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Traffic Sign Detection Using CNN

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Abstract- Road signs are essential to ensure creaseless traffic flow without bottle necks or accident. Road symbols are the pictorial correspond having antithetic necessary message required to be understood by driver. Road signs in front of the transport are ignored by the driving force and this can lead to catastrophic accidents. Road signs give out a number of messages regarding the road and what you as a driver should expect on the road. They keep the traffic flowing freely by helping drivers reach their destinations and letting them know entry, exit and turn points in advance. Pre-informed drivers will naturally avoid committing mistakes or take abrupt turns causing bottlenecks. This work present's traffic sign board detection and recognition and implements a procedure to extract the road sign from a natural complex image, process it and alert the driver using voice command. It will implement in such a way that it will act as a boon to drivers to make easy decisions.

Keywords- Traffic Sign, CNN Algorithm, Machine Learning, Road Safety, Image Processing.

I. INTRODUCTION

To regulate the traffic safety, variable speed limitations, informational signs, and directional signs are placed along the road according to the environmental conditions and traffic situations of the road. Therefore, rapidly updating traffic signs is essential for transportation agencies to manage and monitor the status and usability of traffic signs. Vehicles are the primary means of transportation in our day to day life.

Due to increase in the number of vehicles the drivers are experiencing several risks while driving and this may also lead to accidents. A vast amount of accidents are happening every year all over the world. These accidents are mainly because of the driver inability to process all the visual information that is available while driving. According to the 'World Road Statistics' report published by the International Road Federation (IRF), Geneva, India has recorded the second highest number of road accident deaths in the world in the year 2015.To regulate the traffic safety, variable speed limitations, informational signs, and directional signs are placed along the road according to the environmental conditions and traffic situations of the road. Therefore, rapidly updating traffic signs is essential for transportation agencies to manage and monitor the status and usability of traffic signs.

Traffic signs are placed beside the roads to warn about the dangerous road conditions ahead and to provide necessary information to the driver. Sometimes, a heavy traffic, weather conditions or miss attention of drivers causes a chance of missing a sign and it might lead to accidents. So, it is necessary to detect and recognize these traffic signs automatically and alert the driver about the situation. Current traffic sign detection and recognition systems are based mainly on digital images and videos. To warn and guide drivers, traffic signs, well defined by highly contrasting colours (e.g., red, blue, yellow, and white), can be distinguished easily from a complex environment.

Developing automated traffic sign recognition systems helps assisting the driver in different ways in order to guarantee his/her safety, which preserves as well the safety of other drivers and pedestrians. These systems have one main goal: detecting and recognizing traffic signs during the driving process. With these functionalities the system can guide and alert the drivers to prevent danger. Even though it is possible to develop a system that can recognize traffic signs, it doesn't mean that any sign can be correctly recognized by the system due to some traffic environmental challenges, for example: lightning variations, bad illumination, weather changes and signs in a ruined condition. Road signs, bespeak turns, directions and landmarks, also help to prevention time and fuel by supply message on the route to be taken to reach a special destination. Road signs are located in specific areas to guarantee the safety of drivers. These grade let drivers know how accelerated to drive. They also tell thrust when and where to turn or not to bend. In order to be an intense driver, someone needs to have a perceptive of what the sign average.

Traffic signs (TS) are generally divided into three main categories according to theirs functions: regulatory signs to give notice of traffic laws or regulation, warning signs to give notice of a situation that might cause danger and finally guide signs to

show information about route destinations, distances, etc. In each mentioned TS category, there are different subclasses with similar generic shape and appearance but different details. This suggests that traffic sign recognition should be carried out in two phases: the first phase consists of detecting traffic signs in a video sequence or an image using image processing algorithms that are generally based on shape and colour segmentation. The second one is normally related to recognition of the detected signs in the first step, by applying a classification algorithm. Various methods have been developed in this area on top of them, artificial neural networks.

1. Problem ingredients:

A change in light basis circulation can cause an important change in the arrival of the road sign image. There is a large factor of non-rigidity and textural changes among road sign. Road sign detection is also made problematic because of additional features, such as dust, which can either be current or totally inattentive from a road sign.

