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Vehicle Surveillance from Video

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Abstract: ***Importance of data has increased dramatically in recent times. Companies are using the online data available to improve their products and data analysis. Traffic data of vehicles on road can be of great importance if they can be effectively retrieved from the videos. Contrary to normal data traffic data is the form of videos as a result immense amount of data is found in surveillance videos which goes unprocessed thus resulting in loss of information. Our project aims to provide an effective way to retrieve vehicle data from videos.***

This data includes the vehicle's license plate number, colour, manufacturer's name, and the time-stamp. This data can then be used for various purposes. This data will help to analyse the traffic on road at a much deeper level. This analysis will help to gain insights which will help improve the future of road transportation. Also, since the data is in a text form it will be much easier and faster to search or filter data.

If required this filtered data can be correlated with video data. In the above process without the text data, one would have to scrub through the video files to reach a required point. Also, the data which is stored in the text form is of much less size than video files. Implementation of our project will help to create a smart traffic system. We retrieve the required information one at time. Firstly, the vehicle is detected with the help of YOLO (You Only Look Once). Then from the images of each vehicle required data is extracted.

Firstly, the license plate of the vehicle is detected. With some pre-processing applied the license plate image is sent for OCR (Optical Character Recognition), which retrieves the text on the license plate. Then the vehicle's colour is extracted. Efforts are being made to remove environmental interference on the vehicle, so that the genuine colour of the vehicle is obtained. Also, the vehicles manufacturer is identified. As one can notice all the listed features (license plate, colour, manufacturer) are the primary attributes to identify a vehicle. Combinations of these attributes can be used to recover other required data about the vehicle. If speed detection of vehicles is done in an effective way, it will be possible to reduce speed violations. Thus, making the roads a much safer place.

Keywords:

PIL	***Python Imaging Library***
OCR	***Optical Character Recognition***
CNN	***Convolutional Neural Network***
RNN	***Recurrent Neural Network***
RCNN	***Recurrent Convolutional Neural Network***
YOLO	***You Only Look Once***
OpenCVOpen Source Computer Vision	
ResNet	***Residual Neural Network***

I. INTRODUCTION

With the concept of advancement of growth in technology, transmuting of smart cities there's a need to make traffic system more indispensable component among the society. Road traffic is a complex phenomenon, where various entities(pedestrians, cars, trucks, buses, tramps, bicycles, etc.) interact one each other, when using common infrastructure. Due to rising number of vehicles and infrastructure constraints it is a complex task requires application of dedicated algorithms together with precise traffic data. The information about number of vehicles, their license plate, their colour and model of the car all this information can be useful for analysis of traffic and for work in the law enforcement area .Traffic data allows us not only to increase effectiveness of traffic control, but also to adapt management policy to changing conditions and to catch people violating traffic rules and regulations. The advanced traffic management system encompasses systems such as traffic violation reporting, incident detection, vehicle counters, and classifiers. All these stream live data into a Vehicle Control Room, allowing traffic officials and consumers to receive real-time updates.

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A. Problem Definition

Due to increasing number of vehicles on road it is difficult to identify and track down people who are violating the laws of traffic so we need an intelligent system which can not only identify culprits breaking the laws but also reduce the time taken to initiate action against them. As the number of vehicles are increasing on road its difficult to analyse the car details and store them. Also the size of videos getting stored in increasing due to which we have to delete video footage every 3 months due to space constraints. While travelling most of them are always in hurry due to which they try to drive their vehicles faster which may lead to accidents and around 3.19 lakh road accidents in India is caused due to over speeding.

II. REVIEW OF LITERATURE

A. Approach 1

In this approach we try get frames from video and try to detect all vehicles in the frames. After all vehicles getting detected One by one we detect license plate from each vehicle and try to recognize the written number on it using OCR technique. But for using this approach the number plate recognized from license plate should be 100% accurate. So that license plate number can be given to e-vahan website where by entering the number plate we can obtain the details of car owner with its car colour, manufacturer of car, model of the car. For the speed detection part of vehicles we were trying to do using speed trap gun so that over speeders vehicles can be caught and noted their license plate and get all information about driver.

