An Investigative Approach towards Various Image Segmentation Algorithms used for Traffic Sign Recognition

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Abstract:

As far as the safety of a driver is concerned, more focus should be put on correct interpretation and information which is conveyed by a traffic sign, while driving a vehicle along the road. A sign board can be thought of as an emblem which disseminates important and meaningful information regarding the potential hazards prevailing among road users comprising roadways cladded with snowfall, construction worksites or repairing of roads taking place and telling the people to follow an alternative route. It alerts the person who is passing through the road about the maximum possible extremity that his vehicle is trying to achieve indicating slowing down the speed of vehicle since chances of having collision cannot be ruled out. With constant increasing of the training database size, not only the recognition accuracy, but also the computation complexity should be considered in designing a feasible recognition approach. The traffic sign images were acquired from the image database and were subjected to some pre-processing techniques such as applying Histogram of Oriented Gradients algorithm which consists of extraction of the HOG features from an image with the help of cell size as well as around the corner points and contrast stretching of color images that are present in the image database. In the future, we will concentrate on detecting, recognizing as well as classifying a particular sign board.

Keywords: Color; Shape; Histogram of Oriented Gradients (HOG); Contrast Stretching; Cell Size

I. INTRODUCTION

One of the main objectives of an intelligent transportation system is to provide a safe and secure driving environment thereby ensuring the safety of the surrounding traffic. We can devise a new technique ensuring the safety of the surrounding traffic by implementing an on-board camera-based driver alert system which helps in recognizing sign board images such as stop signs and speed limit signs [1][2][3]. Traffic Sign board images convey important information regarding the present condition about the roadway as well as tend to provide other information for the purpose of navigation. They can be thought of as planar rigid objects which are having different colors and shapes. The primary visual characteristics of an image constitute the color, shape and pictogram which help us to provide relevant information which is embedded in it. The area of Intelligent Transportation Systems is gaining popularity nowadays and many car manufacturing companies are focusing their eyes on the area of Advanced Driver Assistance Systems since it contains a broad spectrum available for carrying out research and development especially in the domain of Traffic Sign Recognition [4][5] [8]. In the year 2008, Mobil eye entered into a joint venture ship with Continental AG and three additional new updates were installed in the BMW 7 series that comprised of lane departure warning, speed limit information based on the method of detecting sign board images and intelligent headlight control. One of the major challenging tasks which is confronted by modern car manufacturing companies is to recognize the sign boards correctly particularly in an uncontrolled environment [9] [10] [12] [15]. There are three steps in a typical traffic sign board image recognition system that mainly consists of detecting a particular traffic sign from other signs by using some detection method followed immediately by the process of elimination of noise from it with the help of some pre-processing techniques and finally recognizing that traffic sign by using some pattern recognition and machine learning approaches. We can augment the existing system with the help of tracking algorithm so that the speed of recognition can be increased, so that we can focus on a tiny region of the object which is detected for the purpose of recognition. In this research paper, more emphasis is laid on the process of recognizing traffic sign board images; we can leave the remaining three methods, viz., detection, rectification and tracking.

