Density Based Traffic Control Systems using Deep Learning and Open CV

Abstract

In recent days due to the increase in the population increasing vehicle count in bulk amounts. Due to the increasing number of vehicles, there are various problems are occurring day by day such as increasing the pollution, increasing accidents, and for that many peoples are died also. But now a days the traffics control department are facing so many problems while controlling the traffic, because the vehicles are more so at that time manual decided that which side how many times required to cross al the vehicles and based on that provide the time. Because if vehicles are less and time given more so at that time other site vehicles are waiting more and spread more CO2 in the atmosphere and if vehicle are more but the given time is less then there is a chance collision between them. That's why the author tries to create an automation

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1 Introduction

1.1 Background of Study

In day-to-day Activities, traffic congestion is a very significant problem in today's world. The labor hours of traffic signals are lost on the roads, it is reducing both individual and societal production (Agyapong and Ojo 2018). On the roads, they have various causes of disorganization congestion has a large number of cars, poor infrastructure, and erroneous allocation of the traffic signal system. People are migrating into urban areas, and the constant increase in the number of vehicles and cars, they are contributing to the urban areas of Congestion. The various negative impacts are to increase in both automotive and pedestrian traffic, in the major cities are congested,

Networks (CNN), Recurrent Neural Networks (RNN), LSTMs, etc. for the prediction of these research projects.

1.6 Outline of the Thesis

The overall analysis of the five chapters as Chapter 1 gives detailed information in the introduction part, it has a background of the study, the purpose of the requirements of the traffic control system based on the density, the aim and objectives of forecasting the density of the traffic, and some of the research questions, the thesis is discussing the overall research paper. Chapter 2 is analyzing, Review of the literature, it consists of an overview of the section, Role of machine learning using density traffic control prediction, the author has explained the existing research methods such as traditional and modern approaches for the prediction of density-based traffic and the author has been identified the gaps in the various research papers, a summary of this section. In Chapter 3, the author used various deep learning methods such as CNN, RNN, and LSTMs many more to find the models used in the prediction of the density traffic system. In Chapter 4, they are discussing the Results and analysis section for the cleaning, pre-processing, and model creation finding the accuracy to compare the relation and best value for the prediction of the density-based traffic control system. In Chapter 5, the author was discussing the overall conclusion, suggestions or recommendations, and the scope of the future for the prediction of density-based traffic control systems.

2 Literature Review

2.1 Overview

The section of chapter literature review gives the entire overview of the literature review of Density-Based Traffic Control Using Deep Learning Methods. Section 2.1 describes the existing research available in developing density-based traffic control. This section also provides information about the Traditional methods and Modern methods. Section 2.2 explains the Role played by the Deep Learning Approaches in developing the Density Based Traffic Control system. It also talks about the different deep learning frameworks available to implement the study, their advantages, and why deep learning methods are used in this research instead of the machine learning approach. Section 2.3 gives the recent study in the field of density-based traffic control. This section covers different studies carried out on density-based traffic control. Section 2.4 provides a brief summary of this chapter.

2.2 Existing Research

This Section discussed the existing approaches for a traffic control system that include both traditional and modern methods. In the older days, what are the methods people were using for traffic control, and in today’s world what methods people are using for traffic signal controlling?

can help to reduce traffic congestion and improve traffic flow during peak periods. But large amounts of data to train the CNN. Collecting and processing this data can be time-taking and expensive. CNN needs high-quality sensors to gather precise data. If the data collected by the sensors is noisy or incomplete, it can reduce the accuracy of the forecasts made by CNN (Maharana et al., 2022). This allows the traffic signals to be adjusted in real-time to improve traffic flow and reduce overcrowding.