B. Approach 2

In this approach instead of relying on an external source for getting information about a vehicle. We can implement more detection modules to extract all the vehicle information from the input image itself. Although this approach uses more resources from our side, it does not require a 100% accuracy in the OCR module. Also a dependency on an external source for the vehicle's information is eliminated.

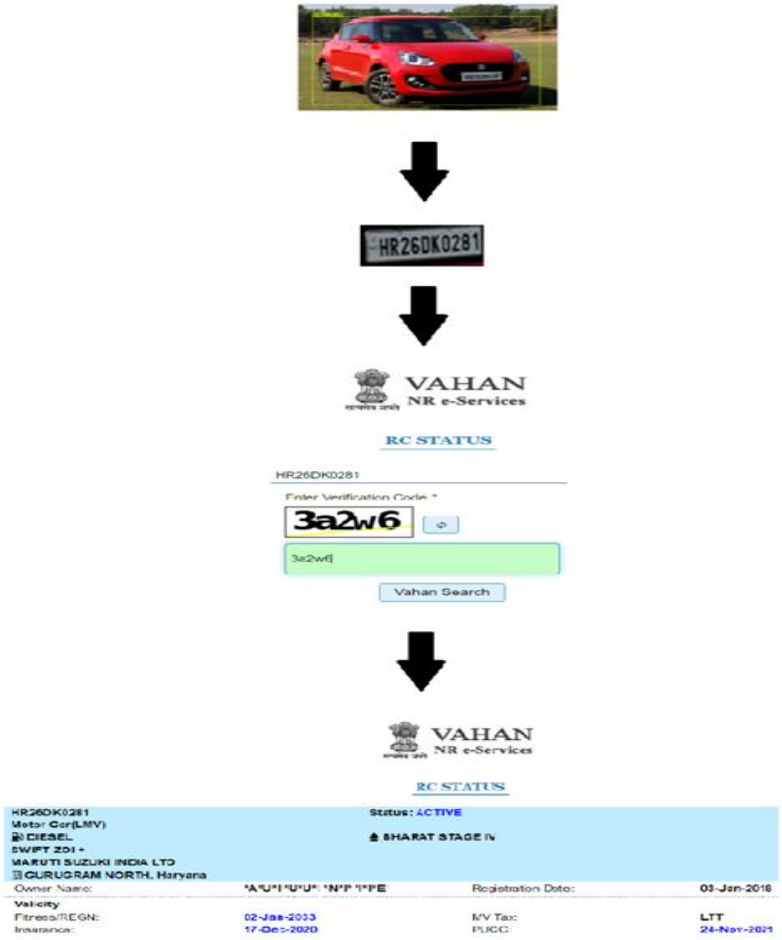


Fig 1: Overview of approach 1

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III.DESCRIPTION

Data is a valuable asset in this digital age. Any form of data that goes unprocessed can result in loss of information. The aim of this paper is to provide a way through which data can be extracted from vehicle footage. This data can be used for analysis, improving law enforcement thus making the roads a much safer place. Since the data is converted from video and text, searching and filtering by words will be possible. Also, storage space required is also greatly reduced. The primary goal of this paper is to provide solutions to capture important vehicle features from vehicle footages. The paper will present the concept, technology stack, components and the outcomes of implementing the solution. Apart from vehicle details extraction we also try to implement speed detection. Combination of both these modules will help to implement "Intelligent Traffic System".

