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# Design Approach for a Novel Traffic Sign Recognition System by Using LDA and Image Segmentation by Exploring the Color and Shape Features of an Image

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**Abstract**
This research paper highlights the problems that are encountered in a typical Traffic Sign Recognition System like incorrect interpretation of a particular traffic sign which is observed by a driver while driving a vehicle causing misunderstanding thereby resulting in road accidents. The visibility is affected by many environmental factors such as smoke, rain, fog, humid weather, dust etc. and it is very difficult to understand the traffic signs in this situations, causing misinterpretations of the particular traffic sign and resulting in road accidents. In order to avoid this condition, a novel method of recognizing traffic signs is developed which take into consideration the color and shape of the traffic sign. A algorithm called as Linear Discriminant Analysis (LDA) is used for classification of different groups of traffic signs which are predefined by a particular set of features after the process of Image Segmentation. The images are segmented by using the color and shape features of an image and the features are extracted by using the Haar Transform and then the classification of images is done by using Linear Discriminant Analysis Algorithm. Finally the GUI of traffic sign images is prepared by using the software tool called as MATLAB.Our main objective is to recognize partially occluded traffic signs in a cloudy environment by using LDA and to make an efficient Traffic Sign Detection system which will be capable of recognizing and classifying any kind of known traffic sign from the other traffic signs by considering the color and shape of the traffic sign on the basis of supervised classification of the training data so that any error which results in a faulty detection or incorrect detection of traffic sign can be eliminated.

**Keywords**: Image Segmentation, Linear Discriminant Analysis, Traffic Sign Recognition System, Graphical User Interface, Color, Shape, Supervised Classification

## I. Introduction

Currently, the driver support systems (DSS) are under development by most vehicle manufacturing companies. The reason why DSS are critical in intelligent vehicles is because in the event of the driver being intoxicated or feeling drowsy or lethargic, sometimes a slight misconcentration from him may cause deadly accidents. Therefore, DSS play an important role to prevent road accidents. Traffic Sign recognition is challenging as visibility is affected by weather conditions such as fog, rain, clouds and snow.[1] The color information is very sensitive to the variations of light conditions such as shadows, clouds and the sun [1-3]. It can be affected by the illuminant color (daylight), illumination geometry and viewing geometry [4]. The prescence of objects like buildings or vehicles, similar in color and shape to the road signs in the scene under consideration can also affect recognition efficiency. Signs may be found disoriented, damaged or occluded. If the image is acquired from a moving car, then it often suffers from motion blur and car vibration. Fig. 1 depicts this potential traffic sign problems.


**Figure 1 Typical road sign occlusion conditions**

The process of traffic sign recognition is divided into two steps: First a traffic sign is detected in the image, later this traffic sign is recognized using a shape recognition algorithm. Further the algorithm is extended to classify traffic signs based on information given in the pictogram. First phase is usually done by color segmentation. Since traffic signs have edges of a specific color, color based segmentation represents a good base for easier extraction of traffic signs from image background. In [10], color based segmentation is done in two steps: color quantization followed by region of interest analysis. For color model, RGB color space is usually used, although YIQ, YUV, L*a*b and CIE can be used also. After color segmentation, shape based segmentation is performed for final detection of circles, ellipses and triangles. Second phase is traffic sign classification where various methods like template matching, linear discriminant analysis, Support Vector Machines (SVM), Artificial Neural Networks and other machine learning methods can be used [10]. For traffic sign detection AdaBoost [18] and SURF [19] algorithms can be used also

Types of Traffic Signs:

There are several hundreds of traffic signs available to handle different situation at the time of driving. They can be classified into three main categories:

1.Mandatory Signs
2.Cautionary Signs
3.Informatory Signs

1.Mandatory Signs:

These signs require the driver to obey the signs for the safety of other road users. These signs use red circular or octagon border with white blue or background and black pictogram.

2.Cautionary Signs:

These signs are for the safety of drivers and advice them to obey these signs. Generally it uses red triangle with white background and black pictogram.

