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Traffic Violation Detection Camera

Adamya Jain
Student of Electronics and Telecommunication Department,
Bharati Vidyapeeth
(Deemed to be University)
College of Engineering Pune, India

Aabhas Deekshit
Student of Electronics and Telecommunication Department,
Bharati Vidyapeeth
(Deemed to be University)
College of Engineering Pune, India

Jagjit Singh
Student of Electronics and Telecommunication Department,
Bharati Vidyapeeth
(Deemed to be University)
College of Engineering Pune, India

Snehal Mane
Assistant Professor of Electronics and Telecommunication Department,
Bharati Vidyapeeth
(Deemed to be University)
College of Engineering Pune, India

Abstract:- Poor road safety is a crucial developmental issue, a public health concern and a ruling cause of injury and demise in India. As per the Report of Ministry of Road Transport and Highways on road accidents in India 2019 [1], there were 1,51,113 accident-related deaths in India in 2019. It is a matter of great concern that despite the fact that there are so many road laws introduced by our government for the safety of the passengers and drivers, the number of accidents are still increasing alarmingly. The main reason behind these accidents is that people do not follow the basic traffic rules like wearing a seat belt or helmet, over speeding and triple riding. This paper proposed a method to monitor these violations and store the information of violators to report it to the concerned authorities. Our proposed system does not need any human interception which makes it free from human error and bribery.

Keywords:- *AI; Deep Learning; Road accidents; Python; Raspberry Pi; Machine Learning; Character Recognition.*

I. INTRODUCTION

According to the 2017 WHO Global Health Estimates one of the most common causes of deaths in India is road accidents, it is also the 9th most common cause of premature deaths and the 10th most common reason for disability.

India is one of the busiest countries in the world in terms of road traffic. The automotive industry across the south Asian country became the fourth largest in the world in 2017. There were almost 3 million new car registrations in the country in 2019. The Indian road network, which is spanning over 5 million kilometers, carries approximately 90 percent of the country's passenger traffic and around 65 percent of the goods. With the rapid increase in the number of cars bought by people and the mercilessly congested Indian roads, road safety has turned into a factor of utmost importance for the country's citizens. India loses almost 1.5 lakh lives every year on account of road accidents. Road accident is one of the most unwanted things to happen to a road user, though they happen quite often. The most unfortunate thing is that we do not understand that the reason for these road accidents is because of our carelessness. Most of the road users are aware of the general traffic rules and safety measures/precautions for their as well as fellow road user's safety but it is only the indifference on part of road users, which cause accidents and crashes. Main cause of accidents and crashes are due to human errors like over speeding, triple riding, avoiding safety gears like seat belts and helmets etc.

India's traffic laws are stricter than those of other countries, but these laws are not enforced. India's enforcement of laws on speeding are rated 3 and 4 out of 10, respectively, compared to 8 and 9 in China and 9 in Sri Lanka, by the Global Road Safety Report 2018, that analyzed traffic laws of 175 countries. When it comes to enforcement, we know human behavior is affected by enforcement and in India, enforcement is largely driven by human beings and is prone to corruption.

Our project aims to catch these violators and maintain a database of their vehicle information so that this database can be sent to the concerned authority for penalty generation. Since our project is fully automated it is free of corruption and human error. We have used raspberry pi 3 module along with its camera module to monitor the traffic [2]. In the first phase of our project, our system detects and divides the traffic into two categories that are- 2-wheeler and 4-wheeler vehicles. In the second phase if the detected vehicle is a 2-wheeler vehicle the system checks for the speed of the vehicle determines whether the driver is wearing a helmet and checks for tripling riding if any of the mentioned aspects are violated a snap of the video is taken and sent to the third phase of the system. In the third phase of the system the license plate of the vehicle is detected and the vehicle details along with the violation is stored in a data base.

II. DATASET

As huge numbers of parameter is needed to be tuned by the algorithm a fair amount of training data is required in deep learning. The image data set is divided into validation data, training data and testing data in the deep learning approach. Then, trained data sets are utilized to train networks. A sample data set is used to verify, after a network is trained, if network is properly working or not. Poor quality images are removed from the data set before training the network which enhance its performance. In this research paper, we have utilized 4650 vehicle images from different sources. After augmenting the image data, we get 5000 vehicle images, including 2570 two-wheeler and 2430 four-wheeler.

A. Two-wheeler-dataset

The Two-wheeler-dataset on GitHub is a public bike and two-wheeler image data collection. The collection collected 2462 two-wheeler images from different part of country, including 1248 images of bikes, 978 of scooties/scooters and 236 of bicycles.