A. Analysis

1) Data Flow Diagram

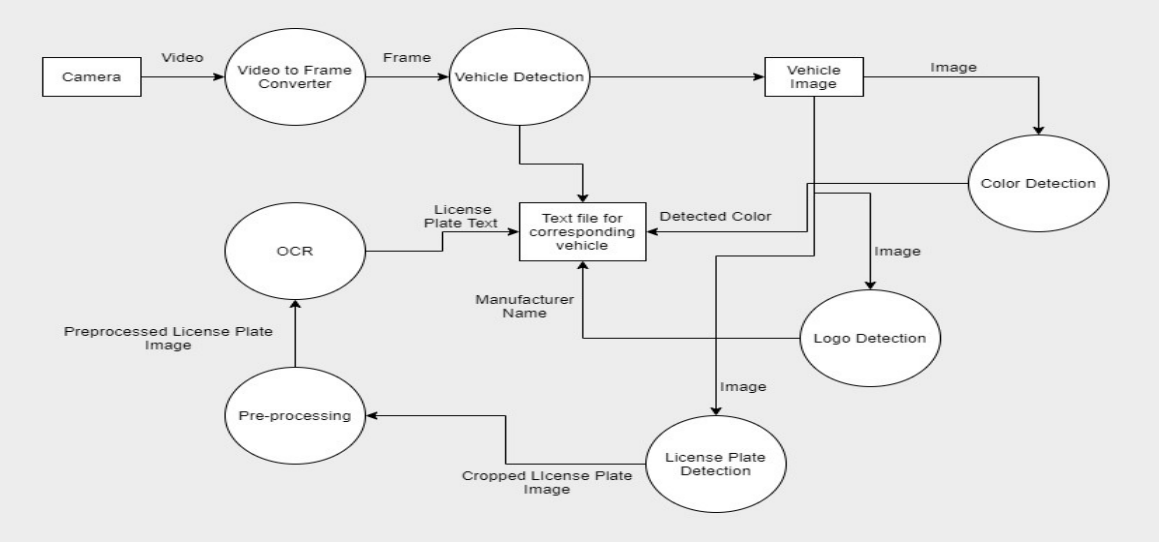


Fig. 2 Data Flow Diagram

Data Flow Diagram represents the flow of data through a process or a system. A Data Flow Diagram provides information about the outputs and inputs of each entity and the process itself.

a) Processes Are

- *Video to Frame Converter:* Video is provided as input then the process converts the videos to frames. The number of frames required from the video input can be set.
- *Vehicle Detection:* The frame obtained from video is given as input and the output is the cropped images and a text file for each vehicle.
- *License Plate Detection:* This process takes the cropped vehicle image as input and gives the cropped license plate image as output.
- *Pre-processing:* The license plate image is taken as input and output is the same image but after applying binarization, Gaussian Blur and rescaling
- *OCR:* The pre-processed license plate image is the input and the text in the image is obtained as the output..
- *Color Detection:* This process takes the cropped vehicle image as input and gives the vehicle's colour as output.
- *Vehicle Logo Detection:* This process takes the cropped vehicle image as input and gives the vehicle's manufacturer's name as output.

b) Entities Are

- *Camera:* To provide the video stream.
- *Vehicle Image:* To perform various operations to detect the vehicle's various features.
- *Text File:* To store the output from above mentioned detection modules.

