형태학적 방법을 사용한 세 단계 속도 표지판 인식법

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Korean Traffic Speed Limit Sign Recognition in Three Stages using Morphological Operations

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Abstract

The automatic traffic sign detection and recognition has been one of the highly researched and an important component of advanced driver assistance systems (ADAS). They are designed especially to warn the drivers of imminent dangers such as sharp curves, under construction zone, etc. This paper presents a traffic sign recognition (TSR) system using morphological operations and multiple descriptors. The TSR system is realized in three stages: segmentation, shape classification and recognition stage. The system is designed to attain maximum accuracy at the segmentation stage with the inclusion of morphological operations and boost the computation time at the shape classification stage using MB-LBP descriptor. The proposed system is tested on the German traffic sign recognition benchmark (GTSRB) and on Korean traffic sign dataset.

1. Introduction

Traffic sign recognition (TSR) system is an essential part of an advanced driver assistance system (ADAS), as it provides drivers with safety information. ADAS include many important components like lane departure warning system, Pedestrian detection system , vehicle collision avoidance system, traffic sign and light detection system and navigation systems to assist the drivers with directions and real time traffic information.

In order to achieve a TSR system with improved accuracy, this paper uses the concept of morphological operations at the segmentation stage and also utilizes the concept of MB-LBP descriptor at the shape classification stage to lower the computation time of the system.

2. Traffic sign recognition system

The proposed TSR system is divided into three stage, segmentation, shape classification and recognition. The segmentation stage comprises of two parts: image binarization and ROI extraction. The potential ROIs are extracted in this stage. The image binarization is done using the hue, saturation and value or intensity(HSV) color space. The given image is first converted to a HSV color space and thresholded for red color to obtain a masked image. This masked image so obtained undergoes two different process: (i)a connected component analysis is done over the masked image, (ii)the masked image initially undergoes a bottom hat filtering using a structural element and then a connected component analysis is done over the output of the bottom hat filtered image as shown in Fig. 1. The two process yield ROIs having potential traffic speed limit signs. The morphological operation used here include the bottom hat filtering, which yields ROIs in terms of blobs. The obtained ROIs are further scrutinized by confining them with ROI properties like, area, aspect ratio and circularity. The ROIs that satisfy the above confinement is fed to the shape classification stage. The main aim of this stage is to classify if the ROI is a traffic sign and furthermore classify if the ROI is circular or not. The shape classification stage is shown in Fig. 1. The multi scale block local binary pattern (MB-LBP) descriptor is used to classify the ROI. This paper makes use of a single support vector machine (SVM) classifier to train and classify the ROI [1] if it is a traffic speed limit sign or not. The preprocessing step as shown under the shape classification step involves a bilinear interpolation in order to bring all the ROIs to same size.

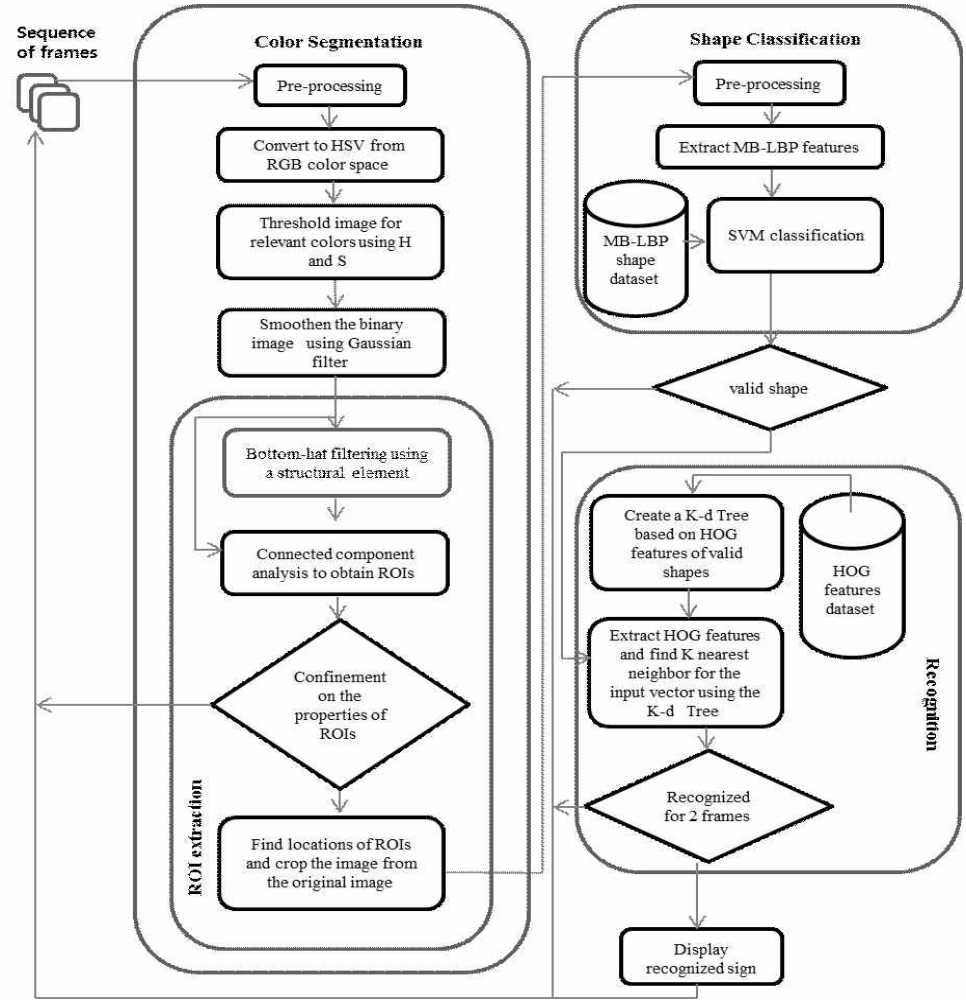

Fig. 1. Proposed algorithm for traffic sign recognition

Given that the output of the shape classification is positive ie. it contains a traffic sign, it is fed to the recognition stage to finally recognize the type of speed limit. This process of recognition is done using histogram of oriented gradients (HOG) and a *K*-d tree. The system is tested on the German traffic sign recognition benchmark (GTSRB) [2] and on Korean traffic sign dataset. The proposed system yields an improved accuracy of 96.81%. compared to the 94.77% best achieved by F.Zaklouta *et al.[3].*

3. Conclusion

This paper proposes a TSR system in three stages using morphological operations and multiple descriptors. The three stages include: segmentation, shape classification and recognition. One of the main reason to consider the morphological operations is to extract occluded traffic signs or traffic signs appearing with similar color background. The proposed system provides an improved accuracy of 96.81% compared to other existing approaches.

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