A

Mini Project

On

SPEED DETECTION AND VEHICLE DETECTION

(Submitted in partial fulfillment of the requirements for the award of Degree)

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In

COMPUTER SCIENCE AND ENGINEERING

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2020-2024

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled **"VEHICLE DETECTION AND SPEEDDETECTION"** being submitted by **YERRAM SHREYA (207R1A05P9) A.NITISH BHARADWAJ(207R1A05J8) & PABBATI SAI KRISHNA (207R1A05M8)** in partial fulfilment of the requirements for the award of the degree of B.Tech in Computer Science and Engineering to the Jawaharlal Nehru Technological University Hyderabad, is a record of bonafide work carried out by them under our guidance andsupervision during the year 2023-24.

The results embodied in this thesis have not been submitted to any other University orInstitute for the award of any degree or diploma.

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ABSTRACT

In recent times, there has been a drastic change in people's lifestyles and with an increase in incomes and lower cost of automobiles there is a huge increment in the number of cars on the roads which has led to traffic and commotion. The manual efforts to keep people from breaking traffic rules such as the speed limit are not enough. There is not enough police and man force available to track the traffic and vehicles on roads and check them for speed control. Hence, we require technologically advanced speed calculators installed that effectivelydetect cars on the road and calculate their speeds.

To implement the above idea two basic requirements, need to be met which are the effective detection of the cars on roads and their velocity measurement. For this purpose, we can use OpenCV software which uses the Haar cascade to train our machine to detect the object,in this case the car.

We have developed a Haar cascade to detect cars on the roads, whose velocities are thenmeasured using a python script.Better search algorithms can allow a faster search and better detection of these vehicles for better efficiency.

This paper is to develop an algorithm to calculate the speed of the object(vehicle) detected. We have implemented the algorithm using Python Script.

LIST OF FIGURES/TABLES

FIGURE NO	FIGURE NAME	PAGE NO
Figure 3.1	Project Architecture of Vehicle Detection and Speed Detection	7
Figure 3.2	Use Case Diagram of Vehicle and Speed Detection	8
Figure 3.3	Class Diagram of Speed Vehicle detection	9
Figure 3.4	Sequence diagram of Speed and vehicle detection	10
Figure 3.5	Activity diagram of Speed and vehicle Detection	11

SCREENSHOT NO	SCREENSHOT NAME	PAGE NO
Screenshot 5.1	Capturing moving vehicle on road	16
Screenshot 5.2	Capturing Speed of moving vehicle	16
Screenshot 5.3	Calculate speed accurately	17
Screenshot 5.4	Recognizing type of vehicle	17
Screenshot 5.5	Accurately Detecting Vehicle	18

TABLE OF CONTENTS

ABSTRACT	i
LIST OF FIGURES	ii
LIST OF SCREENSHOTS	iii
1.INTRODUCTION	1
1.1 PROJECT SCOPE	1
1.2 PROJECT PURPOSE	1
1.3 PROJECT FEATURES	1
2. SYSTEM ANALYSIS	2
2.1 PROBLEM DEFINITION	2
2.2 EXISTING SYSTEM	2
2.2.1 LIMITATIONS OF THE EXISTING SYSTEM	3
2.3 PROPOSED SYSTEM	3
2.3.1 ADVANTAGES OF PROPOSED SYSTEM	3
2.4 FEASIBILITY STUDY	4
2.4.1 ECONOMIC FEASIBILITY	4
2.4.2 TECHNICAL FEASIBILITY	5
2.4.3 SOCIAL FEASIBILITY	5
2.5 HARDWARE & SOFTWARE REQUIREMENTS	5
2.5.1 HARDWARE REQUIREMENTS	5
2.5.2 SOFTWARE REQUIREMENTS	6
3.ARCHITECTURE	7
3.1 PROJECT ARCHITECTURE	7
3.2 USE CASE DIAGRAM	8
3.3 CLASS DIAGRAM	9
3.4 SEQUENCE DIAGRAM	10

3.5 ACTIVITY DIAGRAM 12

4. IMPLEMENTATION

4.1 SAMPLE CODE 13

5. SCREENSHOTS 16

6. TESTING 19

6.1 INTRODUCTION TO TESTING 19

6.2 TYPES OF TESTING 19

6.2.1 UNIT TESTING 19

6.2.2 INTEGRATION TESTING 19

6.2.3 FUNCTIONAL TESTING 19

6.2.4 INTEGRATION TESTING 19

6.3 TEST CASES 20

7. CONCLUSION AND FUTURE SCOPE 20

7.1 PROJECT CONCLUSION

7.2 FUTURE SCOPE 20

8. REFERENCES 21

8.1 REFERENCES 21

8.2 GITHUB LINK 21

1. INTRODUCTION

1. INTRODUCTION

1.1 PROJECT SCOPE

The main objective of this work is to develop vision-based real-time vehicle detection andVSM for ITS in the smart city. This method helps to improve traffic management systems using available surveillance cameras in urban areas. The system helps to reduce traffic accidents, traffic congestion, and improves road network efficiency.