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2) Activity Diagram

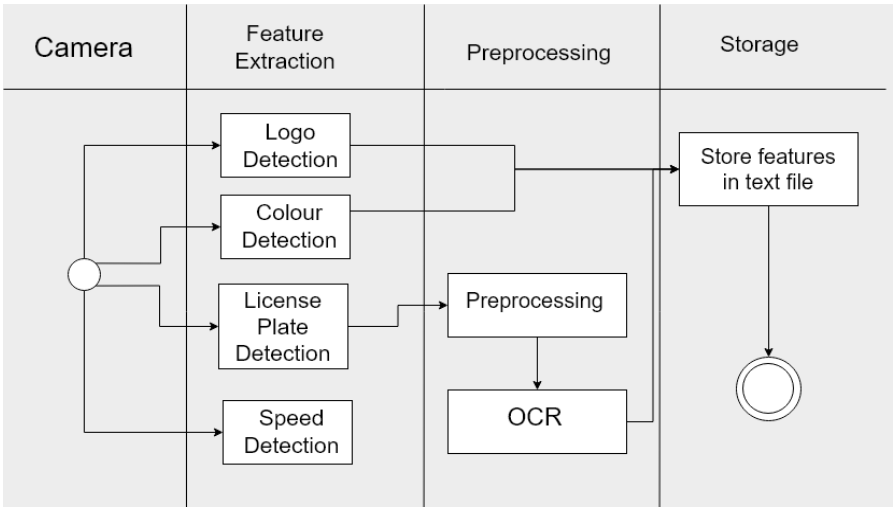


Fig. 3 Activity diagram for the video surveillance system

The activity diagram defines the activities that will be performed by the system.
Initially, the video will be recorded and processing will be done in real time. The video is converted to frames and processing is done on the frames immediately. After the car is detected using object detection, various features are extracted from the frame like, Logo of the car, Colour of the car, License plate and speed of the Car is detected.

B. Design

1) Sequence Diagram

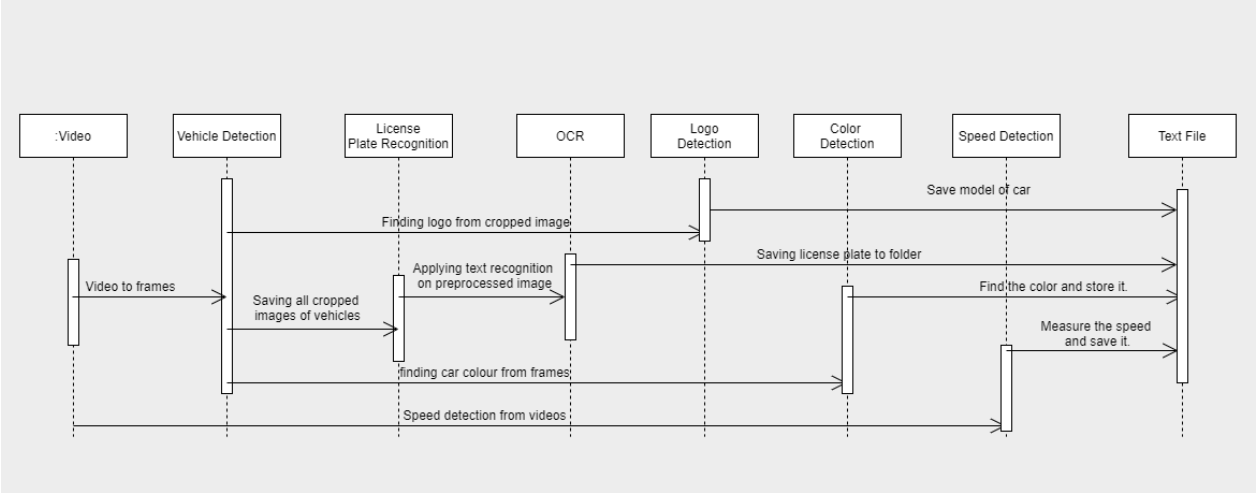


Fig. 4 Sequence diagram for Vehicle Surveillance and Speed Detection.

The video is the starting object of the system .All the process start from video itself. ALL other objects in the sequence diagram are vehicle detection, license plate recognition, OCR, logo detection, Color Detection, Speed detection and text file. The process starts from video where it is converted into frames and given to vehicle detection object to detect vehicles into each frame and store them as images and the same is given as input to speed detection.
Next vehicle detection output is given to license plate detection from image and give it to OCR. The vehicle detected image is also given to logo detection to get the logo of the vehicle .Similarly it is given to colour detection object to identify the car colour. Now output from license plate recognition is given to OCR to find the exact number plate written on license plate. And all the outputs of OCR, Logo Detection, Colour Detection, Speed Detection are saved into text file which can be used for analysis and further work if required.