B. Four-wheeler-dataset

Four-wheeler dataset has 2312 images (JPEG) and 2 categories (cars/heavy vehicle). The four-wheeler images in this dataset is collected from The Ministry of Road Transport and Highways, India. All vehicle images collected by the ministry are used as part of routine traffic detection.

III. MTEHODOLOGY

Collecting dataset images

The datasets contain images of different vehicles. The dataset has 4650 vehicle images including 2462 two-wheeler and 2312 four-wheeler images 64 x 64-pixel(size), RGB (color model) images were used, images were resized to make all the test images of unform size and shape. The dataset was divided into 3 sub datasets, first was used for training the model, the second one is used for validation of the system and the third one is used for testing hence the problem of overfitting is avoided. After the refining of the dataset, it was then used in all the three phases of our system mentioned below.

A. Type of Vehicle

This is the first phase of our system; we used the concept of real time object detection using deep learning and open cv [3] to determine the type of a moving vehicle in a video. We used our video streaming with a Raspberry Pi camera [4] along with two separate databases of 2 wheelers and 4 wheelers which we got from internet. The system divides and iterates through the video frame by frame and converts these frames to gray images. 2 wheelers and 4 wheelers are detected from these frames and a loop is run to put a box around the detected vehicle. These frames are then sent for phase two of our system where the vehicles are scanned to detect the violators.

Flow of type of vehicle detection:

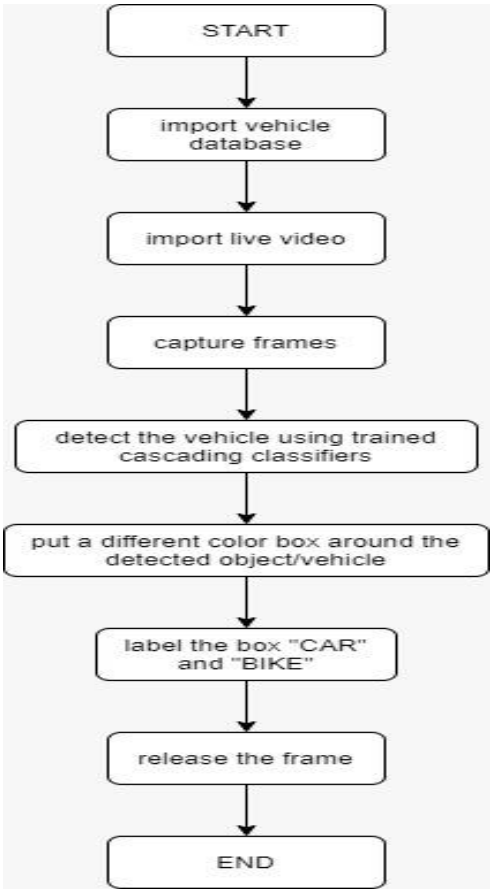

Figure 1.1. FLOW CHART OF TYPE OF VEHICLE

B. Over Speeding

Here to detect the speed of an over speeding vehicle we used Doppler radar (HB 100). In this set-up, a continuous wave doppler radar is used which provides a velocity output and the Arduino micro is used to calculate the speed of the vehicle. To drive the microcontroller as the sensor output is in micro volts and to amplify the voltage level, an amplifier is used. The speed levels can be seen through an LCD screen. A Doppler radar regulate the frequency shift that occurs in EM waves due to the motion of scatters toward or away from the observer through measurement of the phase change that occurs in electromagnetic waves during a series of pulses. If the Doppler frequency is negative then the objects is receding from the radar. If its Doppler frequency is positive then the object is approaching the radar.[5]

Flow of over speeding detection:

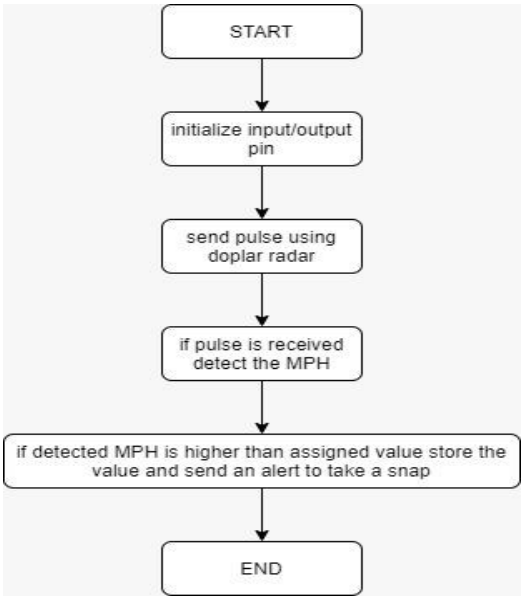

Figure 1.2 FLOW CHART OF OVERSPEED DETECTION

C. Helmet Detection

The system is trained with YOLO and obtained datasets which gives trained weights for analyzing the video for helmet detection. The Raspberry pi camera module give the real time video through which the images are extracted frame by frame. Which is loaded in the trained model along with the obtained trained weights. The trained model detects if a person is wearing a helmet or not. If the person is not wearing the helmet the snapshot is taken and transferred to 3rd phase for license plate number extraction.[6]

