Grenze International Journal of Engineering and Technology, June Issue

Traffic Rule Violation Detection System

Jitender Kumar[1] and Gulshan[2]
[1-2]Department of computer science engineering, Chandigarh University, Punjab, India

***Abstract*— Traffic rules play an important role in regulating traffic flow, ensuring the safety of all road users and preventing the occurrence and frequency of accidents. Without the implementation of traffic rules, the roads will always be chaotic and the risk of accidents will be much higher, but traffic rule violations are now a big emerging problem for the majority of nations. In the developing countries there are many technologies which are solving the crisis, but still the accidents are happening in roadways. As both the number of vehicles and the number of traffic law offences are growing quickly, even the literate people fail to understand the importance of following traffic rules and they also break them. Increasing traffic on the roads make it difficult for the traffic controlling authorities to control it, despite the fact that the traffic management has automated but still there are many challenges which we need to overcome. The major purpose of this project is to control traffic rule violations correctly and efficiently. Automated traffic rule detection system locates vehicles that violate the traffic guidelines it includes jumping signal, driving in opposite direction, takes unethical turns, driving without helmets etc.**
Due to these scenarios, there are chances of occurrence of accidents which may cost someone life. These can be reduced by finding the vehicle which is violating the traffic rules with the help of machine learning and deep learning techniques.

***Index Terms*— Traffic violation detection, Yolov5, image processing.**

I. INTRODUCTION

A moving violation is a violation done by the driver of vehicle when it's in movement, this may include traffic light violation, over speed, wrong and fast cuts etc. This major purpose here is to deal with these violations. This system will be composed of mainly two components:

- Detection of the vehicle
- Recognizing the type of violation.

The video footage will be sent to the system. The vehicles will be identified using the video footage. In this way the vehicle violating the traffic rules will be detected.
This automated detection system which works with help of cameras being installed at traffic signals already exists but still there are some problems which we need to overcome this includes varied plate sizes, rotations and lighting that isn't consistent conditions at the time an image was taken. To control these violations in an efficient and correct manner we need to improve the existing system. The main technique is to setup a system by the use of deep learning integration for surveillance which will detect any kind of violation. Using this kind of setup, the human error will be minimized and less limitation will occur. Here the identification on real time basis has greater role in the safety and security. It also helps to manage the excess flow of the traffic. Appropriate punishments will

Grenze ID: 01.GIJET.10.2.327_1

be given on the basis of nature of violation like fine slip, licence ban for certain period or even behind the bars.

II. Literature Review

A. Timeline of the reported problem

In existing system, a traffic policeman monitors the traffic and in case of any violation he/she tries to capture the violator for manual penalty or capture a photograph, which will be submitted to the system for further action. In this case sometimes it's difficult to capture in flowing traffic or taking a clear snap at that moment.

- *Existing solutions*

a. In the suggested technique, the system detects the vehicle using YOLO based object detection, and then checks each vehicle for particular violations this was for the motorcycles only. A CNN (Convolutional neural network) based classifier is used to detect such violations. [1].
b. Computer vision-based violation detection systems are a highly effective instrument for tracking and penalizing traffic infractions. For traffic infraction detections such as signal violation, motorcycle speed, motorcycle count this system is proposed built using YOLOV3 object detection. [2]
c. A one-way traffic rule violation system that automatically without the intervention of a person detects the vehicles, three wheeled vehicles were taken into account because they had a higher proclivity for breaking one way traffic laws. [3]
d. Techniques for analysing videos are utilized in traffic research for a variety of tasks, including counting and classifying vehicle, detecting crashes, and evaluating traffic density. Vehicle identification, tracking wrong way violation detection are made possible. [4]
e. A system where every step is automated, a good database may be kept to track driver records regarding traffic rule breaches. It also allows for the recognition of fingerprints and facilitates in the detection of drunk and unauthorized drivers. [5]
f. A Vision based technique of accident detection by the use of wireless sensor network and RFID technologies in real time. Here the sensors are used to identifies the location of an accident. [6]
g. A High-level traffic violation detection, this provides an effective and real time-based analysis for camera visions allow to fetch the key details of violator like vehicle type and speed. [7]
h. A model including scale invariant feature transform (SIFT), speeded up robust features (SURF), template matching, rotated brief to identify objects such as cars, helmets, license plates, seat belts. [8]
i. It is now incredibly difficult to control traffic and enforce the law by keeping track of every single car. utilization of automation nowadays is used more and more to manage traffic flow. [9]
j. A method of detecting the vehicle occurring in the red light jump in a particular area of interest using mean square displacements (MSD). Also here detect a vehicle changing the lane in a particular road of that region using MSD. [10]

B. Problem Definition

The existing system is not able to detect the hand painted number plates, sometimes the image captured is not clear or insufficient amount of light creates problem. To avoid this problem traffic control authorities can take the access to the datasets of the number plates from RTO which are old or are hand painted and can feed it to the application so that those vehicles could also be recognized.

