International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

# Automated Generation of Challan on Violation of Traffic Rules using Machine Learning

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**Abstract:** ***Nowadays, people violating traffic rules has become a major issue and the carefree and irresponsible attitude of people is damaging the moral fibre of the society. The traffic regulations in our country have improved leaps and bounds in the last few years but still the human interference aspect in our current system is a liability and leads to mediocre results which could have been much better. This in turns leads to late and sometimes inaccurate delivery of E-challans and papers based challans which in turn encourages such irresponsible drivers .Our proposed uses object detection, machine learning , object tracking and number plate detection techniques to automate the process of picking out traffic offenders (using object detection and object tracking ) and generating the E-challans by directly fetching the vehicle information from the RTO after extracting the number plate data ( number plate detection ) and deliver the E-challan via Email and SMS on the same day the offence is registered .This will significantly increase the efficiency and accuracy of the system and eliminate the possibility of any human error as there is in the current system***

**Keywords:** Number Plate Detection, Automatic Number Plate Recognition (ANPR), Character Segmentation, Character Recognition, Image Processing, Machine Learning, Challan Generation

## 1. Introduction

As we walk into a new future with every passing day, the dream of owning your own vehicle is no longer something that is limited to the rich and affluent. The technological and industrial advances coupled with the availability of multiple financial instruments have made the dream of owing your own vehicle a very real possibility for every individual. Well as a society and country, it is an indicator that the population and so the country is doing well economically. But there is always a silver lining to every cloud, in this case a bad one. As we witness a significant rise in the number of vehicles on the roads, there is a corresponding increase in the number of traffic rule violations. On an average about 1 lakh people are killed on Indian Roads every year and traffic rule violations are responsible for a major chunk of these deaths [1][2]. As long as we don't go for a more stringent and technologically advanced traffic regulation system, the attitude of the drivers on the roads is not going to change.

Street paving has been found from the first human settlements around 4000 BC in cities of the Indus Valley Civilization on the Indian subcontinent in modern-day Pakistan, such as Harappa and Mohenjo-Daro[3].Well back then we didn't have any traffic regulation systems as such but since Industrialization came into the picture, we have experimented with various systems such as use of image processing for vehicle surveillance [4], use of detector data for traffic control strategies [5], use of photo enhancement using Unicam for traffic management [6], Vision based traffic monitoring at road intersections[7], IoT based road traffic surveillance and accident detection systems [8], Dynamic traffic rules violation monitoring systems [9], Automated Traffic Monitoring using Computer Vision [10], Hierarchical and Networked Vehicle Surveillance [11], Use of Unmanned Aerial Vehicles (UAVs) for traffic monitoring [12]. Well these are some of the most recognized approaches for monitoring traffic across the globe in all possible environments. All of them have been extremely effective and efficient in general but we need is something that is tailored to the requirements our country and our people to be very precise. Delivering E-challan on the same day the offense is committed. Reducing the manual work load on traffic police by eliminating the need of manual picking of offending vehicles[16] and then contacting the RTO to get the data of that particular vehicle. This intermediary process should be eliminated as the system should be smart enough to identify the offender and fetch the data automatically. The system should make it very easy for the Ministry of Road and Transport, India to have a proper and valid count of the revenue generated from the fines collected. Apart from monitoring traffic and identifying the offenders, the system should also be able to maintain a generic database of the offenses committed by drivers which can used to predict driving patterns and general tendencies of some particular driver. Keeping all this in mind, we propose a system that will be very much economical and can be readily implemented with the present hardware and a few software tweaks

## 2. Methodology

We will begin with the basic flow of the system and then we will discuss individual modules in detail.

### 2.1 Basic Flow

To begin with, the proposed system works on both live video feed, recorded footage and static images. Whenever any of the street cameras catch any vehicle breaking any of the laws, the officers monitoring the feed in the monitoring centre draw a bounding box around around that vehicle and then that image is fed to our proprietary API which performs object detection, license plate detection, character segmentation, character recognition and finally returns the extracted license plate number in the GUI of our system along with a magnified image of the license plate. If in any case the system returns a license plate with any errors/mistakes in character recognition, then the officers can correct that with the help of the magnified image. Once we have the license plate number, the system fetches the information about that vehicle by mapping it with the RTO Database (Our local database in the prototype). And with that information we generate an electronic challan which is sent to the offender on the same day via email. Thus you can clearly see how we are proposing to the fastrack a process which is very tedious at the moment. The flow of the system can be seen in the fig 1.a and 1.b