1.2 PROJECT PURPOSE

To implement the above idea two basic requirements, need to be met which are the effective detection of the cars on roads and their velocity measurement. For this purpose, we can use OpenCV software which uses the Haar cascade to train our machine to detect the object,in this case the car. we have developed a Haar cascade to detect cars on the roads, whose velocities are then measured using a python script. Better search algorithms can allow a faster search and better detection of these vehiclesfor better efficiency.

1.3 PROJECT FEATURES

This technique of identifying image displacements which are easiest to interpret is feature based modelling. The technique helps in identifying edges, corners and other structures in an image which are restricted properly in a two-dimensional plane and trace these objects as they transit between multiple frames. This technique comprises of two stages; finding the features in multipleimages and matching these features between the frames.

2. SYSTEM ANALYSIS

2. SYSTEM ANALYSIS

2.1. SYSTEM ANALYSIS

Stage 1: In this step, the features are found in a series of two or more images. If carried out perfectly, with no overhead cost; it may work efficiently with less overload and reduce the extraneous information to be processed.

Stage 2: Features found in stage 1 are matched between the frames. Under most common scenarios, two frames are used and two sets of features are matched to a resultant single set ofmotion vectors. These features in one frame are used as seed points which use other techniquesto determine the flow.

Despite this, both these stages of feature-based modelling possess drawbacks. In the stage of detecting features, it is necessary that features are located with precision and good reliability.This is proved to be of immense significance and research is performed on feature detectors. This feature holds an ambiguity of possible matches to occur as well; unless it is priorly knownthat image displacement less than the distance between features.

Frame Differencing and motion-based methods: Frame differencing is a method of finding thedifference between two consecutive images from a sequence of images to segregate the moving object (vehicle) from the background. If there is a change in pixel values, it implies that there was a change in position in the two image frames. The motion rectification step of detecting a vehicle in a trail of images by alienating the moving objects, also known as blobs based on it’s speed, movement and orientation.

2.1 PROBLEM DEFINITION

The main challenge face during vehicle detection and speed tracking is detecting the mainobject (In our case the vehicle). To detect moving object there are various approaches such as temporal differencing method, haar cascade algorithm.

2.2 EXISTING SYSTEM

There are various existing systems for speed detection and vehicle detection, ranging from simple manual methods to complex automated systems. Here are a few examples:

Radar-based speed detection systems: These use radar technology to measure the speed of a moving vehicle by bouncing radar waves off the vehicle and measuring the time it takes for the waves to return.

LIDAR-based speed detection systems: These use LIDAR (Light Detection and Ranging) technology, which works by emitting a laser beam and measuring the time it takes for the beam tobounce back off an object.

2.2.1 LIMITATIONS OF THE EXISTING SYSTEM

There are several disadvantages of speed detection and vehicle detection technologies, including:

Limited accuracy: Speed detection and vehicle detection technologies are not always 100% accurate. Factors such as weather conditions, vehicle type, and calibration issues can affect the accuracy of these systems.

High cost: Implementing speed detection and vehicle detection technologies can be expensive, requiring the installation of specialized equipment and infrastructure. This can be a significant barrier for smaller organizations or municipalities with limited resources.

2.3 PROPOSED SYSTEM

A proposed system for speed detection and vehicle detection would use sensors and cameras to detect the presence of vehicles and measure their speed. The system would be placed at strategic locations, such as near intersections or along highways. Once a vehicle is detected, the system would measure its speed.

The data collected could be used for traffic management, enforcement of speed limits, oridentifying areas where improvements in road safety are needed. If a vehicle is detected travelling at an unsafe speed or violating traffic laws, the system could trigger alerts or notifications to law enforcement or other relevant authorities.

2.3.1 ADVANTAGES OF THE PROPOSED SYSTEM

- Road safety: Speed detection helps ensure that drivers do not exceed the speed limit,which in turn reduces the number of accidents on the road and makes the roads safer for everyone.
- Traffic management: Speed detection can help in managing traffic flow, particularly during peak hours. By monitoring the speed of vehicles, traffic authorities can adjust traffic signalsand timings to ensure smooth traffic flow and reduce congestion.
- Improved fuel efficiency: Speed detection can help drivers maintain a consistent speed, which can improve fuel efficiency and reduce fuel consumption.