C. Task Identification

The main task here is to overcome the problems faced by the pre-existing systems it may be in getting the clear images of the vehicle or number plate because of lighting fluctuations, different angles etc, hand painted number plates could not be detected by some of the systems, basically we have to increase the surveillance quality to meet the standard of safety and precautions in an efficient manner. In this way we can make the roads safer for pedestrians, cyclists and motorists, this will help in reducing the road accidents. The punishments offered at making the offences will pressurize the road users to be disciplined while driving on the roads. This will also reduce the work of traffic controlling authorities, "chalan" could be sent online easily to the owner as our pre-existing systems are also functioning like this. The same money will be received by the government bodies cases of bribe offences will also reduce.

D. Planning

Smart video control system for capturing clear angles is the first requirement. A system with pre-fed traffic control traffic system details, can say user allotted. Supervisory computer control system will work as a hub to store whole data. Peripheral devices will be connected to it. (As shown in fig 1)
For the controlling and monitoring of traffic, two categories are there:

- Traffic control and traffic flow detection.
- Video surveillance and incident management.

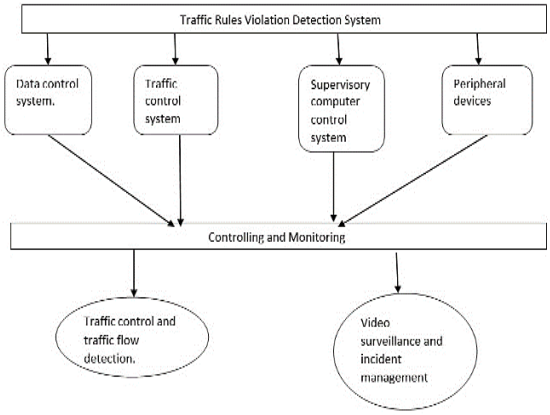


Fig. 1. Components of traffic rule violation detection system

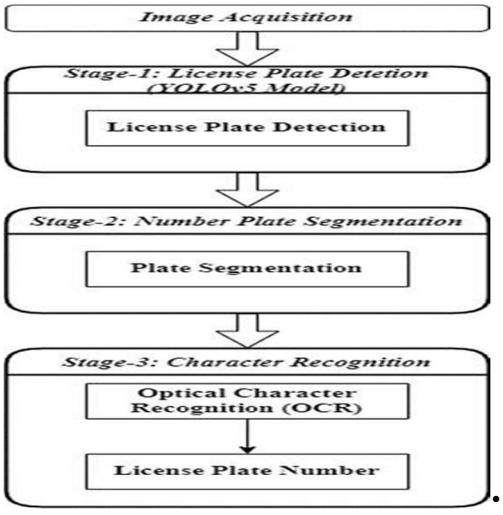


Fig. 2. Stages of detection system

III. PROPOSED SYSTEM

Let's enlighten for better understand the functioning of the system, the preparation process is divided into 3 different stages. Create a custom YOLOv3 model for all three levels to achieve accuracy on the license certificate. In this process, the YOLOv5 model is only used for license plate identification and the license plate is further classified. It uses YOLOv5 instead of previous YOLO versions because it detects small objects better while training differently than its predecessors. The system uses Google OCR Tesseract to recognize characters of the license and converts them to text after segmentation.
The method is further substituted in mentioned categories:
A) Image Acquisition: Images of vehicles are taken using cameras at number and station. For our system, it uses a database containing images of different cars on the internet with images taken from mobile devices. Our database contains of nearly 500 images of various types of vehicles (bikes, cars, etc.), including front views and rear views. It also has a carless photo driver's license used to validate driver's license card for our YOLO network for driver's

license verification. Even though our dataset does not have a specific size of, i.e., not all images are the same, it converted all images as training data to the same size, for example 640x640. Additionally, we provide annotations using Labelling, an open-source API for creating tutorials in YOLO format.

