# Automatic Traffic Rules Violation Control and Vehicle Theft Detection Using Deep Learning Approach

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**Abstract** - *There is a rapid increase in number of vehicles using on road due to growing population and people's need for comfort, more and more automobiles are being purchased in both urban and rural areas which leads to increasing traffic as a result there is a greater number of traffic violations happening in every corner of the world. As the traffic violation increases the number of road accidents happening are also increasing and leads to death of many lives. To control the traffic flow and create the safer environment there is a need to develop automatic tracking of traffic violation detection systems to automate the rules and regulations to eliminate lack of awareness among the humans. The proposed system can identify lane detection, over speed of the vehicles and also thefted vehicles. The proposed system gives high accuracy in detecting these violations with overall 90%. The proposed system is achieved using Computer Vision and Deep Learning techniques.*

***Key Words***: ***Traffic Violation, YOLOv5, CNN, Vehicle Theft, Image Processing, Vehicle Detection, Vehicle Tracking.***

## 1. INTRODUCTION

With the ever-increasing population of people and vehicles, traffic accidents increase every day. Traffic should be controlled fast and in time to prevent these types of situations. However, the size of the data can make it harder to control traffic. For this reason, detecting lane and wrong way violations from cameras would make traffic control easier. In this study, a software-based system is proposed that will minimize human errors.

The problem of traffic violation has become a very serious in the present day. The very high volume of traffic is due to the increasing number of vehicles.

A moving violation is any violation committed by the driver of a vehicle while it is in motion. Moving Violations are speeding, which can be exceeding a limit or (in some jurisdictions) simply driving at an unsafe speed, improper lane usage, such as failing to drive within a single lane. Every day, the problem is turning out to be more and more critical and crucial. With the increase in population the vehicles are also increasing due to which there is a increase in the rate of accidents in cities all over the country.

According to 2021, 1214 road crashes occur every day in India. Two wheelers account for 25% of total road crash deaths. It is much obvious that people are violating the traffic rules and regulations and there is a high requirement to control it. Manual checking of vehicles is troublesome, and mistake-inclined, and problematic human memory. As a result, the need arises for a traffic violation detection system to deal with this, which can identify criminal traffic offenses instantly. The new system was required that could monitor these offenses 24x7, with least or no human resource requirement and could identify multiple traffic violations with high accuracy. This system is achieved by using computer vision technologies which enables computers to derive meaningful information from the digital images, and videos and deep Learning mainly used for classification which is been widely used in image classification. Since videos are captured from moving vehicles, the whole city is covered instead of a few signals and junctions. This enables traffic police to capture traffic violations happening in small lanes to highways.

### 1.2 PROPOSED SYSTEM

The Closed-Circuit Television (CCTV) is placed at every street in public, in signals, in highways and also in junctions to capture the videos of vehicles. The captured vehicles footage is sent to the system as input to detect the vehicles that is violating traffic rules and regulations and classifies the type of violation such as Lane Detection, Over Speeding and stolen vehicles caused by that vehicle.

The proposed system uses Computer Vision for image processing and uses the popular CNN algorithm for classification of violations. After the detection and classification is done the system extracts the number plate of that vehicle reads the license plate and intimates to the nearby police station so that further actions can be taken by police. Vehicle detection and tracking has to be done first in order to detect security lane or wrong lane and speed detection.

### 1.3 RELATED BACKGROUND

Lane boundaries is detected using a camera that captures the view of the road, mounted on the front of the vehicle. The lane markings on the road by giving the video of the road as an input to the system by using computer vision technology

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[12]. The importance of the decoder in recovering the boundary information of the target pixel, the decoder branch is added based on the existing direct up-sampling lane line detection algorithm. It improves the classification and prediction ability of the lane line boundary pixel [13]. Camera calibration is a method of settling the camera model, which is a geometric relationship between 3D space and 2D image. In here, the purpose of camera calibration was to calculate the target position in real 3D space to determine the vehicle speed [14]. The fingerprint is a unique biometric signature that can be used to identify individual people uniquely. The computer is good at matching the fingerprint pattern and recognizing it fast and accurately. There are different methods for authenticating the fingerprint that as an optical fingerprint scanner and capacitive scanner [15]. A wireless vehicle security system which implements the mobile communication protocol is used. The most known existing car security system is car alarm [16]. The speed limit is set if the speed exceeded the limit, then a message will be transferred to the owner and then if owner sends a reverse message, then according to message either speed will be controlled or the car will stop [17].

