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DFR TSD A DEEP LEARNING BASED FRAMEWORK FOR ROBUST TRAFFIC SIGN DETECTION UNDER CHALLENGING WEATHER CONDITIONS

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ABSTRACT:

Robust traffic sign detection and recognition (TSDR) is of paramount importance for the successful realization of autonomous vehicle technology. The importance of this task has led to vast amount of research efforts and many promising methods have been proposed in the existing literature. However, most of these methods have been evaluated on clean and challenge-free datasets and overlooked the performance deterioration associated with different challenging conditions (CCs) that obscure the traffic-sign images captured in the wild. In this paper, we look at the TSDR problem under CCs and focus on the performance degradation associated with them. To this end, we propose a Convolutional Neural Network (CNN) based prior enhancement focused TSDR framework. Our modular approach consists of a CNN-based challenge classifier, Enhance-Net–an encoder-decoder CNN architecture for image enhancement, and two separate CNN architectures for sign- detection and classification. We propose a novel training pipeline for Enhance-Net that focuses on the enhancement of the traffic sign regions (instead of the whole image) in the challenging images subject to their accurate detection. We used CURE-TSD dataset consisting of traffic videos captured under different CCs to evaluate the efficacy of our approach.

Keywords:CNN, TSD, TSDR, CC, traffic video.

INTRODUCTION

Traffic sign detection and recognition play a crucial part in driver assistance systems and autonomous vehicle technology. One of the major prerequisites of safe and wide-spread implementation of this technology is a TSDR algorithm that is not only accurate but also robust and reliable in a variety of real-world scenarios. However, in addition to the large variation among the traffic signs to detect, the traffic images that are captured in the wild are not ideal and often obscured by different adverse weather conditions and motion Manuscript received March 28, 2020; revised October 9, 2020 and Decem- ber 12, 2020; accepted December 17, 2020. The Associate Editor for this article was S.-H. Kong. (Corresponding author: Md. Kamrul Hasan.) The authors are with the Department of Electrical and Electronic Engineering, Bangladesh University of Engineering and Technology, Dhaka.

LITERATURE SURVEY

Vision-based traffic sign detection and analysis for intelligent driver assistance systems: Perspectives and surveyAUTHOR: A. Mogelmose, M. M. Trivedi, and T. B. Moeslund

In this paper, we provide a survey of the traffic sign detection literature, detailing detection systems for traffic sign recognition (TSR) for driver assistance. We separately describe the contributions of recent works to the various stages inherent in traffic sign detection: segmentation, feature extraction, and final sign detection. While TSR is a well-established research area, we highlight open research issues in the literature, including a dearth of use of publicly available image databases and the over-representation of European traffic signs. Furthermore, we discuss future directions of TSR research, including the integration of context and localization. We also introduce a new public database containing U.S. traffic signs

A review on automatic detection and recognition of traffic sign, AUTHORS :A. Gudigar, S. Chokkadi, and U. Raghavendra

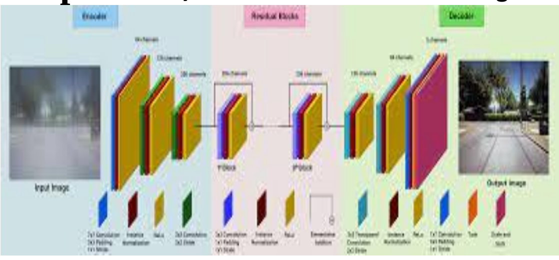
Evidently, Intelligent Transport System (ITS) has progressed tremendously all its way. The core of ITS are detection and recognition of traffic sign, which are designated to fulfill safety and comfort needs of driver. This paper provides a critical review on three major steps in Automatic Traffic Sign Detection and Recognition(ATSDR) system i.e., segmentation, detection and recognition in the context of vision based driver assistance system. In addition, it focuses on different experimental setups of image acquisition system. Further, discussion on possible future research challenges is made to make ATSDR more efficient, which inturn produce a wide range of opportunities for the researchers to carry out the detailed analysis of ATSDR and to incorporate the future aspects in their research.

EXISTING SYSTEM

Traffic sign detection is often viewed as an image segmentation and recognition problem. The authors of SegU- Net [22] has reported a benchmark result on CURE-TSD dataset. While their performance on the challenge-free dataset is appealing, they show that incorporation of the challenging dataset significantly deteriorates the performance. This is due to the fact that the adversaries present in those images obscure the color and shape information of small traffic sign regions in particular. Therefore, an overall approach that is robust to the adverse effect of these CCs is of utmost importance for practical application [16]. While many promising CNN-based approaches have been proposed in the literature for traffic sign detection and classification, none of them considers such CCs. As a result, the performance of these methods are severely vulnerable to the quality of the captured image.