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II. LITERATURE SURVEY

One may consider the process of recognizing a particular sign board image amongst all other members, a Herculean task when it comes to recognizing sign board image from a group of other sign boards. It is found that a variety of techniques are available in the arena of classifying known sign board images ranging from ordinary methods like the matching of templates to sophisticated machine learning techniques. One of the very significant and most important algorithms which are employed to perform the task of classifying multiple sign board images can be attributed to well-known Support Vector Machine (SVM) algorithm. If the transcripts authored by [1][3][4][5][6] are taken into account, one can find the significance attached to automatically detecting and recognizing sign board images taking help of Support Vector Machines (SVMs) in combination with Gaussian kernels. However, the system was required to classify candidate blobs into a shape class before recognition. As a sequence, only the pixels that were part of the sign were used to construct the feature vector. In [8][12][14][16], different methods other than those which are currently available in the context of detecting and recognizing sign boards in an automatic fashion were brought to the notice of people. It can be very well understood from this study that a comparatively greater emphasis was laid in enhancing the accuracy of existing methodologies prevalent in detecting and recognizing sign boards in an automatic fashion thereby resulting in the reduction of number of support vectors which are required in due course of the complete process leading to a sudden fall in the necessity of memory and time for testing new samples [18][19][20][21][22]. An SVM segmentation approach for traffic sign recognition was given in [1][3][5][7][8], while in [10][12][13][14][15], an effective strategy helping in the process of recognizing slanted speed limit signs by extracting the rotation invariant features with the help of Fourier based wavelet descriptor was introduced. The different categories of sign board images were classified with the help of Support Vector Machines (SVMs) consisting of binary tree architecture. In [18][20][21][22][23], a shape-based classification was developed using an SVM. In order to represent the features, two types of features including a binary image and Zernike moments were used. The main objective behind carrying out this research work was recognizing seven categories of traffic sign shapes as well as five categories of speed limit signs. In addition to SVMs, AdaBoost is also a popular classification approach. A color insensitive Haar wavelets feature combined with the AdaBoost algorithm was introduced in to develop a country-independent recognition module [14][15][17][21][23]. By using the concept of a class similarity measure that is learnt from image pairs, realization was achieved with the help of a new newer version of the existing AdaBoost algorithm which is known as SimBoost algorithm [15][17][18][22][23]. The solution to the problem of classification between multiple classes can be obtained if we compare the similarities between an unknown example and prototype from each class, subjected to the condition that an estimate of the similarities between any two images is made available. The stop and give way signs in different and complex surroundings were successfully classified by taking help from an array of weak classifiers in a reliable fashion [1][4][5][7][8], In [12][14][15][16][18], the help of classifiers which are trained to refine the type of traffic sign like neural networks and AdaBoost classifiers was also being taken. With the help of AdaBoost feature selection procedure, suitable features were chosen from a very large pool of features consisting of Haar, moment, symmetry, frequency and other features. The results which were obtained from the various classifier algorithms were combined over time and merging of the signs that are quite similar on both the sides of the roadway was accomplished taking help of fusion module that incorporated combining a Bayesian network and a decision tree [21][22][23][24][25]. An Error Correcting Output Codes (ECOC) which takes help from a forest of optimal tree structures that are embedded in the ECOC matrix were also being formulated along with the existing methods. An entirely different approach that is suitable for classifying sign boards belonging to different classes by using the ECOC technique was introduced in [12][14][15][17].

III. SOFTWARE TOOL USED

MATLAB R 2016 a was used for the process of simulation of various images that are present in our database.

IV. PROPOSED RESEARCH METHODOLOGY TO BE EMPLOYED

In our experiments, a traffic sign image database is prepared which consists of different types of traffic signs of different colors, shapes, sizes and variations in the lighting conditions according to the surrounding weather conditions like sunny, cloudy, rainy, foggy, snowy, smoky and hazy weather etc. After the traffic sign images are acquired from the traffic sign image database which is done with the help of external moving camera placed on the top of the car or in some cases may be mounted in the body of the car itself and in some cases, the driver who is driving the vehicle may wear a camera which is attached by a string with its two ends tightly fitted to the two ends of the camera and the assembly is worn by the driver. The process consists of five modules, viz., image acquisition from the image database, pre-processing of the input images, detecting the traffic sign which is followed by the process of recognizing the sign board which is followed subsequently by the process of traffic sign recognition which is then classified accordingly. The input image is acquired from the image database and subjected to some pre-processing operations such as noise

removal as well as enhancing the image in the spatial domain. The images were detected by taking the aid of some methods that are used for segmenting an image. The input images were then subjected to the process of segmentation in which the complete image is partitioned into multiple images or a group of similar images by using an appropriate segmentation procedure. After the process of segmentation, the images were subjected to the process of feature extraction in which a set of suitable features was extracted from an image by using some feature extraction techniques. The images were then classified with the help of some appropriate classification algorithm that is most commonly used in the domain of applications pertaining to the engineering discipline where a correct and accurate interpretation of sign boards is required for ensuring safety of the driver who is driving the vehicle for the purpose of classifying the images. The output of the complete system can be given as an input to Driver drowsiness detection module that estimates the amount of drowsiness that the driver experiences during the course of driving a vehicle. An Alerting System can be designed by using some hardware such as microcontroller or similar equipment so that the driver can be alerted by generating an alarming signal thus warning the driver about the potential danger of facing a collision while driving a vehicle. So far, we have done the pre-processing of the traffic sign image databases which includes conversion of the original RGB or the color image to a gray scale image. The output of the complete system can be given as an input to Driver drowsiness detection module that estimates the amount of drowsiness that the driver experiences during the course of driving a vehicle. The complete summary of this method can be illustrated in a diagrammatic representation which constitutes the backbone of a pre-collision warning and avoidance scheme.