2.5 Summary

This section describes the summary of the Literature Review chapter. It covers the existing research both in terms of traditional and modern approaches. The author explained the different modern approaches to deal with density-based traffic control like Real-time Traffic Flow Optimization using Deep Learning, Advanced Traffic Prediction using Deep Learning and Machine Learning, Automatic Incident Detection using Deep Learning, Pedestrian and Cyclist Detection using Machine Learning, Predictive Traffic Analysis using Machine Learning and Deep Learning. In the traditional methods, the traffic lights were used in traffic management where the lights are turned on and off periodically after a certain time delay. The author then explains the Role of Deep learning in Density Based Traffic Control. Here the emphasis was made on how the traffic flow is optimized using Deep learning techniques. Deep learning provides Convolution Neural Networks which deal with tasks like object detection, and analyze the large volume of data originating from different sources like traffic sensors, Image and video information from cameras. In the recent study, the author describes the different methods and techniques implemented by different researchers across different locations. The different techniques and methods in the Recent Study have helped the authors to decide the different algorithms or neural networks that can be used in the implementation of the study.

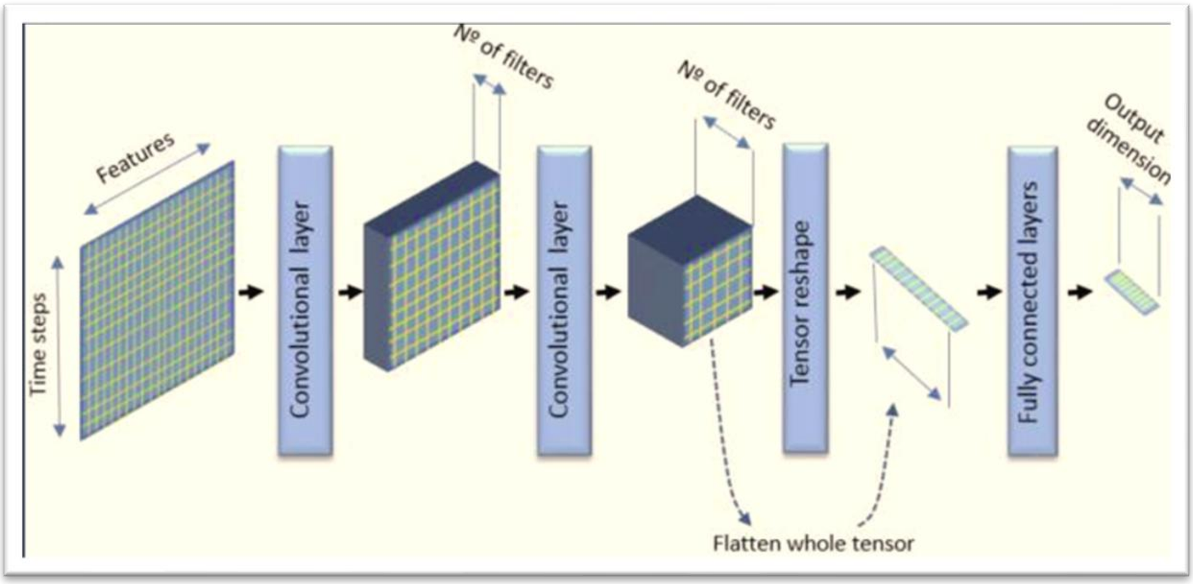
3 Methodology

3.1 Overview

This section provides an overview of the different deep-learning methods that have been used and it also explains the applications of different DL methods. In Section 3.1, there will be a detailed explanation of the methods that have been used in the completion of the project. Section 3.2 consists of the different DL techniques that are being used in the market for analyzing the data related to traffic. Section 3.3 consists of a brief overview of the convolutional neural networks that have been used to analyze the videos and images of the traffic. CNN's main application is to analyze the behavior of the traffic based on the learnings that have been obtained from the visuals. Section 3.4 explains the OpenCV architecture and its applications in analyzing the data from the pictures that have been obtained from the traffic cameras. It just obtains the data related to traffic and understands the pattern, and behavior of different drivers based on their movements. In the final section, there will be a thorough glance at the different techniques that have been used in traffic analysis. This section is the summary of the overall methodology, and it showcases the results that have been obtained by the application of different deep learning techniques.

3.2 Types of DL Techniques

Different deep learning techniques are present in the real world to solve many issues and these techniques can also help to predict the outcome of different incidents based on the learnings from them. DL is one of the trending technologies and it consists of different techniques that have brought a rapid change in the field of artificial intelligence. Some of the DL techniques that are CNN. ANN, RNN, and many more.