3.Informatory Signs:

These signs provide information to the driver about the facilities available ahead, and the route and distance to reach the specific destinations. These signs use rectangle shape of blue border with white background and black pictogram.

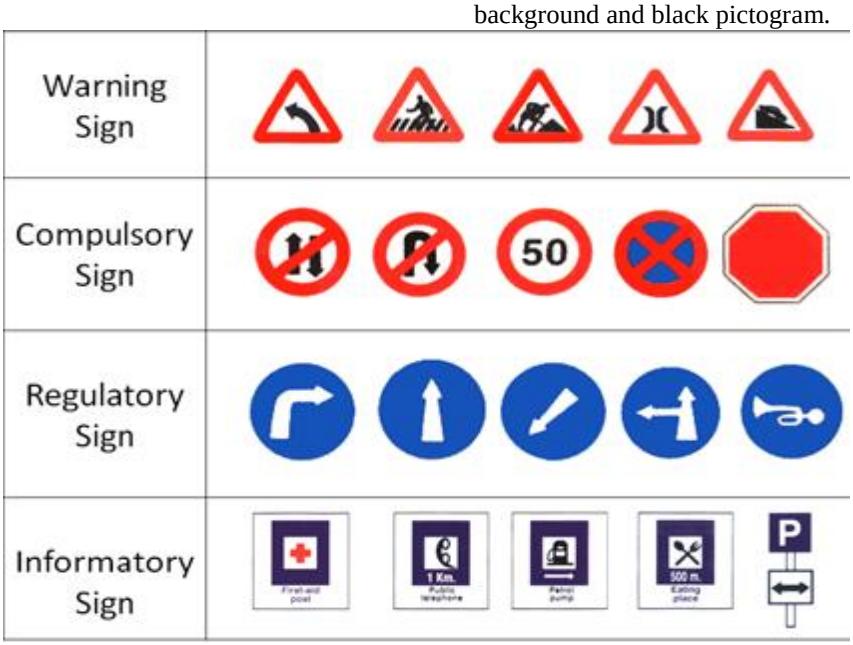



**Figure 2 Typical category of traffic signs**

Challenges in Traffic Sign Recognition:

The problems which are generally faced by a Traffic Sign Recognition system are given as below:

1.Lighting Conditions:

Lighting conditions cannot be the same every time, it is changeable and not controllable. Lighting is different according to the time of the day, season, cloudiness and other weather conditions etc. [2].

2.The prescence of other objects:

Sometimes objects other than the traffic sign boards surround the traffic signs. This produces partial occlusions, shadows etc.[2]

## II. Literature Survey

In recent years, research in traffic sign recognition has grown rapidly because of the real need for such systems in future vehicles. Performance indices headed for by these systems include high recognition rates, real time

