International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Prediction of Traffic Signs for Automated Vehicles using Convolutional Neural Networks

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Abstract - *Road Traffic accidents is one of the major reasons for deaths taking place in India. These accidents not only result into serious injuries but may also lead to deaths. Image recognition technology is one of the widely used techniques used in various fields in research like agriculture, medicine, automobile etc. Image recognition techniques are being used which are not only time consuming but also very simple to handle. It also provides improved algorithms, and makes them more and more efficient and robust. Principles of convolution neural network are used. Its numerous applications in the domain of Image Processing helps to handle traffic sign recognition systems by indicating driverless vehicles about the approaching traffic signs and gives alerts to the vehicle. Finally, the challenges faced by Convolution Neural Network in terms of time complexity and accuracy were analyzed and is being enhanced by uses more accurate filters and using tensor flow algorithms for giving accurate result of traffic sign*

Key Words: **Image Processing, Sobel Edge detection algorithm, Frame extraction, Frame normalization, Tensor flow, Convolution Neural Network, Median filter, Trained Datasets**

1. INTRODUCTION

Traffic accidents are a major reason for death and injuries in the country. The condition is improving in many parts of the world, whereas large number of accidents is still taking place in India. A recently conducted survey shows 64% of drivers in India on an average have regretted missing road traffic This may also result in road traffic accidents causing into serious injuries or even deaths at times. Almost 24% of drivers in India follow Google maps application without even paying any attention to the on road traffic sign boards (Y. Hatolkar et al, 2017). This could possibly be another reason for on road accidents resulting into serious injuries or deaths. Traffic Symbol recognition is basically a methodology in which the vehicles are able to determine road traffic signs and avoid the accidents taking place. These signs may include various road symbol alerts like "speed limits", "one-ways", "school ahead", etc. Considering the current Traffic management system, there is high possibility that the driver would miss out the road traffic symbol plate alerts due to overcrowding of the traffic on-road. The condition is even worsening due to over population in urban cities. Some of the road traffic sign information can also be obtained from GPS, but it is not always up to-date. After extraction of the road traffic signs from the system, they can be displayed on the panel of the cars, or could injuries or deaths. Traffic Symbol recognition is basically a methodology in which the vehicles are able to determine road traffic signs and avoid the accidents taking place. These signs may include various road symbol alerts like "speed limits", "one-ways", "school ahead", etc. Considering the current Traffic management system, there is high possibility that the driver would miss out the road traffic symbol plate alerts due to overcrowding of the traffic on-road. The condition is even worsening due to over population in urban cities. Some of the road traffic sign information can also be obtained from GPS, but it is not always up to-date. After extraction of the road traffic signs from the system, they can be displayed on the panel of the cars, or could driving as well.

1.1Literature Survey

Initially image segmentation techniques were used. They were inaccurate and incompatible with changing environmental conditions(1989).Thus later in 2016,successful implementation of the system was done using canny edge detection algorithm. It highlights edges to compare shape of traffic sign with data set. In (H. Fleyeh et al, 2003) Image segmentation technique is used to determine the shape of the traffic sign by comparing it with the provided data set. Image segmentation technique for road traffic sign recognition results in inaccurate output due to blur images captured during motion of the car. In (V. Andrey et al, 2006), RGB color segmentation technique is used along with rule based approach. Image morphological analysis is done to determine the shape of traffic sign. Results obtained contain large amount of false positives. In (H. Gómez-Moreno et al, 2010) basically, the approach is based on Maximally Stable

External Regions (MSERs). Support Vector Machine (SVM) is cascaded for training system. This detection technique is significantly insensitive to variations in illumination and lighting condition.

1.2 Existing System

Images captured from the camera are usually of poor quality. The system needs to enhance the quality of the images, in order to obtain the correct outcome. There are various pre-processing techniques applied before actual classification of the image. Image is transformed into various color spaces. Different color spaces such as HSI (A. de la Escalera et al, 2003), Improved HLS (H. Fleyeh et al, 2004), normalized color space (W. Ritter et al, 1995) and (J. Greenhalgh et al, 2012) are used. Basically, image normalization technique is used for adjusting the brightness of the image, so as to detect the traffic symbols accurately. In (Y. Wu et al, 2013) and (M. Liang et al, 2013), SVM classifier was used in order to train the system and map each pixel of the frame to gray scale. Traditionally, threshold based methods (M. Young et al, 1989), and (A.de la Escalera et al, 2003) were used for object classification using various image segmentation techniques, and compared in order to get the optimal technique. These techniques proved less accurate for environmental changes such as lightening and bright images during sunny days. Frame extraction is primary step from the videos captured from car-mounted camera. RGB is an additive color component model in which red, green and blue colors are combined in order to get various shades of colors. RBG color component is used in order to reduce the time and space complexity of the system. Frame normalization technique is used to adjust the brightness in the images due to environmental factors. This was considered as a drawback in previous papers (W. Ritter et al, 1995), (J.Greenhalgh et al, 2012). In Binarization technique, the traffic signs are highlight to white pixels, while background remains blurred. Initially, techniques used for classification involved feature extraction and classifier training. SVM classifier was used along with HOG features (I. M.Creusen et al, 2010), MLP (Multi-Layer Perceptron) having radial features (Y.Jiang et al, 2011), ANN (artificial Neural Network) along with RIBP (Rotation Invariant Binary Pattern) (S. Yin et al, 2015). In short, an optimal feature extraction, and accurate classifier is a challenging job. Application of Gaussian Blur algorithm for noise reduction .Finding intensity Gradient of the image: Calculation of intensity gradients $G = (Gx2 + Gy2)1/2$ $\theta = \tan$-$1(Gy/Gx)$ Non-maximal suppression: Threshold is chosen so as to suppress the noise and determine the exact edges. Further, it is necessary to suppress the non-maximal pixels for accurate edges detection. Hysteresis Thresholding: edge > threshmax : Included edge <threshmin : Excluded threshmax > edge >threshmin : Included (Only if edge is connected to strongly connected edge).