PROPOSED SYSTEM

To alleviate this problem, we propose Enhance-Net, a deep CNN-based image enhancer, that performs a prior enhance- ment of these traffic images. In [6], Temel et al. has stated that all of the twelve different types of CCs present in the dataset need not be addressed at a time and also highlight the fact that benchmark algorithms performance is more vulnerable in challenging weather conditions such as Rain, Snow, and Haze. In addition, Lens blur and Dirty Lens are two frequently occurring CCs in the real world scenarios. Therefore, in this work, we highlight the focus of our approach on five different CCs: Rain, Snow, Haze, Dirty lens, and Lens blur associated with five different levels of severity. Due to the different nature of these challenges, training a single network for all these challenges may result in suboptimal performance. Therefore, we use five different Enhance-Nets trained with a single type of challenge at a time to ensure the best possible enhancement for each of the CCs. We incorporate the modular TSDR approach proposed in [22] for sign detection and classification from the enhanced traffic images. Therefore, our approach consists of four separate modules-challenge classifier, enhancement blocks, sign detector and sign classifier.



METHODOLOGY

Many algorithms are available to detect traffic signs but all those algorithms are trained on clear images and expect clear images only for detection but some time due to weather condition quality of the image will be degrade and existing algorithm may not able to detect signs from such weather affected images. To overcome from above problem author of this paper has introduced CNN algorithm which consists of two parts. First part will remove weather affected part from the image and clear it and second part will detect traffic signs.

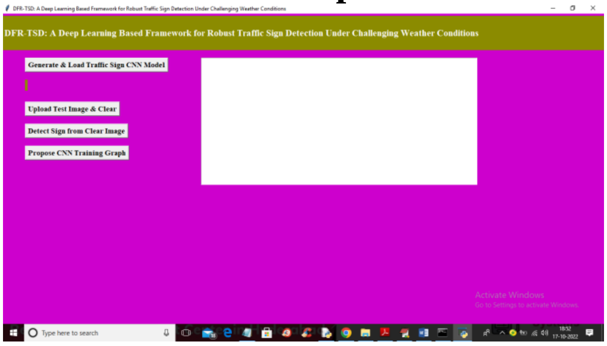
Propose algorithm is based on Deep learning CNN algorithm to detect traffic signs robustly hence called as DFR-TSD. Propose algorithm get trained on 'CURE-TSD' dataset and able to get accuracy up to 99%.

To implement this project we have designed following modules

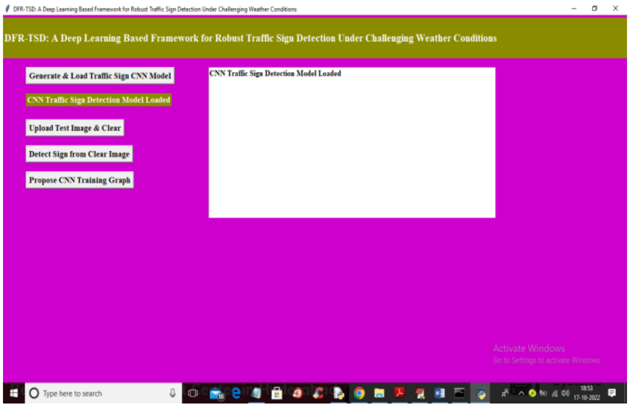
1) Generate & Load Traffic Sign CNN Model: using this module we will generate and load Traffic sign CNN model
2) Upload Test Image & Clear: using this module we will upload test image and then apply CNN model to clear weather affected images
3) Detect Sign from Clear Image: now clear image will be input to CNN sign detection model to detect sign
4) Propose CNN Training Graph: using this module we will plot CNN training accuracy and loss graph

SCREEN SHOTS

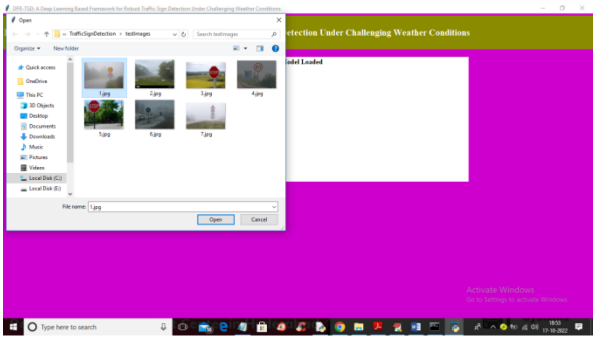
To run project double click on 'run.bat' file to get below screen



In above screen click on 'Generate & Load Traffic Sign CNN Model' button to generate and load CNN model and get below screen

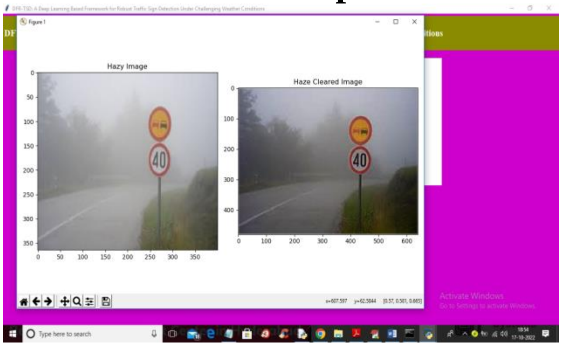


In above screen CNN Model loaded and now click on 'Upload Test Image & Clear' button to upload weather affected test image and then clean it

