Traffic Sign Detection and Recognition using Color Space and Circle Contour Segmentation in Videos

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Abstract. *The detection and recognition of road signs TSR (Traffic Sign Recognition) is one of the first areas of application for Advanced Driver Assistance Systems (ADAS). Currently it becomes a very attractive application because it helps reducing the risk of accidents by alerting the drivers regarding the presence of road signs and allowing the driver to react on time according to the indication of road signs. The proposed method detects candidate regions with maximum similarity against template signs. Detection is based on a binary mask after color space and circle contour segmentation in original frames. Our method avoids training a large quantity of data, instead we use structural similarity to calculate just the similarity between a template and candidate regions. The experimental analysis has been done using a database of videos obtained under different conditions of lightness with complex backgrounds. According to initial experiments, satisfactory results have been obtained using our approach.*

1. Introduction

In recent decades, the rapid growth of automobiles resulted in development of modern systems to recognize traffic signs. With the increase of road traffic, the number of accidents has also increased significantly. Among different causes of these accidents, a major cause is the ignorance of road signs by drivers Malik & Siddiqi (2014). Hence, the traffic sign recognition (TSR) becomes a widely studied subject, due to its great complexity and wide range of applications. The automatic sign detection involves some difficulties as relatively high-speed moving car that cause in scene vibrations, affecting the quality of color information extracted. Other difficulties in road signs are frequently partially occluded by objects present in traffic scenes and lighting conditions and presence of patterns similar to that of road signs.

Most traffic algorithms identify the regions of interest by color segmentation, as indicated by Farhat et al (2015) and geometrical edges or analysis in natural scenes. Another work such as Ruta et al (2010) use a tracker methodology to predicts the position and the scale of the detected sign candidate by capturing instances of equiangular polygons filtered to extract relevant color proprieties. The recognition process uses a distance metric based on the *Colour Distance Transform* and idealized templates to calculate dissimilarity quotient. Zaklouta & Stanciulescu (2014) presented a TSR method with image segmentation and adaptive threshold followed by circular and triangular signs detection obtaining a precision rate of over 90% at a processing rate of 18–28 frames/sec.

Based on the context exposed briefly in this section, the main objective of the present work is to develop a robust algorithm for recognizing the traffic signs using a variety of real-life images obtained under different lighting conditions with complex backgrounds. The different lighting conditions include, for example, morning or evening, sunny and cloudy day.

2. Traffic Signal Recognition Process

The proposed approach consists of two main stages, detection and recognition, in addition to the segmentation of color space and circle contour. The present implementation creates a mask based on color segmentation in HSV color space which is obtained from the RGB. Then a binary image with regions of interest is obtained using a threshold. The region of interest (ROI) include the red color regions in the original frame. A morphological transformation is applied to reduce the noise caused from original frames followed by extraction of circular shapes candidates through mask scanning. The morphological operation includes the opening filter, that is given by the erosion and followed by the dilation.

The present approach is not based on training and testing methodology as common in literature. Instead we have used the Structural Similarity - SSIM to calculate the quotient of similarity between a template and ROI. The SSIM is a perception-based model that considers image degradation as perceived change in structural information, including both luminance masking and contrast masking terms. This model mainly uses the intensity of pixel values to compute the similarity distance between a template and ROI. Before implementing SSIM, the model needed to be resized to the same size as the extracted ROI.

The important aspect of the structural information is that the pixels have strong inter-dependencies specially when they are spatially close. In addition to this, the main advantage of this approach is to find the circular road sign shapes in time optimized the hardware processing time. During the detection and classification process, each circular road sign template is compared with the selected ROIs from the video frames using the similarity distance. The match with maximum distance is selected as the best result for each road sign. In fact, the best match represents the presence of a traffic sign in the video frame. The main steps of TSR process is shown in Figure 1.

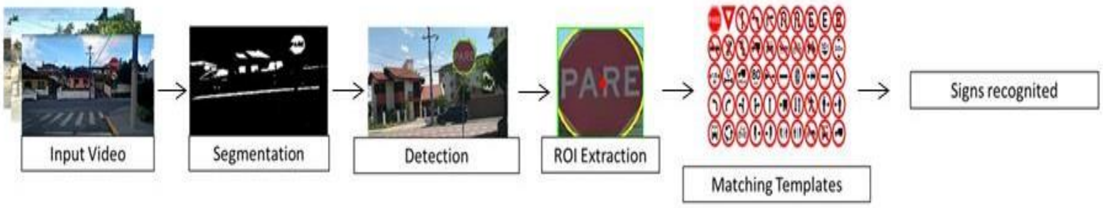

Figure 1. Schematic Overview of TSR Process.

3. Experimental Results

To test the proposed method, a database of 180 traffic videos were captured from a moving vehicle on Brazilian roads at different conditions which include videos obtained in different part the day. A smartphone was used to capture sequences of video with resolution of 640x480 pixels and average 30 fps, running on a 2.80 GHz AMD Phenom X4 processor. At the first part of our work only two of ten sign traffics were tested. The overall detection and recognition results are shown in Table 1.

Table 1. Recognition rates of the proposed method

Sign	Detection	Recognition
	97%	97%
	99%	93%

4. Final Considerations

This paper proposed a system that extracts an interest region by shape scanning using a created mask and the similarity quotient to compare ROI with template from video frames. Using a part of our database, the present approach presented a high detection and recognition rate. Our future works will be focused on testing other traffic signs with complex backgrounds and developing robust algorithms to compensate different categories of traffic signs obtained under a variety of conditions mainly with different lighting conditions.

7. References

Farhat W. et al. (2015) “Effect of color spaces on video segmentation performances”, IEEE Transactions on Intelligent Transportation Systems, p.1-5.

Zaklouta, F.; Stanciulescu B. (2014) “Real-time traffic sign recognition in three stages”, Robotics and Autonomous Systems, v.62, p. 16-24.

Farhat W. et al. (2015) “Novel Approach for Real Time Detection and Classification Based on Template Matching in Video”, World Congress on Information Technology and Computer Applications (WCITCA), Hammamet, p.1-7.

Malik Z.; Siddiqi I. (2014) “Detection and Recognition of Traffic Signs from Road Scene Images”, 12th International Conference on Frontiers of Information Technology, Islamabad, p. 330-335.

Ruta A.; Li Y.; Liu X (2010) “Real-time traffic sign recognition from video by class-specific discriminative features. Pattern Recognition v.43, p.416-430.

specific discriminative features”, Pattern Recognition v.43, p.416-430.