2.4 FEASIBILITY STUDY

The feasibility study for the Agriculture Helper Chatbot project is essential to assess its viability, potential challenges, and economic sustainability. Here are the key components of a feasibility study for this project:

- Economic Feasibility
- Technical Feasibility
- Social Feasibility

2.4.1 ECONOMIC FEASIBILITY

The developing system must be justified by cost and benefit. Criteria to ensure that effortis concentrated on a project, which will give the best, return at the earliest. One of the factors, whichaffect the development of a new system, is the cost it would require. The following are some of the important financial questions asked our preliminary investigation:

- **Estimation**: Estimate the project's initial development costs, including technology,personnel, and data acquisition expenses.
- **Revenue Projections**: Create revenue models, considering potential income sources such assubscriptions, partnerships, or Cost government support.
- **Return on Investment (ROI)**: Calculate the expected ROI based on revenue projections andcompare it to development costs**.**

Since the system is developed as part of project work, there is no manual cost to spend for the proposed system. Also, all the resources are already available, it indicate that thesystem is economically possible for development.

2.4.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirementsof the system. Any system developed must not have a high demand on the available technical resources. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

- **Technology Infrastructure**: Evaluate the availability of the necessary technologyinfrastructure for chatbot development including servers, databases, and software tools.
- **Development Expertise**: Assess the availability of skilled developers and data scientists tobuild and maintain the system

2.4.3 SOCIL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. Vehicle detection process is based on the process of feature detection. The features which are extracted are tracked over sequential frames.[Mohit] Matching algorithmis used to determine whether it is the same object or a different one. distance is used in object matching algorithm. During the past decade, distance learning hasattracted a lot of interest.

2.4 HARDWARE & SOFTWARE REQUIREMENTS

2.5.1 HARDWARE REQUIREMENTS

Hardware interfaces specify the logical characteristics of each interface between the software product and the hardware components of the system. The following are some hardware requirements.

- Processor : Intel Dual Core I3 and above
- Hard disk : 40GB and above
- RAM : 4GB and above
- Input devices : Keyboard, mouse

2.5.2 SOFTWARE REQUIREMENTS:

Software Requirements specifies the logical characteristics of each interface and software components of the system. The following are some software requirements,

- Operating system : Windows 8 and above
- Languages : Python, Html, CSS
- Tools : Python IDEL3.7 version

3. ARCHITECTURE

3. PROJECT ARCHITECTURE

3.1 PROJECT ARCHITECTURE

This project architecture shows the procedure followed for classification,starting from input to final prediction.

