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Traffic Light Violation Detection & Speed Radar

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Abstract: *The purpose of this paper is to understand the implementation of Automation & Machine learning in the domain of traffic management, using tools like YoloV5 & Computer Vision (CV) we aim to detect vehicles; 2 or 4 Wheelers breaking the traffic rules in place.*

Keywords: Traffic, Violation, Detection, etc.

I. INTRODUCTION

To effectively control traffic conditions and solve problems such as traffic congestion and traffic accidents, many developed countries, such as US, Japan, and Germany, have started to develop the Intelligent Transportation System (ITS). ITS is a way to integrate many advanced technologies, such as Car Navigation, Traffic Signal Control Systems, and Automatic Number-plate Recognition (ANPR), to a single transportation management and control system. One of the fundamental building blocks for these technologies is traffic flow identification, i.e., to count the number of passing-by vehicles at a given point. The mainstream methods to count and classify vehicles can be roughly segmented into hardware solutions and software solutions.

Inductive loops and piezoelectric sensors are the two most widely used systems in the ITS hardware solution. Although the hardware solutions have higher accuracy than the software solutions, it cost more to maintain and in pavement destruction.

With the rapid improvement of computer computing performance and the development of image recognition technology in recent years, the software solutions use the technique of image recognition to calculate the vehicle passing through the surveillance screen. After all the vehicles in the video are identified by the trained model, the system needs to find out the relevance of the vehicles which detected in different frames to achieve the purpose of vehicle counting. Although using the tracking algorithm to process the coordinates of the detected vehicle in each frame can achieve the purpose of vehicle counting, recognition failure in a short period of time may cause a wrong tracking. It will lead to a bad performance of traffic counting.

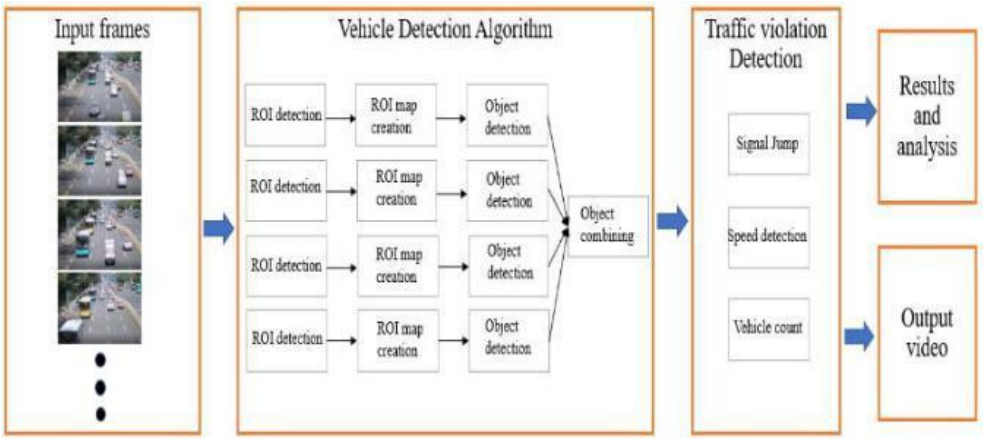

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Figure 1 shows the basic block diagram of the traffic violation detection system, the proposed architecture of surveillance system with intelligent violation detection and tracking of multiple vehicles from CCTV using YOLOv5 as an object detection algorithm. This is done through a Devolution Neural Network and an object detection model trained to detect vehicles specifically which are used in the classification of the moving objects into different respective classes, thus achieving vehicle classification. Volations are detected based on violations are then detected these can occur on the road which are signal jump, speed detection, and vehicle count. The main objective is to detect multiple vehicle violation detections and it gives a more detailed picture of concepts and technology involved in creating a traffic violation detection system using computer vision.

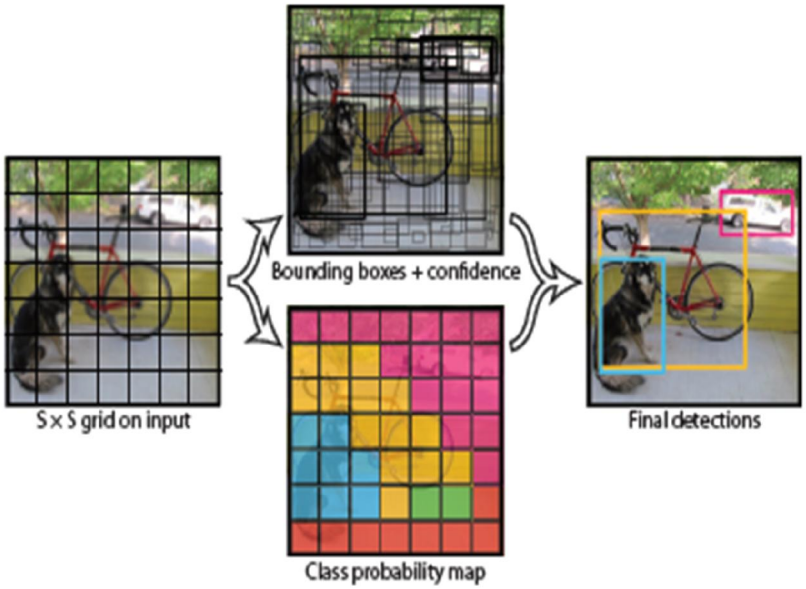
II. LITERATURE SURVEY

In the existing system, the law enforcements use manual work assisted by systems like ANPR, Speed Camera, Radar Based Cameras which is used to issue an e-challan to the commuter. But these system's require specialized hardware & can run up the cost to thousands of rupees. In a country like India with dense population & a lot of roads infrastructure to cover it becomes increasingly hard to get such devices on every corner.

