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Detection and Recognition of Myanmar Traffic Signs from Video

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Abstract**:** *The efficient traffic sign detection and recognition (TSDR) is an important and challenging task for intelligent transportation systems. Traffic signs are an essential part of a Driver Assistance System (DAS) that automatically alerts and informs the driver of the traffic signs ahead. They are designed to be easily seen and understood. This paper describes a software application for the automatic detection and recognition of Myanmar traffic signs from a video sequence. The proposed system accomplishes two main modules: traffic sign detection and recognition. Before traffic signs are detected, color information, mainly red, yellow and blue, contained on the video is analyzed. In traffic sign detection module, there are three steps: 1) RGB to HSL conversion, 2) color filtering to extract color and 3) shape detection by using Harris corner detector. Traffic sign recognition module consists of three steps: 1) grayscale conversion, 2) edge detection with Sobel edge detector and 3) classification with template matching. The output of the system is audio. The proposed system can operate under a range of different lighting conditions at an average speed of 30 frames per second and is accurate even at high vehicle speeds. The experiment results show that the overall recognition rate of the proposed algorithm is 94%. It is proved that the proposed method is robust, effective and accurate to recognize the traffic signs. It is implemented with C# programming language.*

Keywords: *Traffic sign detection and recognition (TSDR), video, audio*

1. Introduction

With the development of society economy, the rapid growing volume of traffic causes large amount of traffic accident. The traffic problems become one of the bottle-neck of modern city. Specific rules are provided by every government to provide safe and harmonious flow of traffic. Some of these rules are displayed to the driver by means of traffic signs which needs to be interpreted while driving. Traffic signs control the flow of traffic, give the right of way, inform a road user about the directions and warn in dangerous places. However, the ability of the driver to locate and identify the traffic signs is highly influenced by his/her physical and mental alertness and the most important risk factors are caused by tiredness, emotional stress or side effects caused by medication [1,2].

A large fraction of all automobile accidents is caused by the drivers' lack of concentration while operating their vehicles. So, the traffic sign detection and recognition (TSDR) systems have become the advanced driver assistance systems as the crucial parts. The aim of this work is to design, implement and test a system of Myanmar Traffic signs detection and recognition (MTSDR). The purpose of detection is to maintain sign objects and remove non-sign objects from road sign frames while recognition is used to classify different road signs to their categories.

The rest of this paper is organized as follows. Section 2 presents the related works which include methods of object detection and recognition. In Section 3, traffic sign detection with RGB to HSL color conversion, color filtering and shape detection are described. Section 4 discusses traffic sign recognition with template matching. Finally, the experimental results and conclusions are presented in Section 5 and 6.

2. Related Works

Nowadays, many researchers have done the various methods and techniques of detection and recognition for the traffic signs. Fang et al. have implemented two separate neural networks to extract relevant colour and shape features of signs which were further integrated in a fuzzy way. This approach was reported to be accurate but computationally very intensive [3]. In [4], color filtering and segmentation were used to detect the boundary of traffic signs. Particle swarm optimization was used to identify all types of traffic signs used in Thailand. The processing time for all stages of their system was around 1.806 seconds. Furthermore, classifiers as support vector machines (SVM) are being used for recognition of road signs in [5]–[9]. Jiang Yanhua et al. used color segmentation, shape detection and pictogram recognition algorithm to detect and recognize traffic signs [10].

3. Traffic Sign Detection

There are four types of traffic signs in Myanmar: prohibitory signs, warning signs, ordered signs and directional (guided) signs. Among these signs, only the first three signs are recognized in this paper. In this paper, although training data are traffic road sign images, testing data are videos of road signs. Some trained images are obtained from google and some are real images.

For data acquisition, roads signs are captured by using digital video camera mounted on a moving car. This system captures image of current frame from playing video in each second. Before traffic signs are detected, color information, mainly red, yellow and blue, contained on the video is analyzed. The illumination variation degrades considerably the performance of the detection module. Thus, in order to reduce the influence of luminance, acquired images were converted from RGB color model to the HSL color model. The colors and shapes of the traffic signs are very different from natural environment. So, these colors and shapes are chosen as features to detect the traffic signs. Prohibitory signs are also called red sign. Also warning and ordered signs are called yellow and blue signs. So, color filter is used to remove unneeded colors from image and to extract the colors of traffic signs from image.

3.1. Color filter

Color filter algorithms targeting images have the ability to modify or manipulate the color values expressed by an image. It is applied to filter out image regions that have color characteristics similar to the color found in one of the signs known to the system.

3.2. Shape detection

For shape analysis, Harris corner detector is used. A corner is defined as the junction point of two or more straight line edges. Corners are special features in an image. Harris corner detector is a combined edge and corner detector. The basic idea is to recognize the point by looking through a small window easily. The core idea is to calculate the eigenvalues and eigenvectors of a small region.