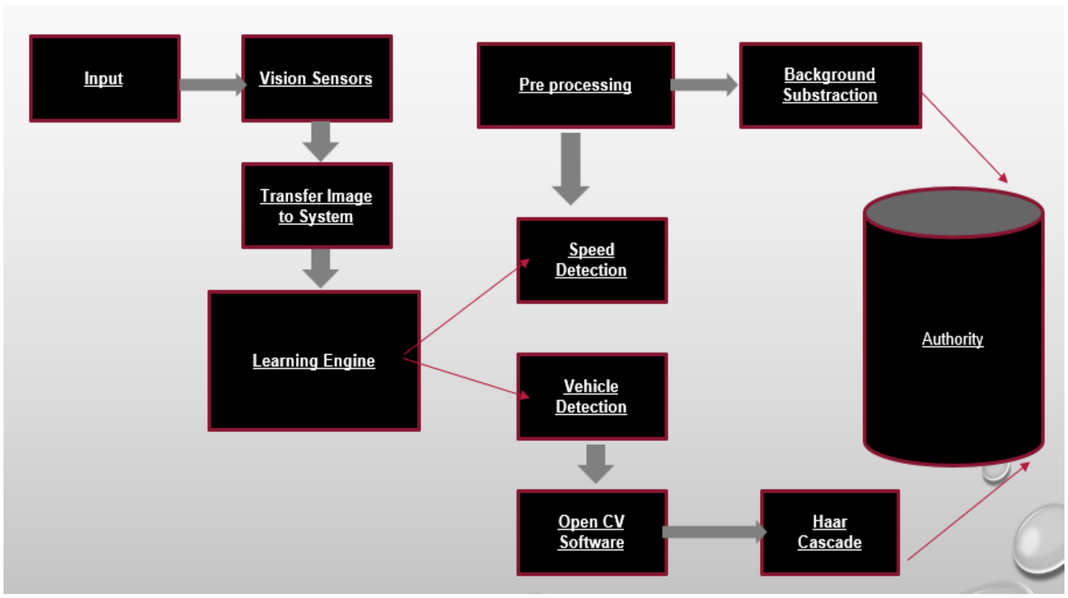


Figure: Project Architecture of speed detection and Vehicle detection

3.1.1 DESCRIPTION

Vehicle Detection Techniques and Approach [1] Recognition of change in location of a non-stationary object in a series of images captured of a definite region at equal intervals of time is considered as an interesting topic in computer vision. A plethora of application from multiple nuances are deployed to function in real time environments; video surveillance, identifying objectslying underwater, diagnosing abnormalities in patient and providing proper treatment in the medicaldepartment. Among these, one of the applications is detection of vehicle in traffic and identifying the speed of the vehicle.

3.2 USE CASE DIAGRAM

In the use case diagram, we have basically one actor who is the user in the trained model.

A use case diagram is a graphical depiction of a user's possible interactions with a system. A use case diagram shows various use cases and different types of users the system has. The use cases are represented by either circles or ellipses. The actors are often shown as stick figures.

