A COLOR AND SHAPE BASED REAL TIME TRAFFIC SIGN DETECTION AND RECOGNITION SYSTEM

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ABSTRACT

Traffic or road sign detection and recognition system is a real time system. It is also known as a Driver Assistant System(DAS) which is useful to the driver to provide information regarding the traffic rules, instructions and information given on the road at the time of driving. The traffic rules are represented in a small pictorial form, erected at road sides. This paper describes various algorithms for color identification, shape recognition and matching process. Centroid feature of the image is used to identify the shape of the traffic sign. Canny method is used to find edges of the sign for matching process. Temporary template is translated according to the coordinates of the centroid stored in a knowledgebase. The accuracy level of the proposed system is more than 90%.

Keywords: Centroid, DAS, Translation, Traffic sign detection, Traffic sign recognition

1. Introduction

Traffic rules are the rules which regulate the traffic and help drivers to drive the vehicle safely. Traffic signs are pictorial information which is used to regulate traffic and give the information about the road and traffic rules. These rules are not just pictorial representation but also depicted some small sentences. This paper describes the process to detect and identify the traffic signs. **Types of traffic signs**
There are several hundreds of traffic signs available to handle different situation at the time of driving. They can be classified into three main categories:

- Mandatory Signs
- Cautionary Signs
- Informatory Signs

Total number of mandatory signs are 38, cautionary signs are 40 and informatory signs 18 approximately.[1]

Mandatory Signs: These signs require the driver to obey the signs for the safety of other road users. It is offence not to obey these signs [5]. These signs use red circular or octagon boarder with white blue or background and black pictogram.[4]

Cautionary Signs: These signs are for the safety of drivers and advice them to obey these signs. Generally it uses red triangle with white background and black pictogram.[4]

Informatory Signs: These signs provide information to the driver about the facilities available ahead, and the route and distance to reach the specific destinations. These signs use rectangle shape of blue boarder with white background and black pictogram.[4]



Straight prohibitedor no entry Right hand curve First – aid post

(a) (b) (c)

Figure 1: Example of (a) Mandatory Signs , (b) Cautionary Signs and (c) Informatory Signs

2. Need of the system

It is said that life is safe if driving is safe. When driver is driving a vehicle, it is possible that he is doing some another task simultaneously like talking with others, listening music, talking on a phone, etc. In such a situation driver may not be aware about the traffic signs and as a reason minor or major accidents takes place. To avoid such incidents some automated intelligent system is required which inform the driver about the rules and regulations given on the traffic signs. Now a day such systems are available in very costly car which is known as intelligent vehicle. But some systems are failed with partial traffic signs, some are failed with bad weather or some are failed with bad light conditions. In proposed system the information about the signs are produce in a text, images and audio format. Such multimedia information traffic signs are very useful to the driver.

3. Model of Traffic sign detection and recognition system(TSDRS)

The model of traffic sign detection and recognition is as shown in figure 2. In this model input data are video frames which are captures by cameras mounted on a vehicle. From the whole scene of a video frame, the traffic signs are detected and recognized by the system. The proposed system produced the information of the traffic signs identified by the system in a text, an image and in an audio format as an output.

Figure 2: Model of TSDRS

4. Modules of TSDRS

TSDRS consists of following modules:

- Fetch the frame from video
- Color Identification
- Shape Identification and template creation
- Sign Recognition
- Sign tracking

The flow of above modules is given in figure 3.

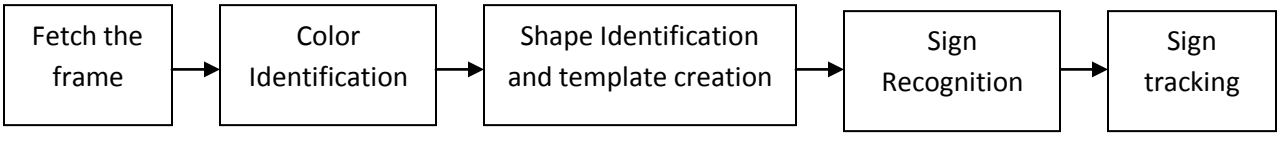


Figure 3: Modules of traffic sign recognition system

Let's discuss each module in detail.