4. Traffic Sign Recognition

There are three steps in traffic signs recognition. Firstly, color is converted to grayscale. This function transforms a 24-bit, three-channel, color image to an 8-bit, single-channel grayscale image by forming a weighted sum of the red, green and blue components. The formula used for the grayscale function is $Y = 0.3R + 0.59G + 0.11B$. And then edge detection is done with Sobel edge detector to segment road sign. After that segmented road signs are matching with images stored in the database by using template matching method.

4.1. Sobel edge detector

Edge detection is a fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction. An edge is the boundary between an object and the background and indicates the boundary between overlapping objects. This means that if the edges in an image can be identified accurately, all of the objects can be located and measured. The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. It looks for edges in both horizontal and vertical directions, then combine the information into a single matrix. It is slower to compute than the Roberts Cross operator but it is less sensitive to noise.

4.2. Template matching method

It is a technique in digital image processing for finding small parts of an image which match a template image. There are two types of template matching approaches: feature-based approach and template-based approach. This system uses template-based approach. A basic method of template matching uses a convolution mask (template), tailored to a specific feature of the search image which is wanted to recognize. This technique can be easily performed on gray images or edge images. Gray images are used in this system. In matching, the resultant image is compared 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 achieved. Fig.1 shows the flow chart of the proposed system for traffic sign detection and recognition.

5. Experimental Results

The traffic sign video files are captured by digital camera mounted on a moving car at day time from sunrise to sunset under different lighting conditions. Total frame number for each video file is 900 frames. The color usage of frame image is HSL format. The time duration of tested video files is 5 minutes. The total number of prohibitory sign video files is 25. The total number of warning sign video files is 30. The total number of ordered sign video files is 28. The total number of all road sign video files is 83.

In this section, the implemented results of the proposed traffic sign recognition system are described. The input video file is needed to load as described in Fig. 2. The results of each detected and recognized traffic sign in the loaded video are shown in Fig. 3, Fig. 4 and Fig. 5, respectively. In Fig.3, the recognition result shows that the recognized signboard name is bicycle road, similarity is 0.728827 and execution time is 205 milliseconds. In Fig. 4, the recognition result shows that the recognized signboard name is no truck, similarity is 0.759691 and execution time is 870 milliseconds. In Fig. 5, the recognition result shows that the recognized signboard name is keep right, similarity is 0.872393 and execution time is 396 milliseconds. The detected region in a frame is shown with red circle. Traffic sign detection rate is calculated according to the following equation:

$$\text{Detection Rate} = \frac{\text{No of correct detected traffic signs}}{\text{Total tested traffic signs}} \times 100\ \% \tag{1}$$

Example,

$$\text{Detection Rate for all traffic signs} = \frac{79}{83} \times 100\ \% = 95\ \% \tag{2}$$

Detection and recognition rates are described in Table 1. Recognition rate is calculated according to the following equation:

$$\text{Recognition Rate} = \frac{\text{No of correct recognized traffic signs}}{\text{Total tested traffic signs}} \times 100\ \% \tag{3}$$

Example,

$$\text{Recognition Rate for all traffic signs} = \frac{78}{83} \times 100\,\% = 94\,\% \quad (4)$$