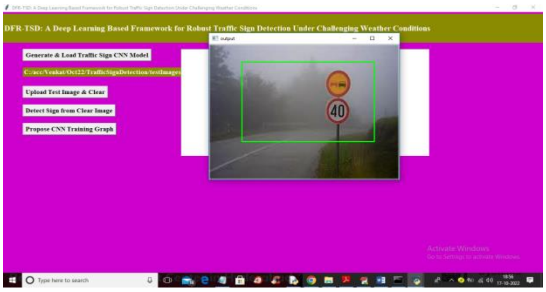


In above screen selecting and uploading '1.jpg' file and then click on 'Open' button to load and clean image and get below output

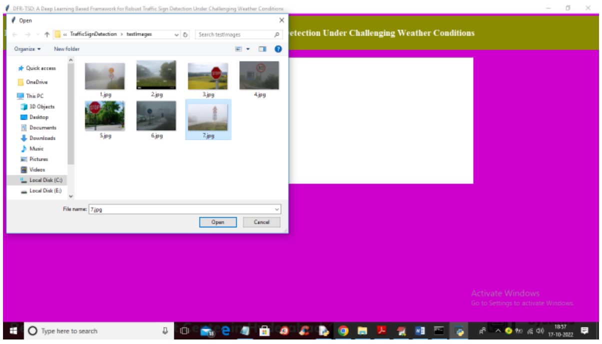
*Corresponding Author



In above screen first image is the weather affected image (which can be from cloudy haze, rain, or bad light or bad camera lens) and second is the clean image and you can see the difference between both images and now click on 'Detect Sign from Clear Image' button to get below output



In above screen CNN model detected traffic sign and put bounding box around it and now test other image



In above screen selecting and uploading 7.jpg and then click on 'Open' button to get below output

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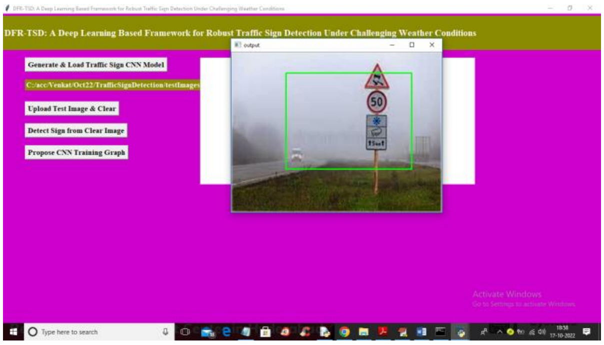
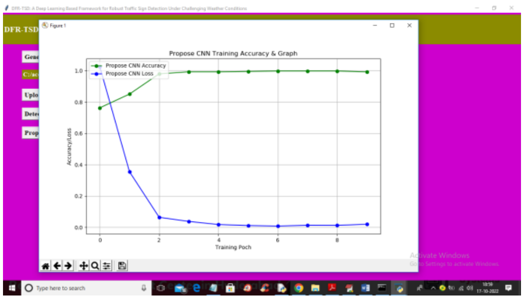
In above screen first image is the weather affected image and second one is the clean image and now click on ‘Detect Sign from Clear Image’ button to get detection output



In above screen traffic sign detected and similarly you can upload and test other images and now click on ‘Propose CNN Training Graph’ button to get below output



In above graph x-axis represents ‘Training Epoch’ and y-axis represents ‘Accuracy and loss values’ and green line represents accuracy and blue line represents loss. In above graph we can see with each increasing epoch accuracy got increase and loss got decrease.

Note: no detection algorithms are accurate so sometime some bounding boxes may not predict accurately

CONCLUSION

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In this paper, we have presented a deep CNN-based modular and a robust framework for TSDR under various CCs. We have highlighted the performance degradation of the existing TSDR algorithms due to the presence of different CCs and proposed a deep CNN-based approach that effectively alleviates the problem. A VGG16 architecture-based challenge classifier, that successfully detects and classifies the challenge, directs the image to the appropriate Enhance-Net which recovers the features that are useful for the successful detection of the traffic sign regions. Unlike the existing whole image enhancement-based methods, the Enhance-Nets are trained by our proposed novel loss function and training pipeline that incorporate traffic sign region focused MAE in both pixel and feature domain with the sign detection loss as a constraint. This effectively ensures the enhancement of the sign regions subject to their accurate detection. We have also experimentally showed that traffic sign regions are more important for enhancement, in order to obtain higher detection performance. Finally, we evaluate the efficacy of the modular structure of our approach by comparing its performance with different end-to-end trained deep CNN-based object detection networks where our approach outperforms all of them. Due to our modular approach, each module of our framework can be designed independently.

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