implementation, many traffic sign categories as recognition objects, robustness for variant environments and feasibility under poor visibility conditions. Liu and Maruya [6] studied the effect of adverse weather conditions on the development of traffic sign recognition. They developed two approaches to enhance the traffic concerns auto exposure control of onboard vehicle cameras. Paulo and Correia [7] proposed a recognition algorithm that analyses the outer contours of pictograms. Matching of signs against the database is done using the curvature scale space representation. Hoferlin and Zimmermann[8] presented a system for the recognition of circular traffic signs. The system introduces the application of scale invariant feature transform local features for content-based traffic sign detection along with widely applied shape-based approaches. Ruta et.al. [9] utilized a novel image representation and discriminative feature selection algorithms to detect and track traffic signs. The detector captures instances of equiangular polygons in the scene which is first appropriately filtered to extract the relevant information and establish the regions of interest. The tracker predicts the position and scale of the detected sign candidate over time to reduce computation. Bascon et. al. [10] proposed a preprocessing methods and improvements in the support vector machines (SVM) to increase the accuracy of recognition while reducing the number of support vectors. Results showed an accuracy improvement by 3-5%. Tam T. Le has proposed a Support Vector Machine method to retrieve candidate region of traffic sign in real time video processing in which it utilizes a block of pixels as an input vector [1]. Another method has also been proposed by Hassan Shojania based on thresholding, convolution masks and geometric constraint method but in this they didn't implemented the pictographic recognition stage [2]. Auranuch Lorsakul proposes the system with Neural Network technique with canny edge detection method, in this test sign images including distortion images are provided into the program in order to identify the network generalization Because the algorithm attempts to detect the circles or ellipse in the test images, this requires more processing time in the much complex background images that have high numbers of the potential area candidates [3]. The color segmentation algorithm to segment the road sign from the image is proposed by Hossain et. Al.[1]. The RGB color segmentation algorithm is used to segment the road sign from the image. The segmented road sign is then classified according to their color and shape. Hu moment invariants are used as the feature set and neural network classifier is used to classify road signs to their respective classes. Finally, individual road sign from its class is recognized using another neural network classifier. Pattern Matching of the unknown sign's shape with standard shapes of the traffic signs is proposed by Fleyeh and Khan [2] in detecting traffic signs in life images and videos. The pattern matching algorithm works with shape vertices rather than the whole image. Gabor wavelet for road sign detection and recognition using a hybrid classifer to detect and classify of red road signs is proposed by Fatmehsanet al.[3]. The input image is transferred from RGB color space to the YCbCr color space and the red pixels are extracted. Road sign image is then convolved with a bank of Gabor wavelets and the feature vectors are then extracted for classification. These feature vectors are classified by a hybrid classifier. Detection and recognition of mandatory and cautionary road signs using unique identifiable features is proposed by Hemadri and Kulkarni [4]. The image is categorized depending on the color and the form and extracting unique identifiable features of the image. The sign is recognized by comparing these patterns with standard set of road signs. A method for prohibition traffic sign detection is proposed by Quingsong et. Al. [5]. The color information in HIS color space and the symmetry property of circles are used to detect signs, and the histograms of oriented gradient feature and the nearest distance method are used to recognize them. Eigen-based traffic sign recognition is introduced by Fleyeh and Davami [6]. This technique is based on invoking the principal component analysis algorithm to choose the most effective components of traffic sign images to classify an unknown traffic sign. A set of weights are computed from the most effective eigen vectors of the traffic sign. By using the Euclidean distance, unknown traffic sign images are then classified. Combining detection and classification of circular traffic signs is proposed by Huang et. al. [7]. The position and scale of sign candidates within the scene are captured by detecting the center of circle using improved fast radial symmetry detector. In the classification stage, pictogram distribution histogram is used to represent the pictogram. A computer vision based system for real time robust traffic sign detection and recognition is proposed by Chen et.al. [8]. Sign candidates within ROI's are detected by a set of Haar wavelet features obtained from AdaBoost training. Then, the speeded up robust features is applied for the sign recognition. The recognition is performed by finding out the template image that gives the maximum number of matches [8]. A two stage symbolic road sign detection and classification is developed by Ruta et.al.[9]. A well constrained circle/regular polygon detector is used and augmented with the appropriate color filtering. The Kalman filter based tracker is additionally employed in each frame of the input video to predict the position and scale of a previously detected candidate [9]. The color enhancement with an adaptive threshold is combined to extract red regions in the

image is presented by Zaklouta et.al. [10]. The detection is performed using an efficient linear support vector machine with histograms of oriented gradients (HOG) features [10]. Kiran et.al. proposed detection and recognition of traffic signs from image sequences using the color information. In order to improve the performance of segmentation, product of enhanced hue and saturation components 8is used. Linear support vector machine with the distance to border features of the segmented blobs is used to obtain better shape classification performance [11]. Sebastian Houben establish a new probabilistic measure foir traffic sign color detection and propose a novel Hough like algorithm for detecting circular and rectangular shapes [1]. Kyung-in Min etc proposed a method which can recognize about four directional road signs in regions of interest and the experiments are based on unmanned ground vehicle [2]. The method using Coherence vector of oriented gradienys features with neural network classifier is promised by R.Rajesh etc. and they prove the results based on the combination of other features can acquire better recognition rates [3]. Siti Sarah Md Sallah etc. propose a road sign detection and recognition algorithm for an embedded application, which use HIS color space to segment the road signs color and the shape to classify road signs [4]. Besides, the visual attention mechanism is introduced to detect traffic sign, which mainly for prohibition sign and it is very important for traffic safety [5].