Flow of helmet detection:

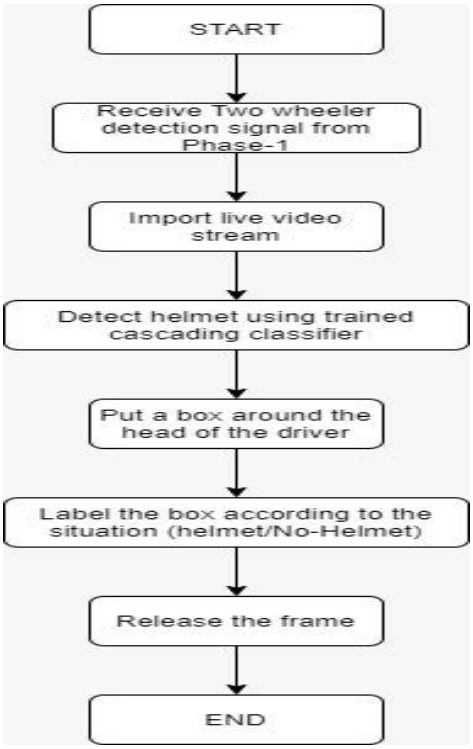

Figure 1.3 FLOW CHART OF HELMET DETECTION

D. Seatbelt Detection

It is one of the parts of 2nd phase of the project. To detect the seatbelt, we used the live video from the camera module which contains full view information of the car including driver's body and seatbelt portion. The suggested method is a two-step method. [7]

In the first step, the location of driver area is taken out i.e., the borderline of driver where the seatbelt is possibly located. Vertical and horizontal boundary detection is used to do that. The top bounds of the area of the driver seat is used as the horizontal boundary. It is also weighed as the top edge of windshield. The area where the driver seat is located is used as the vertical boundary. It is also weighed as the right edge of the license plate. In the second step, the seat belt is detected in the driver's area. Edge detection is used in this step, by obtaining driver's region and the final detection. The dataset contains – images of four-vehicle including 450 positive and 450 negative sample images. In addition to a mixed dataset with arbitrary images taken from the set of all images. Some images do not clear that standard, hence they are standardized by resizing them to the required size. If the model detects seat belt violation it immediately transfers the data to 3rd phase for the capture of the licensed number plate.

Flow of seatbelt detection:

