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Road Sign Detection and Recognition System

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Abstract- *In today's world human errors can be rectified with the help of technology. One such scenario is while reading the road signs. There are many people who fail to recognize the road signs and there are situations where a driver might ignore the road signs intentionally or might miss the road signs due to some reasons. Hence, road accidents may occur. So to rectify this human error, proposed system will detect and recognize the road sign to assist the driver. The proposed system consists mainly of two phases: Detection and Recognition. The detection phase consists of finding the neon marker which will be placed on the pole of the road sign, finding the Area of Interest (AoI). The recognition phase consists of feature extraction and classification of the road sign using Distance based Classification.*

***Key Words*: Neon Marker, Erosion, Dilation, finding the AoI, Feature extraction, Distance based Classification.**

1. INTRODUCTION

The input to the proposed system is an image containing the road sign. The road sign consists of a neon marker on its pole. The reason behind using the neon marker is to boost the system's efficiency of detecting the road sign at various conditions like low light, foggy weather etc. The image will then be converted to YCbCr color model, where the Cb component is extracted. Cb component does not depend on the intensity of the light and thus the neon marker would be visible at any lighting condition. Then the image will be converted to the binary image where in except the neon marker all the other elements of the image are converted to black leaving the neon marker in white. The next step would be selecting the AoI. This is done by the method called thresholding where some threshold values are provided in order to extract the AoI. This step completes the detection phase.

The recognition phase consists of feature extraction and classification. The feature extraction includes of selecting few random points in the AoI and finding the mean and standard deviation of those points.

Classification is done by comparing these mean and standard deviation values with the values stored in the database of various road signs. The dataset consists of the images of the road sign taken under different conditions which are of HSV format in which only S component is extracted. Then the images are resized into 120x120. Different classes are formed for different road signs. 12 such classes are formed and for experimental purpose 6 of them are considered. The Database consists of the mean and standard deviation of each point considered in the AoI of the images in those 6 classes along with the class number which is manually entered for the class. Since the classification method used is distance based classification, the distance column matrix will be formed where the row number with the least value will be considered and checked for the corresponding column which contains the class of the road sign in the database.

2. METHODOLOGY

This section provides brief information of the various methods used in the proposed system. Figure 1 provides us the detailed block diagram of the proposed system. This section is divided into two main subsections Detection and Recognition. Detection is further divided into 3 stages i.e., Detection of neon marker, Noise removal (optional) and Selection of Area of Interest (AOI).

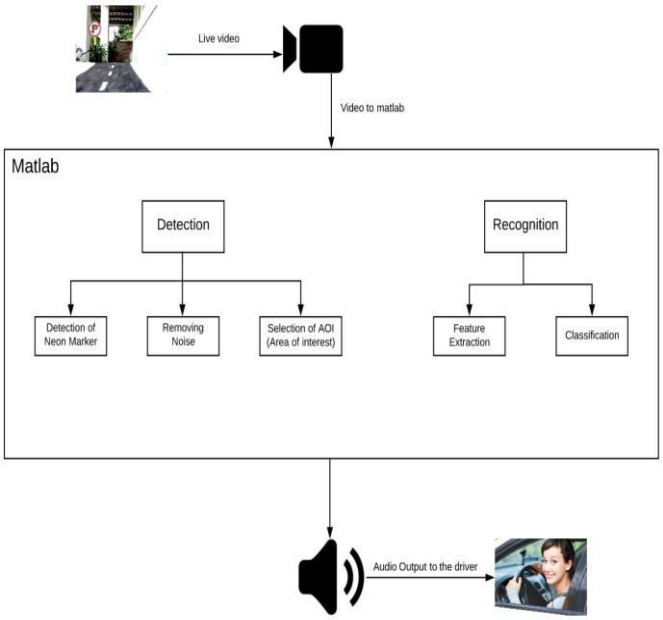

Fig-1 Block diagram of the proposed system

2.1 DETECTION

Detection of the road sign mainly consists of detecting the neon marker on the pole of the road sign. The image containing the road sign is first converted to different color models such as YCbCr, HSV. Various experimentations are done on to select the color model by varying the light intensity to select the best color model for further

processing. It is observed that the neon marker is best visible when we extract the Cb component from the YCbCr image. Since it also does not depend on the light intensity, the image with the Cb component is selected for the further processing. The Cb image is then converted to binary where the neon marker will be converted white and the rest of the pixels as black.

Fig-2 Frame selected from the video

Fig-3 Detected neon marker (Noisy image)

Then the image is subjected to morphological processes like Erosion which removes the noise from the image and Dilation which regains the lost parts of our interest which is the neon marker. This completes the first step towards Detection.

Fig-4 Eroded image (Noise free image)

Fig-5 Dilated image (Lost parts of the neon marker are recovered)

The second step towards detection is Selection of AoI. Selecting the AoI is done by the method called thresholding where a suitable threshold value will be selected. The first pixel of the dilated image will be found out in order to crop the image in both X and Y direction. On the other hand the frame selected will be converted to HSV color model to extract the S component of the image. The image then is cropped for the Area of Interest with X and Y values.

Fig-6 Detected Road sign (Area of Interest)

2.2 RECOGNITION

In order to classify the cropped image (road sign), we require some features from the image and then based on those features we need to decide what class does the road sign belong to. Thus Feature extraction is an important step which is to be performed. The features considered for the proposed system are the *Mean* and *Standard Deviation* of random points selected from the cropped image. These mean and standard deviations are used for the further comparison with the values in the database.

After feature extraction the next stage would be classification. This stage consists of classifying the road sign based on the features extracted in the previous stage. It is important to talk about the database used in the stage of classification since the features extracted are being compared with the values in the database. The database consists of the same features extracted from the images from the dataset. The Dataset used is synthetic, which consists of the images of the road sign which are taken in different conditions like early morning, morning, noon, afternoon, evening and night. The S component of the HSV model is extracted from the image which will be then cropped and resized to 120X120. Their Mean and Standard deviation will be calculated and stored in the database ordered by class number. The class numbers for each set of road signs are

entered manually while creating a database. This Database will be used for comparing the values.

Fig-6 Selected road sign converted to HSV

When the proposed system extracts the mean and standard deviation, it will be subtracted from corresponding entries in the database, and then a distance column matrix will be formed with all the subtracted results. This is a key factor in distance based classification, where distance is being checked between trained dataset and testing dataset. The matrix is checked for the least value and the corresponding row number is noted. For this row number in the original database, the column with the class number is selected. Thus, the class to which the road sign belongs to is identified. Based on the class decided for the road sign audio output will be given to the driver through speaker.

3. EXPERIMENTAL RESULTS

The proposed system is tested under various lighting conditions, such as early morning, morning, afternoon, evening and night.

While testing the proposed system, detection and recognition phases are considered as completely independent phases. Rate of detection is 90% and rate of recognition is 93.34% (considering all the above mentioned lighting conditions). If detection and recognition phases are considered as dependent then the over success rate is 91.67% which is quite acceptable.

4. CONCLUSION

Automatic driving vehicle is the future as many automobile companies are trying to build their respective automatic driving vehicle. Road sign detection and recognition system is one of the most important components of automatic driving vehicles. The proposed system can be integrated in any vehicle and it can serve the purpose of detection and recognition of road sign. Also this can be just used by the drivers to be alert and be aware of road conditions. This will lead to safety of driver and co-passengers.

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