### 2.2 Individual Modules

**1) License Plate Detection (YOLOv3)**

You Only Look Once or more popularly known as YOLO is one of the fastest real-time object detection algorithm (45 frames per seconds) as compared to R-CNN family (R-CNN, Fast R-CNN, Faster R-CNN, etc.) The R-CNN family of algorithms uses regions to localise the objects in images which means the model is applied to multiple regions and high scoring regions of the image are considered as object detected. But YOLO follows a completely different approach. Instead of selecting some regions, it applies a neural network to the entire image to predict bounding boxes and their probabilities [14] [15]. In our system, we feed the screenshot of the vehicle to our API which runs the object detection model in the background and then the model detects the license plate and draws a bounding box around those plates and returns the coordinates of the bounding box. YOLOv3 offered us a good balance between speed and accuracy without the use of any GPU.YOLO v3 performs at par with other state of art detectors like RetinaNet, while being considerably faster, at COCO mAP 50 benchmark. It is also better than SSD and it's variants [13]. Some results of our license place detection module are shown in fig 2.a

**2) Character Segmentation (YOLOv3)**

Once the license plate is localised, then the system further performs character segmentation on the license plate. Character segmentation is an operation that seeks to decompose an image of a sequence of characters into subimages of individual symbols. It is one of the decision processes in a system for optical character recognition (OCR). Its decision, that a pattern

isolated from the image is that of a character (or some other identifiable unit), can be right or wrong. It is wrong sufficiently often to make a major contribution to the error rate of the system[17][18][19]. Character Segmentation finally returns an image in which there is a bounding box around individual characters. We have again used YOLOv3 for the segmentation process because it offered better accuracy over the other models that we tested. The results of this are shown in fig 3.a

**3) Character Recognition ( ResNet50 + ResNet50V2 +DenseNet169)**

Finally Character Recognition also known as Optical Character Recognition recognizes the characters on the segmented license plate[20][21][22]. In our system the recognized characters are returned as a json object which are then displayed in the GUI of our system along with other details. We have here used an ensembled model that combines three individual models to improve the overall accuracy and performance of the system. The results of this are shown in fig 3(a) and 4 (a).

Once the system gets the characters of the license plate, it can be then used to generate the electronic challan by cross referencing the license plate with the RTO Database (our database in the prototype) and getting the information about the owner of the vehicles. The GUI screenshots and electronic challans are shown in fig 5.a and 5.b

Apart from that the statistics of the models we have used are shown in the fig 6.a