The existing systems that detect cars uses previous version of the latest technology. A YoloV3 instance to detect objects, it was developed from darknet to detect accurately but it can drive up processing power & can be overwhelmed & inturn Increases the costs for the hardware.

III. PROPOSED SYSTEM

To achieve the goal for Proposed System we'll be using an Algorithm called YoloV5. It's an acronym for 'You only look once', is an Open-Source object detection algorithm that divides images into a grid system. Each cell in the grid is responsible for detecting objects within itself. YOLO is one of the most famous object detection algorithms due to its speed and accuracy.



The proposed model necessitates three things in particular:

1. Vehicle detection filteration & ignoring other objects
2. Traffic Light violation detection
3. Speeding Violation & Estimation

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1.1 Vehicle Detection Process:

To detect Vehicles YoloV5 is trained with CoCo configuration models that gives us access to data on 11,000+ Vehicles & 50,000+ annotation, with such a large data base we're able to accurately differentiate not only between Vehicles & Non-Vehicles but also different classes of vehicles like Bus, Truck, Cars or Bikes.

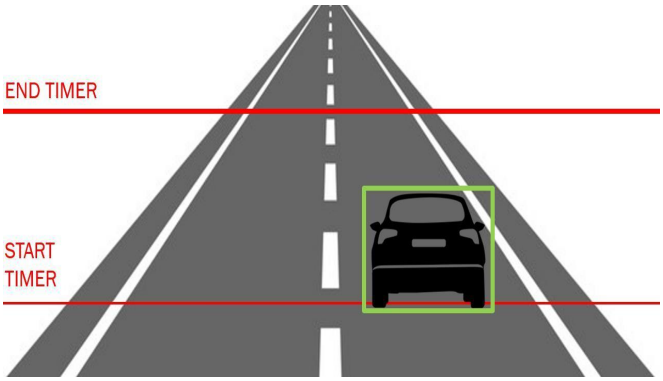
1.2 Traffic Light Violation Detection

Our project mainly focuses on one violation that is signal violation. Signal violation: On road we have some predefined lines, so we draw those predefined lines on the screen wherever required, whenever the vehicles cross those lines at wrong time or while the traffic signal is red, then the vehicles are violating traffic rules. Those vehicles pictures are captured and license number can be extracted.

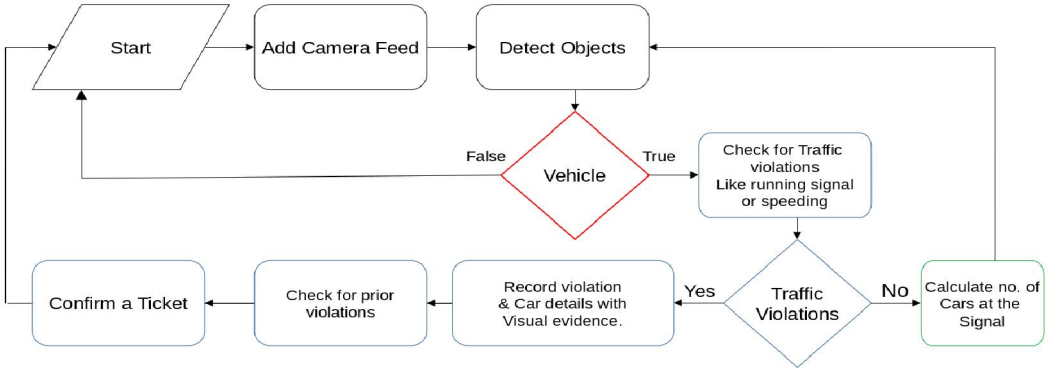
The CCTV camera footage that was recorded from different areas will be sent to the system. Vehicles will be detected from the footage. Whenever the proposed software tests the footage, the violation will be detected. The proposed software supports signal violation by involving the models trained in DNN.

1.3 Speed Estimation

The speed of a vehicle can be estimated when a tracked vehicle covers a segment of road. Time difference between the position of a vehicle can be calculated by counting the number of pixels traversed in that time at a video's general speed of 25 fps. The timer starts when the vehicle crosses the first line, and the timer ends when the vehicle crosses the second line. The speed is displayed on top of the bounding box only when the vehicle crosses both the lines. And a violation is recorded if it exceeds the permissible speed.