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2) Flowchart Diagram

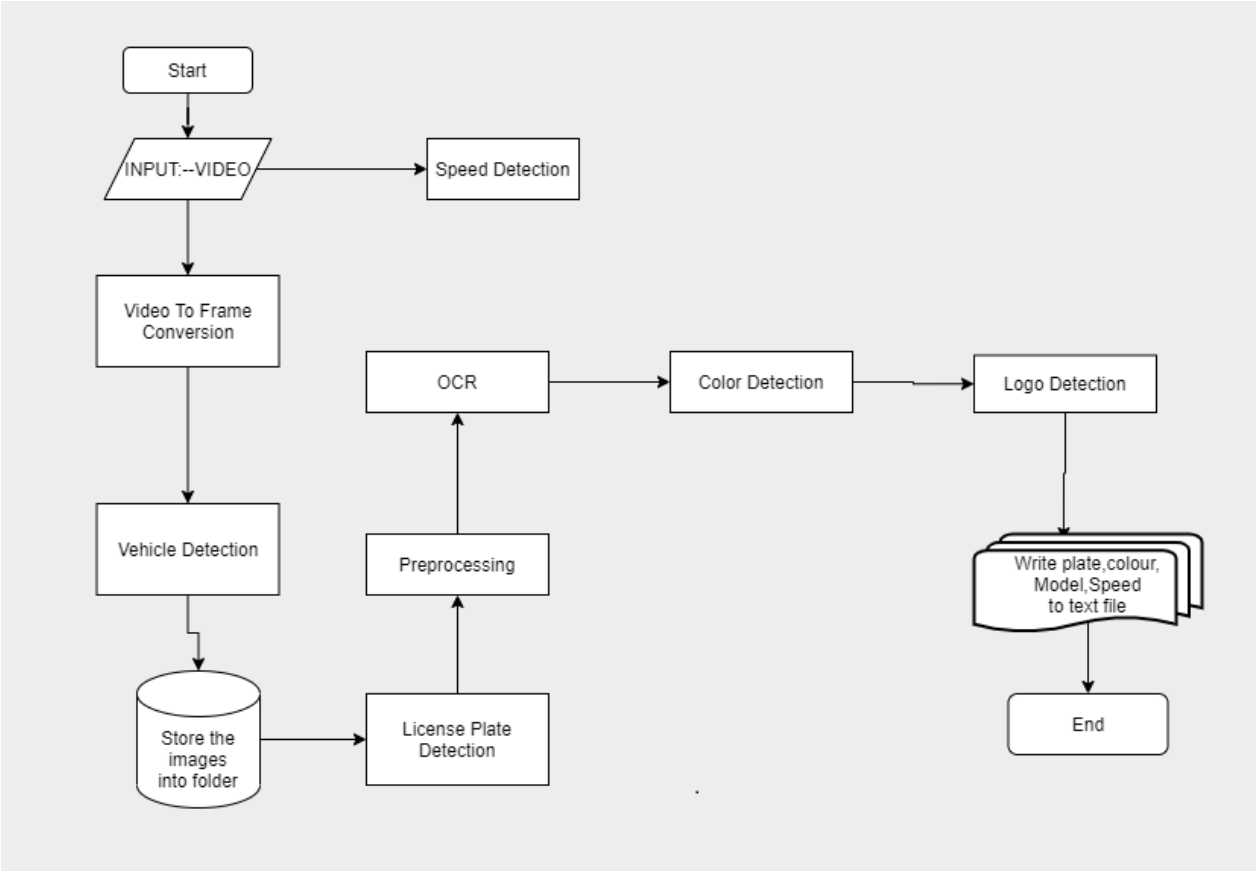


Fig. 5 Flowchart diagram for Vehicle Surveillance and Speed Detection

The above flowchart depicts the flow of control of the system.
The system starts by taking the video stream as input and converts it into frames. Then each frame is sent for vehicle detection, if there are vehicles then the cropped image is saved. Then each of the vehicle images is sent for license plate detection.
Every license plate image is pre-processed to increase OCR accuracy. Then the license plate text is extracted using OCR. Then the colour detection and logo detection are performed. and all these results are stored in the text-file.

C. Implementation Methodology

1) Vehicle Detection: The image frame is given to YOLO detector for vehicle detection, the output of the detector is a text file which contains the classes of the objects detected along with the coordinates of their bounding-boxes. The output file is read, if the required class (i.e. car) if found and the confidence of detection is above 80% the bounding box coordinates of the car is retrieved and stored in a folder with a text file which will contain the information of the car detected.