Features
Time steps
Convolutional layer
Nº of filters
Convolutional layer
Nº of filters
Tensor reshape
Fully connected layers
Output dimension
Flatten whole tensor

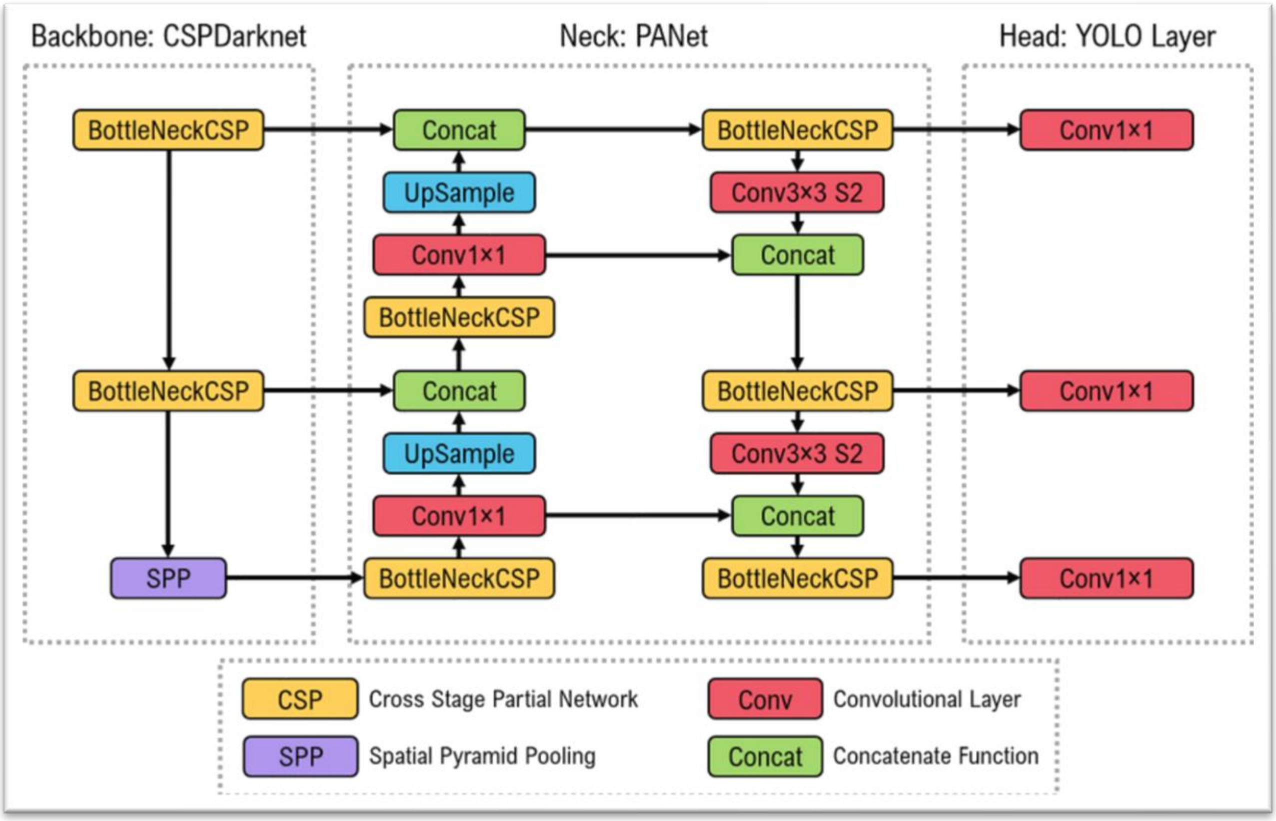


Figure 3.2 Structure of Yolov5 model

3.5 Summary

In conclusion, after a thorough analysis of the above sections, it can be understood that CNN and OpenCV techniques are used in understanding traffic density. These techniques are applied to different sets of images, and videos, and they have learned a huge amount of information from the data by observing the pattern. However, there are some limitations in the application of DL techniques as they will consume a huge amount of data in the RAM for executing the dataset. The learning that is observed using the DL techniques will help in providing efficient results and a good number of results can be observed.

