Traffic Rules Violation Detection using AI and Machine Learning

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Declaration

I certify that this research work titled "*Traffic Rules Violation Detection using AI and Machine Learning*" is my own work. The work has not been presented elsewhere for assessment. The material that has been used from other sources it has been properly acknowledged / referred.

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Copyright Statement

Acknowledgements

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Abstract

This system is being designed to ensure a safe and smooth flow of traffic on roads of Pakistan. As static cameras do not serve the purpose completely, this system is based on dashboard camera video/image processing to ensure the obedience of traffic rules in dynamic environment. Not all the traffic rules can be detected with the help of camera i.e driving without a license. This system detects the following:

1. Running Red Light
2. Wrong indicators
3. Wrong overtaking
4. Driving on wrong way

After detecting a violation, a short video clip of 7 to 10 sec would be sent to traffic police portal and database record would be maintained in firebase. A traffic personnel would accept or reject the request based on the video, for generation of challan.

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CHAPTER 1: INTRODUCTION

The research work in this dissertation has been presented in four parts. First part is related to the detection of traffic rules violations that again includes four parts:

1. Running Red Light
2. Wrong indicators
3. Wrong overtaking
4. Driving on wrong way

Second part is to extract the information of vehicle violating the rule and maintaining video clips as a proof of violation.

Third part is to send the extracted information to concerned traffic police portal through an android application.

And forth part is to maintain the records of violation on traffic police database for further processing and to generate challan defined by Islamabad Traffic Police, against the vehicle.

1.1 Background, Scope and Motivation

Monitoring of traffic rules violation, manually is a very tricky and hectic task. Human force in the form of traffic police staff cannot be deployed on every single road to keep track of the violations taking place on roads. Different approaches are being followed to make this an easily achievable task. The approaches include static cameras installed on sensitive places to monitor and the use of simple machine learning algorithms.

This project has been developed specifically for Pakistani roads (Motorways and Highways). Keeping in view the economic status of Pakistan this project offers a very effective and less expensive solution to above mentioned problem.

1.1.1 Problem Statement

The real time problem is to detect traffic rules violations in fully dynamic environment using dashboard camera and a combination of different AI models effectively and efficiently.

1.1.2 No. of rules violation to be detected

Not every traffic rule violation is detectable with the help of a simple camera i.e Driving without a license. There are four sort of rules violations that our system detects successfully.

1. Running Red Light
2. Wrong indicators
3. Wrong overtaking
4. Driving on wrong way

1.1.3 Hardware and Support

The proposed system user the following support to detect the rules violations in real time:-

1. Dashboard cameras
2. Raspberry Pi Model 4
3. OpenCV Algorithms
4. Machine Learning
5. Android Application

1.1.4 Novelty

There are two unique features in this research:-

1. Only one sensor
2. 100% Dynamic environment
3. Specific for Pakistani roads

1.1.5 Challenges

Following are the major challenges while working with the system

1. Arbitrary Orientation
2. Complex Backgrounds
3. Non-clarity of Licence Plates

4. Dataset Availability
5. Dynamic Camera Placement
6. Combination of Algorithms

CHAPTER 2: LITRATURE REVIEW

As autonomous vehicles, smart roads and machine learning based technologies are getting importance day by day, there are many approaches being used regarding solving the above mentioned problem.

2.1 Android based Traffic Rules Violation Detection System (Vehitrack)

2.1.1 Abstract

The main objective of the project is to detect the traffic rule violator on road by means of sensor, RFID reader and RFID tag technology and capture image by means of camera. The system will control the traffic density of the specific location. The project will also focus on mobile application which will help to know information about the vehicle tracked by sensor on road. This mobile app will maintain the database related to image as proof and RFID Tag number such as name, address, license number, photo, mobile number, their bank account number and also the list of previous rules broken with image as proof, date and time and fine paid by vehicle owner. This all data about the vehicle will display on smart phone of traffic police. This application will automatically receive the fine from the owner bank account and send the message to their mobile application or number about the rules and their fine. If same vehicle found to be encountered again and again then a specific action could be done.

Figure 2.1.1: City View Karachi

2.1.2 Working

The project will reduce all the issues related to traffic rule violation on road. In this system there are automatic traffic rules violation detection devices, message sending and this system, RFID reader will read the RFID tag number which is given to the individual vehicle while purchasing or passing the vehicle for the number plate received by RTO which will be mandatory. The camera will also be there for capturing the image of vehicle that has broken the rule RFID reader will read the RFID tag number, latest image capture by digital camera and send this information to the server database. Server Database will send the Information from its stored database related to RFID tag number and image on traffic police android application number and related image from server and related details about that particular vehicle such as name of owner, address, license number, passing number, photo, mobile number, their bank account number and also the list of previous rules broke by that vehicle owner or driver with the date, time, fine and the type of rule. This application will received the fine automatically from vehicle driver and its actual fine decided by government. This application will also send the message to vehicle owner about the type of rule broken by them, fine according to that rule, proof of breaking the rule in the form of image capture by digital camera, date and time of breaking the rule and accurate amount receiving by their bank account as fine paid for breaking the rule. According to this whole process done, there will be reduction in the workload of traffic police and government and also reduction in accidents and corruption too in world.

2.2 A Video-based Traffic Violation Detection System

2.2.1 Abstract

Traffic violation detection systems are effective tools to help traffic administration to monitor the traffic condition. It can detect traffic violations, such as running red lights, speeding, and vehicle retrogress in real time. In this paper, we propose an improved background-updating algorithm by using wavelet transform on dynamic background, and then track moving vehicles by feature-based tracking method. A complete traffic violation detection system is realized in C++ with OpenCV.

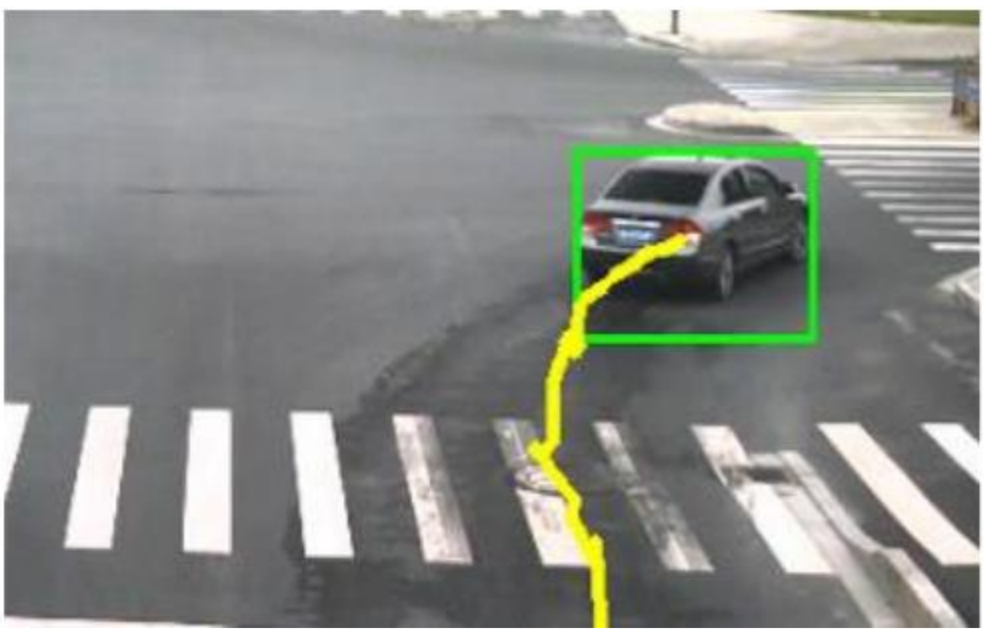

Figure 2.2.1: Vehicle Tracking

2.2.2 Working

It is very difficult to identify moving vehicles, then to track and classify them in real time within a complex environment. There are a variety of approaches to vehicle detection in videos streams, including background difference, inter-frame difference, inter-frame corresponding, and edge detection methods

This paper also discusses a dynamical background update method based on the wavelet transform, which is combined with background difference and feature-based tracking to Detect moving vehicles

The system consists of three modules, namely video loading, detection of violating vehicles, and violation evidence storage. The detection of violating vehicles contains image preprocessing, violation detection, and background update.