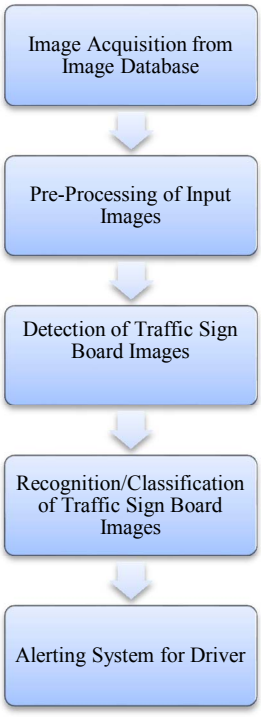

Fig.1. Block Diagram of the Proposed Research Methodology to be employed

V. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this experiment, a traffic sign image database was prepared which consists of different types of traffic signs of different colors, shapes, sizes and variations in the lighting conditions according to the surrounding weather conditions like sunny, cloudy, rainy, foggy, snowy, smoky and hazy weather etc. There are 610 traffic sign images which belong to 18 different categories of traffic signs. It was divided into two main categories, viz., the non-textual information traffic sign images which contain only the color, shape and there is no textual information present on it and the textual information traffic sign images which contain the color, shape as well as textual information present on it. The examples of different traffic sign images which are present in our image database are shown as below in Fig.2.

Fig. 2 Examples from Our Traffic Sign Image Database Which Consists Of Textual and Non-Textual Information Traffic Sign Images

The different types of algorithms that are used in the above experiment are discussed in the section that is given as below:

A. Application of Histogram of Oriented Gradients (HOG) Algorithm consisting of Extraction and plotting of the HOG Features from a given image (HOG Type 2)

We can take the help of Histogram of Oriented Gradients (HOG) algorithm in order to provide detailed information regarding the features that are present inside a particular image and finds a large application in the domain of computer vision as well as processing of digital images for the purpose of detecting the objects. The above process takes into account the existence of orientation of the gradients that are present inside the localized portions in an image. All the images that are present in the database were subjected to the process of extraction of HOG features that uses the technique of extracting the HOG features with the help of cell size from a particular image and the results that are obtained by using the above method are shown as below:

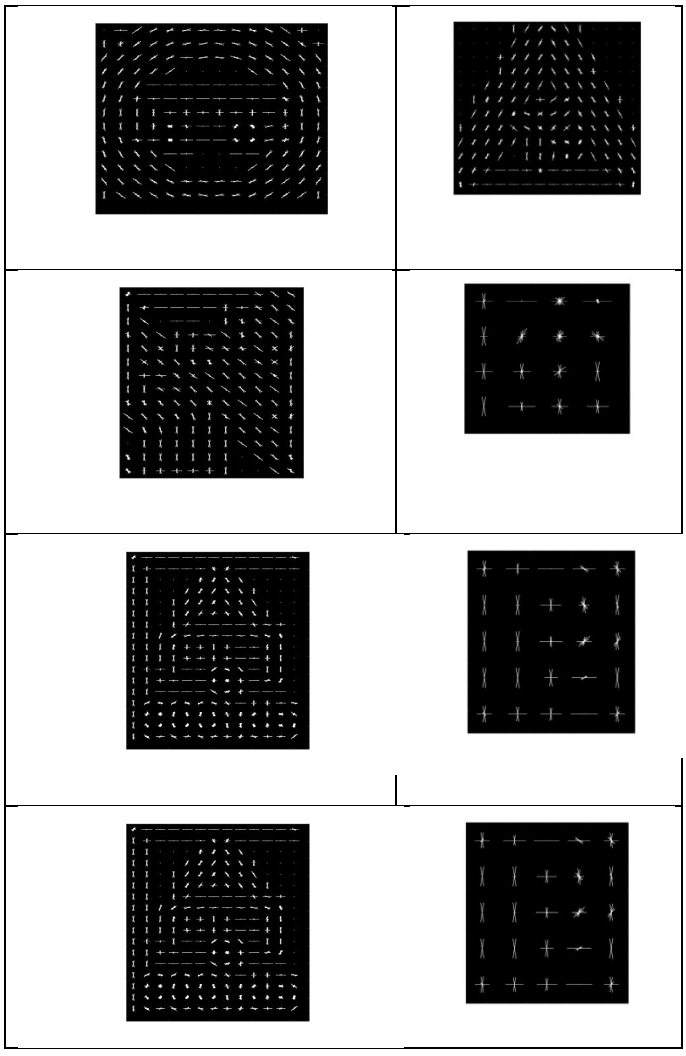

Fig. 3 Results obtained by the process of Extraction and Plotting of the HOG Features from the Color images in the image database by using Histogram of Oriented Gradients (HOG) Type 2 Algorithm