4 Result and analysis

4.1 Overview

The author offers comprehensive data on the results and analysis of traffic control in this chapter. When available on websites, the dataset description for traffic videos is described in Section 4.2. Section 4.3 of the proposed project's procedures. The project's implementation phases are, however, described in section 4.4. The objects used in this study are listed in section 4.5.

```
'person', 'bicycle', 'car', 'motorcycle', 'airplane', 'bus', 'train', 'truck', 'boat',
'traffic light', 'fire hydrant', 'stop sign', 'parking meter', 'bench', 'bird', 'cat',
'dog', 'horse', 'sheep', 'cow', 'elephant', 'bear', 'zebra', 'giraffe', 'backpack',
'umbrella', 'handbag', 'tie', 'suitcase', 'frisbee', 'skis','snowboard', 'sports ball',
'kite', 'baseball bat', 'baseball glove', 'skateboard', 'surfboard', 'tennis racket',
'bottle', 'wine glass', 'cup', 'fork', 'knife', 'spoon', 'bowl', 'banana', 'apple',
'sandwich', 'orange', 'broccoli', 'carrot', 'hot dog', 'pizza', 'donut', 'cake',
'chair', 'couch', 'potted plant', 'bed', 'dining table', 'toilet', 'tv', 'laptop',
'mouse', 'remote', 'keyboard', 'cell phone', 'microwave', 'oven', 'toaster', 'sink',
'refrigerator', 'book', 'clock', 'vase', 'scissors', 'teddy bear', 'hair drier',
```

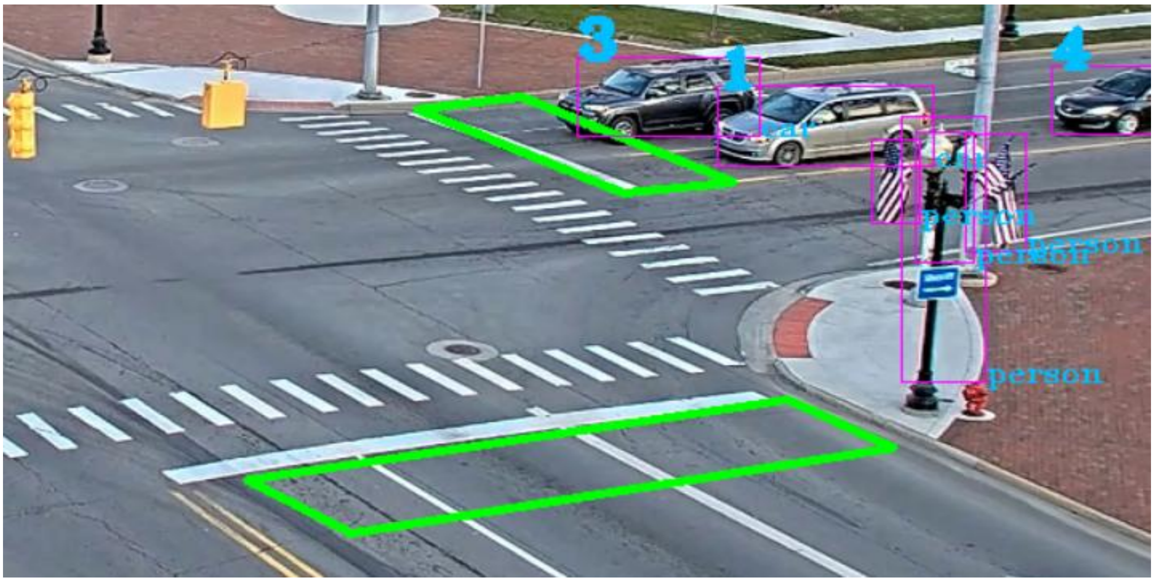
```python
import cv2
import torch
import time
from tracker import *
import numpy as np
```

```python
model = torch.hub.load('ultralytics/yolov5', 'yolov5s', pretrained=True)
cap=cv2.VideoCapture('1.mp4')
```

```python
def POINTS(event, x, y, flags, param):
    if event == cv2.EVENT_MOUSEMOVE:
        colorsBGR = [x, y]
        print(colorsBGR)
cv2.namedWindow('FRAME')
cv2.setMouseCallback('FRAME', POINTS)
```

```python
area11 = [(668,540),(938,495),(991,522),(720,570)]
area12 = [(648,513),(915,476),(886,457),(625,489)]
area13 = [(342,568),(605,518),(584,499),(325,545)]
area22 = [(817,376),(725,334),(685,338),(785,384)]
area21 = [(856,379),(753,332),(805,325),(911,373)]
area23 = [(870,390),(925,385),(992,413),(936,431)]
area31 = [(155,368),(170,382),(425,353),(409,338)]
area41 = [(93,456),(150,448),(204,533),(137,542)]
area32 = [(451,350),(645,333),(610,325),(430,330)]
```

```python
cv2.polylines(frame,[np.array(area11,np.int32)],True,(0,255,0),3)
#cv2.polylines(frame,[np.array(area12,np.int32)],True,(0,255,0),3)
cv2.polylines(frame,[np.array(area21,np.int32)],True,(0,255,0),3)
```




```
while True:
    ret,frame=cap.read()
    frame = cv2.resize(frame,(1280,720),fx=0,fy=0, interpolation = cv2.INTER_CUBIC)
    if not ret:
        break
    count+=1
    if count % 3 != 0:
        continue
```

