

# Traffic Sign Detection and Recognition for Automated Driverless Cars Based On SSD

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**ABSTRACT:** Self-driving cars has the potential to revolutionize urban mobility by providing sustainable, safe, and convenient and congestion free transportability. Autonomous driving vehicles have become a trend in the vehicle industry. Many driver assistance systems (DAS) have been presented to support these automatic cars. This vehicle autonomy as an application of AI has several challenges like infallibly recognizing traffic lights, signs, unclear lane markings, pedestrians, etc. These problems can be overcome by using the technological development in the fields of Deep Learning, Computer Vision due to availability of Graphical Processing Units (GPU) and cloud platform. By using deep learning, a deep neural network based model is proposed for reliable detection and recognition of traffic lights (TL).

**KEYWORDS:** Driver Assistance Systems (DAS), Graphical Processing Units (GPU), Traffic Lights (TL).

## I. INTRODUCTION

The road traffic scenes are usually complex and traffic video is vulnerable to external factors such as light, weather and obstructions. It is difficult to extract the traffic parameters and detect the traffic anomaly exactly with the existing image processing technologies under such uncertainty factors. A deep neural network based model is proposed for reliable detection and recognition of traffic lights and signs using transfer learning. The proposed method incorporates use of faster region based convolutional network (R-CNN) Inception V2 model in TensorFlow for transfer learning. The model was trained on dataset containing different images of traffic lights and signals in accordance with Indian Traffic Signals. The model accomplishes its objective by detecting the traffic light with its correct class type.

## II. RELATED WORK

Various studies and related works can be done for the detection of objects. Methods for detecting Traffic Lights and they can be broadly classified as image processing based, machine learning based or map based techniques [2]. A deep learning based solution is performed in the driverless cars to overcome Traffic Light (TL) detection problem that reliably detects and recognize TL which outperforms traditional image processing methods.

In the paper [3] Abduladhem Abdulkareem Ali proposed a RFID based method used to recognize traffic lights status. The proposed is responsible for the recognition and proper presentation of those signs to the vehicle. The RFID technology uses the electromagnetic fields to transmit signals, RFID tags can be placed on the road. Each of the RFID tags should be already defined to both the vehicle and the traffic light controller. Once the vehicle passes an RFID tag, it broadcasts a request message using the XBee module. Only traffic light controller receives that message. This message contains two fields: an RFID tag number for the vehicle detected and the vehicle ID number. While the vehicle ID number defines that address of that vehicle in order to unicast an acknowledge message that contains the traffic light status on that road. If the road has multiple track and destinations, then all the status of road destinations is broadcasted to the vehicle.

Sang-Hyuk Lee, Jung-Hawn Kim, Yong-Jin Lim and Joonhong Lim [4] proposed an algorithm for traffic light detection and recognition based on Haar-like features. Here Haar-like features are used to learn about the traffic light image and detect the candidate area based on the learning data. The detected candidate image is verified by the pre-learned SVM (Support Vector Machine) classifier, binarization and morphology operations are performed on the verified candidate image for detection of the traffic light object. The detected traffic light is divided into respective signal areas to determine the current on/off status of traffic lights. The signal signs in the respective areas are defined by regulation and the sign of traffic lights can be recognized by recognizing on/off of the signals in the respective areas.

Shraddha Mane [5] proposed a novel CNN based object tracking algorithm which is used for robust object detection. The proposed approach is able to detect the object in different illumination and occlusion. In this proposed system, the video is taken as an input. For object detection and object tracking process is done through deep learning methods therefore Tensor flow based object detection algorithm has been used. After object detection, their locations are important to start the tracking process. Here Convolutional Neural Network (CNN) based tracking algorithm is used. In this approach first load the weights of the pre-trained model. The model is capable of incorporating the temporal information. Rather than focusing on the objects in the testing time, the pre-trained model which is trained on large variety of objects in real time. This lightweight model has ability to track the object at the speed of 150 frames per second and it is able to remove the barrier of occlusion. The object locations obtained from the TensorFlow based object detection algorithms are passed to the CNN based object tracking algorithm.

Priyanka D, Dharani K, Anirudh C, Akshay K [6] proposed a new method based on Raspberry Pi. Automatic recognition of traffic signs is also important for an automated intelligent driving vehicle system. Here, the input to the system is video data which is continuously captured from the webcam. Images are pre-processed with several image processing techniques such as; Hue, Saturation and Value (HSV) color space model technique is employed for traffic light detection, for sign detection again HSV color space model and Contour Algorithm has been used. The signs are detected based on Region of Interest (ROI). The ROI is detected based on the features like geometric shape and color of the object in the image containing the traffic signs. When a sign or traffic light is detected audio command is played through the speaker.

Ying Li, Lingfei Ma, Yuchun Huang [7] proposes a segment-based traffic sign detection method using vehicle-borne mobile laser scanning (MLS) data. This method has three steps: road scene segmentation, clustering and traffic sign detection. The non-ground points are firstly segmented from raw MLS data by estimating road ranges based on vehicle trajectory and geometric features of roads (e.g., surface normal and planarity). The ground points are then removed followed by obtaining non-ground points where traffic signs are contained. Secondly, clustering is conducted to detect the traffic sign segments (or candidates) from the non-ground points. Finally, these segments are classified to specified classes. Shape, elevation, intensity, 2D and 3D geometric and structural features of traffic sign patches are learned by the support vector machine (SVM) algorithm to detect traffic signs among segments. The proposed algorithm has been tested on a MLS point cloud dataset acquired by a Lector system in the urban environment. The results demonstrate the applicability of the proposed algorithm for detecting traffic signs in MLS point clouds.