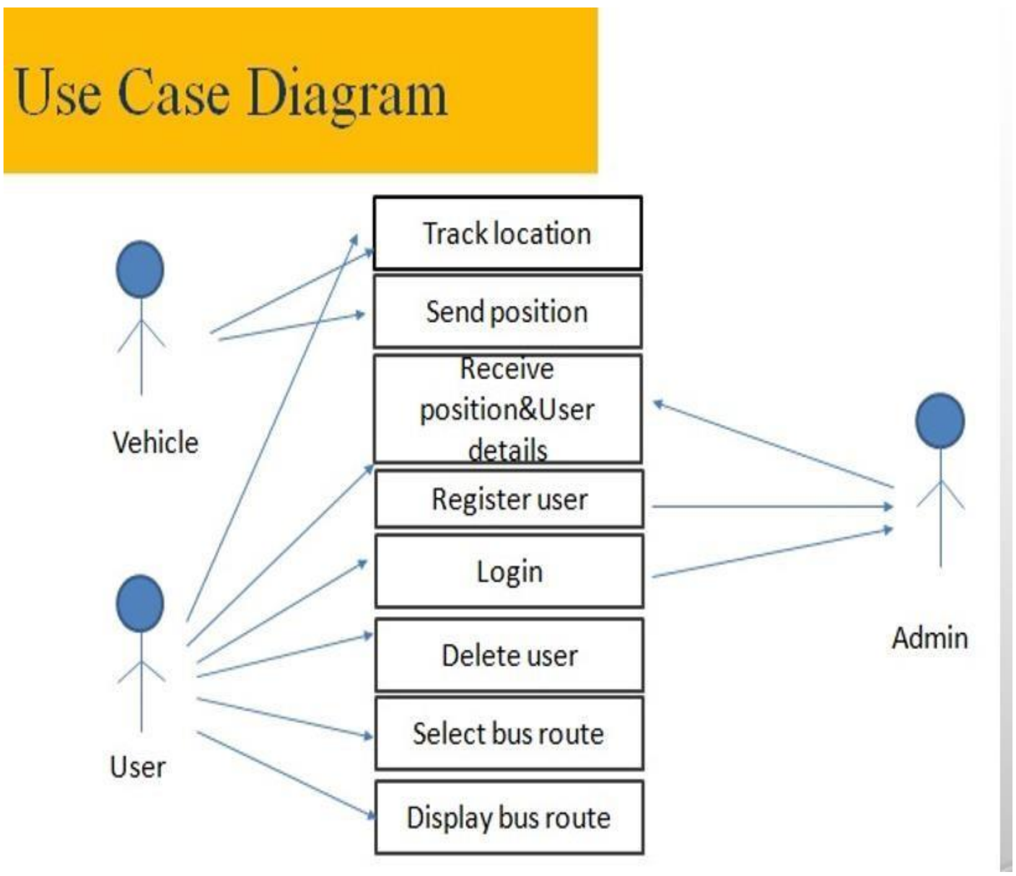


Figure 3.2: Use Case Diagram of Speed detection and vehicle detection

3.3 CLASS DIAGRAM

Class diagram is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

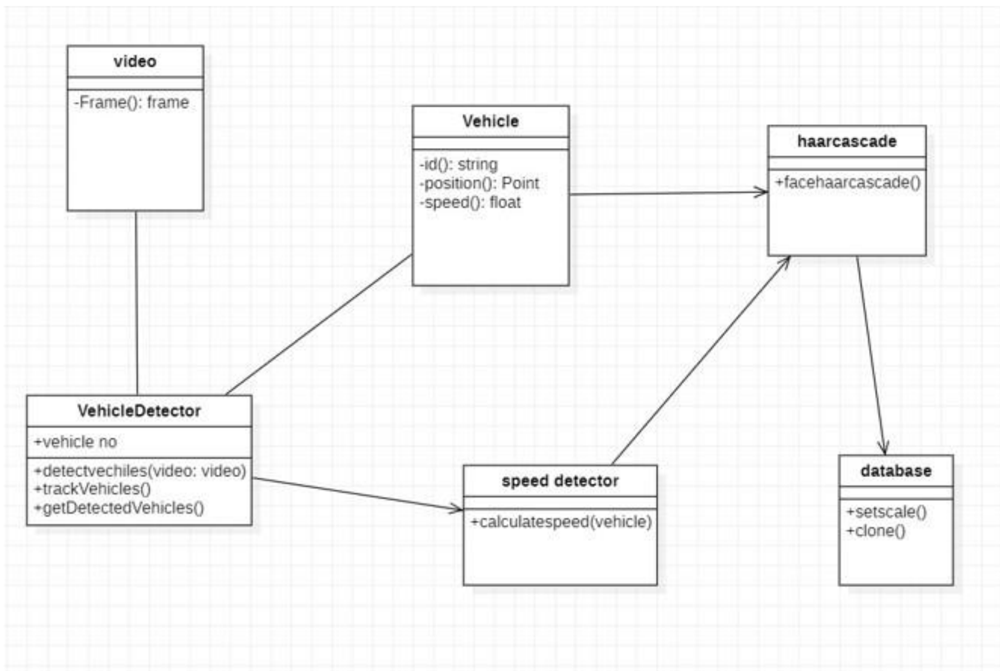


Figure 3.3: Class Diagram of Speed detection and vehicle detection

3.4 SEQUENCE DIAGRAM

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the logical view of the system under development.

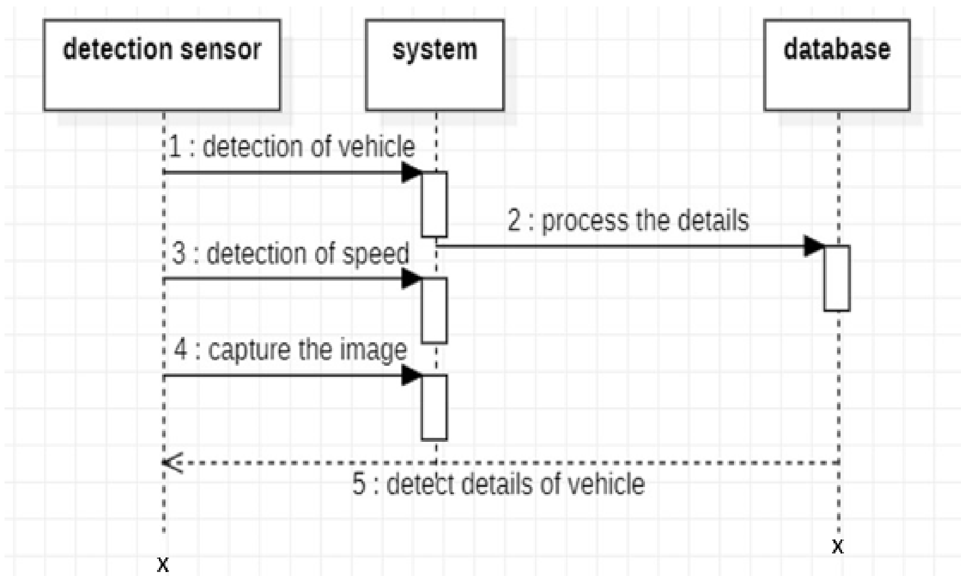


Figure 3.4: Sequence Diagram of Speed detection and vehicle detection

3.5 ACTIVITY DIAGRAM

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. They can alsoinclude elements showing the flow of data between activities through one or more datastores.