4.1 Fetch the frame:
Video frame is fetch from the camera after every fixed frame grab interval as an input. The fetched frame is given to the next module for color identification.

4.2 Color identification:
Traffic sign can be classified into two groups mainly as red traffic signs and blue traffic signs [3].Frame received from the first module is converted to grayscale image. After subtraction of the gray scale image from original RGB image the red/blue component can be produced. Red/Blue color can be tracked using bounding process of the same color components. The result of this algorithm is shown in figure 4.[6]

Figure 4 : output of color detection process
#Algorithm to find the red and blue color.
Step 1: Fetch the video frame *data*.
Step 2: get the gray scale image *grayimg*.
Step 3: Fetch the red and blue color component by subtracting the gray scale image from original RGB image.
Step 4: Remove small objects.
Step 5: Call binimg (*grayimg*) //Convert image into binary
Step 6: Get the connected component of the binary image *bin*.
Step 7: Find the boundary and centroid of the image.
Step 8: Bound the red color.
Step 9:End.

4.3 Shape Identification and template creation:
Proposed system uses centroid feature of the shape to identify whether it is circular or triangle. The centroid is the mean position of all the points in all of the coordinate directions in a shape [2].
Following steps are performed to identify the shape of the sign:

1. Find out edges of gray scale image and retrieve coordinates of centroid from color detection algorithm.
2. Save the edges as a temporary template to be compared.
3. Identify the shape depend on the value of coordinate of a centroid stored in a template.

4.3.1 Conversion of grayscale image to edges of the sign:
Next step in the proposed system is to convert the resultant grayscale image into binary image. This conversion can be done using following algorithm. With this algorithm the pixels with the intensity greater than 100(a threshold value) are considered as black pixels and other are as white pixels. Canny method of the application is applied on binary images to find the edges of the sign. The result of the algorithm is as shown in figure 5.

(a) (b) (c)

Figure 5 : (a) grayscale image (b) binary image (c) Edge of the binary image

#Algorithm to find the edges of the sign.

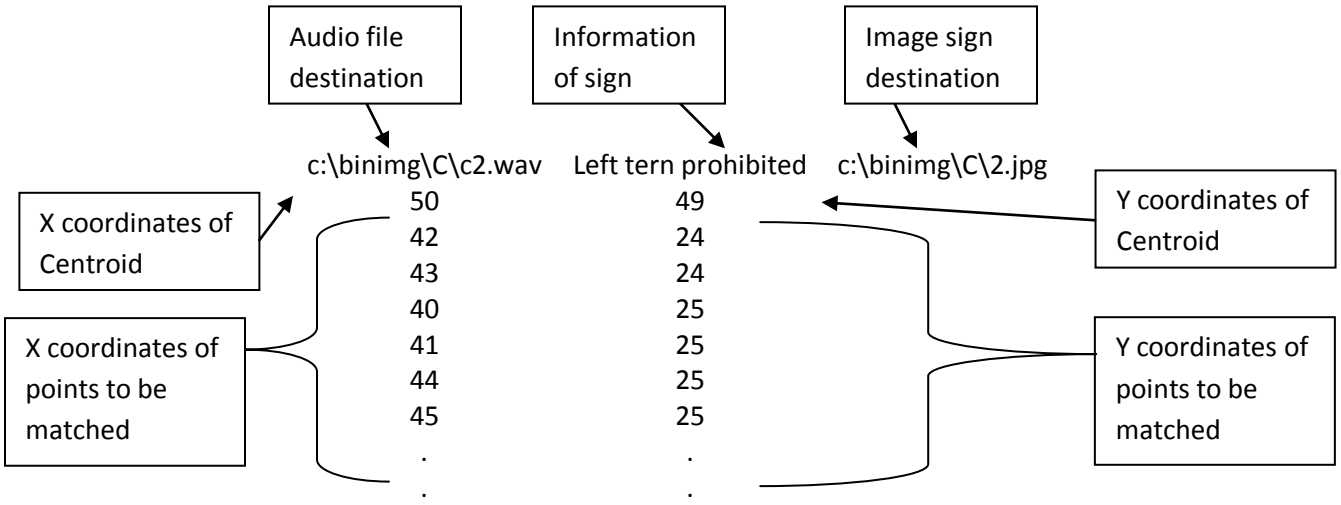
Binimage(Grayimg)
Step 1: Read the Grayscale image *grayimg*.
Step 2: //Repeat step 3 to step 6 for all rows*row*.
Step 3: //Repeat step 4 to Step 5 for all columns*col*.
Step 4: if *grayimg*(*row,col*)<100
bin(*row,col*)=0;
else
bin(*row,col*)=1;
Step 5 : End of for loop of columns
Step 6: End of for loop of rows
Step 7: Retrieve *edge* of the binary image using canny method.
Step 8: Return resultant *edge*(edges of binary image).
Step 9: End of the function