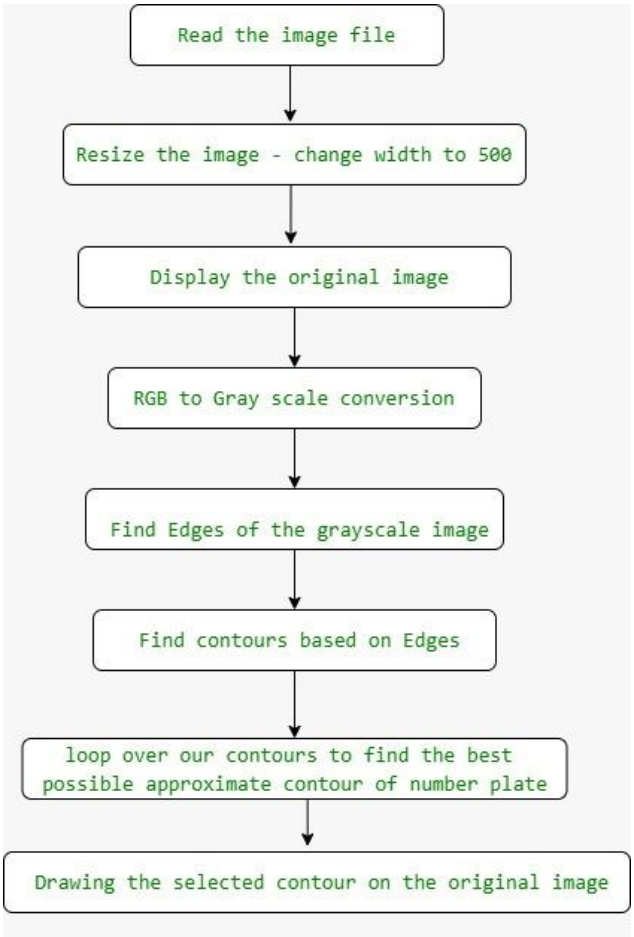

Figure 1.4 FLOW CHART OF SEATBELT DETECTION

E. Triple Riding

For real-time triple riding detection, precision and speed is required. Hence You Only Look Once (YOLO) a Deep Neural Network based model is selected. YOLO is a clever neural network for doing object detection in real-time. The Raspberry pi camera module is used as the input device to receive the live video for object detection in real-time. The video is then converted into image frames for proper detection. The glossed images are provided as input to YOLO model to train for the custom classes. The model is then loaded with the weights generated after training. Once this is completed, an image is given as input. The model detects the triple riding violation and if found violated it send the data to the 3rd phase of the project to capture license number plate.

Flow of triple riding detection:

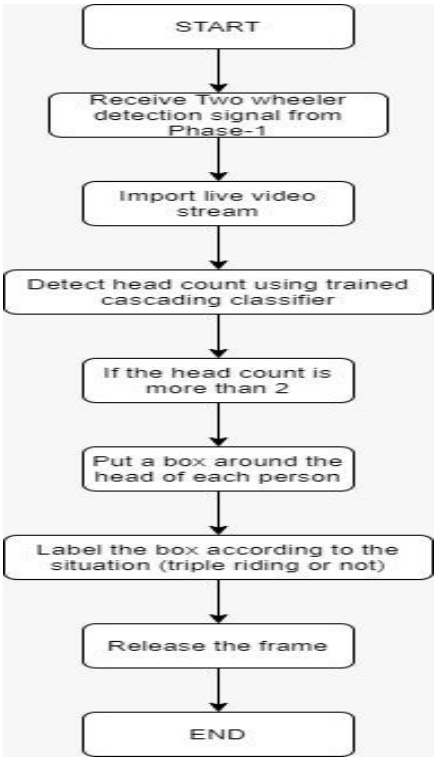

Figure 1.5 FLOW CHART OF TRIPLE RIDING

F. License plate detection

This is the third phase of our system, when a violation is detected then snap of the video is taken and using that snap, we detected the license plate number of the vehicle. The image is converted to gray image then bilateral filtration and edge detection is performed on that image. The number plate is then detected using the find contour and draw contour functions of OpenCV python. [8]

Flow of license plate detection:

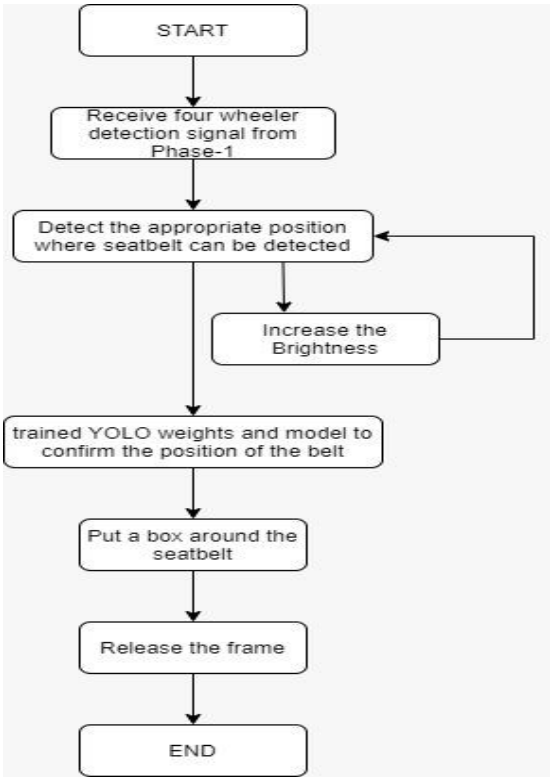

Figure 1.6 FLOW CHART OF LICENSE PLATE DETECTION

IV. EXPERIMENTAL RESULTS

The project is tested using live video samples from Raspberry Pi Camera module. Different samples of running vehicle are taken from traffic signals and roads. These samples are given input to the raspberry pi in which all the code is already pre initialized.

1. Phase 1

Phase 1 consist of detection of the type of vehicle (two-wheeler or four-wheeler) and marks the box and label them accordingly.

