Study of Various Image De-noising Methods used for the Purpose of Traffic Sign Board Recognition in an Intelligent Advanced Driver Assistance System

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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 removing the noise present in a particular image with the help of Arithmetic Mean Filter as well as Geometric Mean Filter. In the future, we will concentrate on detecting, recognizing as well as classifying a particular sign board.**

Keywords: Color; Shape; Image De-noising; Arithmetic Mean Filter; Geometric Mean Filter

I. INTRODUCTION

There is a huge demand in the market as there is a rapid development in improving the existing system which help to provide a safe driving environment thereby facilitating the growth of systems that provides a helping hand thereby incorporating some new techniques used for the purpose of detecting as well as recognizing the traffic signs nowadays as many automobile industries are spreading their legs in the market due to an increase in the demand for smart cars as a result of the rising competition among its fellow industries [1][2][3][4][5]. If we consider the areas where there is a large amount of travelling, the regulation of the speed of the vehicles is done by the use of sign boards that are used for limiting the current velocity of moving vehicles and are considered to be a part that comprises of some major categories of traffic signs [6][7][8][9][10]. It is observed that there is a rise in the number of roadway accidents because of ignoring the sign boards that indicate limiting the velocity of a moving vehicle for the persons who are driving a vehicle who are not aware of the same during the course of driving and consequently meet a serious accident that may even lead to the death of the person who is driving the vehicle [11][12][13][14][15]. There is an urgent need for development of a system which can be used to recognize the Speed Limit Signs (SLS) in an automatic fashion and may be used for alerting the driver [16][17][18][19][20][21][22][23][24]. There are two major steps which are involved in the processes of detecting and recognizing the SLS, the first step is to detect the potential candidates which are known as the Regions of Interest (ROI) that usually comprises of the sign board images and the second step is to recognize the ROI in order to extract the correct category of sign board images [2][5][8][12][13]. The primary visual features of an image like the color and the shape are normally used the purpose of detecting a sign board image, for example, the color is used for detecting the red SLS while the shape is used for detecting circular or rectangular sign board images [15][18][21][22][24][25]. If we study the research work which is done in the past, we will come to know that the rectangular speed limit signs are usually detected with the help of shape-based methods, for example, if we study the research work which is carried out by [12][15][18][20], we will find that the rate of detecting

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the sign board images was increased in the rough conditions, especially, during the night time. The circular sign board images are detected by making use of the color-based and/or the shape-based methods, for example, if we consider the research work which is carried out by [21][22][23][24][25]. Next step which is involved in the process of recognizing the SLS comprises of two important techniques, namely, the processes of recognizing sign boards that are available in a broad range as well as recognizing each and every character on a given sign board. If we take an example of strategy that incorporates recognizing a given sign board which is made available in a wide range, one may find a complete candidate sign to be considered for recognizing process [4][8][12][15][17]. If we take the example of digit-based methods, the process of extracting multiple characters for recognizing numerical portrait of velocity which is exhibited by a moving vehicle rather than classifying a complete sign board image treating it as a single entity is performed [18][22][24][25]. The process of recognizing sign board images contributes significantly for helping the driver thereby playing an important part in controlling the road traffic thereby issuing a warning signal and giving proper guidance to the drivers [4][8][12][15][18]. It is observed that ignoring the sign boards because of distraction or being in a psychological state by the drivers is the main cause of roadway accidents which are occurring in last few years. There is an urgent need for incorporating an automatic system for the purpose of recognizing the sign boards and is considered to be a main factor for building an autonomous navigation system [19][22][23][24][25]. In order to detect and recognize the sign boards with a faster speed and higher efficiency, particularly, in a real time scenario, the proposed system should have a higher precision so that the process identification of sign board images can be performed in a correct manner. The detection and the recognition efficiencies can be affected if the system is busy in managing certain complicated issues. The various problems that are associated with these systems include the variations in the illumination such as variations in the level of intensity of a stream of photons, wee hour duration, moist weather conditions, falling of water drops from sky as well as projection of a human being on ground especially in standing position, condition of having a distorted version of surrounding objects when they are subjected to moving in a back and forth position as well as having an irregular vision of a particular roadway symbol when it is exposed to various atmospheric conditions [2][5][8][12][15]. The effectiveness can be considered to be one among the major factors because the complete navigation system is damaged by the improper classification and lack of detection of sign board images. But, later it was revealed that the systems that are currently present in the literature part are unable to provide 100% accuracy. The research scholars were motivated by the results which are given in the section above and there was an improvement in the performance of system that is capable of detecting as well as recognizing the sign board images even in the complicated situations and thus highlights the importance of our research work in building this method that is being presented in this review paper A novel technique which is used for the process of detecting, tracking and classifying the sign boards at a faster speed from a moving vehicle even in the difficult conditions was proposed by [18][20][21][23][25]. 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.