The System Architecture:



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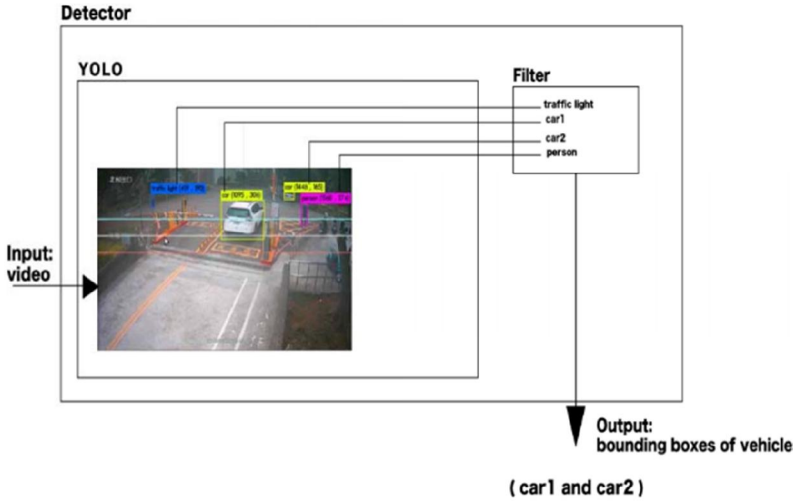
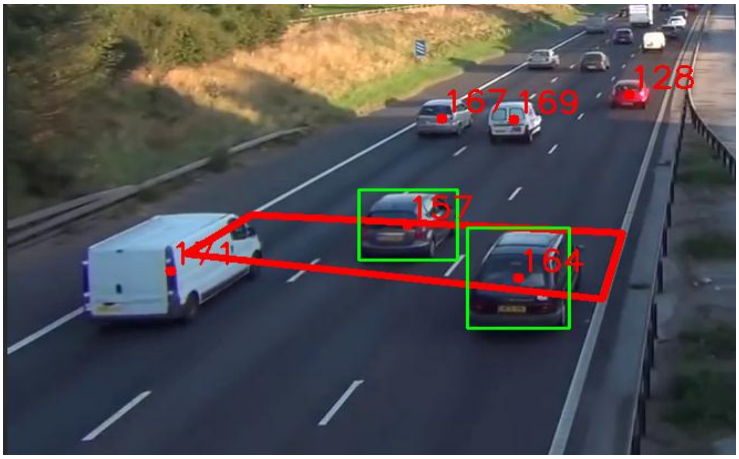
- **Background Subtraction**
  To subtract from the reference frame by the current frame, background subtraction has been used and as a result, the required object‟s area will be obtained.
  Equation (1) shows the method.
  dist(I) = saturate(|frame1(I) − frame2(I)|)
- **Binary Threshold**
  To remove the noise and other disturbances from the input video, the binarization method has been used. Holes and noises are removed in this process. equation (2) shows how binary threshold process.
  dist(x,y) = MaxVal if frame(x, y) > thresh else
- **Dilation and find the contour**
  When the we get the threshold image, to fill the holes we need to do dilation, according to the image the contour is calculated reform the better image.



IV. RESULT

When the signal violation detection system was executed on the input video which is gathered from CCTV footage, the input is pre-processed and after drawing Polygons the output of the system is: wherever the violation of traffic rule occurs system takes a snapshot of the vehicle.

V. OUTPUT



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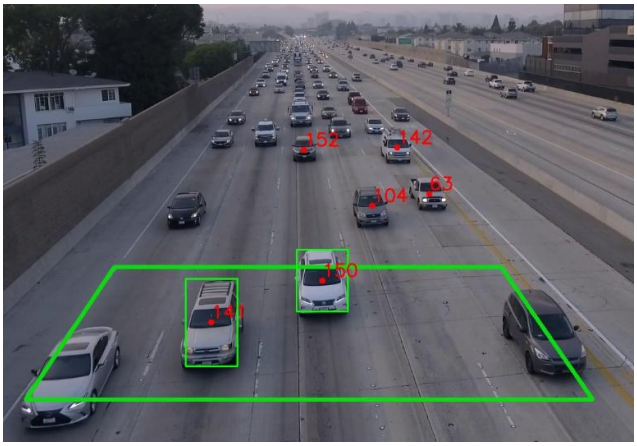

Figure 3: Initially Inputted Video & Frame

Figure 4: Final Output Image Which is Cropped

VI. CONCLUSION

The designed system is able to detect vehicles by filtering them from various that can be detected by an algorithm like YoloV5. After filtering the vehicles from non-vehicles we're able to sort the vehicle according to the violation. A picture of the vehicle is taken & reported to the appropriate authorities.

VII. FUTURE WORK

With future plans we can use YoloV5's object detection to detect Animals on the road, this will help the Animal Rescue team locate & reach out to the distressed beings, this will not only help a moral cause but also reduce the number of accidents that happened on roads or from Animals suffering deaths on the road from ongoing vehicles.

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