Fig. 6 Demo for vehicle detection.

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2) *License Plate:* An image of a car which was detected before is now sent into the license plate detector, the image of the cropped license plate is obtained as output. Before extracting the text from the license plate, pre-processing is done to the license plate image to improve the OCR's accuracy. After applying pre-processing methods like binarization, rescaling and Gaussian blur OCR is applied on the image to get the text of the license plate. This text is then store in the text file of the corresponding vehicle.



Fig. 7 Overview of Pre-processing

3) *Logo Detection:* A custom trained YOLO detector is used on a car's image to detect the logo on the vehicles which gives us the manufacturer's name. The process mentioned in 3.3.1 is repeated to store the manufacturer's name in the text file of the corresponding vehicle. Another approach used for logo detection was using ResNet with a sliding window, which did not give the expected result. Since vehicle logo dataset for was not available, a dataset consisting of major car manufacturers in India was created. The dataset is available on GitHub.

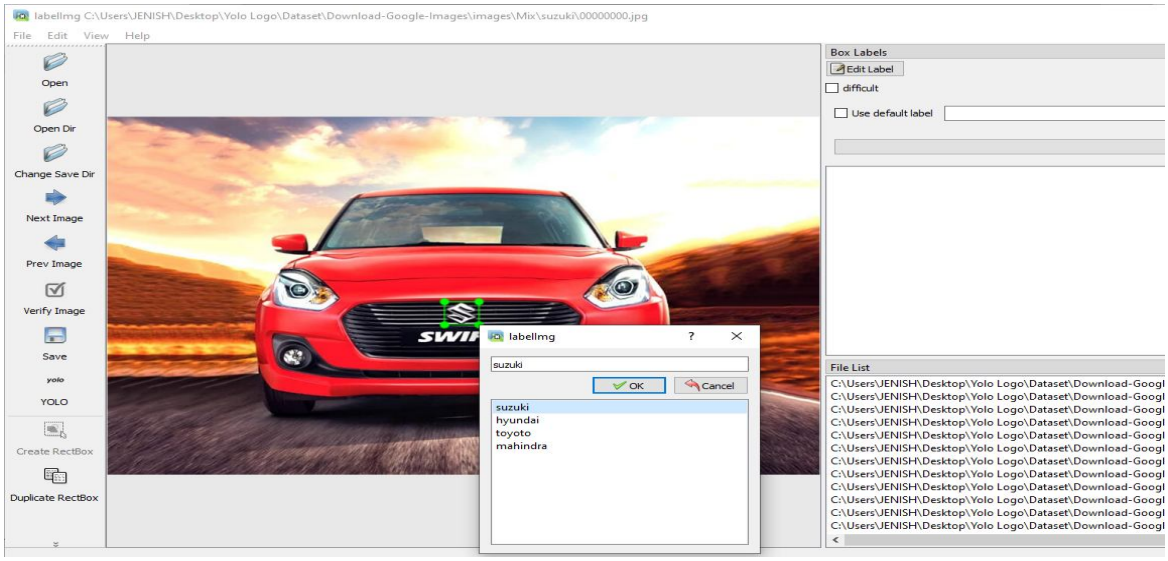


Fig 8 Process of dataset creation for YOLO

4) *Colour Detection*

a) *Dehazing of Images:* A large part of this project will discuss the removal of haze from pictures. You can apply this algorithm to several other problems as well. To provide us with clearer images, this algorithm uses ambient light. We are encountering more air and light pollution as cities grow larger. Both lead to hazy images that, in real time, are difficult to process. To produce a clear picture, we will be using transmission maps and atmospheric light.

b) *Pixel Method To get Color:* In this part we iterate through every pixel present into the image and find out the the value of (r,g,b) and then compare it with given 9 classes to get the prominent color.So that the result will show the color of car in percentage with other colors also.

c) *Haze Removal:* Before we use Dark Tube, which is an assumption based on their haze-free outdoor image analysis. It represents the finding that at least one color channel(R/G/B) has pixels with very low intensity in most non-sky pictures.