Fig. 3. Image Acquisition of the vehicle

Stage 1: Detection of License Plate

By using the automatic driver's license search and recognition system, the vehicle has driver's licenses and thanks to the calculation module using local algorithms, driver's license characters are parsed and recognized. Here the YOLOv5 model for license plate verification is used. Convolutional Neural Network (CNN) to get the real time and this algorithm to get the license of the car. Such algorithms are used in AI programs to find certain items based on options. We decided to use the YOLOv5s, the smallest and lightest model with the fastest output, to take screenshots. Here we can see the difference in accuracy and performance of the different model sizes of v5.

TABLE I OUTPUT AFTER PERFORMING OPTICAL CHARACTER RECOGNITION (OCR)

Segmented License plate	Character Recognition ofLicense plate
	MH02LA7975
	M H 2 0 E E 7 5 9 8

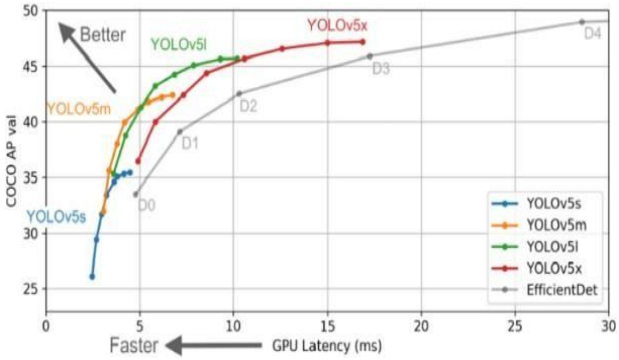


Fig 4. Accuracy of YOLOv5 compared to other YOLO versions

The YOLO algorithm for license check uses the following steps:

- *Residual Blocks:* In this process, all images are converted to a grid form of squares, each N * N in size. Here it will show the mesh where the objects are checked.
- *Bounding Box* Regression: In this method, an outline box is created around identity located in the whole image. This bounding box has the distinctive features of; bounding box width (bbw), bounding box height (bbh), Class c (this describes what elements are in it. License here), and bounding box center coordinates. Here detection of the license plate held. In Fig 5, green paper bounding boxes and their green/red plates represent plates detected by the image using the YOLOv5 model.

Proposed System has achieved the following results after training over 100 epochs.

TABLE:II TRAINING RESULTS OF PROPOSED SYSTEM

Precision	0.629
Recall	0.943
map@0.5	0.0958
map@0.5	94% confidence as 0.417

Fig. 5. Image after the detection of license plate

Stage 2: Plate Segmentation

Segmentation is the next important step to recognize plate, the plate is separated from the original image, then we apply OCR Tesseract to it to recognize the behaviour.

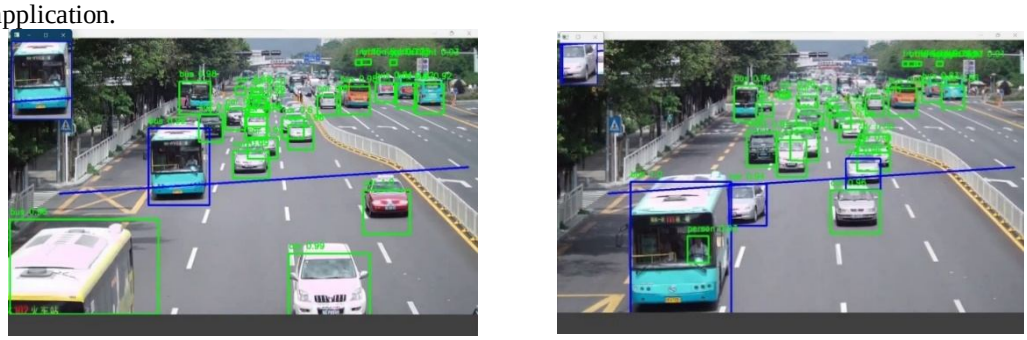
Fig 6. Language translation using google API

Stage 3: Character Recognition

It recognizes each character individually based on its type using OCR Tesseract, which is the last step in LP recognition [1]. Optical Character Recognition (OCR) allows a service to recognize text or words in a user's communication without human intervention. Optical behaviour recognition has greater significance in the field of pattern recognition and artificial intelligence. It also tested the regional license for India, (as we can see in fig 6), at all levels be estimated as shown below for Marathi license. Here it uses Google Translate API to translate Marathi words into English after going through the same YOLOv5 standard. While the accuracy is good, it can be improved as more information will be found in the future.