## 3. Diagrams and Images

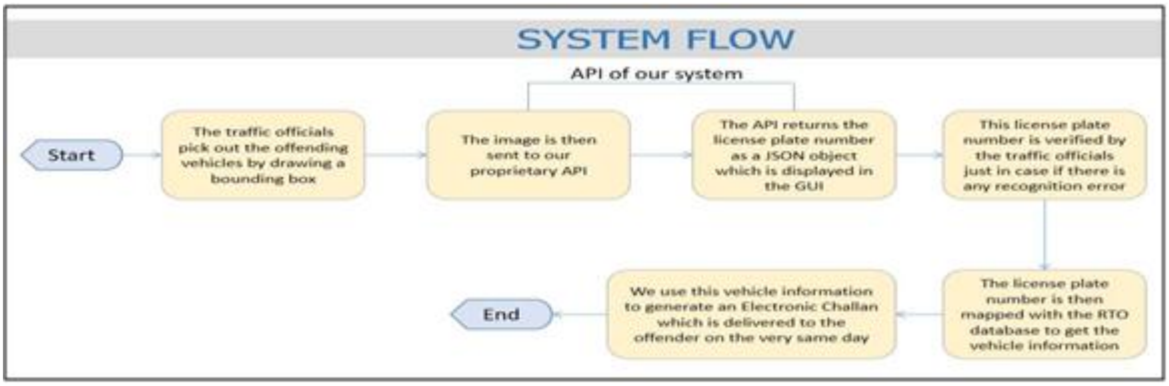


**Figure 1 (a):** Basic flow of the system

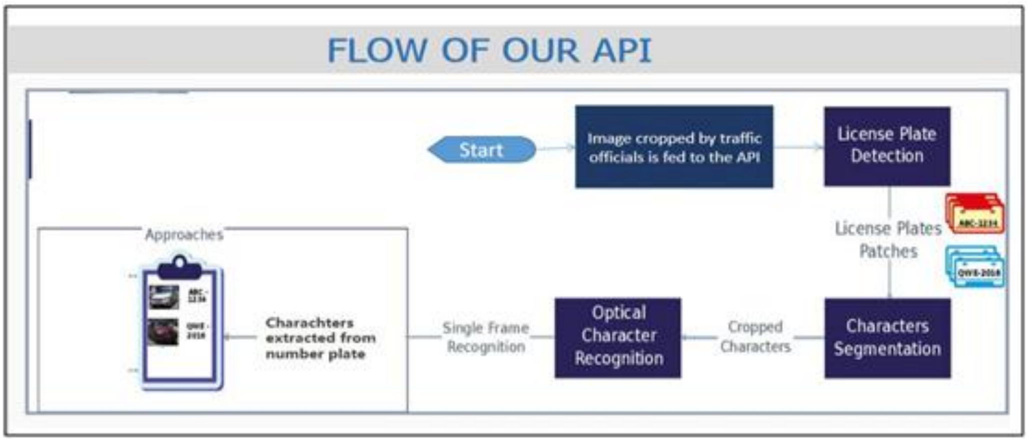


**Figure 1 (b):** Flow of the API

## 4. Results and Experimentation

**Figure 2 (a):** Results of License Plate Detection


**Figure 3 (a):** Results of Character Segmentation and Character Recognition

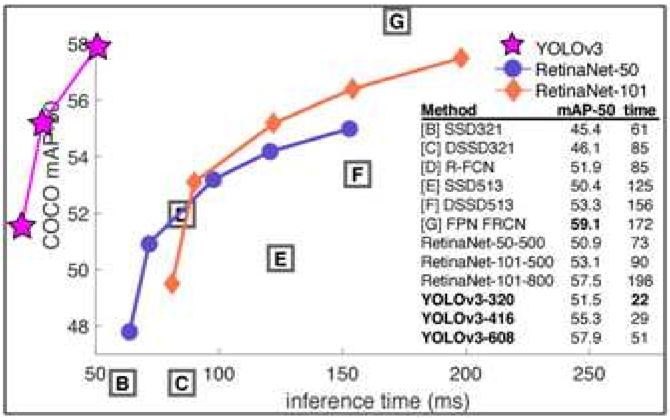


**Figure 3 (b):** How YOLOv3 outperforms other detectors when tested on COCO mAP-50

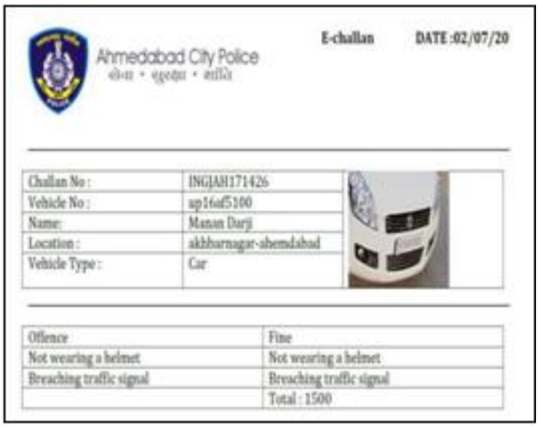


**Figure 4 (a):** Proposed E-Challan


**Figure 5 (a):** GUI of the proposed system

| S No | Module | Model Name | Accuracy After 1000 iterations | Accuracy After 2000 iterations | Accuracy After 3000 iterations | Accuracy After 4000 iterations | Accuracy After 5000 iterations | Accuracy After 6000 iterations | Final Accuracy |
|---|---|---|---|---|---|---|---|---|---|
| 1 | License Plate Detection | Yolov3 | 63.48% | 90.33% | 92.94% | 93.84% | 92.99% | 93.86% | 93.86% |
| 2 | Character Segmentation | Yolov3 | 92.77% | 98.08% | 98.27% | 97.45% | 97.42% | 97.38% | 97.38% |
| 3 | Character Recognition | ResNet50 + ResNet50V2 +DenseNet169 | 67.52% | 70.43% | 74.67% | 79.19% | 86.32% | 89.11% | 89.11% |

**Figure 6 (a):** Statistics of our Machine Learning Models

- The dataset for our machine learning models have been compiled from multiple sources.

The dataset for Vehicle Images have been compiled by combining:
- Stanford Cars Dataset
- Kaggle Vehicle Datasets
- Smart India Hackathon 2020 Training Dataset
- Google Images

The dataset for License Plate images have been compiled by combining:
- Kaggle Number Plate Datasets
- Smart India Hackathon 2020 Training Dataset
- Google Images

The dataset for License Plate Characters have been compiled by combining:
- Kaggle Number Plate Datasets (Cropped from license plate datasets)
- Google Images

**License Plate Detection:** Total Images - 3700, Training Images - 3289, Testing Images - 411
**Character Segmentation:** Total Images - 2158, Training Images - 1919, Testing Images-239
**Character Recognition:** Total Images - 2158, Training Images - 1919, Testing Images – 239

## 5. Conclusion

This paper focuses upon automated generation of e-challan using machine learning approach. The machine learning models have achieved 93.86% accuracy in number plate detection, 97.38% for character segmentation and 89.11% accuracy in character recognition. This system promotes the era of digitization and will impose less usage of paper thus speeding up the entire process of challan generation. This will also generate huge amounts of data which can be used in various pattern findings.

## 6. Acknowledgements

The authors would like to thank Ms. Himani Trivedi for her guidance. This work has been supported in part by Sarva Vidyalaya Kelavani Mandal Student Project/Innovation catalyst-KadiSarvaVishwavidyalaya.

**Grant Number:** KSV/SVKMSPG/0007/ENGG/2019

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