2. Objectives:

The aim of the project is to regulate traffic safely to develop a system which is useful to identify the traffic signal. To reduce road accidents and to help uneducated people who don't know the meaning of a particular traffic symbol.

3. CNN Algorithm:

Convolutional Neural Network (CNN) algorithm is used for image recognition. Having an image an input, CNN scans it many times to look for certain features. This scanning (convolution) can be set with 2 main parameters: stride and padding type.

II. LITERATURE SURVEY

There are many researches in the literature dealing with Road Traffic Sign Recognition (TSR) problem. The very first work on automated traffic sign detection was presented in Japan in 1984. Different researchers introduced several methods afterwards, to develop an efficient traffic sign recognition and detection (TSDR) system. The subsequent section discusses the literature related to traffic sign recognition.

A. Gudigar et al. [1] presents an Automatic Traffic Sign Detection and Recognition (ATSDR) system, involving three modules: segmentation, detection, and recognition. Region of Interest (ROI) is extracted using multiple thresholding schemes with a novel environmental selection strategy. The traffic sign detection is carried out using correlation computation between log-polar mapped inner regions and the reference template. Finally, recognition is performed using Support Vector Machine (SVM) classifier. This system achieved a recognition accuracy of 98.3 % and the experimental result demonstrates the robustness of traffic sign detection and recognition in real-world scenario.

J. M. Lillo-Castellano et al. [2] proposed system which is divided into three stages: (1) segmentation of chromatic and achromatic scene elements, where two machine learning techniques (*k*-Nearest Neighbours and Support Vector Machines) are used; (2) post-processing in order to discard non-interest regions, to connect fragmented signs, and to separate signs located at the same post; and (3) sign-shape classification by using Fourier Descriptors, which yield significant advantage in comparison to other contour-based methods, and subsequent shape recognition with machine learning techniques.

Hee Seok Lee et al. [3] proposed traffic sign detection system that simultaneously estimates the location and precise boundary of traffic signs using convolutional neural network (CNN). In this work, the boundary estimation of traffic signs is formulated as a 2D pose and shape class prediction problem, and this is effectively solved by a single CNN. With the predicted 2D pose and the shape class of a target traffic sign in an input image, author estimated the actual boundary of the target sign by projecting the boundary of a corresponding template sign image into the input image plane.

Safat B.Wali et al. [4] developed technique is invariant in variable lighting, rotation, translation, and viewing angle and has a low computational time with low false positive rate. The development of the system has three working stages: image preprocessing, detection, and recognition. The system demonstration using a RGB colour segmentation and shape matching followed by support vector machine (SVM) classifier. The area under the receiver operating characteristic (ROC) curves was introduced to statistically evaluate the recognition performance.

Hasan Fleyeh et al. [5] described a system for identification of the road signs. The system works in two main stages: detection, and recognition. In the detection phase, the image is pre-processed, enhanced, and segmented according to the sign properties such as colour or shape. The output is a segmented image containing potential regions which could be recognized as possible road signs. In the recognition stage, each of the candidates is tested against a certain set of features (a pattern) to decide whether

it is in the group of road signs or not, and then according to these features they are classified into different groups. The shape of the sign plays a central role in this stage and the signs are classified into different classes such as triangles, circles, octagons, etc. Pictogram analysis allows a further stage of classification.

H. Li et al. [6] proposed traffic sign detection method by integrating color invariants based image segmentation and pyramid histogram of oriented gradients (PHOG) features based shape matching. Color invariants from given image are extracted in Gaussian color model, and then segmented the image into different regions to get the candidate regions of interests (ROIs) by clustering on the color invariants. Next, PHOG is adopted to represent the shape features of ROIs and support vector machine issued to identify the traffic signs.

Y. Yang et al. [7] dealt with real-time traffic sign recognition, i.e., localizing what type of traffic sign appears in which area of an input image at a fast processing time. To achieve this goal, authors proposed a detection module. This detection module is based on traffic sign proposal extraction and classification built upon a color probability model and a color HOG. Convolutional neural network is used to further classify the detected signs into their subclasses within each superclass.

X. Yuan et al. [8] proposed a Color Global and Local Oriented Edge Magnitude Pattern (Color Global LOEMP). It effectively combines color, global spatial structure, global direction structure, and local shape information and balance the two concerns of distinctiveness and robustness.