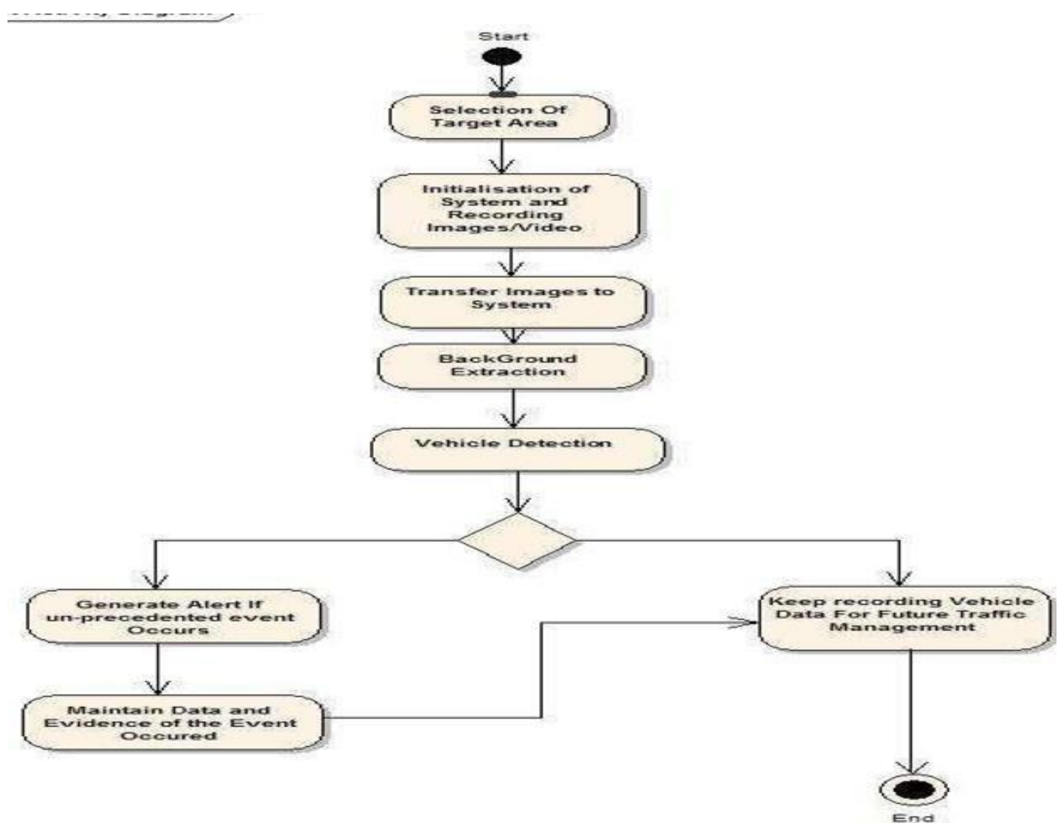


Figure 3.5: Activity Diagram of Speed detection and vehicle detection.

4. IMPLEMENTATION

4.SAMPLE CODE

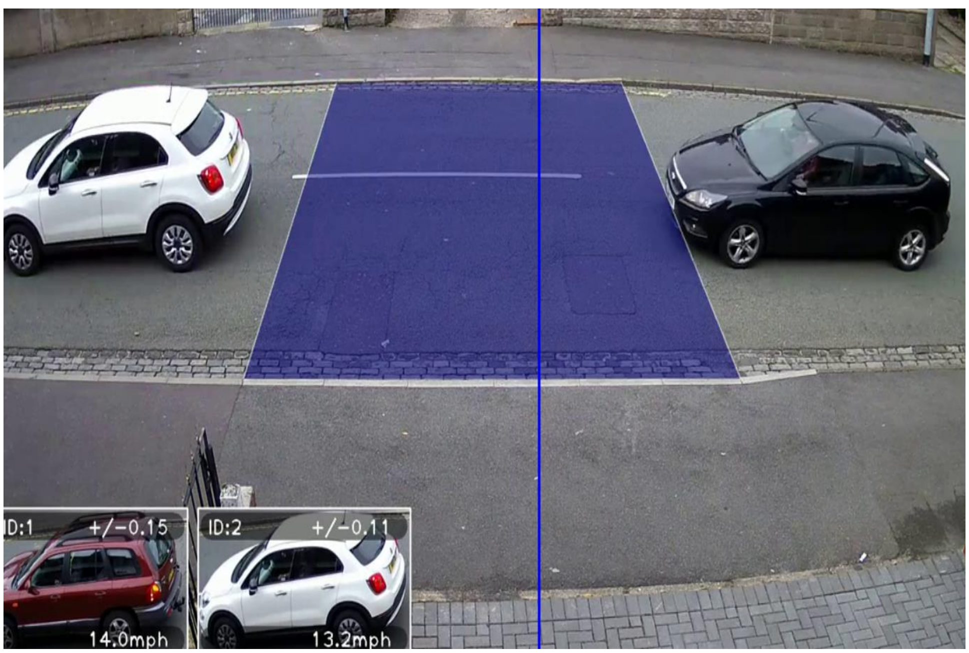
4.1 SAMPLE CODE

```
import numpy as np
import cv2
import time
car_cascade = cv2.CascadeClassifier('hand.xml')
cap = cv2.VideoCapture('car.mp4')
wide=0.1   #depends upon size of car(~2.5)
flag=True
start=end=0
time_diff=0
while(cap.isOpened()):
 ret, img = cap.read()
height,width,chan=img.shape
#print(height,width,chan)
 gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
 cars = car_cascade.detectMultiScale(gray, 1.3, 5)
 #crp=gray[0:480,0:int(width/2)+10]
for(x,y,w,h) in cars:
cv2.rectangle(img, (x,y), (x+w,y+h), (0,255,0),2)
center_x=(2*x+w)/2
center_y=(2*y+h)/2
#print(center_x,center_y)
dist1=((wide*668.748634441)/w)
#print("Distance from car:",round(dist1,2),"m")
roi_gray = gray[y:y+h,x:x+w]
roi_color = img[y:y+h,x:x+w]
dist0=((wide*668.748634441)/w)
actual_dist=dist0*(width/2)/668.748634441
#print("Actual Distance:",actual_dist)
if flag is True and int(round(center_x)) in (range(0,80) or range(400,480)):
start=time.time()
```