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We created four functions that give us clear images as outputs:

- *atmospheric_light:* Finds the atmospheric light by scanning through the image.
- *Dark_channel_find:* Finds the dark channel for each pixel in the image.
- *Coarse:* Finds the coarse map for image
- *Dehaze:* Uses input from the 3 functions mentioned above and generates a dehazed image which is finally used to train the models.

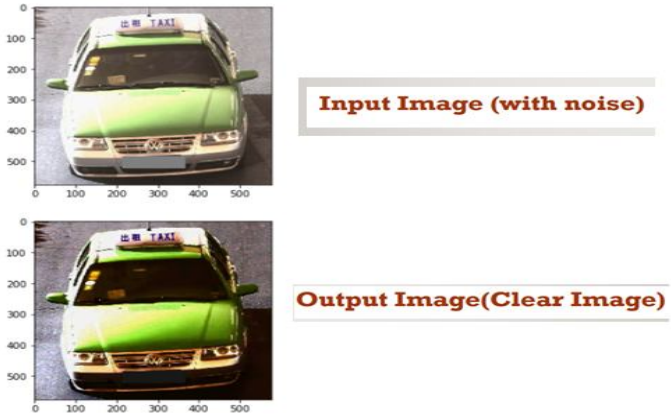


Fig. 10 Output after noise removal

5) Pixel method to get Prominent Color.

We have used the PIL library to do it.

Firstly Creating 9 class for colour then getting r,g,b value of every pixel present in image.Find count and strength of colour in image.We have taken count of all pxl and store them in dictionary and with value>10 we find sum of all that pixel into the image.Now that pixel is given to color heel function which is responsible for estimating the colour of that pixel.So no every pixel is associated with 3 classes and one value.

Estimate Color of pixel

```
    if Colors.Red in color_classes and Colors.Green in color_classes:
        return Colors.Yellow(dominant_colors[0].value)
    elif Colors.Red in color_classes and Colors.Blue in color_classes:
        return Colors.Pink(dominant_colors[0].value)
    elif Colors.Blue in color_classes and Colors.Green in color_classes:
        return Colors.Teal(dominant_colors[0].value)
elif total_colors == 3:
    if dominant_colors[0].value > 200:
        return Colors.White(dominant_colors[0].value)
    elif dominant_colors[0].value > 100:
        return Colors.Gray(dominant_colors[0].value)
    else:
        return Colors.Black(dominant_colors[0].value)
else:
    print("Dominant Colors : %s" % dominant_colors)
```

Fig. 11 Pixel method implementation

Result: It will show all colour present with their percentage.

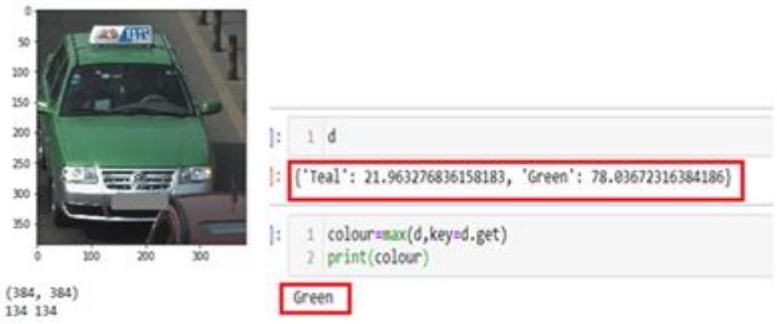


Fig. 12 Colour Detection results

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IV. CONCLUSION

Our work will benefit the Intelligent Traffic System. It will provide them better and efficient way to analysetraffic. Time taken for data retrieval from the stored data is reduced. In case of videos now only images can be stored and we can analyse through images. Information in videos is converted to text files, which in turn minimizes storage space. Digital speed detection can help to reduce overspeed violations, which is the main cause for accidents.

