International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

Traffic Rules Violation Detection System

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Abstract – *The world is rapidly urbanizing. This has resulted in a manifold increase in the number of vehicles plying on city roads engendering traffic violations to become more critical nowadays. This causes severe destruction of property and more accidents that may endanger the lives of the people. To solve the alarming problem and prevent such unfathomable consequences, traffic violation detection systems are needed.*

Key Words: **Image processing, Vehicle detection, Violation detection, V1 Mobilenet Architecture, Graphical User Interface.**

1.INTRODUCTION

A traffic violation detection system must be realized in real-time as the authorities track the roads all the time. Hence, traffic enforcers will not only be at ease in implementing safe roads accurately, but also efficiently; as the traffic detection system detects violations faster than humans. A user-friendly graphical interface is associated with the system to make it simple for the user to operate the system, monitor traffic and take action against the violations of traffic rules. This system can detect most common three types of traffic violation in real-time

1.1 Signal Violation

If a vehicle crosses a predefined line on the road while there is red signal, it is detected as a signal violation.

1.2 Parking violation

If a vehicle stands still in no parking zone for a predefined time, it is detected as a parking violation.

1.3 Direction Violation

When a vehicle comes from a wrong direction, it is detected by tracking the vehicle. The direction of the vehicle is determined using its current position and previous few positions.

1.4 Existing Approaches

The first approach that relays on human participation is the traffic patrols. A traffic patrol is a police unit created primarily for the purpose of overseeing and enforcing traffic safety compliance on roads and highways. Another technology to fight the traffic violations is by using cameras installed on the traffic lights. The goal is just to detect the red-light crossing violations.

2. SYSTEM OVERVIEW

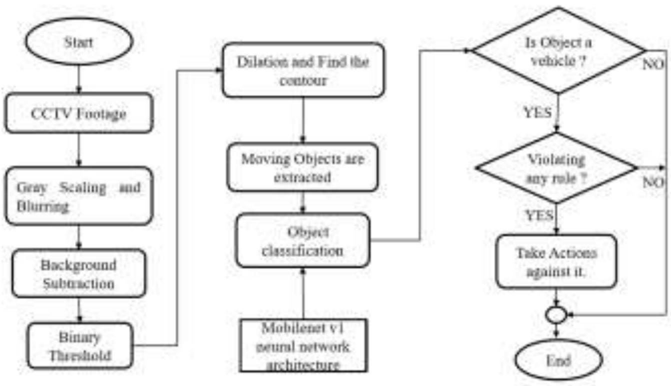

Figure 1: Flow diagram of traffic rules violation detection system

The System consists of two main components –

- Vehicle detection model
- A graphical user interface (GUI)

First the CCTV camera footage from the road side is sent to the system. Vehicles are detected from the footage. Tracking the activity of vehicles system determines if there is any violation or not. Different types of violations have different algorithms to determine the violation. A system flowchart 1 shows how the system works. The Graphical User Interface (GUI) makes the system interactive for user to use. User can monitor the traffic footage and get the alert of violation with the captured vehicle image. User can take further action using the GUI.

3. METHODOLOGY

3.1 Image Processing

- Gray scaling and blurring: As the part of preprocessing the input frame got from the CCTV footage, the image is gray scaled and blurred with Gaussian Blur method.

• Background Subtraction: Background subtraction method is used to subtract the current frame from the reference frame to get the desired object's area. equation (1) shows the method. ▯▯▯(▯) = ▯▯▯▯▯▯▯▯▯(|▯▯▯1(▯) − ▯▯▯2(▯)|) (1)

▯▯▯1 = ▯▯▯▯▯▯▯▯ ▯▯▯▯▯ ▯▯▯2 = ▯▯▯▯▯▯▯▯▯▯ ▯▯▯▯▯ ▯▯▯ = ▯▯▯▯▯▯▯▯▯▯▯ ▯▯▯▯▯

• Binary Threshold: Binarization method is used to remove all the holes and noises from the frame and get the desired object area accurately. equation (2) shows how the binary threshold works. ▯▯▯ (▯, ▯) = ▯▯▯▯▯▯, if ▯▯▯ (▯, ▯) > ▯ℎ▯▯▯ℎ 0 otherwise (2)

• Dilation and find the contour: After getting the thresholded image, it is dilated to fill the holes and the contour is found from the image. Drawing rectangle box over the contours desired moving objects are taken.

