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A Neural network Based System Architecture of An Automatic Traffic Sign Detection and Recognition System

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ABSTRACT

In recent years, automatic traffic sign detection and recognition system is a very important research in the development of advance driver assistance systems. However, the performance of the system depends on variant lighting condition, blurring and fading effect etc. This paper proposed a combination of Fast Neural Network (FNN) and Classical Neural Network (CNN) based system architecture of an automatic traffic sign detection which will improve the efficiency of the system by removing the false detection problem as well as minimize the effect of illumination of light, blurring and fading and different environmental effect over detection scheme.

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INTRODUCTION

Traffic Sign Detection and Recognition (TSDR) is an important application for Advance Driver Assistance Systems (ADAS). Traffic signs offer significant visual information that can help the driver when the vehicle is operating on the street.

According to (Paclik, 1999), the first work on automated traffic sign detection was reported in 1984. Since then, a number of different methods have been introduced for traffic sign recognition system. In (Ruta, 2008), RGB color space as a distinguished feature is used for detecting traffic sign from environment. In (Gauri, 2012), HSI color space is used for detection whose main advantage over RGB color space are that it has only two components, hue and saturation, and both are very similar to human perception. In (Hechri, 2012) YCbCr is used instead of RGB color space because YCbCr represents color as brightness and the difference of two color signals. In (Naguwi, 2006), neural network is used which is known as the most well known and useful method because of its robustness and flexibility. AdaBoost classifier is used in (Chen, 2012) which is a fast method with high accuracy rate. Suppor Vector Machine which is also a fast method is used in (Martinovic, 2010). Fringe-adjusted joint Transform Correlation is used in (Khan, 2011) which have excellent discrimination ability between object and non-object. Decision tree has been used in (Greenhalgh, 2012) which have a very high accuracy rate. 3D Reconstructive Algorithm which is very effective in recognizing damaged or occulted road signs is used in (Soheilian, 2013).

In this study, a unique method of image processing and algorithmic details of detection and classification of traffic sign and non traffic sign is described. Finally, this research is proposed the system architecture of the automatic traffic sign detection and recognition system.

Methodology:

The development of an efficient TSDR system is tedious job as the surrounding is changing rapidly. Traffic sign differs by its colour and shape from the surrounding. In our proposed system we will use both colour and

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shape feature to detect traffic sign and FNN and CNN to verify and classify the signs.

Image Pre-Processing stage:

The main idea is to use colour characteristic of the preferred object. After filtering and analyzing the features of detected object, the candidates of traffic sign are selected based on the shape matching.

Colour Enhancement:

Image enhancement algorithm is very important to obtain the useful information of images.

RGB Colour Segmentation:

The input image is RGB which is asymmetrical to colour perception. The difference of perception between two colour points is unequal to the difference between them. Correlating particular colour in R, G and B directly is the main difficulty.

Objects Features Analysing:

In the proposed system for eliminating noise Median filter is used to make the image smoother and according to the expected region of interest (ROI).

Shape Matching and Candidate Selection:

The proposed method used to detect those regions with *k* in the range of 0.7-1.3 is accepted as candidates for road signs.

$$k = \frac{a}{\pi \times w} \tag{1}$$

where*a* is area of the region, *w* is the longest width. The block diagram of the proposed system is presented in FIGURE 1.

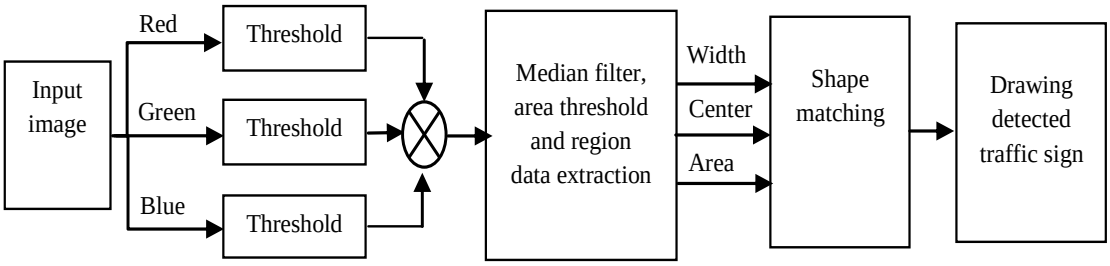

Fig. 1: The overall block diagram of preprocessing stage.

Canny Edge Detection:

By reducing the amount of data in an image, while preserving the structural properties to be used for further image processing is the purpose of Canny Edge Detection.