## 2. IMPLEMENTATION

An Open ALPR system consists of three main modules to provide reasonable outcomes. These three steps are License Plate Detection (LPD), Character Segmentation (CS), and Optical Character Recognition (OCR) which can be found in most of the approaches. In the first step LPD the video or a image of the stolen vehicles is given then license plate is recognized is given as the input. YOLO V5 (You Only Look Once version 5) containing CNN is used for vehicle and number plate detection. In image preprocessing labelled data is use for training the dataset which is supervised learning machine and OpenCV function used to crop the image as required and remove the noise in the background for extracting the features.

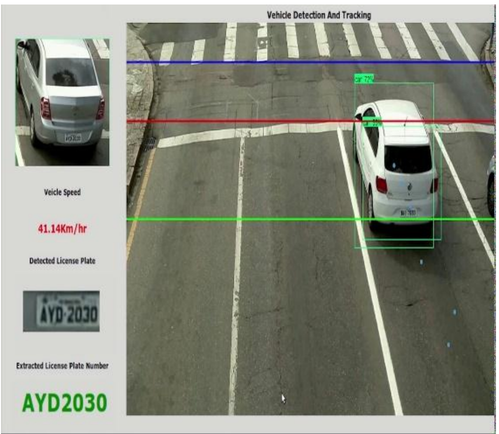


**Fig -1**: Speed and number plate recognition

In second step Character Segmentation method is used after the license plate of the vehicle is detected. Here the image is converted in to convert the grey scale image to reduce complexity. CNN is trained in such a way that Characters in the license plate (0-9, A-Z) along with the margin of the license plate is detected.

In the next step Character Recognition is done where the characters present in number plate are compared with the complaint registered vehicle number plate. If the complaint registered number and the vehicle number is matched then the intimation is sent to the owner of the vehicle and the area police station with the place and time using Twilio library.

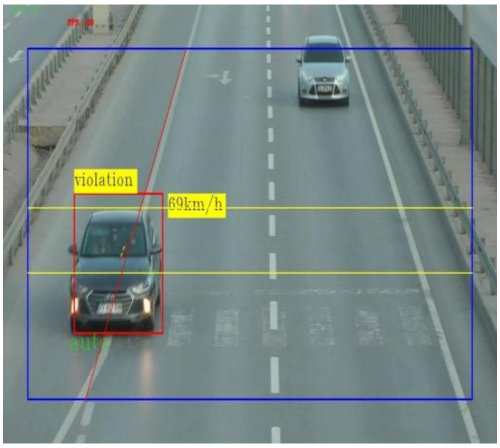


**Fig -2**: Lane violation with bounding box

To detect lane violation first the lane on the road should be identified. Two points in the lane are asked from used, then a line is drawn to the screen defining this lane. Vehicles crossing this line is assumed to violate security lane.

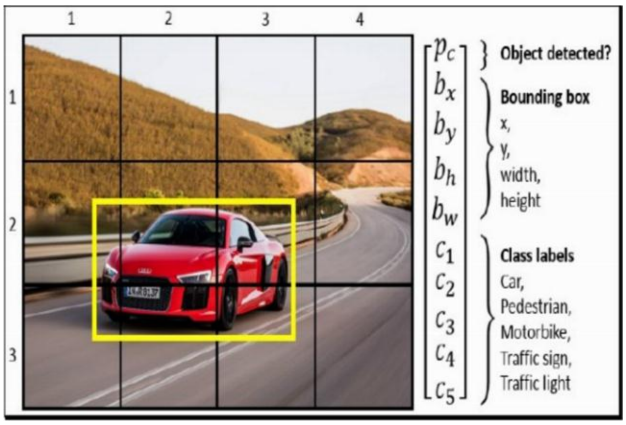


**Fig -3**: Bounding Box Prediction

Yolov5(You Only look once)

It is a novel convolutional neural network (CNN) that detects objects in real-time with great accuracy. This approach uses a single neural network to process the entire picture, then separates it into parts and predicts bounding boxes and probabilities for each component.