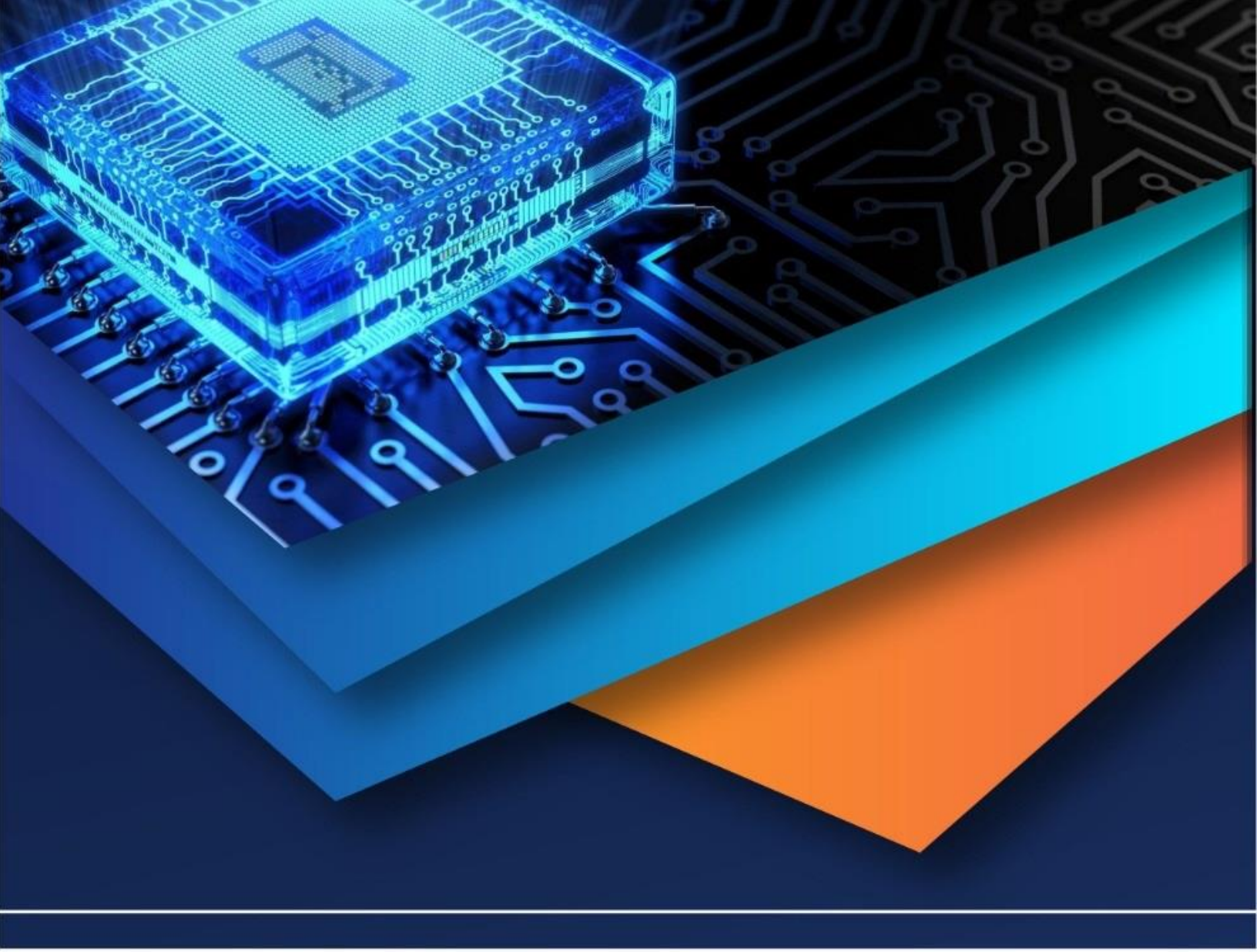
V. FUTURE SCOPE

We would like to implement this Video Surveillance and Speed Detection with the following features in it:
We would try to implement speed detection with the help of videos we get and try to achieve a high accuracy in comparison with true value.
We will try to find an optimized algorithm to achieve maximum efficiency and throughput for all.

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