As a result of above algorithm and color detection algorithm raw data for template file is ready. In next step the structure of the template has been derived.

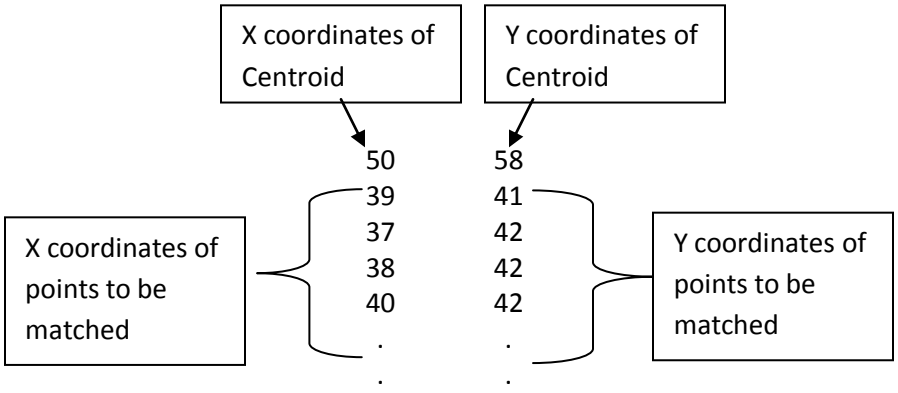
4.3.2 Template structure:
The resultant edge of the binary image is a template file which is used for the comparison with the existing pre stored knowledge. The template stored in the knowledgebase consists of centroid, audio file detail, image file detail, short description of the sign and binary image data. Temporary template contains information about centroid and binary image. Temporary template is captured after every frame grab interval from the video and compared with the pre stored template from the relative knowledge base.

#Algorithm to save temporary template file
Step 1: Start
Step 2: Fetch *edge (Binimage)* file.
Step 3: Store centroid in first row.
Step 4: Save all pixels of *bin* to *tempfile from second row*.
Step 5: Return *tempfile*.
Step 6: End.

The structure of the template file of knowledge base **is** shown in figure 6 (a) and temporary template file is in figure 6 (b).



(a)



(b)

Figure 6 : Format of (a) Knowledgebase (b) temporary template file

4.3.3 Shape identification:

Traffic sings are classified using shape of the image. Following algorithm is used to identify shape of the sign. If the color of the image is blue then the shape is rectangle. If the color is red and Y coordinates of the centroid is greater than 55 then shape is triangle else the shape is circle. [7]

#Algorithm to identify the shape of the image.

Step 1: Read *tempfile*. //open the template file
Step 2:Fetch centroid.
Step 3:// if the y coordinate value of centroid of *tempfile* is more than 55 then the fetched image is triangle.
if *y*> 55 then

imagelist = trisigndb
// Open triangle shape knowledgebase
Else
imagelist = cirsigndb
//Open circular shape knowledgebase
end if
Step 4: return *imagelist*.