3.2 Vehicle Classification

Table 1 shows how the neural network architecture is designed.

Type / Stride	Filter Shape	Input Size
Conv / s2	3 x 3 x 3 x 32	224 x 224 x 3
Conv dw / s1	3 x 3 x 32 dw	112 x 112 x 32
Conv / s1	1 x 1 x 32 x 64	112 x 112 x 32
Conv dw / s2	3 x 3 x 64 dw	112 x 112 x 64
Conv / s1	1 x 1 x 64 x 128	56 x 56 x 64
Conv dw / s1	3 x 3 x 128 dw	56 x 56 x 128
Conv / s1	1 x 1 x 128 x 128	56 x 56 x 128
Conv dw / s2	3 x 3 x 128 dw	56 x 56 x 128
Conv / s1	1 x 1 x 128 x 256	28 x 28 x 128
Conv dw / s1	3 x 3 x 256 dw	28 x 28 x 256
Conv / s1	1 x 1 x 256 x 256	28 x 28 x 256
Conv dw / s2	3 x 3 x 256 dw	28 x 28 x 256
Conv / s1	1 x 1 x 256 x 512	14 x 14 x 256
Conv dw / s1	3 x 3 x 512 dw	14 x 14 x 512
Conv / s1	1 x 1 x 512 x 512	14 x 14 x 512
Conv dw / s2	3 x 3 x 512 dw	14 x 14 x 512
Conv / s1	1 x 1 x 512 x 1024	7 x 7 x 512

From the preprocessed image moving objects are extracted. A vehicle classification model is used to classify those moving objects into three class - Car, Motorbike and Non-vehicle. The classifier model is built with ▯▯▯▯▯▯▯▯▯ ▯1 neural network architecture.

Table 2: Training Parameters

Parameter name	Value
learning rate	0.01
training steps	100

3.3 Violation Detection

After detecting the vehicles three violation cases arises-

• Signal violation: If a vehicle crosses a predefined line on the road while there is red signal, it is detected as a signal violation.

• Parking violation: If a vehicle stands still in no parking zone for a predefined time, it is detected as a parking violation.

• Direction violation: When a vehicle comes from a wrong direction, it is detected by tracking the vehicle. The direction of the vehicle is determined using its current position and previous few positions.

3.4 Database Structure

We have used SQLite database with python to manage the whole data of our application. Here, in the relational database we have used BCNF of 5 tables. The tables are:

Cars: This table will hold the recorded cars by the camera. A car entity is a car with a unique identifier(id), color(color), license-number of the car(license), where the car is first sighted (first_sighted), an image of the license number (license_image), an image of the car(car_image), number of rules broken so far(num_rules_broken) and the owner of the car (owner).

Rules: This table holds all the rules, their description(name) and fine for breaking that rule (fine).

Camera: Camera table holds a unique identifier for the camera(id), location description(location), the longitude(coordinate_x) and the latitude(coordinate_y) of the location of the camera, where the camera will feed its data video(feed) and in which group the camera is in(group).

Camera_group: This table simply holds the unique group names of the camera groups(name). Violations: This table takes all the ids of other tables as foreign key and creates a semantic record like this: A car with this id has broken that rule at this time, which is captured by this camera.

3.5 Database implementation

We have used the lightweight SQLite for our database. With python's built-in library for managing SQLite database, we can easily maintain several database instances for our testing. Also, as this file table structures can be shared synchronously, it is a good choice for this project.

Libraries used for database management:
1. Sqlite3
2. Enum(future-python)

4. CONCLUSION AND RECOMMENDATION

The designed algorithm was effectively able to detect the type of violation specified on this project which are denying traffic signal, parking in no parking zone and wrong direction driving. The convergence of detection for the three kinds of traffic violations mentioned is dissimilar, since there each has a different threshold condition. The system provides detection for all three violation but detects signal violation and parking violation better than direction violation. Further, the system is able to process one data at a time. Also, the program runtime is somewhat slow, and can be improved by using a computer with high speed processor specifications or GPU. Future research about the application of the designed algorithm for other advanced image processing techniques. Since, this may improve the program runtime of the system by neglecting other unnecessary steps done in a background difference method. A computer vision algorithm may be done instead to provide more intelligence in the system. Our future plan is to implement the number plate detection with OCR support to make this system more robust.

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