns listed aside.
8) For each surviving bounding box, extract the corresponding rectangular, circle, triangle area from the original image and save it into the ROI list

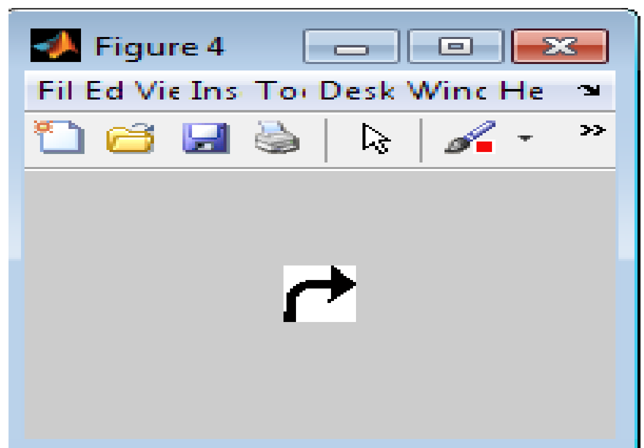

Figure 6. Extract road sign.

III. EXPERIMENTS

Table 1 shows the results for two individual runs, while Table2 shows the corresponding percentages.

Table I. Performance of Sign Detection and Recognition

Ru n	No. Frame s	No. Sign s	No. De-tected	No. Recog-nized	False Detec-tions	False Recogni-tions
1	5,47	38	29	27	9	2
2	4,32	32	25	22	7	3

Table II. Percentage results for Sign Detection and Recognition

Ru n	No. Frame s	No. Sign s	Percent De-tected	Percent Recog-nized	False Detec-tions	False Recogni-tions
1	5,47	38	76.3%	93.1%	31%	7.4%
2	4,32	32	78.1%	88%	28%	12%

IV. CONCLUSIONS AND FUTURE WORK

Road signs are deliberately designed and positioned to make it easy for humans to detect them and recognize what they mean. It is still a challenge to enable a computer to perform as well as humans, especially over the full range of possible signs. While the sign detection method is robust and accurate, sign recognition suffers because the extracted sign regions are small and often blurred. Actively pointing a camera at the locations of detected signs and zooming in would enable more accurate sign recognition, as in [9] and [10].

While it is straightforward to extend the current method to recognize new signs that have colored backgrounds, the method does not work well for white signs with black writing. This is because many regions in the images may have uniform gray values (e.g., the sky, road surface, and buildings) and, depending on the lighting, the sign may appear lighter or darker than these regions. This means that the detection process either fails or is overwhelmed by non-sign regions. A road sign detection and recognition algorithm has been described that makes use of color and shape to detect road signs in video imagery. Regions that are candidate signs are further processed using a template matching approach to identify the signs. Information about signs is determined in close to real time, which means that it can be provided to an autonomous robotic vehicle quickly enough to enable it to modify its behavior according to the information on the signs.

V. REFERENCES

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