The traffic signs can be categorized using shape as described in above algorithm. After classifying the sign, next task is to identify it.

4.4 Sign Recognition:
In this proposed system image translation method is used. The temporary template file which is derived from the video frame is translated according to the coordinates of centroid point of the pre stored template from the knowledgebase. Matching points are calculated and if they are more than the threshold value, the fetched image is considered as similar image with the image form the knowledge. The audio file, actual image and description about the matching image is narrated from the knowledge. The algorithm for this process is as follow.[8]

#Algotithm to recognize the traffic sign#
Step 1: start
Step 2: Read *tempfile. //read the temporary* template file .
Step 3:Read *imagelist*.
//open the knowledgebase of prestored images
Step 4 : Repeat step 3 to step for all sign stored in *imagelist*.
Step 5 : Read *signfile* //open signfile for processing.
Step 6 : Find the difference of centeroid coordinates of both the files.
Step 7: Translate the *tempfile* according to the pre stored image.
Step 8: Find matching points. If the value of coordinates lies between threshold (-5 to +5) difference, consider the coordinated as matching points.
Step 9: If matching points >threshold value (30) than images are considered as similar images. Retrieve audio and text information of the image from the template.
Step 10: End.

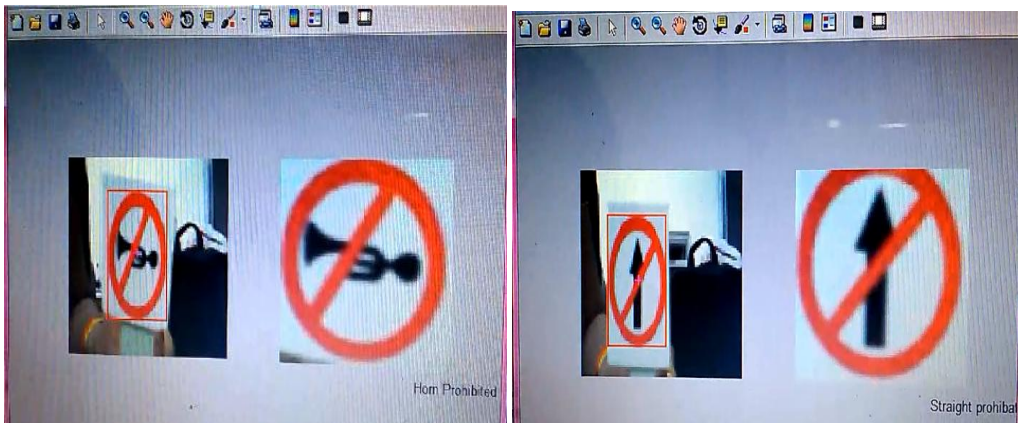
5. Result

Above all algorithms are implemented in MatLab. Layout of the output of the proposed system is given in figure 7(a, b). The left window of both figures displays the video which is captured using cameras. In this video if any traffic sign appear it is identified and recognized by the system. The resultant matched sign with information from the knowledgebase is displayed in right window. In video the identified sign is also tracked with red rectangle to alert the driver.

After testing the system, it is observed that traffic sign is identified and recognized during 5-6 seconds (approx.). The result is given in table 1. Examples of two videos are taken for result analysis. First video consists of 15 traffic signs. 15 signs are correctly identified by the proposed system. The second video consists of 6 traffic signs and 5 are correctly identified. So the average output ratio is 91.5%, which is good compared to existing systems.

Video	Total Signs Appear	Correct identification	Result
1	15	15	100%
2	6	5	83%

Table 1: Result analysis.



(a) (b)

Figure 7 (a, b): Output of the system

6. Conclusion

After implementing above algorithms and comparing the proposed system with existing systems it is concluded that the proposed system is producing improved output. The proposed system produces more than 90% accuracy level but still lack of 100% success. Also it is not properly working for partial traffic signs.

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