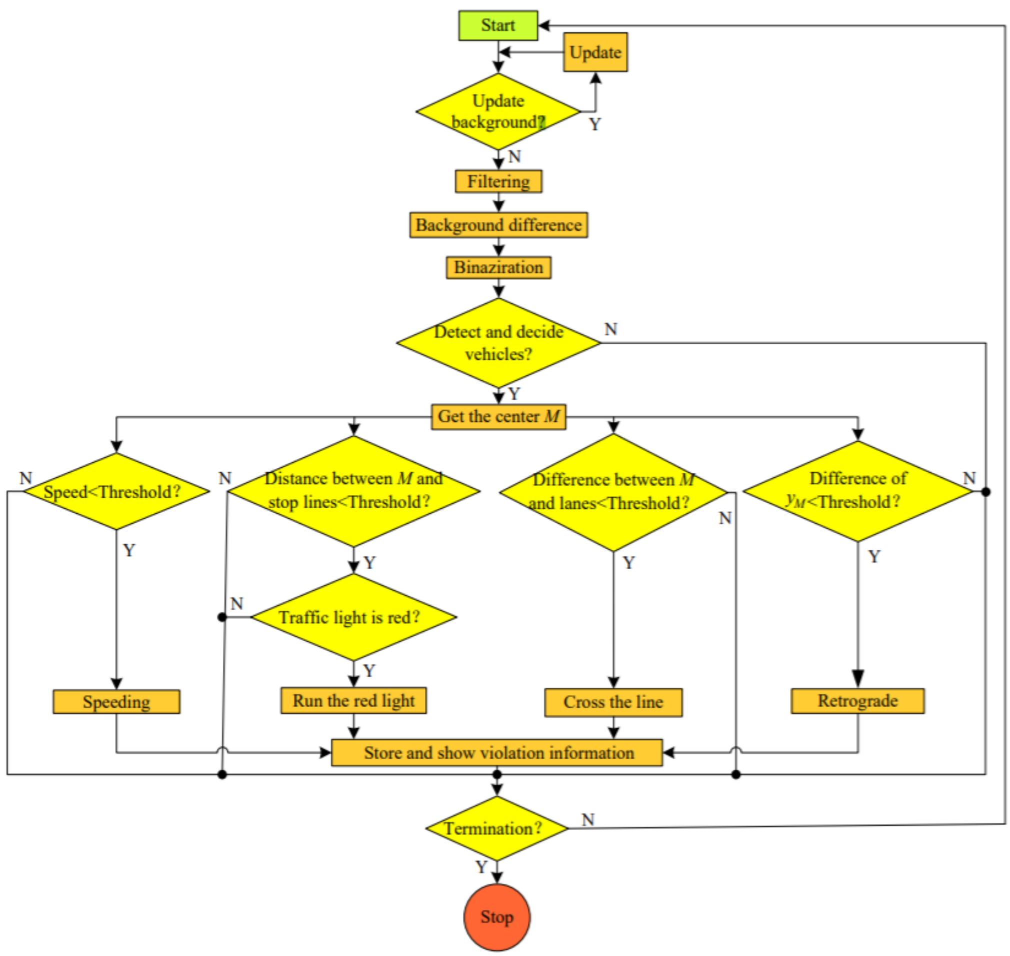

Figure 2.2.2: Flowchart

2.3 Algorithm for detecting violations of traffic rules based on computer vision approaches

2.3.1 Abstract

We propose a new algorithm for automatic detect violations of traffic rules for improving the people safety on the unregulated pedestrian crossing. The algorithm uses multi-step proceedings. They are zebra detection, cars detection, and pedestrian detection. For car detection, we use faster R-CNN deep learning tool. The algorithm shows promising results in the detection violations of traffic rules.

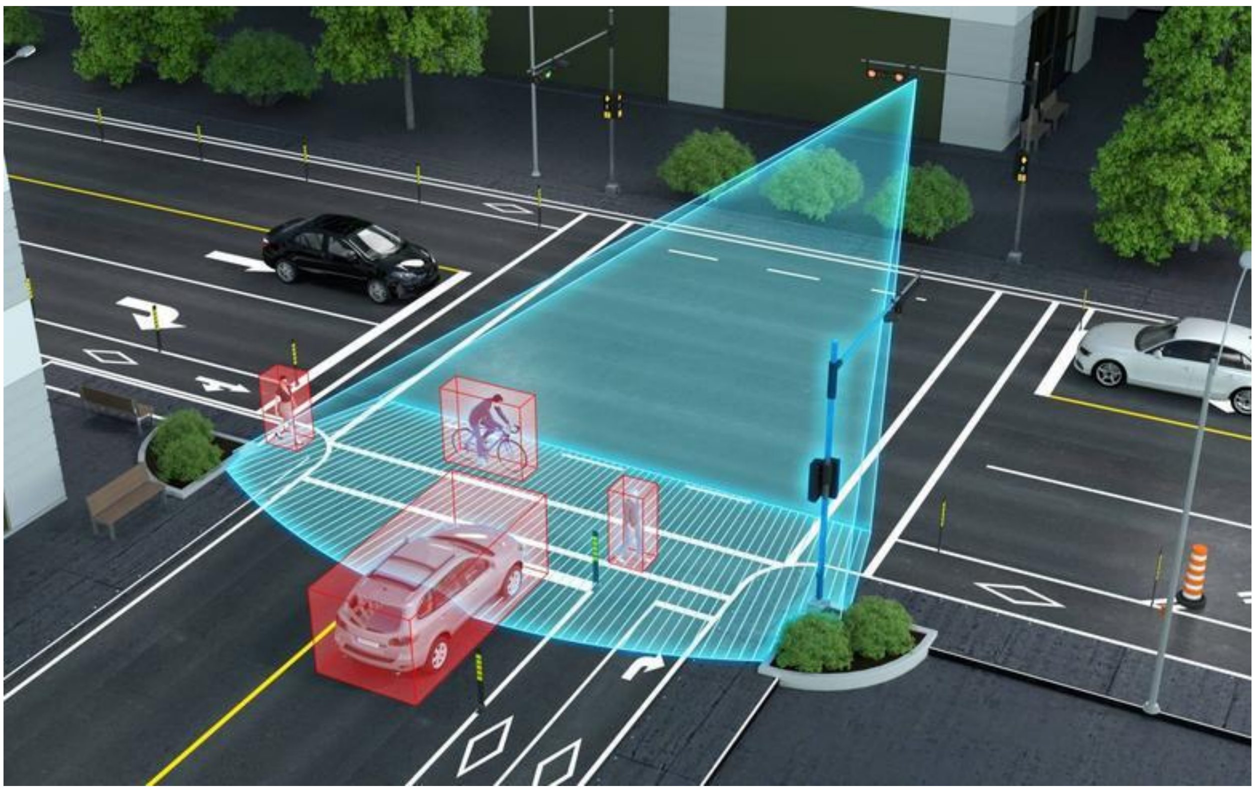

Figure 2.3.1: Pictorial Depiction of computer vision approaches

2.3.2 Working

Analyzing the statistics of road traffic violations in the Russian Federation in 2015, it can be concluded that the creation of automatic detection systems for traffic violations on unregulated crosswalks is necessary to improve safety on the roads of the country. Therefore, the development of an algorithm for fixing traffic violations on unregulated crosswalks is urgent and will be in demand.

The algorithm works in two stages. At the first stage, it is necessary to detect three classes of objects in the video sequence. First class crosswalk (zebra), the second-class moving vehicles and the third class the pedestrians going on the crosswalk. After all the object classes are found on each frame of the video sequence, the second stage begins. It is necessary to impose video sequence frames with the allocated objects at each other. If on the same frame of the video sequence the pedestrian and the vehicle are is at the crosswalk, the vehicle means violates Traffic regulations, having done not pass the pedestrian.

2.4 Automatic Traffic Rule Violation Detection and Number Plate Recognition

2.4.1 Abstract

In the new evolving world, traffic rule violations have become a central issue for majority of the developing countries. The numbers of vehicles are increasing rapidly as well as the numbers of traffic rule violations are increasing exponentially. Managing traffic rule violations has always been a tedious and compromising task. Even though the process of traffic management has become automated, it's a very challenging problem, due to the diversity of plate formats, different scales, rotations and non-uniform illumination conditions during image acquisition. The principal objective of this project is to control the traffic rule violations accurately and cost effectively. The proposed model includes an automated system which uses IR sensors and camera based on Arduino to capture video. The project presents Automatic Number Plate Recognition (ANPR) techniques and other image manipulation techniques for plate localization and character recognition which makes it faster and easier to identify the number plates. After recognizing the vehicle number from number plate, the SMS based module is used to notify the vehicle owners about their traffic rule violation. An additional SMS is sent to Regional Transport Office (RTO) for tracking the report status.