The color angular patterns are proposed to provide the color distinguishing information and a context frame is established to provide global spatial information, due to the fact that the context frame is established by the shape of the traffic sign. Also a LOEMP is proposed by authors to represent each cell. In each cell, the distribution of the orientation patterns is described by the HOG feature, and then, each direction of HOG is represented in detail by the occurrence of local binary pattern histogram in this direction.

S. Salti [9] et al. proposed a system which deals with high appearance variations, which typically occur in traffic sign recognition applications, especially with strong illumination changes and dramatic scale changes. The proposed approach is specialized in three variants, each aimed at detecting one of the three categories of Mandatory, Prohibitory and Danger traffic signs.

A. Ruta [10] et al. described the concept of a robust sign similarity measure that can be inferred from the domain-specific data. Two novel machine-learning techniques are proposed by the authors as a framework for automatic construction of such a measure from the pairs of images representing either the same or different classes. One is called SimBoost, which is a variation of the AdaBoost algorithm, and the other is based on the fuzzy regression tree framework.

X Kuang [11] et al. proposed a maximally stable external regions (MSER) method with image enhancement. Firstly authors employed gray world algorithm to process original images then potential areas of traffic signs are obtained through increasing the image contrast ratio and extracting the image-enhanced MSER. According to the characteristic variable and the geometry moment invariants, the geometric characteristics of traffic signs are extracted to obtain the ROIs. Finally, HSV-HOGLBP feature is constructed and the random forests algorithm is used to identify the traffic signs.

III. WORKING OF PROPOSED MODEL

Figure 1 shows system architecture of proposed system. The architecture shows how the system detects and classifies traffic signs using trained model using database. The database mainly contains the data of all existing traffic signs. The detailed working of the proposed system is explained in the subsequent section.

A. Data Set: A data set used for this system is a collection of traffic related discrete items. These are all traffic signs which are used to implement this system.

B. Sign Detection: In this phase, the image obtained from the camera in the vehicle is preprocessed before the process of detection starts. General preprocessing steps involve converting the obtained RGB image into an HSV image. Once the HSV image is obtained, the next is to detect objects based on their colour followed by finding out their shape and validating the object to be a traffic sign. The first and most important thing we notice in a sign is the colour. Once we see the colour red, we realize that the board on the side of the road is actually a traffic sign. The second part is shape detection; this is done using number of edges and the area. The main type of areas identifies are triangle, circle and rectangle. One the area is identified, the sign is validated.

C. Classification: The proposed system uses a convolutional neural network for classification of signs. A convolutional neural network can have many layers, the first always being the input layer and the last the output layer anything else in between is called a hidden layer. Convolution neural network assort traffic signs. It is trained to decode aggregation signs from natural

intellectual image using the Traffic Sign Dataset. This data is prepared to maximize the model performance. Convolutional neural network scans two main parameters: stride and padding. The picture process of the convolution gives a set of new frames each frame contains information about one feature and its presence in scanned image. Resulting frame have larger values in places where a feature is strongly visible and lower values where there are no or little such features. Afterwards, the process is repeated for each of obtained frames for a chosen number of times. The code of this system is written in Python.

After the traffic signs are classified those are converted into text format and text message is further converted to voice alert message. The final output of the system traffic sign the voice alert message given to driver, so that he/she will be assisted to drive. Figure 2 shows work flow of traffic sign detection and classification system.