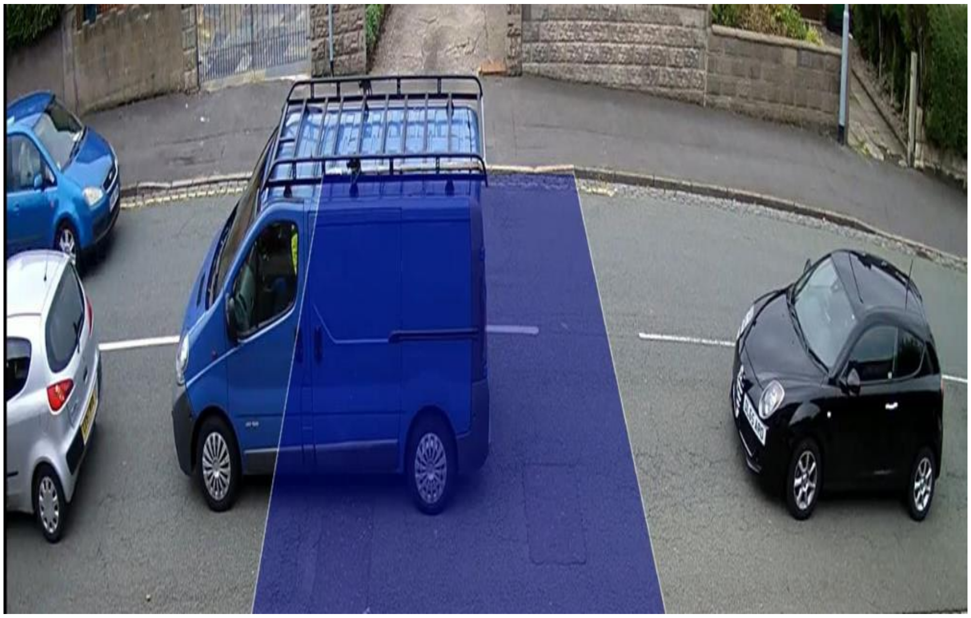
```
flag=False #print("Start:",start)
if flag is False and int(round(center_x)) in range(int(round(width/2))
end=time.time()
time_diff=end-start
#print("End:",end)
flag=True s_flag=True
#print("Time
Difference:",time_diff)if
time_diff>0 and s_flag==True:
velocity=actual_dist/time_diff
#print(round(start),round(end))
vel_kmph=round(velocity*3.6,2)
#print("Time
Difference:",time_diff)
 if time_diff>0 and s_flag==True:
         velocity=actual_dist/time_diff
  #print(round(start),round(end))
   vel_kmph=round(velocity*3.6,2)
  print("Speed:",vel_kmph,"kmph")
        print("Distance from
car:",round(dist1,2),"m")
        s_flag=False
cv2.line(img,(int(width/2),0),(int(w
idth/2),height),(255,0,0),2)
cv2.imshow('frame',img)
  if cv2.waitKey(1) & 0xFF ==ord('
  break
cap.release()
cv2.destroyAllWindows()
if cv2.waitKey(1) & 0xFFord('q'):
break()
cv2.destroy()
```