2.4.2 Working

Automation in day to day life has gained importance in recent years. The number of accidents on the roads is due to the rule violations such as breaking traffic signals, overspeeding, driving on wrong sides etc. To avoid such traffic violations, traffic police must be present on the road and must continuously check if some vehicle is violating the rule. A certain automated solution were developed to eliminate the violations; however, each of them had certain limitations. For example, the video capturing cameras eliminated need of an authority to be present to check rule violation. However, whole stored video had to be checked manually for the rule violation scenario. In this proposed system, a solution for signal breaking violation is given. The system includes an automated system by using IR sensor, camera and number plate recognition application. In this system IR sensor will be placed near zebra crossing line. If any vehicle crosses the zebra line, the desktop application will be initiated and will capture number plate image. Number plate recognition application by using image processing algorithm will recognize number plate and SMS will be sent to the offender in case of rule violation scenario.

2.5 Driver Cell Phone Usage Violation Detection using License Plate Recognition Camera Images

2.5.1 Abstract

The increased use of digital video and image processing technology has paved the way for extending the traffic enforcement applications to a wider range of violations as well as making the enforcement process more efficient. Automated traffic enforcement has mainly been applied towards speed and red-light violations detection. In recent years, there has been an extension to other violation detection tasks such as seat-belt usage, tailgating and toll payment violations. In the recent years, automated driver cell phone usage violation detection methods have aroused considerable interest since it results in higher mortality rates than the intoxicated driving. In this study, we propose a novel automated technique towards driver's phone usage violation detection using deep learning algorithms. Using an existing license plate recognition camera system placed on an overhead gantry, installed on a highway, real world images are captured during day and nighttime. We performed experiments using more than 5900 real world images and achieved an overall accuracy of 90.8 % in the driver cell phone usage violation detection task.

Figure 2.5.1: Cellphone Usage Detection

2.5.2 Working

Using the existing license plate recognition cameras that are installed for smart city purposes, we propose a driver cell phone usage enforcement method using deep learning algorithms. Although mobile phone usage while driving is prohibited in many countries, roadside surveys indicate that around 1% to 11% of drivers use phone while driving (ERSO report, 2015). In a recent study, the World Health Organization (WHO) reports that distracted driving (e.g. driver cell phone usage) results in higher mortality rates than that of intoxicated driving (WHO2017). Therefore, traffic safety agencies highly desire an automated cell phone usage violation detection system. Roadway surveillance camera images may offer an inexpensive and efficient solution to this problem (Artan et al., 2014; Berri et al., 2014; Seshadri et al., 2015; Le at al., 2016; Elings 2018). Many studies in the past have proposed image-based solutions towards traffic enforcement purposes. Most of these earlier study's present solutions towards seat belt detection, red-light violation detection, autonomous driving etc. to name a few (Zhou et al., 2017; Bojarski et al., 2016). In this study, we propose driver cell phone usage violation detection using license plate recognition camera images. Proposed method utilizes deep learning-based object detection method in the subtasks of the cell phone violation detection process; windshield region detection, driver detection and phone usage detection.

2.6 Traffic rules violations detection using faster RCNN neural networks

2.6.1 Abstract

This software was created for demonstration purpose and in some cases, it is not able to detect corresponding violations. In case of further development, it will be able to automatically detect most of the types of traffic violations and not only the ones which are related to solid line intersections and red light.

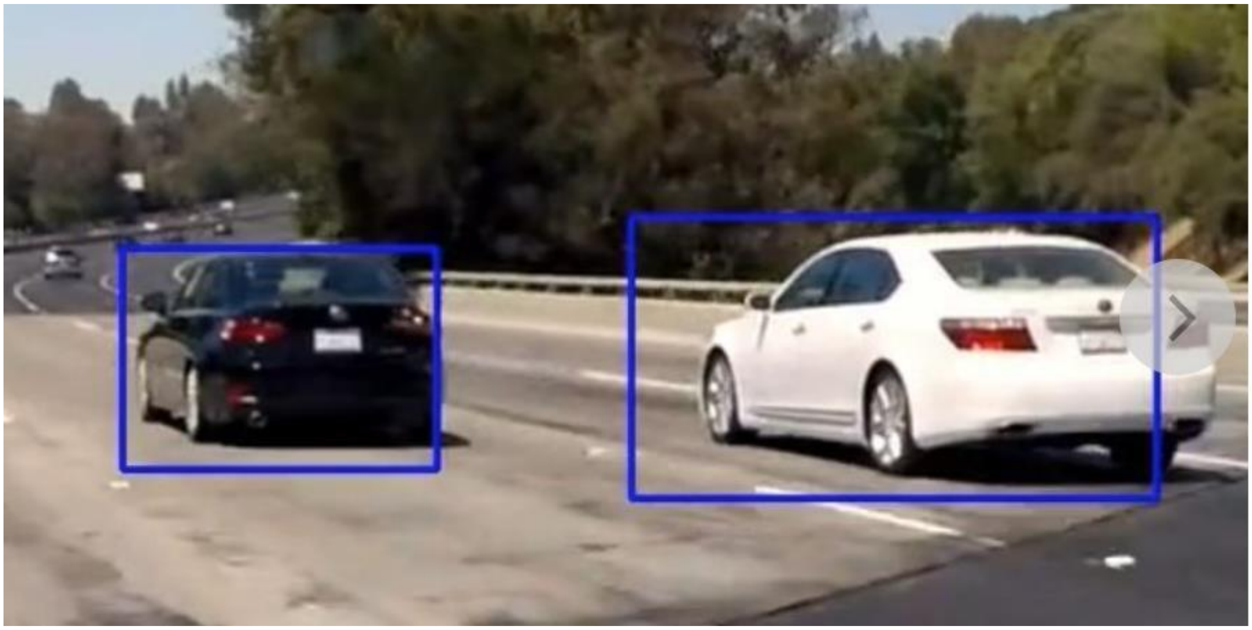

Figure 2.6.1: Vehicle Detection

2.6.2 Working

To analyze a video and to detect the violations which are present in the video, the following approach was taken. First, models of the road and of vehicle movements are obtained by processing the video stream. Second, these models are combined and analyzed to detect traffic violations.

2.7 An Innovative Smartphone-based Solution for Traffic Rule Violation Detection

2.7.1 Abstract

This paper introduces a novel smartphone-based solution to detect different traffic rule violations using a variety of computer vision and networking technologies. We propose the use of smartphones as participatory sensors via their cameras to detect the moving and stationary objects (e.g., cars and lane markers) and understand the resulting driving and traffic violation of each object. We propose novel framework which uses a fast in-mobile traffic violation detector

for rapid detection of traffic rule violation. After that, the smartphone transmits the data to the cloud where more powerful computer vision and machine learning operations are used to detect the traffic violation with a higher accuracy. We show that the proposed framework detection is very accurate by combining a) a Haarlike feature cascade detector at the in-mobile level, and b) a deep learning-based classifier, and support-vector machine-based classifiers in the cloud. The accuracy of the deep convolutional network is about 92% for true positive and 95% for true negative. The proposed framework demonstrates a potential for mobilebased traffic violation detection by especially by combining the information of accurate relative position and relative speed. Finally, we propose a real-time scheduling scheme in order to optimize the use of battery and real-time bandwidth of the users given partially known navigation information among the different users in the network, which us the real case. We show that the navigation information is very important in order to better utilize the battery and bandwidth for each user for a small number of users compared to the navigation trajectory length. That is, the utilization of the resources is directly related to the number of available participants, and the accuracy of navigation information.

Figure 2.7.1: Smartphone based vehicle detection

2.7.2 Working

Our proposed system automatically detects several traffic rule violations on the roads. Specifically, we propose that each driver willing to participate can download our application on his/her smartphone. The major sensor used is the camera in the device. This is different from the currently used technologies where an on-board unit monitor the vehicle in which it is installed. Our proposed system would make each car act as a monitor for the other vehicles on the roads. The system has two main components, namely, an immobile component, and an in-cloud component. The in-mobile component first detects the traffic rule violation on the roads using based on multiple subsequent time frames. This component is fast and had limited resources, and hence limited accuracy. After that, if a traffic rule violation is detected, the snapshot of the video-frame is sent to the in-cloud component which is more intensive in resources and has higher accuracy. We evaluate our proposed system by validation with video traces captured by cameras on the cars in the Middle East and USA. Our system shows a very high accuracy for multiple traffic scenario detection, which hypothetically represent traffic violation detection. We used multiple data sets for training and testing. We used some images as is, and we created some data from video traces. Our results strongly support the feasibility of the proposed scheme. Furthermore, we propose a model to optimize the use of participatory sensors selection under the limited resources scenario. The main challenge of this optimization problem is to simultaneously optimize multiple resources within a dynamic mobile environment. We show that the proposed model can achieve near-optimal resource utilization results compared to the fully known mobility dynamic. The contributions of this paper are as follows:

1. We propose a novel smartphone-based participatory sensing system for traffic rule violation detection that is accommodating to new computer vision, sensing, and networking technologies.
2. We propose the relative positioning and relative speeding concept in out system design in order to infer the traffic violation from the computer vision algorithms and the smartphone sensors readings. These two metrics allow us to understand the driving context from which the traffic rule violation can be detected.
3. We evaluate the proposed system using multiple data sets, and videos that are taken by smartphones (or smartphone like cameras).