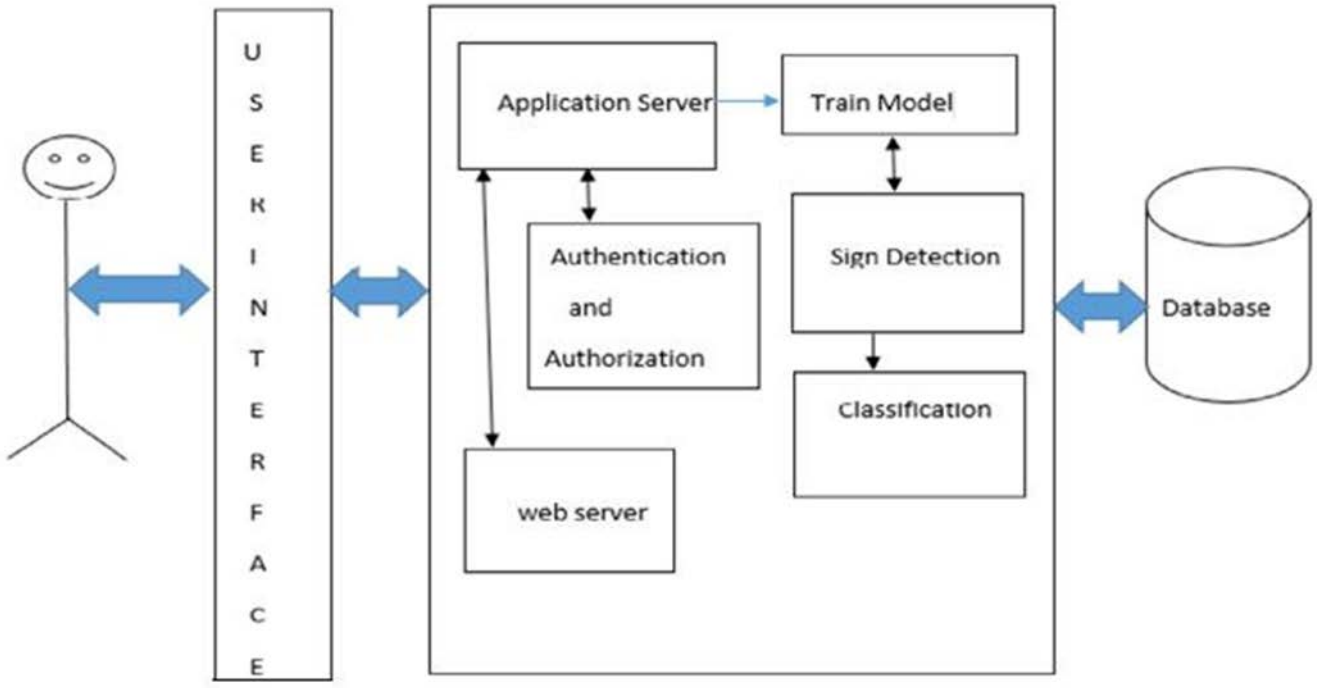

Fig. 1 System Architecture

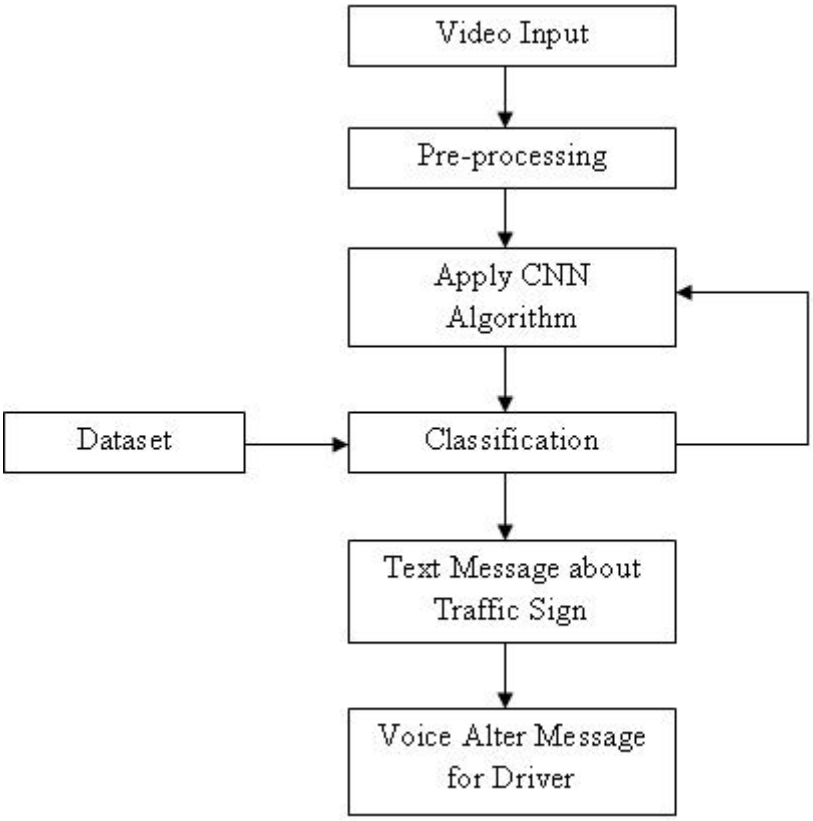

Fig. 2 Work Flow

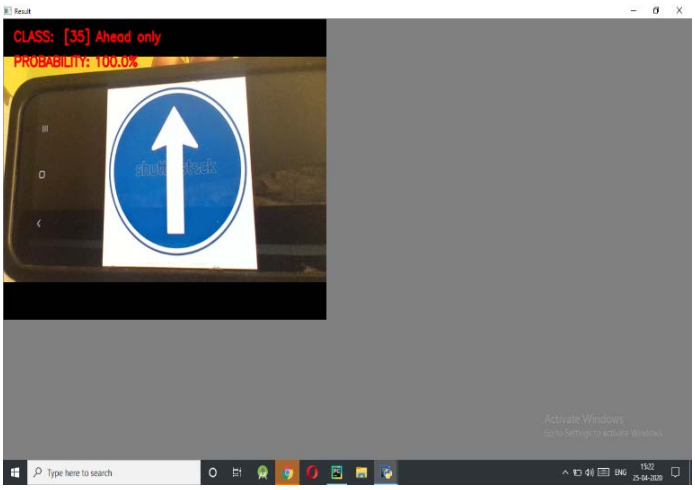