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 [12][16][19][22][23], 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 [13][17][19][22][24], 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 multiple vectored inputs which prove to be more useful in the task for supplementing above parameters that may be required during executing complete process leading to a sudden fall in the usage which demands capacity and duration for testing latest specimens [12][14][16][18][20]. An SVM segmentation approach for traffic sign recognition was given in [17][19][22][23][24], while in [18][19][22][23][25], 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 [11][13][18][21][23], a shape-based classification was developed using an SVM. In order to represent the features, two types of features including a matrix of pixels in which the values that are associated with them are normalized in the range 0 to 1 representing the variation in the intensity levels as well as moment feature representation that are discovered by a popular scientist who has carried out research work in this arena. The main objective behind carrying out this research work was to identify different types of roadway symbols as well as different types of roadway symbols which are used to regulate the velocity of moving vehicles. 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 [12][14][18][19][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 [12][14][16][20][22][23].

III. PROPOSED RESEARCH METHODOLOGY TO BE EMPLOYED

MATLAB R2016a was used for the process of simulation of various images that are present in our database. In our experiments, a traffic sign image database is prepared which consists of various roadway symbol images belonging to numerous classes comprising 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. 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 complete summary of this method can be illustrated in a diagrammatic representation (Fig.1) which constitutes the backbone of a pre-collision warning and avoidance scheme.

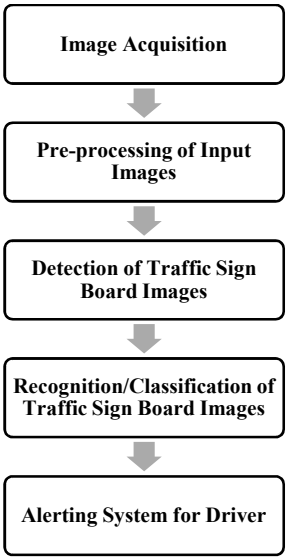

Fig.1. Block Diagram of the Proposed Research Methodology to be employed

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this experiment, a traffic sign image database was prepared comprising various roadway symbol images belonging to numerous categories 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. The different types of algorithms that are used in the above experiment are discussed in the section that is given as below:

A. Arithmetic Mean Filter:

An Arithmetic Mean Filter can be considered as one of the most simple of mean filter amongst other types of mean filters. This subsequent procedure calculates the average value of an image that is subjected to corruption in an area that is defined by S_{xy}. We can obtain a particular numerical estimate if we consider frames of roadway symbol that are subjected to the task of recovering from its altered version, for example, if we denote it with an abbreviation called as f, thereby choosing the location of corresponding pixel which can be denoted by representing it in Cartesian co-ordinate system by calculating the average by taking help from the 'pels' surrounding that specific area that is characterized with the help of conventional symbolic representation. The amount of noise can be reduced by taking the help of blurring operation.

Fig. 2 Examples from Our Traffic Sign Image Database which consists of Textual and Non-Textual Information

B. Geometric Mean Filter:

The pixels that are restored are given by taking the product of the pixels that are present inside the region which is particularly important when we are working on frames that are derived from the main frame. In a filtering operation which is performed by calculating the average of the pixel values in a more systematic fashion, the process of smoothing that can be compared to that of an arithmetic mean filter.

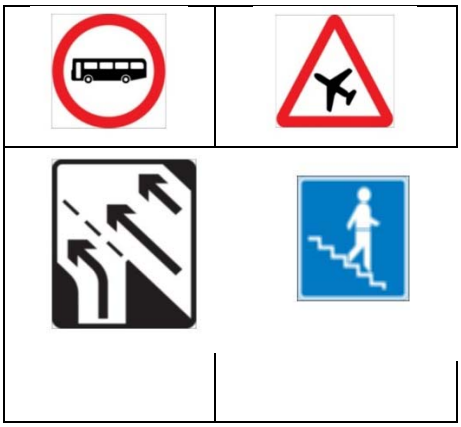

Fig. 3. Results obtained after performing the operation of Arithmetic Mean Filtering on the images that are present in the image database

The major disadvantage of using this operation is that the minute details which are present inside an image are not lost during the whole procedure.

Fig. 4. Results obtained after performing the operation of Geometric Mean Filtering on the images that are present in the image database

V.CONCLUSION

If we consider the significant contribution of monologue, an entirely new strategy for the prevention of accidents is suggested. The results indicate 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. This 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. 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 and collision prevention.

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