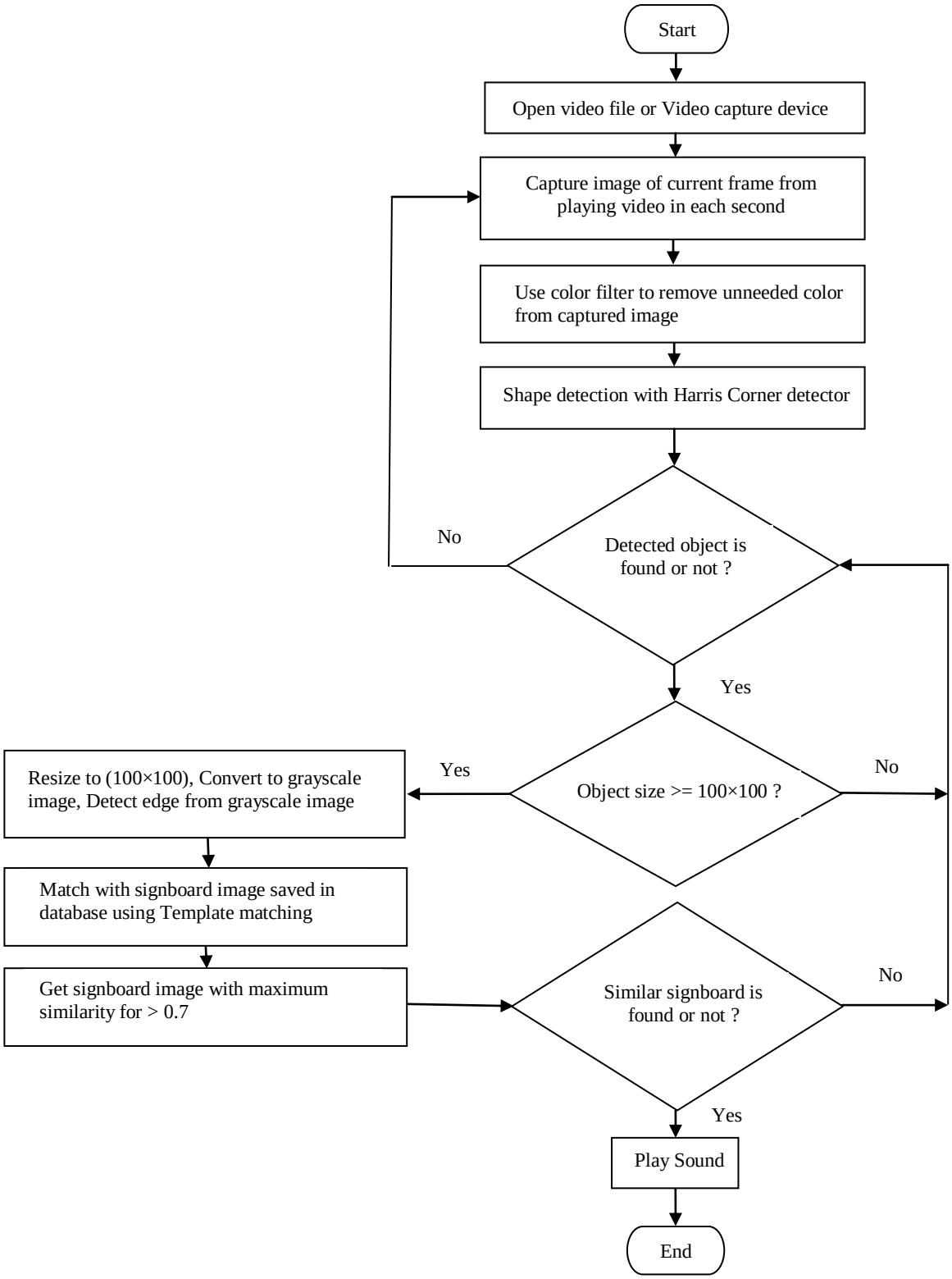

Fig. 1: Flow chart of the proposed system for traffic signs detection and recognition

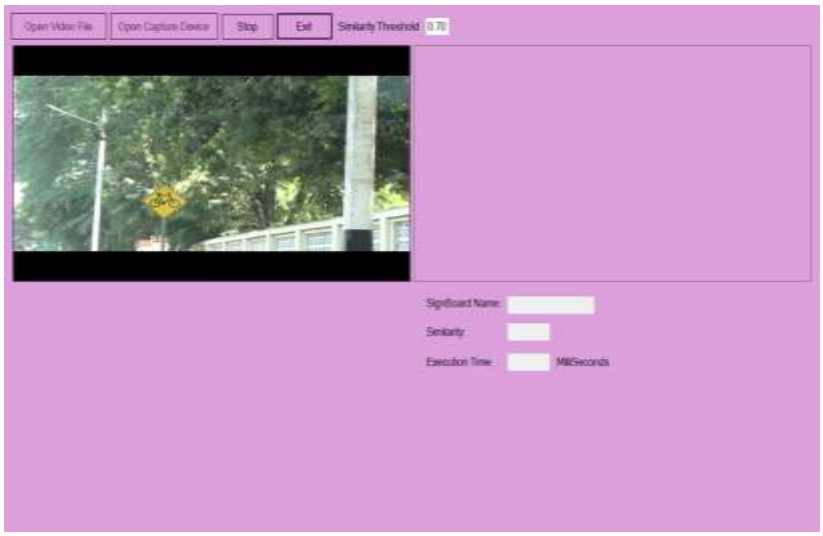

Fig. 2: Load input traffic sign video

Fig. 3: Warning sign detection and recognition

Fig. 4: Prohibitory sign detection and recognition

Fig. 5: Ordered sign detection and recognition

TABLE I: Performance of Traffic Sign Detection and Recognition

Name of Road Signs	No of Road sign videos	Detection Rate (%)	Recognition Rate (%)
Prohibitory signs	25	96	96
Warning signs	30	93	93
Ordered signs	28	96	93
All road signs	83	95	94

6. Conclusions

This paper presents the Myanmar traffic sign detection and recognition system from video. Traffic signs are captured from moving car by using digital camera. The output of the system is audio type. The detection and recognition rates of road traffic signs are different because road signs have large variations such as rotation, scaling, vibration, complex background and illumination. The overall detection and recognition rates are 95% and 94% respectively. The execution time for recognition is between 205 and 870 milliseconds. It can be seen that this traffic sign recognition system can reduce processing time to less than half the time of the system reported in [4].

Now, this proposed system can recognize only signs from the first three types of Myanmar traffic signs capturing at day time. Ongoing work of this research is to detect and recognize more road signs captured at night and different weather conditions. Moreover, this system will recognize Myanmar scene text from the directional signs (guided signs) in the future.

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