Proposed detection & classification system:

A combination of fast neural network (FNN) and classical neural network (CNN) will be used in the proposed system architecture to classify occupant as either traffic sign or non-traffic sign. After pre pocessing and canny edge detection, the detected ROI will pass to the FNN. The Fast Neural Network (FNN) extracted a sub-image from the test images to detect whether it is trafic sign or false detection. Post-processing strategies will be applied to convert normalised outputs back into the same units that were used for the original targets using 2D-multiple detection, 3D-multiple detection and elimination of overlapping detection. As explained earlier, the variation of lighting conditions in FNN stage can caused false detection. To solve this problem, a linear function is proposed to use to adjust the intensity values using histogram equalisation or lighting correction.

An alternative method employing CNN as a traffic sign verification procedure is used. This developed CNN traffic sign verifier helps to reduce false detection. The procedure of the proposed method is given below:

The extracted possible traffic sign images is sub-sampled and interpolated to a resolution of 25x25. A lighting normalisation approach is introduced to minimize the inconsistency due to different lighting condition and camera characteristics. FNN is tried to fix the intensity values of the extracted candidate regions by subtracting with best-fit linear function. To enhance the image contrast, histogram equalisation is performed afterward. For the verification of the traffic sign regions, extracted candidate regions is then mapped into CNN

to produce output of the traffic sign map. Any output below the threshold is rejected otherwise the traffic sign regions are mapped onto the original image.

System Architecture:

The system architecture is given in FIGURE 2. where from the raw image acquisition to the sign classification as an output is shown with required details.

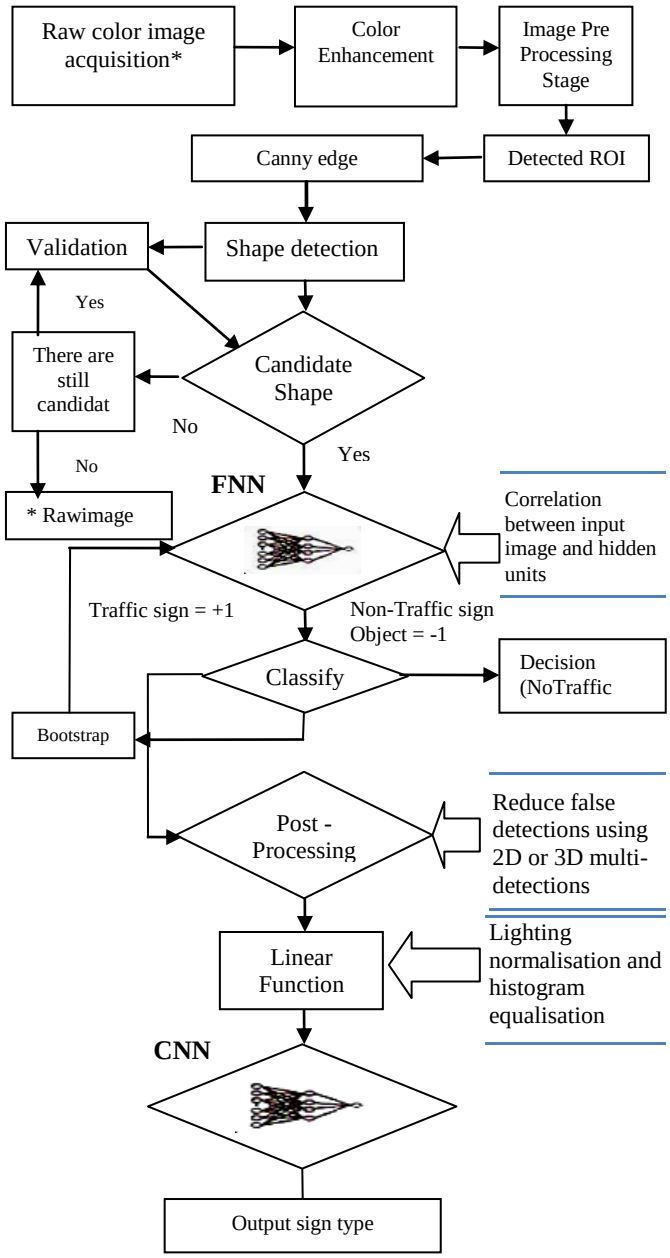

Fig. 2: System Architecture of an automatic TSDR system.

Conclusion:

Robust system architecture for traffic sign detection and recognition by combining Fast Neural Network (FNN) and Classical Neural Network (CNN) is proposed here. For using lighting normalization and histogram equalization method, this proposed system tends to be very effective in eluminating the lighting condition and other environmental effect. The combination of using FNN and CNN is completely remove the false detection problem which is also improved the efficiency of the system.

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