It is a class of multi-layer perceptron, refers to a fully connected network (FCN) in which all neurons of one layer are connected to other neurons in the next layer. It is category of neural networks to process the data in a grid-like manner that divides the images into a grid system, in each cell in the grid is responsible for detecting the objects within itself by drawing bounding box around the defined object.

Bounding box is used to get the co-ordinates of the image such as height, width, pedestrian and probabilities value of a object in a digital image or video. It gives an objectiveness score for each bounding box with truth object. Bounding Box predictions are very important to get the exact location of the object in the entire Image which is usually drawn rectangular in shape around the object. It is mainly used for extracting the features from a single digital image in frame-by-frame from digital video to different sizes. The algorithm is used to detect the multiple objects in a single iteration and hence you only look once.


**Fig -4**: Architecture of YOLO

It is of three parts backbone: CSP Darknet, Neck: PANet and Head: Yolo Layer The data is first given as input to CSP Darknet for Feature Extraction and then to PANet for feature fusion Finally Yolo layer outputs the results.

The model is capable of detecting every frame in the digital video, fig detects the vehicle and its speed from the captured video. Speed is calculated using pixel calculation, area of the boundary box and anchor points. Area of the boundary exactly tells the distance travelled by the vehicle in the video and anchor points adds more perception to these parameters and speed of the vehicle is determined.

Automatic License Plate Recognition (ALPR) has been a frequent topic of research due to many practical applications. However, many of the current solutions are still not robust in real-world situations, commonly depending on many constraints. This paper presents a robust and efficient ALPR system based on the state-of- the-art YOLO object detector. The Convolutional Neural Networks (CNNs) are trained and fine-tuned for each ALPR stage so that they are robust under different conditions (e.g., variations in camera, lighting, and background).

Specially for character segmentation and recognition, we design a two-stage approach employing simple data augmentation tricks such as inverted License Plates (LPs) and flipped characters. The proposed approach is divided into four subsections, one for each of the ALPR stages (i.e., vehicle and LP detection, character segmentation and character recognition) and one for temporal redundancy. Fig.3.1 illustrates the ALPR pipeline. We use specific CNNs for each ALPR stage. Thus, we can tune the parameters separately in order to improve the performance for each task. The models used are: Dark Flow, YOLO V5, NumPy, Tensor Flow, OpenCV and Keras. Dataset used to train the model is form Kaggle. The model is trained in Python environment (version 3.6.3) and implemented using Keras 2.2.4 [15], with TensorFlow 1.3.1 backend.

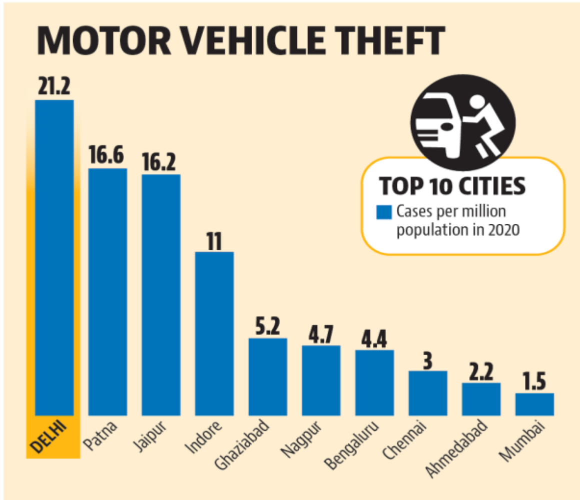


**Fig -4**: Vehicle theft in different cities

## 3. CONCLUSIONS

The proposed system performs better and efficient and provides high accuracy in controlling the traffic rules violation and theft detection using deep learning. Since background subtraction techniques are used in vehicle detection processes, camera shake or movement does not cause probing. The proposed method continues to provide better results in severe weather conditions (fog, snow storm, etc.).

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