Fig. 3 Sign 1

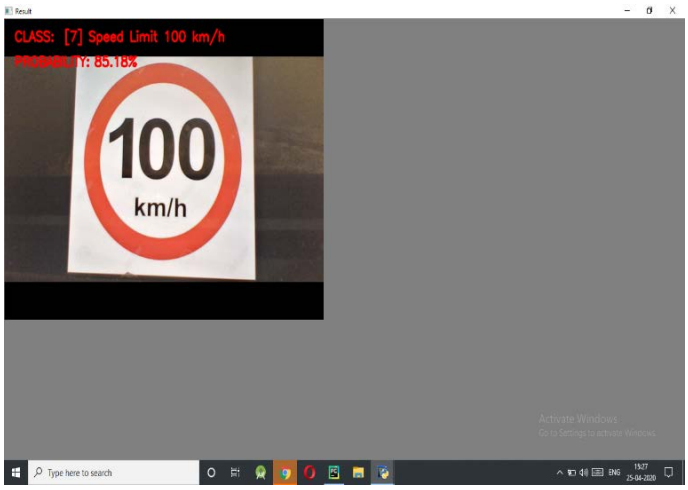

Fig. 4 Sign 2

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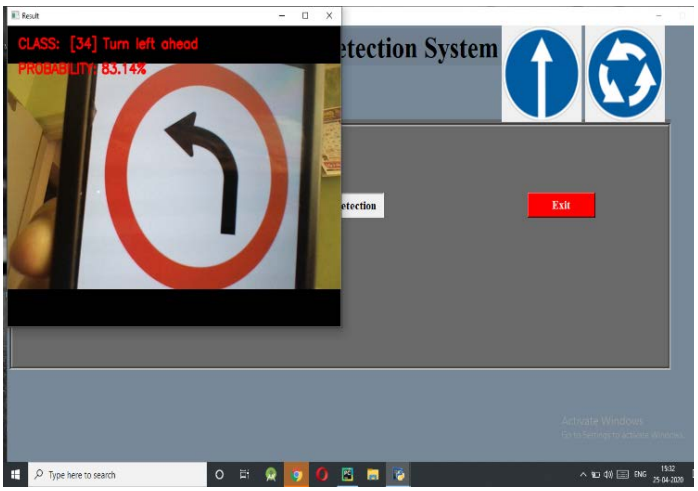