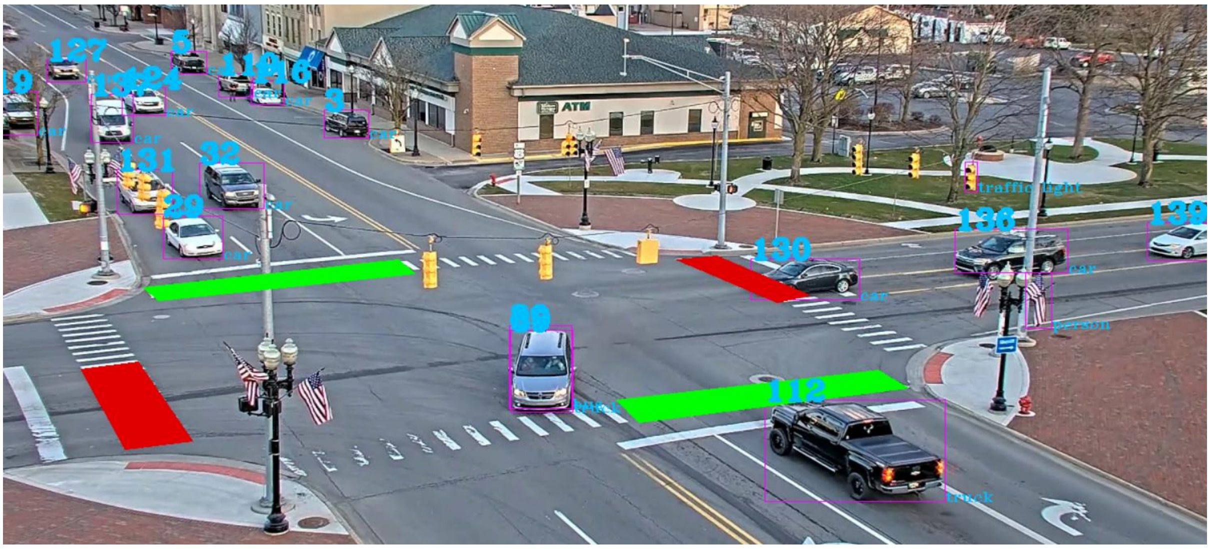
```
cv2.putText(frame,"23 : "+str(p),(58,190),cv2.FONT_HERSHEY_PLAIN,2,(0,255,0),3)
cv2.putText(frame,"23 : "+str(q),(58,250),cv2.FONT_HERSHEY_PLAIN,2,(0,255,0),3)
```