Pre-processing:

In pre-processing phase, image is converted into RGB color component model. Further, frames are normalized in order to optimize the image appearance and control excess brightness due to sunny weather at times. Gaussian filter is used in order to smooth the image and remove unwanted noise which can lead to inaccurate results. This pre processed image frames are sent to image detection module for further processing technique. In binarization, the traffic symbol is represented by white pixels, whereas the background is represented by black pixels. This helps to find approximate location of the road traffic symbol in the image. The result is obtained in the form of (x,y) coordinates.

Shape classification:

Further, after locating the approximate coordinates of the road traffic from the image frame, Canny edge detection algorithm is used to highlight the edges of the road traffic symbol, whose location is obtained from the previous phase. This output is sent to Convolution Neural network, where matching of the actual road traffic symbol from the image frame, and provided template of road sign from the data set is done. This output is further provided to Fuzzy classification in order to improve the accuracy of the system.

Fuzzy Classification:

With reference to the paper (H. Luo et al,2016), Fuzzy classification technique is applied as extension in order to improve the efficiency of the system and optimize the outcome of the application. According to the proposed system, Fuzzy Classification output will be divided into certain set of probabilities and final result will be extracted from matching probable class and will in turn be converted into audio.

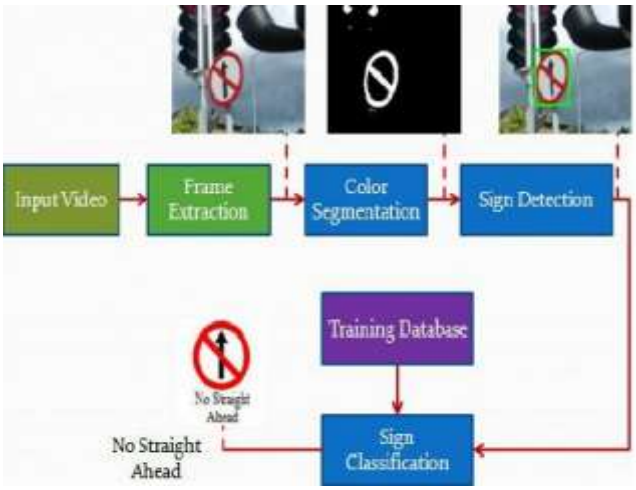
2.1 Proposed System

Convolution Neural Network (CNN), on the other hand can be considered as one of the popular techniques, for training and classification. In (G. Wang et al, 2013) modified version of cross entropy loss was used for CNN training. In spite of the fact that CNN has shown excellent performance in image classification, the task of designing a good architecture and train a workable model is still one of the challenging tasks. In order to handle different geometry variations of road traffic signs, data augmentation technique was used to enlarge the training data set(P. Sermanet et al, 2011) and (J. Jin et al,2014). A video camera is fitted to the vehicle which had digital sensors to sense the nearby traffic sign boards.

IMAGE PROCESSING:

Image is converted to RGB colour component model. It has normalized frames to optimize images .Edge detection is done using sobel operator Their greatest advantage is it's simple to handle and provides greater approximation. Its sensitivity to noise can be overcome using MEDIAN filter which removes noise from images. Image detection is carried out to detect location of traffic signals which examines intensity of each pixel by calculating the threshold for it. It splits images into grid of cells and treats each as separate image. It passes through sign detection where various signs are analysed using tensor flow algorithms .Its then passed

through the convolutional neural network which is a classifier where the probabilities for signs are calculated by providing the trained database as input to it and after a series of refinements using refinements using tensor flow algorithms suitable audio signals are generated from the vehicle and is intimated about the traffic symbol approaching.



Tensor Flow is an open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. TPU is a programmable AI accelerator designed to provide high throughput of low-precision arithmetic (e.g., 8-bit), and oriented toward using or running models rather than training them. Google announced they had been running TPUs inside their data centers for more than a year, and had found them to deliver an order of magnitude better optimized performance per watt for machine learning. It runs on python. It has flexible architecture providing easy deployment of computation. The computations are represented as dataflow graphs.

2.2 Results and discussion:

The proposed system reduces time complexity and it requires little processing through tensor flow algorithm. CNN requires less number of parameters. Canny edge detection algorithms are being replaced by sobel algorithm which is more simple and provides greater approximation in identifying edges. Median filters remove noise providing better normalization than Gaussian filter. Through the pooling layer of CNN larger images can also be easily handled with fewer parameters. Also threshold values for pixels can be identified with ease using OTSUs method to classify black and white pixels by splitting the image into smaller portions. Classification is performed by probabilistic controller by its flexible nature. It can sense images remotely. It improves efficiency and can be used for complex systems.

3. CONCLUSION

In this paper, we propose a new modified approach for road traffic sign recognition technique. Approximate position of the traffic sign is determined, and sent to convolution neural network for training and classification. It is an optimized module for improving the results obtained by CNN. This traffic sign recognition system will help drivers to track the traffic symbols with ease, and avoid the accidents and in turn reduce the number of deaths.

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