B. Application of Histogram of Oriented Gradients (HOG) Algorithm consisting of Extraction and plotting of the HOG Features from a given image (HOG Type 3)

We can take the help of Histogram of Oriented Gradients (HOG) algorithm in order to provide detailed information regarding the features that are present inside a particular image and finds a large application in the domain of computer vision as well as processing of digital images for the purpose of detecting the objects. The above process takes into account the existence of orientation of the gradients that are present inside the localized portions in an image. All the images that are present in the database were subjected to the process of extraction of HOG features that uses the technique of extracting the HOG features from a particular image around the corner points and the results that are obtained by using the above method are shown as below:

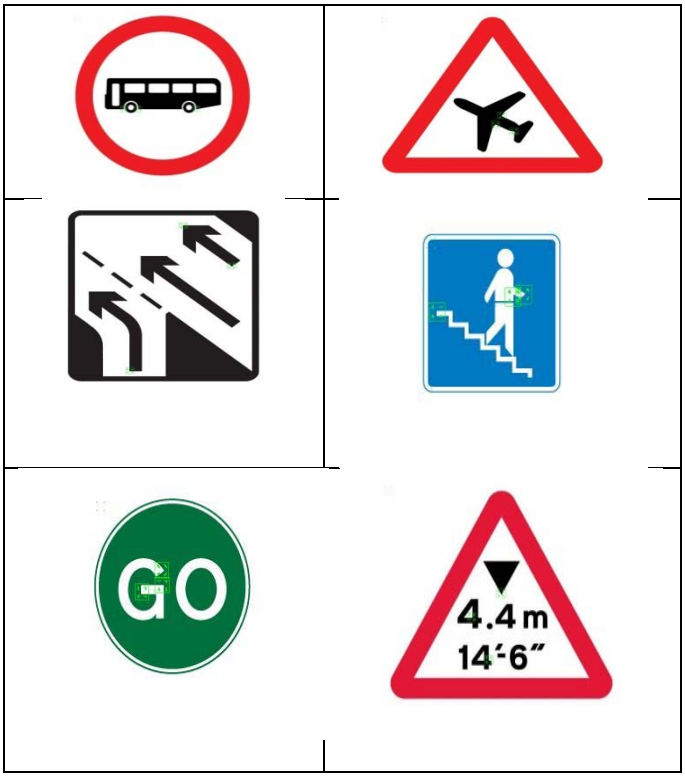

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Fig. 4 Results obtained by the process of Extraction and Plotting of the HOG Features from the Color images in the image database by using Histogram of Oriented Gradients (HOG) Type 3 Algorithm

C. Contrast Stretching of Color images:

The process by which the range of values of intensity of the pixels that are present inside an image can be altered is known as normalization of an image or contrast stretching of an image. All the images that are present in the image database were subjected to the process of contrast stretching and the results obtained are shown as below:

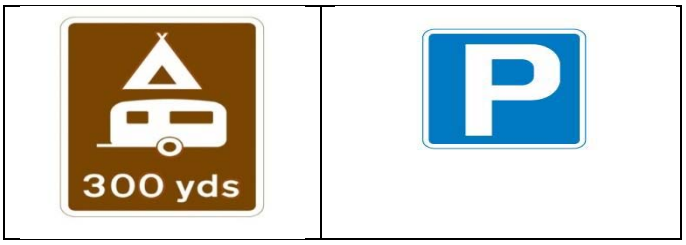

Fig. 5 Results obtained by the process of Contrast Stretching Algorithm applied to Color images

VI. CONCLUSION

If we consider the significant contribution of monologue, an entirely new strategy for the prevention of collision which results from the incorrect interpretation of the traffic sign images as well as due to the drowsiness of the driver who is driving the vehicle is presented which helps the driver to avoid such kind of adverse situation by generating a warning signal when the potential danger of collision is being confronted by him with the help of Automatic Braking System (ABS) and an audio visual warning signal so that he may take preventive care and the danger of having a collision can be avoided to a much greater extent. This research paper also takes into account the contributions which are made by several research scholars and the advantages and disadvantages of their research work particularly in building an efficient and safe driver assistance system, thereby reducing the chances of collision of the vehicle with the object which is in front of it and issuing a message signal to the driver who is driving the vehicle. The research paper also takes into account the shortcomings of the research work of the existing scholars and use it to build a foundation in constituting the subsequent research work which needs to be carried out so that the aims and the objectives of the problem can be fulfilled. In this research paper, brief information about the proposed research methodology which is to be employed is illustrated and the successive steps in formulating this strategy are highlighted and future work includes the traffic sign detection process which will be performed and presented in the next research paper.

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