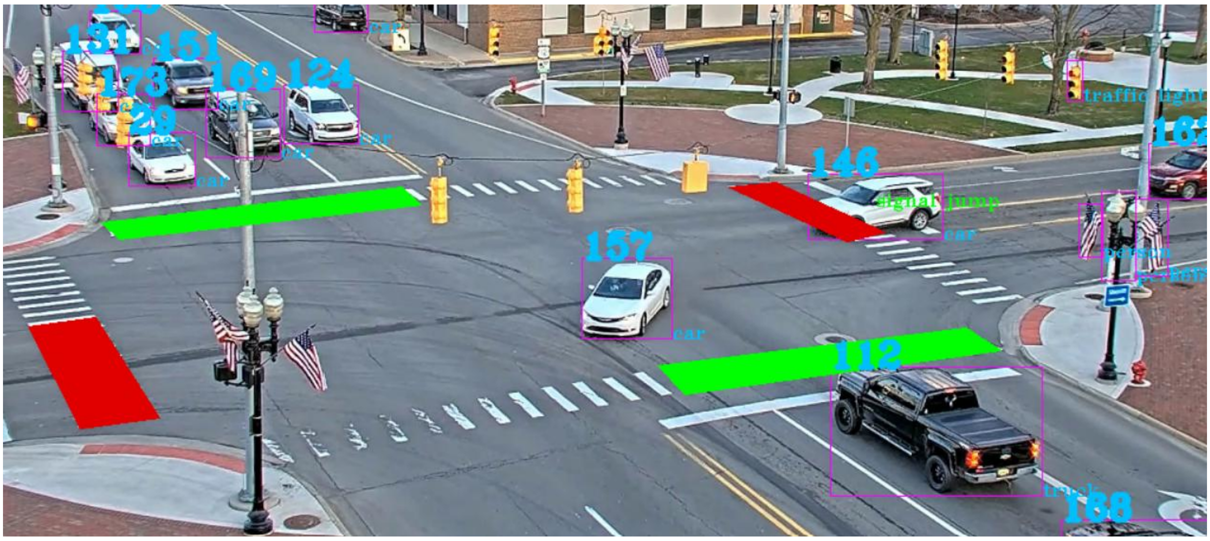

```
result = model(frame)
list=[]
for index, row in result.pandas().xyxy[0].iterrows():
    x1=int(row['xmin'])
    y1=int(row['ymin'])
    x2=int(row['xmax'])
    y2=int(row['ymax'])
    b=str(row ['name'])
    cv2.rectangle(frame,(x1,y1),(x2,y2),(255,0,255),1)
    for i in m:
        if i == b:
            list.append([x1,y1,x2,y2])
        cv2.putText(frame,str(b),(x2,y2),cv2.FONT_HERSHEY_TRIPLEX,0.5,(255, 191, 0),1)
box id=tracker.update(list)
```

```python
for boxid in box_id:
    x,y,w,h,id=boxid
    c1 = (x+w)//2
    c2 = (y+h)//2
```

```python
if (res31 > 0) or (res11 > 0):
    Area31.add(id)
    q=(len(Area31))
    humanentering[id] = time.time()
if id in humanentering:
    res13 = cv2.pointPolygonTest(np.array(area13,np.int32),(int(c1),int(c2)),False)
    res32 = cv2.pointPolygonTest(np.array(area32,np.int32),(int(c1),int(c2)),False)
    res23 = cv2.pointPolygonTest(np.array(area23,np.int32),(int(c1),int(c2)),False)
    if (res13 > 0) or (res32 > 0) or (res23 > 0) :
        #area10.add(id)
        elsp = time.time() - humanentering[id]
        if id not in velsp:
            velsp[id] = elsp
        if id in velsp:
            elsp = velsp[id] /1.8
        dst = 30
        sp  = dst / elsp
        sp = sp *3.6
        cv2.putText(frame,"Speed : "+str(int(sp*0.621371))+" mile/h ",(x,y),cv2.FONT_HERSHEY_TRIPLEX,0.5,(255,225,255),1)
```

```
p=(len(Area21))
if (p) > 15:
    cv2.fillPoly(frame,[np.array(area22,np.int32)],color=(0,0,225))
    cv2.fillPoly(frame,[np.array(area41,np.int32)],color=(0,0,225))
    cv2.fillPoly(frame,[np.array(area31,np.int32)],color=(0,255,0))
    cv2.fillPoly(frame,[np.array(area12,np.int32)],color=(0,255,0))
```






```
if (int(sp*0.621371)) > 5:
    cv2.putText(frame,"over speed",(c1+10,c2),cv2.FONT_HERSHEY_TRIPLEX,0.5,(0,255,0),1)
```

Figure 4.8 Signals violating identification code

If the vehicle violated the posted speed limitations at a zebra crossing, the author can identify them by utilizing Python codes.