We propose a participatory sensor optimization framework to enhance battery and bandwidth utilization while guaranteeing smartphone sensing. In the following section, we discuss the related works to our proposed framework. Then, in Section II, we explain the system model and the traffic detection framework, followed by explanation of the participatory sensor optimization scheme in Section III. After that Section IV demonstrates the experiment setup, the data set used for evaluation, and the evaluation results. We discuss the recent related works in the areas of applied computer vision and intelligent transportation systems in Section V. Finally, Section VI concludes the paper and outlines the position of the proposed framework within current and future technologies including autonomous vehicles.

CHAPTER 3: METHODOLOGY

3.1 Dataset Collection

Dataset for this project has been collected from many different sources including BIT Vehicle Dataset, Cityscape Image Paris, GTI Vehicle Image Database, Google open images dataset, GTSRB and public datasets. These datasets contain images and videos of different resolution and time. And include segmented and annotated images in different light and weather conditions.

Major countries from where data has been gathered are France, Spain, Italy, Germany, Switzerland, Austria, Sweden, USA and Pakistan.

Covered areas of these datasets are highways, motorways and city roads.

This dataset was trained on three major classes:

1. Cars

2. Traffic lights
3. License plates

3.2 Basic Flow

The basic flow of the proposed system is given as follows:

1. Object Detection
2. Lane Detection
3. Red Light Recognition
4. Rule Violation Detection
5. Number Plate Recognition
6. Android Application

A raspberry pi camera is calibrated on vehicle's dashboard that captures the live video of the road scenario. Raspberry Pi processes the video as follows:

1. Object Detection model detects cars, traffic lights and license plates in the given image frame.
2. If a traffic light is present in the picture frame, an adaptive mechanism estimates the tentative location of the final line (not to be crossed in case of red signal).
3. Using Image Processing techniques, system recognizes the color of traffic light (Red, Yellow or Green).
4. Using all the above details, violation of traffic rules discussed earlier is detected.
5. After detection of traffic rule violations, the system extracts the details of license plate of the respective vehicle.
6. Through an android mobile application, the extracted vehicle's details as well as a video clip are further sent to Traffic Police portal (In our case a test android application) for further confirmation of the violation.
7. Traffic police warden approves or rejects the received challan request.

3.3 Object Detection

Collected dataset was trained manually on our custom classes using "Google Colab". The training model for object detection we chose is YOLOV4.