### III. METHODOLOGY

The proposed system is mainly used for detection and recognition of Traffic Light with the help of object detection method and faster region based convolution neural network (F-RCNN). Convolution Neural Network (CNN) is one of the most popular ways of doing object recognition. It is widely used and most state-of-the-art neural networks used this method for various object recognition related tasks such as image classification. This F-RCNN network takes an image as input and outputs the probability of the different classes. If the object present in the image then its output probability is high else the output probability of the rest of classes is either negligible or low. The advantage of Deep learning is that we don't need to do feature extraction from image as compared to machine learning. By using deep learning with the help of Tensorflow platform the input image can be stacked and the objective is:

1. Dataset Preparation
2. Loading to Tensor Flow
3. Input custom image
4. Object Detection
5. Traffic Light Detection in Tensor Flow
6. Display Output

The output generated as the status of the Traffic Light with its correct category.

Step 1: Dataset Preparation

- Dataset created for the system includes different images of Traffic Lights and signs which are taken from Kaggle Dataset. The Traffic Light images with almost same resolution are used as the input for the easiness of proper training and testing.

Step 2: Loading to Tensor Flow

- Prepared images are categorized into separate folders in-order to make inception model. After making inception model .pb file is generated and it will finally load to the Tensor Flow.

Step 3: Input custom image

- User input the image
- Object detection is carried to the input image.

Step 4: Object Detection

- SSD algorithm is used for object detection.
- Single Shot MultiBox Detector (SSD) is designed for object detection in real time. Faster R-CNN uses a region proposal network to create boundary boxes and utilizes those boxes to classify objects.

Step 5: Traffic Light Detection in Tensor Flow

- Faster RCNN is an object detection architecture that uses convolution neural networks like YOLO and SSD. When an object is detected it will pass to the inception model in order to find out in which category the object belongs.

Step 6: Display Output

- Output is displayed based on the status of the Traffic Light with its correct class type.

#### IV. EXPERIMENTAL RESULTS

This section discusses the experimental results of the proposed system. The proposed system is using LIZA traffic light dataset which are taken from kaggle for results assessment. The proposed system is implemented using two modules i.e., object detection module and traffic light detection module. In object detection, Single Shot MultiBox Detector (SSD) algorithm is designed for object detection in real time. For the Traffic Light detection considering the application requirement and available computational resources, Faster R-CNN Inception-V2 model is used which serves the accuracy and speed trade-off. The advantage of deep learning over traditional machine learning technologies is that the accuracy can be improved continuously with a large number of training samples. It is difficult to extract the traffic parameters and detect the traffic anomaly exactly with the existing image processing technologies under such uncertainty factors. Though image processing approach is quite straight and uncomplicated, it undergoes critical phases such as thresholding, filtering. Therefore deep learning based approach is proposed to overcome these external factors.

#### V. CONCLUSION

I have implemented Traffic Light, Sign detection and recognition technique. The algorithm first successfully detects the object region from the image which consists of mixed image -graphic regions. I have applied SSD algorithm on many images and found that it successfully detect the objects within a single shot. A Deep learning system that classifies the traffic light and sign is considered. The system consists of an inception model where the pre-processing steps are already carried out. In the field of self-driving cars or autonomous driving, the use of Faster R-CNN Inception-V2 model through transfer learning improves the accuracy which makes the system more reliable for real time application.

#### REFERENCES

- [1] Aswathy Madhu, Sruthy S, "Survey on Traffic Light Detection and Recognition for Self Driving Cars Using Deep Learning", IRJET, IRJET, Volume: 04 Issue: 2 | Jan – Feb 2020.
- [2] V. John, K. Yoneda, Z. Liu, Senior Member, IEEE, and S. Mita, "Saliency Map Generation by the Convolutional Neural Network for Real-time Traffic Light Detection using Template Matching" in IEEE Transactions on Computational Imaging DOI 10.1109/TCI.2015.2480006.
- [3] Ali and H. A. Hussein, "Traffic lights system based on RFID for autonomous driving vehicle," 2017 Annual Conference on New Trends in Information & Communications Technology Applications (NTICT), Baghdad, 2017, pp. 122-127.
- [4] S. Lee, J. Kim, Y. Lim and J. Lim, "Traffic light detection and recognition based on Haar-like features," 2018 International Conference on Electronics, Information, and Communication (ICEIC), Honolulu, HI, 2018.
- [5] S. Mane and S. Mangale, "Moving Object Detection and Tracking Using Convolutional Neural Networks," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2018.



- [6] D. Priyanka, K. Dharani, C. Anirudh, K. Akshay, M. P. Sunil and S. A. Hariprasad, "Traffic light and sign detection for autonomous land vehicle using Raspberry Pi," 2017 International Conference on Inventive Computing and Informatics (ICICI), Coimbatore, 2017, pp. 160-164.
- [7] Y. Li, L. Ma, Y. Huang and J. Li, "Segment-Based Traffic Sign Detection from Mobile Laser Scanning Data," *IGARSS 2018 - 2018 IEEE International Geoscience and Remote Sensing Symposium*, Valencia, 2018.
- [8] <https://lilianweng.github.io/lil-log/2017/12/31/object-recognition-for-dummies-part-3.html>
- [9] <https://towardsdatascience.com/understanding-ssd-multibox-real-time-object-detection-in-deep-learning-495ef744fab>
- [10] <https://www.hackerearth.com/blog/developers/object-detection-for-self-driving-cars/>
- [11] <https://towardsdatascience.com/faster-rcnn-object-detection-f865e5ed7fc4>