Fig. 5 Sign 3

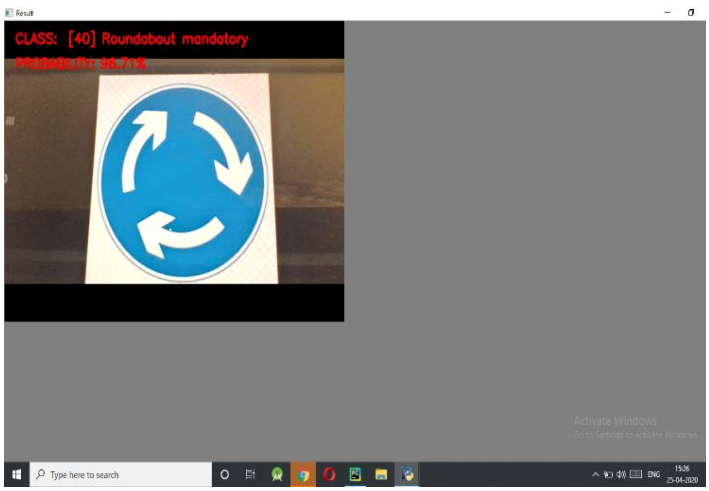

Fig. 6 Sign 4

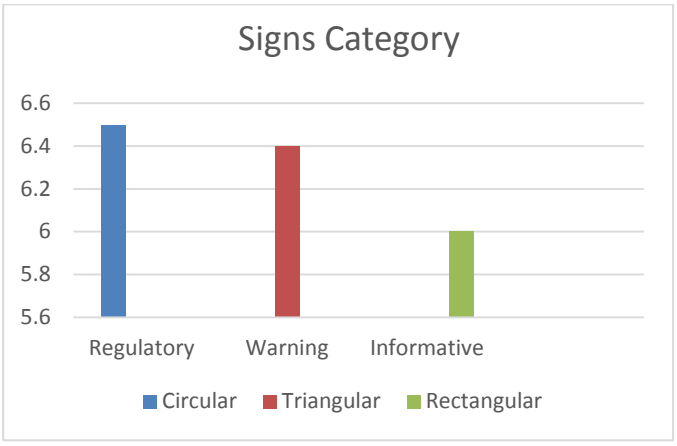

Fig. 7 Sign Category

Fig. 8 Sign Recognition

IV. IMPLEMENTATION

The Implementation of this proposed system consists of below modules.

A. Module I – Data Collection

In this module, System needs an image which has traffic signs and in this system we collect real time images which consist of traffic sign images.

B. Module II –Morphological Operations

In this module, After collecting an image with traffic sign that image should be pre-processed by performing some operations which will remove unwanted noise and make that image ready for further processing. Opening, Closing, Dilation, Erosion these are some operations required for an image in pre-processing step.

C. Module III – Sign Detection

In this Module, Once the morphological operations are performed and image is converted into binary image the observed features are detected based on shapes and colours.

Pre-processing step is repeated until we get some new features. After detecting an image system sends it for further process which is classification.

D. Module IV – Sign Classification

In this module, after detecting an image that particular image is to be classified based on standard dataset which we have already collected and for these system we are using German Traffic Signs Dataset. Based on three Categories and using CNN algorithm the signs are classified into various categories like Circular, Triangular and Rectangular. This shows their functionalities like Regulatory, Warning and Informative.

E. Module V – Text Message

In this module, after classification is done of an image text conversion is done. Every traffic sign has a particular meaning and to have knowledge about that particular sign and its meaning to everyone this system has a module which has meanings of all traffic signs, so it generates text message for sign.

F. Module VI - Voice Alert Message

This is the last module of proposed system and it generates a voice message of sign which has generated its text message.

V. RESULTS AND DISCUSSION

The convolution layer computes the output connected to local regions or receptive fields in the input, each computing a dot product between their weights and a small receptive field to which they are connected to in the input volume. The every computation leads to extraction of a feature map from the input image. An image represented as a 5x5 matrix of values, and system takes a 3x3 matrix and slides that 3x3 windows or kernel around the image. At each position of that matrix, system multiplies the values of 3x3 windows by the values in the image that are currently being covered by the window. As a result, a single number that represents all the values in that window of the images. System uses this layer to filtering: as the window moves over the image, it checks for patterns in that section of the image.

VI. CONCLUSION

This paper proposes efficient traffic sign detection system using Convolution Neural Network. The proposed system is smart driver alert system which detects and recognizes traffic signboards from video stream input and gives text & voice alert messages to the driver. This technology is useful to reduce the road accidents and helps to regulate traffic safely.

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