- *Steps in license review*

1) *Collect a dataset:* to train a model for the permit, you need a dataset, which consists of an image with the license plate viewed from different angles. lighting. You can write your own file or use an existing file like Open ALPR.
2) *Image pre-processing:* The image must be pre-processed to be suitable for tutorial. This includes resizing images, converting them to grayscale, and applying filters to improve.
3) *Annotation:* You need to annotate the images with the coordinates of the number plates in each image. There are many tools available for this, such as labelling.
4) *Train the model:* You can train the model using a deep learning framework such as Tensor Flow or PyTorch. You should choose the model suitable for your model, such as YOLO or SSD, and train on the recorded data.
5) *Evaluate the model:* After training the model, you should evaluate its performance on independent test data. You can evaluate the performance of models using metrics such as precision, recall, and F1 score.
6) *Optimizing the model:* If the performance of the model is not good, you can adjust the hyperparameters with, modify the model or use it to improve the changes.
7) *Deploy the prototype:* Once you are satisfied with the performance of the prototype, you can deploy your application or server to. You can use the API to expose the service license to other applications or embed it in a web application.



8) Fig.7 Sample Outputs

IV. Challenges

Although the number plate recognition technology has shown promising results in traffic rule violation detection. One of the main challenges is the variability in number plate designs and fonts. Different countries and regions have different number plate designs and fonts, making it difficult to develop a universal number plate recognition algorithm. Another challenge is the accuracy of the violation detection. The system may generate false alarms or miss some violations, leading to inefficient enforcement. To overcome these challenges, researchers have proposed various approaches, such as deep learning-based recognition, multi-view recognition, and context-based violation detection. Deep learning-based recognition has shown superior performance in recognizing complex number plate designs and fonts. Multi-view recognition can improve the recognition accuracy by integrating information from multiple cameras. Context-based violation detection can improve the accuracy of violation detection by considering the traffic situation and environment.
Overall, number plate detection from different angles and hand-painted plates is a challenging task that requires a lot of data and a well-designed deep learning model. It is important to experiment with different architectures and hyper parameters to achieve the best performance.

V. Conclusion And Future Scope

Since in previous sections it's already discussed various challenges that traffic police face in maintaining a database of all vehicles that violate traffic laws, this module offers an easier solution to this problem.
The developed module that can justify about 70% of the purpose. Only in few the case of image system unable to get the accuracy of all the characters getting decoded. Here it's able to decode the image of the car number plate and extract the vehicle number. Identified owner will be sent an SMS with the use of GSM module. The SMS will contain the details of the penalty which the owner needs to pay to get his fine record cleared. The details of the vehicle and the penalty amount will be verified before the SMS is sent. The owners will have to pay the penalty amount within 24 hours, or else the system will send out a reminder. The system will be regularly updated with the latest information. As a result, the penalty must be paid only when the person is caught by the traffic police. Also, with our developed system, the person can be notified of the penalty through SMS, making it easier for both traffic police and the concerned party. For the future work the efficiency of system can be improvised using more advance deep learning technique. Also, more parameters of detection can be added up for more secure traffic system.

References

[1] Kenue, S.K., " LaneLok : Detection of Lane Boundaries and Vehicle Tracking Using Image – Processing Techniques - Part 11: Template Matching Algorithms. " Vehicle Systems, 2022.
[2] Ruben J Franklin et al., "Design concepts of an application platform for traffic law enforcement comprising RFID technology. ", 2022.
[3] Chetan Kumar B et al., " Automated traffic estimation using image processing. ", 2021.
[4] Helen Rose Mamipilayil et al., " Embedded system for automatic traffic violation monitoring and alerting. ", 2021.
[5] Ali Sentas et al., "A video based traffic violation detection system. ", 2020.
[6] Sherif, H.M. , "Development of an automated red light violation detection system " 2020.
[7] Satadal Saha , Subhadip Basu, Mita Nasipuri , " Traffic violation detection system based on RFIDs.", 2020.
[8] Xiaoling Wang , " A system for traffic violation detection. ", 2020.
[9] Pejmin Niksazn , " Vision based real time traffic accident detection. ", 2019.
[10] R. shreyas et al., " Real time traffic accident detection system using wireless sensor network. ", 2019.