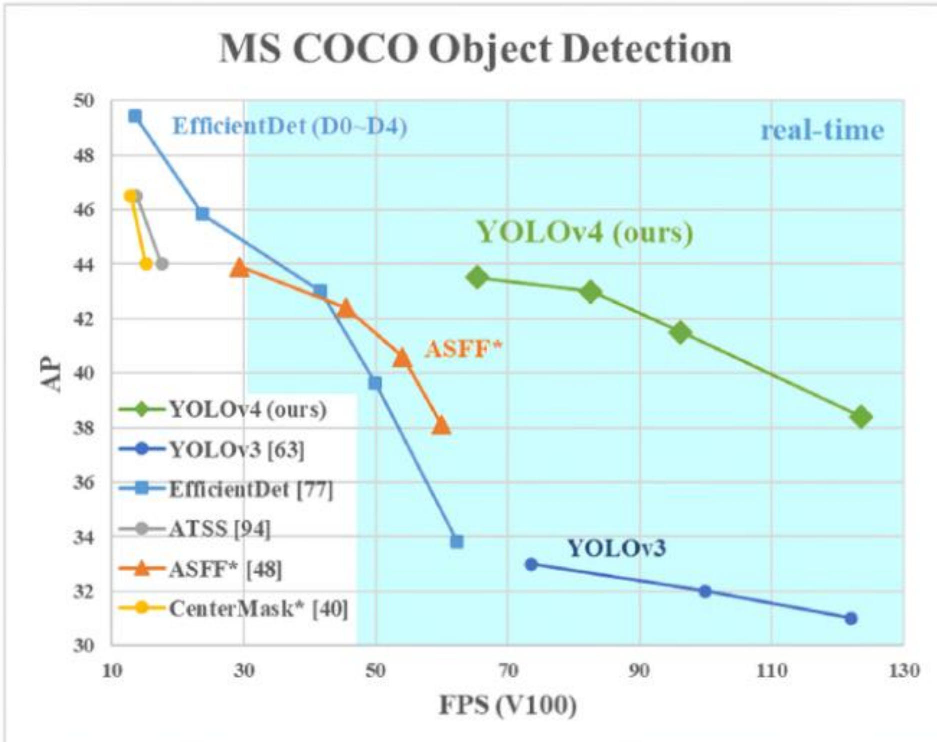

Figure 3.3.1: Yolo

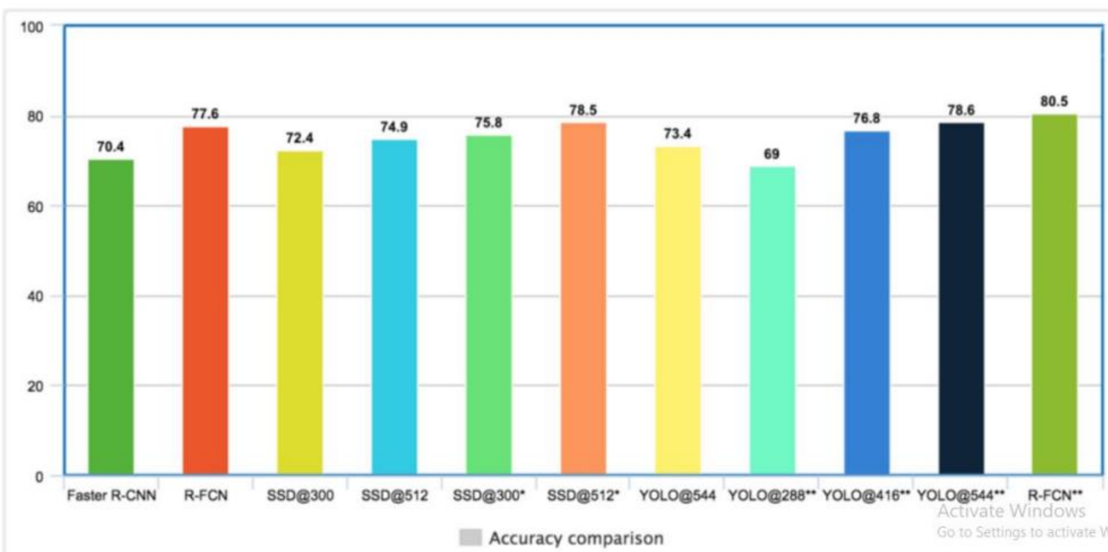

Figure 3.3.2: Yolo comparison with other object detector

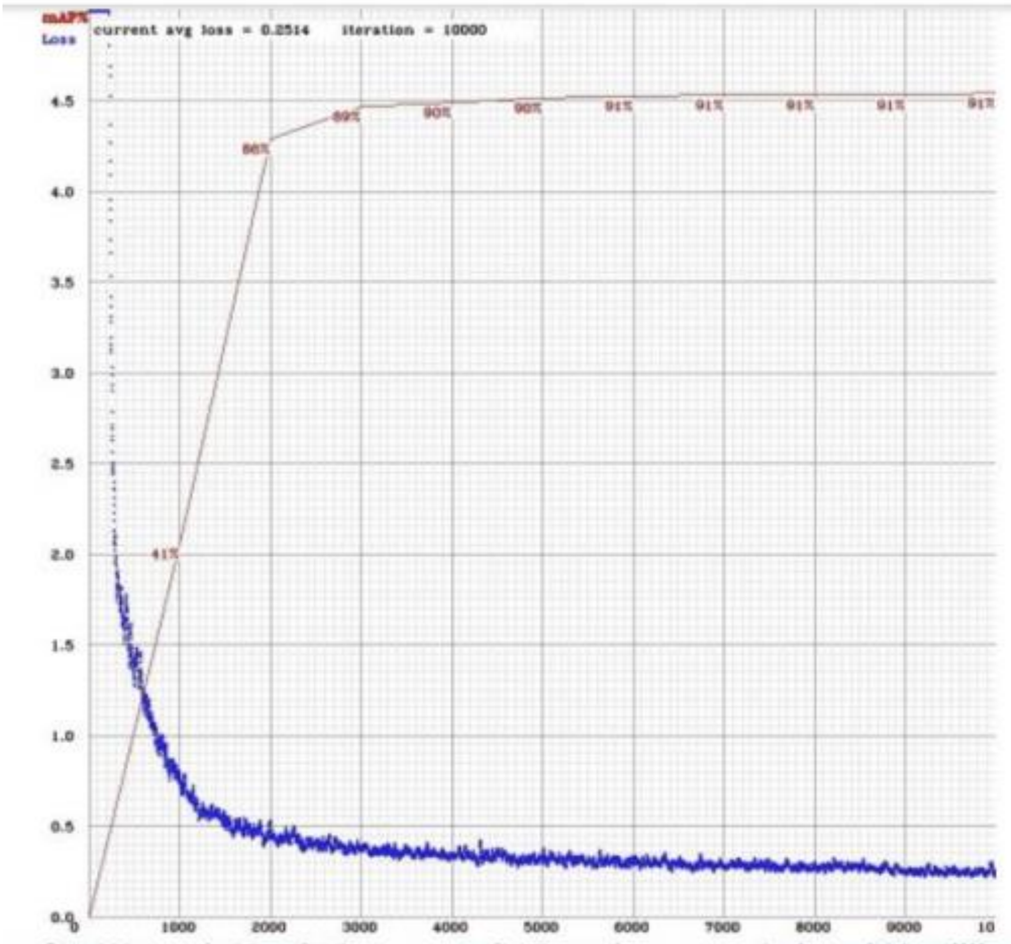

Figure 3.3.3: Training data chart for object detection

In result of YOLOV4 an image with class name, bounding box and its center was received.