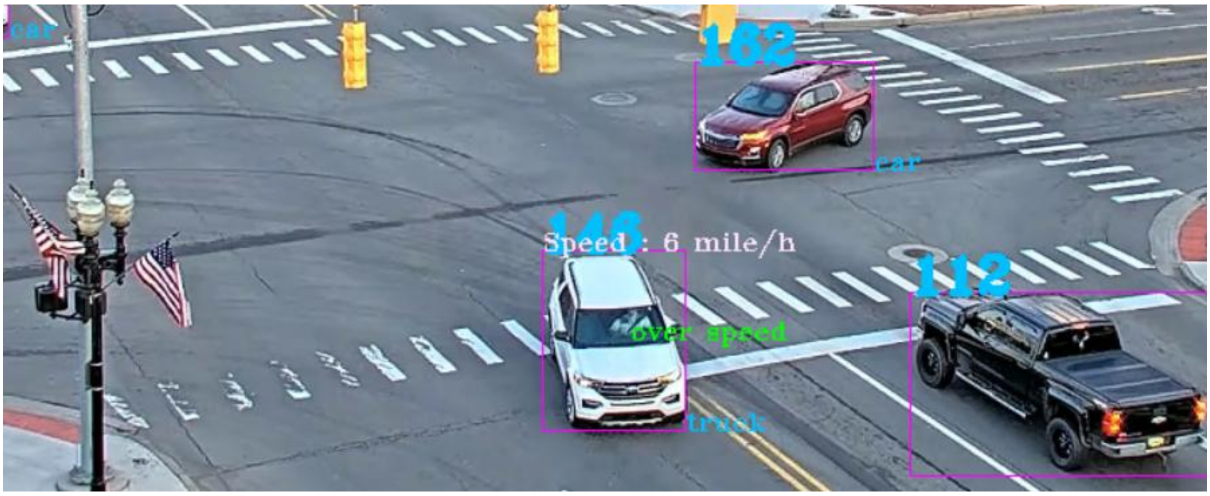


Figure 4.9 Representing the car speed along with speed type

Here Figure 4.9 illustrates the Overspeed of automobiles, a feature that is more useful today.

5 Conclusion, Recommendation, and Future Scope

5.1 Conclusion

The author reviewed the previous steps in this chapter's conclusion, along with any results or outcomes that came from the case study. The question at hand is where the dataset came from, as the author used an open source. Here, the author's videos for this project are the only online videos that have been collected. To make the thesis or document easier to understand, it has been broken into several parts. The author highlighted the significance of this project and how to recognize the complicity problem in the first section of the introduction. In other words, the literature review is all about examining the articles and various writers' points of view. It is about the prior work done with that subject and about the result as well. The methodology chapter provides

method, and the cluster centroids are then used as anchor boxes. The Python code is then applied to calculate how much time is needed to estimate the density of each side. The author included additional elements in this project proposal that are helpful for determining who accidentally operated the car.

5.2 Recommendations

The research's goal is to adjust the traffic signal based on the volume of traffic. To operate the machine, high-tech coding standards are used. Here, the highest-quality cameras are required for identification objectives, and additional lenses are required for locating far objectives. If the author is working on full AIs, like reinforcement learning and Q-learning.

5.3 Future Scope

Nowadays, the majority of people who travel do so in vehicles. If the number of vehicles on the road is not controlled, there is a chance that an accident will occur. Since most people need to arrive at their destination on time, and traffic signals currently operate in random sequences, it is necessary to implement a traffic control system based on artificial intelligence (AI). It will be more beneficial in the future for reducing traffic congestion.

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