## III. Software Tool used:

MATLAB (matrix laboratory) is a numerical computing environment and fourth generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink adds graphical multi-domain simulation and model based design for dynamic and embedded systems.

## IV. Research Methodology to be employed :

The aim of our experiments is to detect and recognize traffic signs of any color, size, shape or type depending on the nature of the traffic sign. There are many different types of traffic signs and consist of different sizes, shapes or colors of the individual traffic sign. The adverse weather conditions like fog, cloudy, sunny, rainy or snow can affect the visibility of driver which is travelling on the road and tend to get mislead because of the wrong information which is perceived by the traffic sign. In order to decrease the amount of road accidents which happen because of the problem of faulty detection of traffic signs, a efficient traffic sign recognition system must be developed so that it can cater the need of the existing user and the rules of traffic. We intend to develop a traffic sign recognition system which is capable of detecting the traffic sign in any bad weather condition may be it seems to be cloudy, rainy or foggy etc. Our proposed system takes into account the contributions of the research scholars in this area of research and the conclusions and scope for future work. The system uses a three step approach in the process of recognition of a traffic sign. The first step is the detection of road traffic sign by using the classical method of image segmentation which is followed by the process of recognition of the traffic sign by using a classifier and the final step is traffic sign classification which is used to classify a given traffic sign from a group of different kinds of traffic signs which fall in the same category by using a selection criteria or by comparing the information contained in a set of images with the information which is extracted from the given traffic sign image belonging in the same category. We follow supervised classification of traffic sign images that is the image database consist of two image databases viz. the training image database and the testing image database out of which the training image database is used as a distinguishing factor in order to classify the testing data from the main database. After the classification of training data the test images are used to distinguish the unknown traffic signs from the set of similar traffic sign images. The algorithm for the proposed traffic sign detection system is given as below :

1.Image Acquisition form image database.
2.Traffic sign detection by using color.
3.Traffic sign Detection by using shape.
4.Feature extraction from traffic sign images.
5.Traffic sign recognition by using LDA.
6.Traffic sign Classification and tracking.

## V. Work done so far:

A database of different kinds of traffic sign images consisting of traffic sign images of various categories like rectangular, hexagonal, octagonal and circular shapes of different colors like red, white, yellow, blue, orange, green and consisting of a white background on which the color of the image is embibed are collected and subjected to some preprocessing operations like resizing an image to 128 x 128 pixels and conversion of a RGB image to binary image has been performed so far and the future work includes application of LDA algorithm to an image so in order to segment the image according to its features like color and shape so that the classification of a particular image from the other

traffic sign images can be done with the help of a suitable classifier algorithm, since the aim of our project is to perform a supervised classification of a traffic sign image from the other images based on the color and shape features extracted from a given image so that one class of traffic signs can be easily distinguished from the other categories of traffic signs.

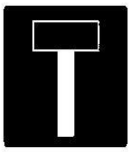
## VI. Results

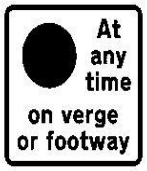
An image database of different kinds of traffic signs like circular, hexagonal, octagonal, rectangular shapes and of different colors like red, green, yellow, blue, orange black, white etc. is prepared and stored in our image database. The examples of some of our traffic sign images collected from the database is shown in the figures which are given below:


The images are resized to 128 x 128 pixels so that the normalization process can be performed on that images without any difficulty.



The images which are resized are converted from RGB to binary images which is a preprocessing operation required for the process of image segmentation because as we know that the image segmentation process can be performed on binary images on




The next step will be segmentation of an image with the help of an algorithm like watershed segmentation algorithm so that the color and shape features can be differentiated distinctly so that the next subsequent step is done successfully.

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