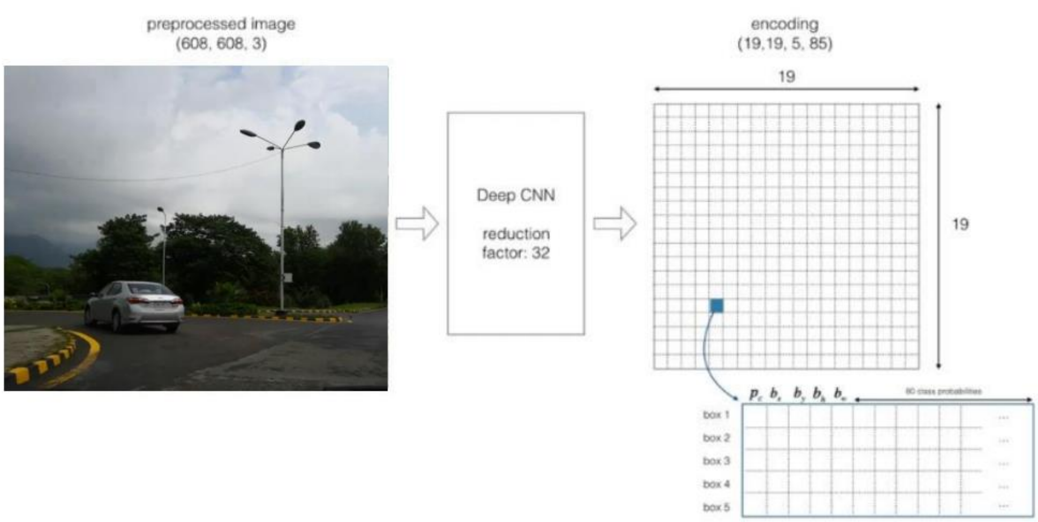

Figure 3.3.4: YoloV4 working

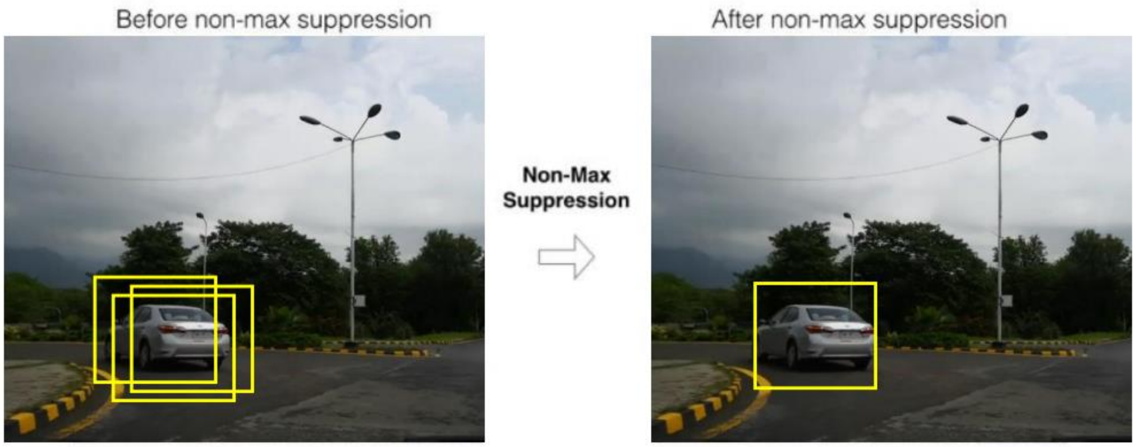

Figure 3.3.5: Yolo Max-suppression

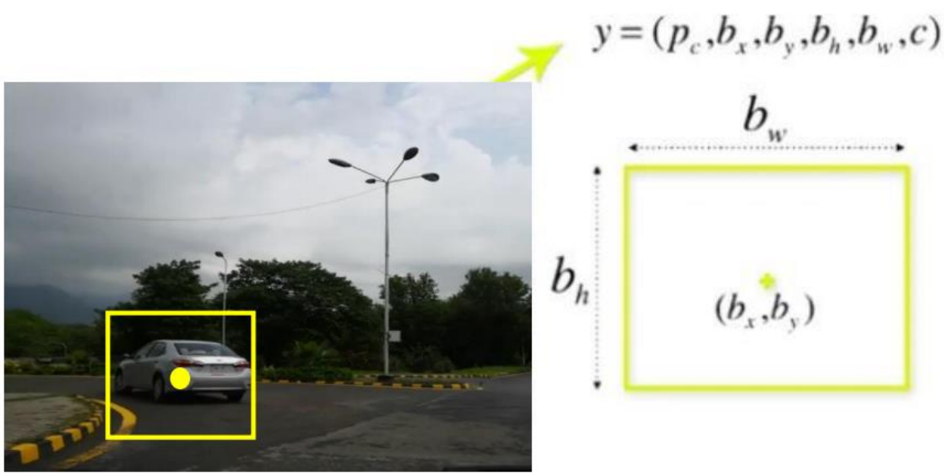

Figure 3.3.6: yoloV4 object detection

3.3.1 Pseudo Code

```
# Load Yolo
net = cv2.dnn.readNet("yolov3.weights", "yolov3.cfg")
classes = []
with open("coco.names", "r") as f:
    classes = [line.strip() for line in f.readlines()]
layer_names = net.getLayerNames()
```

```
output_layers = [layer_names[i[0] - 1] for i in net.getUnconnectedOutLayers()]
colors = np.random.uniform(0, 255, size=(len(classes), 3))

# Loading image
img = cv2.imread("room_ser.jpg")
img = cv2.resize(img, None, fx=0.4, fy=0.4)
height, width, channels = img.shape

# Detecting objects
blob = cv2.dnn.blobFromImage(img, 0.00392, (416, 416), (0, 0, 0), True, crop=False)
net.setInput(blob)
outs = net.forward(output_layers)

# Showing informations on the screen
class_ids = []
confidences = []
boxes = []
for out in outs:
    for detection in out:
        scores = detection[5:]
        class_id = np.argmax(scores)
        confidence = scores[class_id]
        if confidence > 0.5:
            # Object detected
            center_x = int(detection[0] * width)
            center_y = int(detection[1] * height)
            w = int(detection[2] * width)
            h = int(detection[3] * height)

            # Rectangle coordinates
            x = int(center_x - w / 2)
            y = int(center_y - h / 2)

            boxes.append([x, y, w, h])
```

```
            confidences.append(float(confidence))
            class_ids.append(class_id)

indexes = cv2.dnn.NMSBoxes(boxes, confidences, 0.5, 0.4)
font = cv2.FONT_HERSHEY_PLAIN
for i in range(len(boxes)):
    if i in indexes:
        x, y, w, h = boxes[i]
        label = str(classes[class_ids[i]])
        color = colors[i]
        cv2.rectangle(img, (x, y), (x + w, y + h), color, 2)
        cv2.putText(img, label, (x, y + 30), font, 3, color, 3)


cv2.imshow("Image", img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

3.4 Lane Detection

After successfully detecting images, the next step is to detect the road lanes. This step is specially required in detection of wrong side overtaking rule. For this purpose, we used PINet Lane Detector pre trained model.

PINet stands for Point Instance Network and is end to end framework which predics key points and cluster those point to each instance, representing each traffic lane. Therefore it can predict an arbitrary umber of lanes rather than a fixed number.

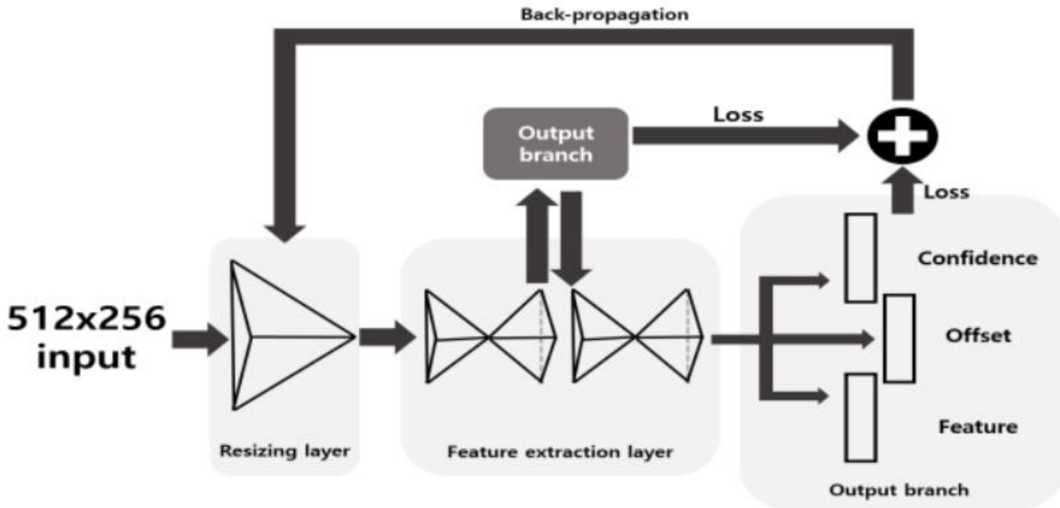

Figure 3.4.1: PINet Lane detection

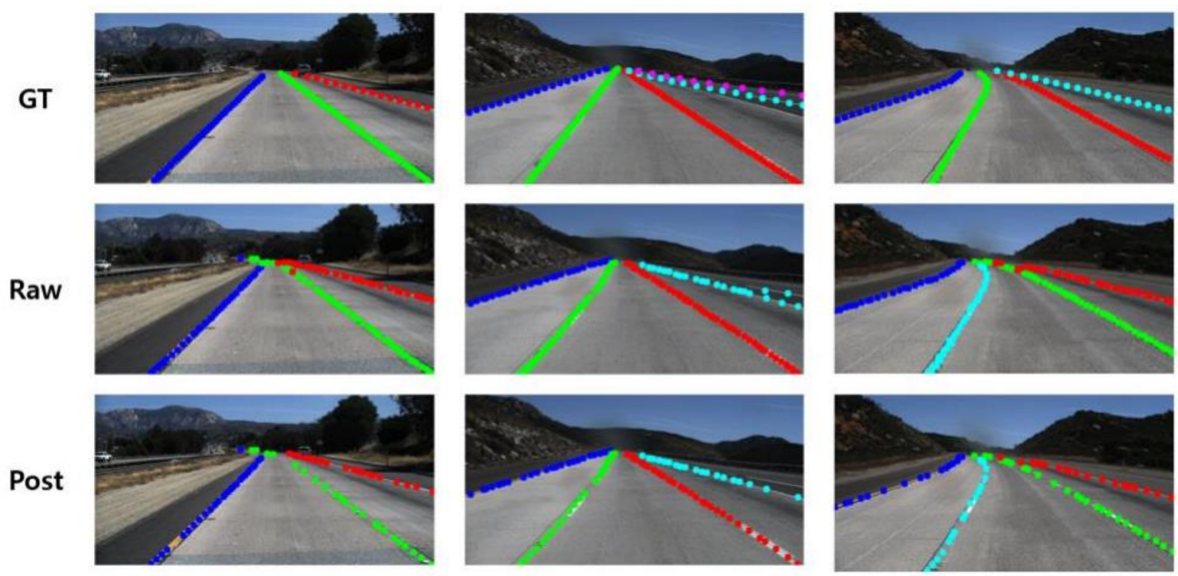

Figure 3.4.2: PINet Result

Category	Proportion	PINet(1H)	PINet(2H)	PINet(3H)	PINet(4H)	SCNN [20]	R-101-SAD [30]	ERFNet-E2E [50]
Normal	27.7%	85.8	89.6	90.2	90.3	90.6	90.7	91.0
Crowed	23.4%	67.1	71.9	72.4	72.3	69.7	70.0	73.1
Night	20.3%	61.7	67.0	67.7	67.7	66.1	66.3	67.9
No Line	11.7%	44.8	49.3	49.6	49.8	43.4	43.5	46.6
Shadow	2.7%	63.1	67.0	68.4	68.4	66.9	67.0	74.1
Arrow	2.6%	79.6	84.2	83.6	83.7	84.1	84.4	85.8
Dazzle Light	1.4%	59.4	65.2	66.4	66.3	58.5	59.9	64.5
Curve	1.2%	63.3	66.2	65.4	65.6	64.4	65.7	71.9
Crossroad	9.0%	1534	1505	1486	1427	1990	2052	2022
Total	-	69.4	73.8	74.3	74.4	71.6	71.8	74.0

Figure 3.4.3: PINet performance

3.5 Violations Detection

3.5.1 Red Light Recognition

3.5.1.1 Pseudo Code

```
lower_red1 = np.array([0,100,100])
upper_red1 = np.array([10,255,255])
lower_red2 = np.array([160,100,100]
upper_red2 = np.array([180,255,255])
lower_green = np.array([40,50,50])
upper_green = np.array([90,255,255])
lower_yellow = np.array([15,150,150])
upper_yellow = np.array([35,255,255])
mask1 = cv2.inRange(hsv, lower_red1, upper_red1)
mask2 = cv2.inRange(hsv, lower_red2, upper_red2)
maskg = cv2.inRange(hsv, lower_green, upper_green)
masky = cv2.inRange(hsv, lower_yellow, upper_yellow)
maskr = cv2.add(mask1, mask2)
bound = 4.0 / 10
  if r_circles is not None:
    light_color = 'Red'
    r_circles = np.uint16(np.around(r_circles))

    for i in r_circles[0, :]:
      if i[0] > size[1] or i[1] > size[0]or i[1] > size[0]*bound:
```

```
        continue

    h, s = 0.0, 0.0
    for m in range(-r, r):
        for n in range(-r, r):

            if (i[1]+m) >= size[0] or (i[0]+n) >= size[1]:
                continue
            h += maskr[i[1]+m, i[0]+n]
            s += 1
    if h / s > 50:
        cv2.circle(cimg, (i[0], i[1]), i[2]+10, (0, 255, 0), 2)
        cv2.circle(maskr, (i[0], i[1]), i[2]+30, (255, 255, 255), 2)
                                cv2.putText(cimg,light_color,(i[0], i[1]), font, 1,(255,0,0),2,cv2.LINE_AA)

                                if g_circles is not None:
light_color = 'GREEN'
g_circles = np.uint16(np.around(g_circles))

for i in g_circles[0, :]:
    if i[0] > size[1] or i[1] > size[0] or i[1] > size[0]*bound:
        continue

    h, s = 0.0, 0.0
    for m in range(-r, r):
        for n in range(-r, r):

            if (i[1]+m) >= size[0] or (i[0]+n) >= size[1]:
                continue
            h += maskg[i[1]+m, i[0]+n]
            s += 1
    if h / s > 100:
        cv2.circle(cimg, (i[0], i[1]), i[2]+10, (0, 255, 0), 2)
        cv2.circle(maskg, (i[0], i[1]), i[2]+30, (255, 255, 255), 2)
```