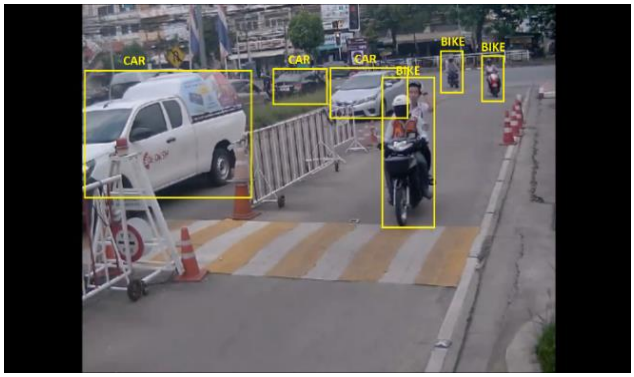

Figure 2.1 OUTPUT OF VEHICLE DETECTION

2. Phase II

Phase II consist of main part of the project-detection of any traffic violation by the vehicle.

Phase II is divided into 2 sub-categories according to the type of vehicle – Two-wheeler and Four-wheeler. These sub-categories are further divided into subparts according to the type of violation.

A. Two-wheeler.

After a two-wheeler being detected in 1st phase then in phase ii it is checked if there are any traffic rules being violated by that two-wheeler. If any violation is detected, then the snap of that vehicle is captured and send to 3rd phase.

1. Helmet Detection.

In this subpart it is checked whether a rider is wearing a helmet or not and if not then mark the head portion if the rider and capture a snapshot.

Figure 2.2 OUTPUT OF HELMET DETECTION

2. Triple Riding.

In this subpart it is checked whether there are 2 person the vehicle or more. If more than 2 people are present on the vehicle then then mark the heads and vehicle and capture a snapshot.

Figure 2.3 OUTPUT OF TRIPLE RIDING

B. Four-wheeler

1. Seatbelt detection.

In this subpart system checks whether a person is wearing a seatbelt or not. If violation is detected same procedure is followed, a snapshot is taken of a vehicle for the number plate extraction. Figure 2.4 shows the seatbelt detection.

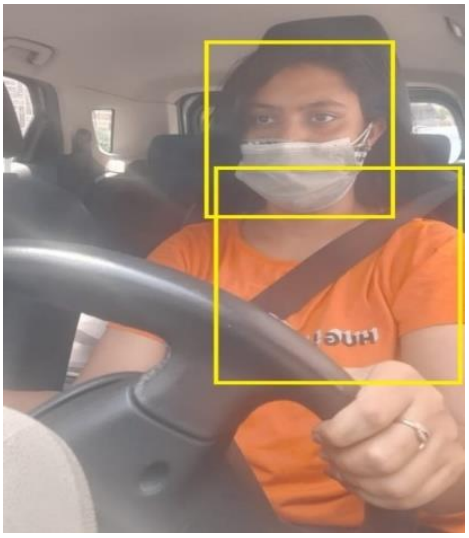

Figure 2.4 OUTPUT OF SEATBELT DETECTION

3. Phase III

In this phase the license number plate is detected, extracted and stored for further process of imposing penalty to the driver through online method.

Once any violation is detected the snapshot is taken and send to this phase where the position of license number plate is detected and then extracted and stored.

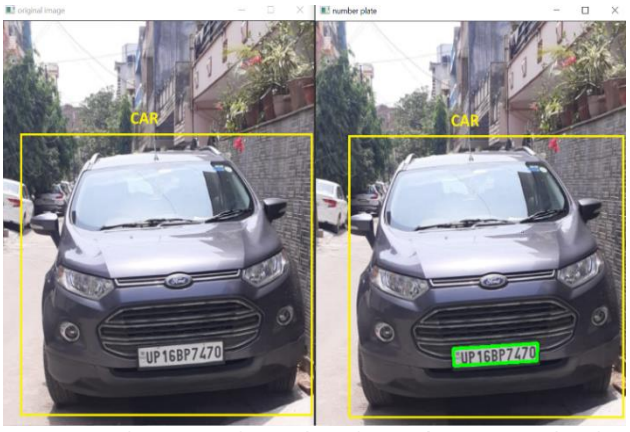

Figure 2.5 OUTPUT OF LICENSE PLATE DETECTION

V. CONCLUSION

Road accidents leads to major injuries and death. Due to the careless behavior of driver and breaching the laws created by government many people lose their lives or lives of their loved ones. The system we proposed in this paper is an automated system based on different deep learning models used together to achieve a compiled mechanism to

detect violators and prevent road accidents. The output and accuracy of each model has been tested and mentioned. Through this model we will be able to detect the violators and charging them a penalty will prevent them from breaching any laws in future. This model can be useful for analyzing all vehicles and extract a database of the violators.

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