```
cv2.putText(cimg,light_color,(i[0], i[1]), font, 1,(255,0,0),2,cv2.LINE_AA)

if y_circles is not None:
    light_color = 'YELLOW'
    y_circles = np.uint16(np.around(y_circles))

    for i in y_circles[0, :]:
        if i[0] > size[1] or i[1] > size[0] or i[1] > size[0]*bound:
            continue

        h, s = 0.0, 0.0
        for m in range(-r, r):
            for n in range(-r, r):

                if (i[1]+m) >= size[0] or (i[0]+n) >= size[1]:
                    continue
                h += masky[i[1]+m, i[0]+n]
                s += 1
```

3.5.1.2 Flow Chart

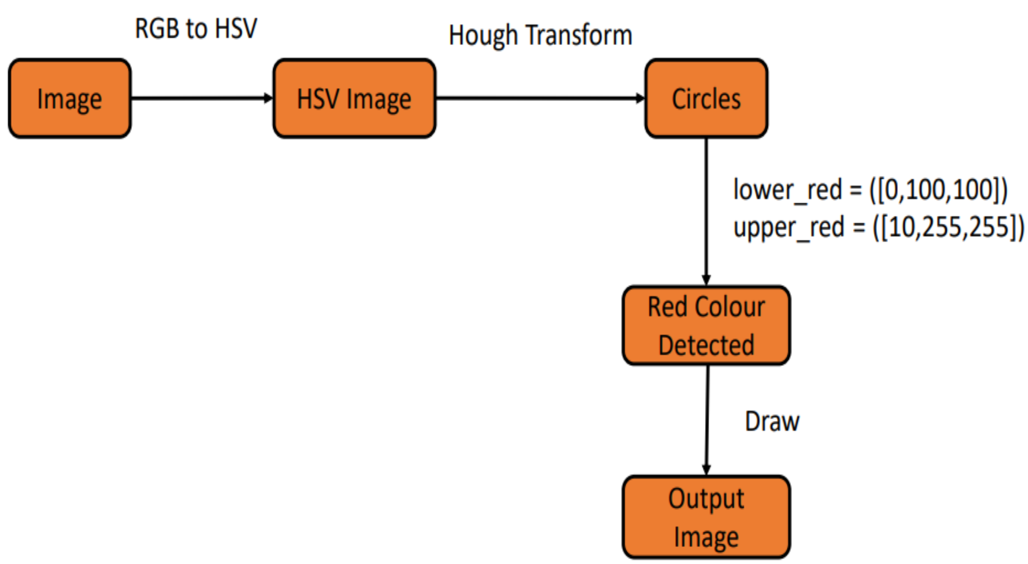

Figure 3.5.1: Flowchart: Red light recognition

3.5.2 Red Light Running Detection

3.5.2.1 Flowchart

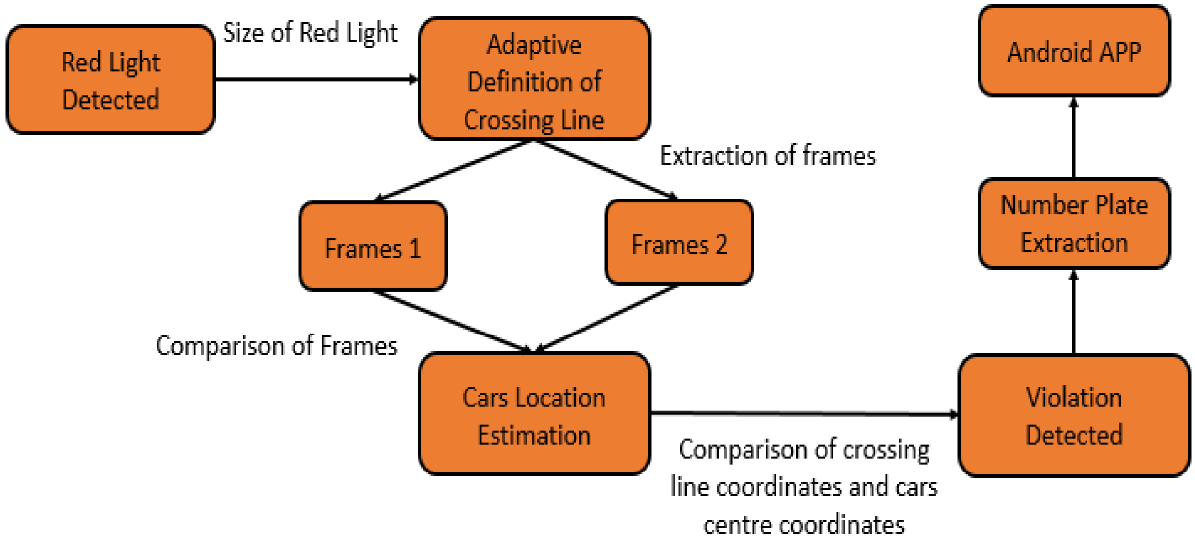

Figure 3.5.2: Flowchart: Red light running detection

3.5.1 Wrong Direction Detection

3.5.1.1 Flowchart

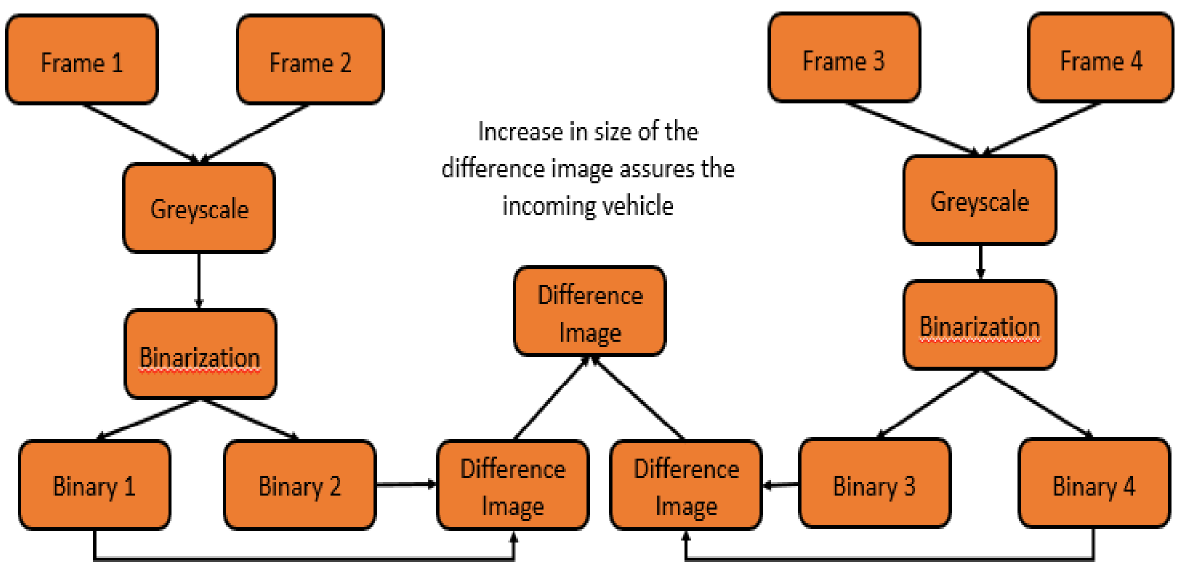

Figure 3.5.3: Flowchart: Wrong direction detection

3.5.1 Left Overtaking

3.5.1.1 Flowchart

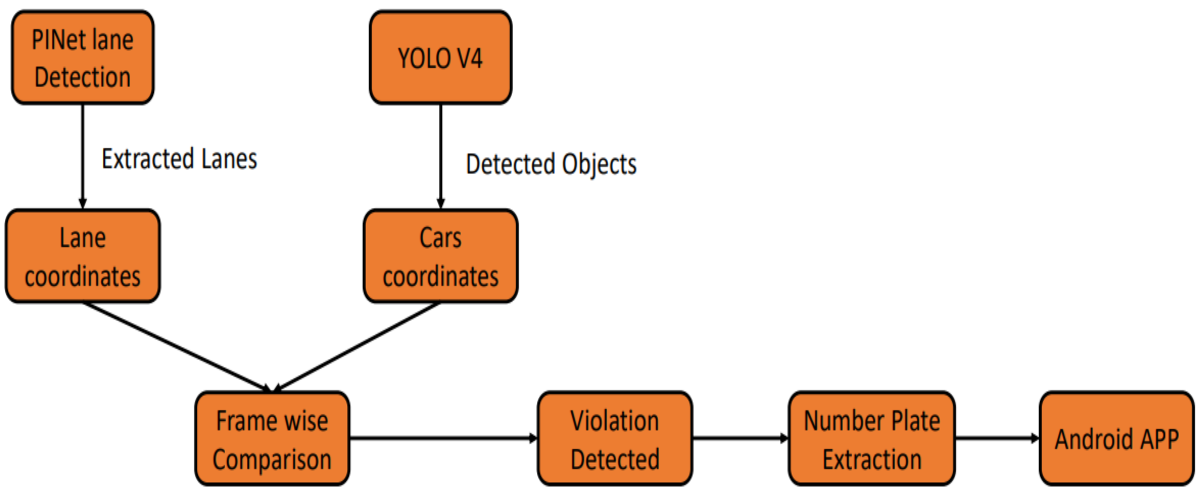

Figure 3.5.4: Left overtaking detection

3.5.1 Wrong Indicator Detection

3.5.1.1 Flowchart

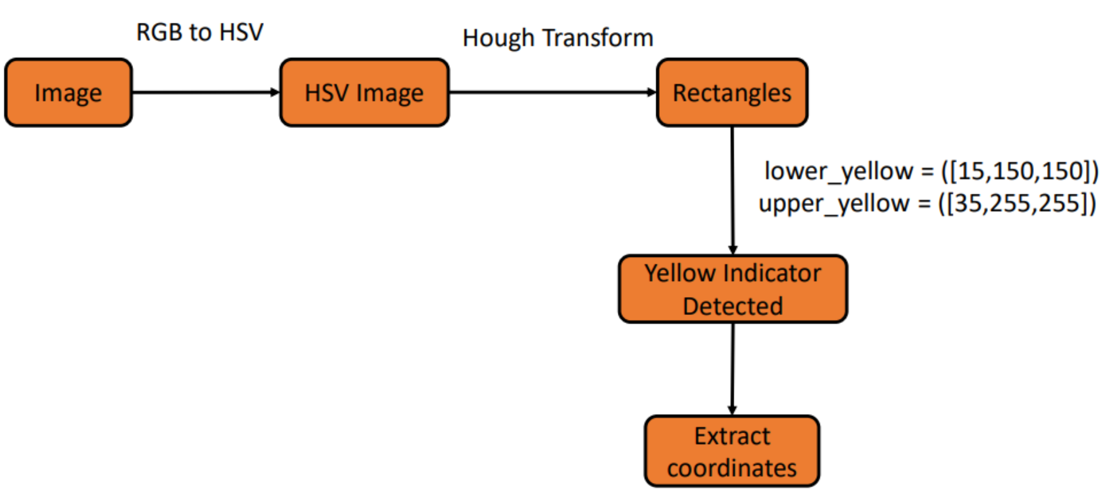

Figure 3.5.5: Flowchart: Wrong Indicator Detection

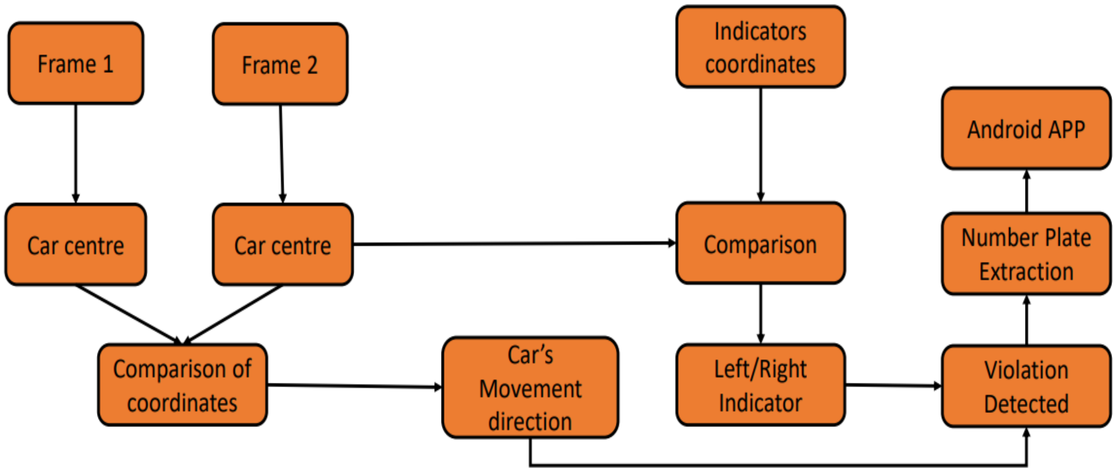

Figure 3.5.6: Flowchart Wrong indicator detection (2)

CHAPTER 4: RESULTS

Figure 3.5.1: Wrong direction detection result

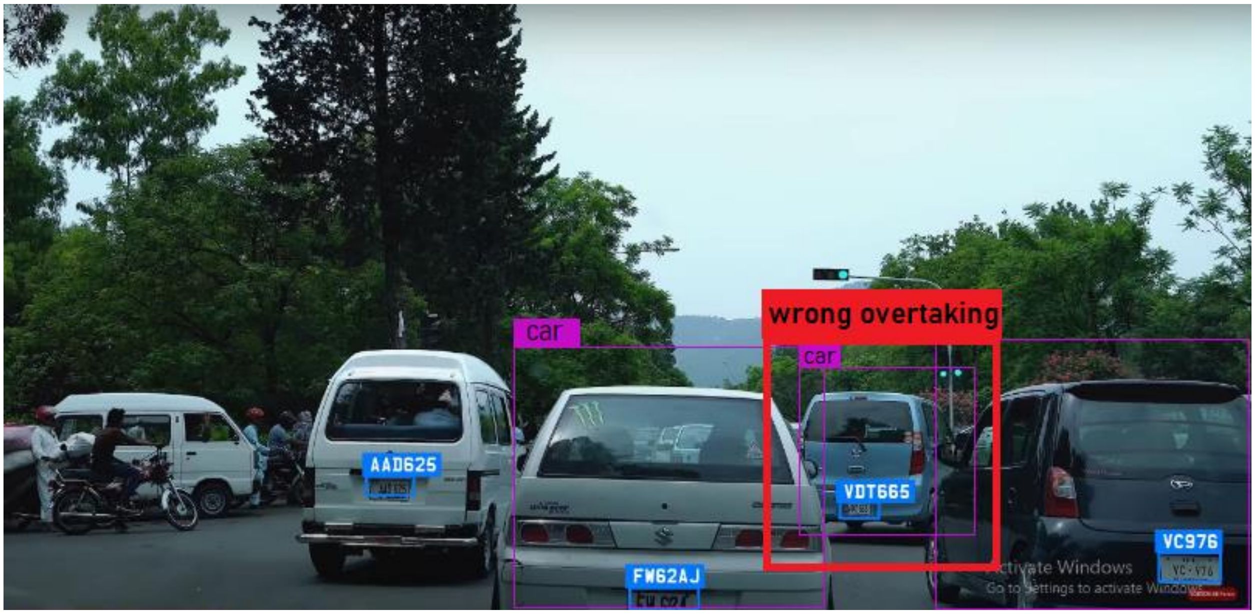

Figure 3.5.2: Wrong overtaking detection result

Figure 3.5.3: Wrong Indicator detection result

CHAPTER 5: DISCUSSION

5.1 Limitations of the system

As it is stated that this system is being developed for Pakistani roads only, the scope of the system is very flexible depending on the road conditions in Pakistan. Sometimes due to construction, poor roads condition, even weather conditions badly effect the traffic flow on roads.

Therefore this is not possible to enforce a fully automated system to detect and report the violations of traffic rule.

To deal with this problem, a manual request approval permission is given to traffic warden through mobile app to finally decide whether the violation reported by our system is actually a violation or a side effect of poor road condition.

With the improvements in our cities structure a fully automated system without human interference can be expected in future.

CHAPTER 6: CONCLUSION

As far as the current system progress is concerned, the system works fine in the ideal road conditions i.e. on motorways and highways. The table given below is the quantitative measure of the results after testing this system on various images and videos:

Title	Videos	Actual Violations	Detected Violations	Accuracy
Wrong Direction	21	21	16	76.19
Wrong Overtaking	14	18	15	83.34
Red Light Running	11	26	21	80.76
Wrong Indicator	3	3	3	100

CHAPTER 7: RECOMMENDATIONS

Following are the recommendations in regards to current project:

1. Maps or trace of location should be implemented to have the precise idea about where the vehicle violated the rule so that it could be determined that whether it was due to the poor road condition, construction or an actual violation.
2. More rules violations detections can be implemented further.
3. The system can be fully automated without human interference.
4. The system can be linked directly with bank accounts of the person after whose name the vehicle is registered, to deduct the challan automatically.

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