5. SCREENSHOTS

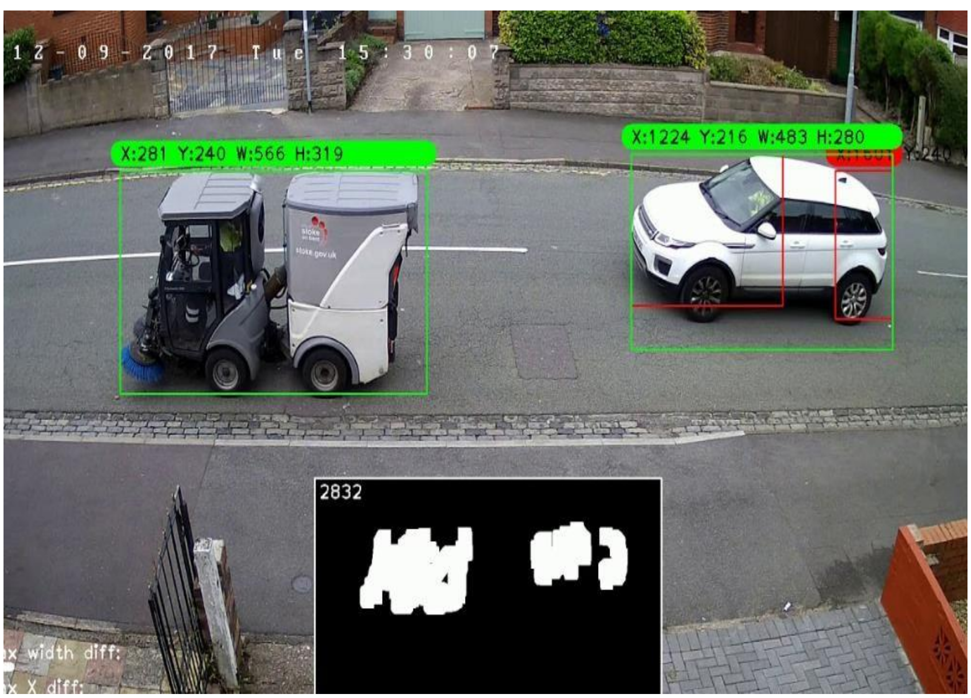
5.1: capturing moving vehicle on the road



5.2:Capturing moving vehicle accurate.



Screenshot 5.3: calculate speed accurately



Screenshot 5.4: Recognizing vehicles based on speed

Screenshot 5.5: Identifying vehicles and marking in database

6. TESTING

6. TESTING

6.1 INTRODUCTION TO TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of tests. Each test type addresses a specific testing requirement.

6.2 TYPES OF TESTING

6.2.1UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .It is done after the completion of an individual unit before integration. This is a structural testing that relies on knowledge of its construction and is invasive. Unit tests performbasic tests at component level and test a specific business process, application and/or system configuration. Unit tests ensure that each unique path of a business process performs accuratelyto the documented specifications and contains clearly defined inputs and expected results.

6.2.2 INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if theyactually run as one program. Integration tests demonstrate that although the components were individually satisfactory, as shown by successfully unit testing, the combination of componentsis correct and consistent. Integration testing is specifically aimed at exposing the problems thatarise from the combination of components.

6.2.3 FUNCTIONAL TESTING

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid : identified class Function identified functions must be exercised.

Output: identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked. Organization andpreparation of functional tests is focused on requirements, key functions, or special test.

6.3 TEST CASES

Testcase Id	Test case name	Purpose	Input	Output
1	Speed detection	Speed detection for moving vehicle.	The user gives the input in the form of some vehicle content.	An output detecting speed of moving vehicle
2	vehicle detection	To detect type of vehicle accurately.	To detect typeo	An output detecting features of vehicle

7. CONCLUSION

7.1 PROJECT CONCLUSION

In this project aim is to create a bigger haar cascade since the bigger the haar cascade developed, the more the number of vehicles that can be detected on the roads. Better search algorithms can allow a faster search and better detection of these vehicles for better efficiency.

7.2 FUTURE SCOPE

To implement the above idea two basic requirements, need to be met which are theeffective detection of the cars on roads and their velocity measurement. For this purpose, we can use OpenCV software which uses the Haar cascade to train our machine to detect the object, in this case the car.

The combination of industrial engineering with an intelligent transportation system helps reduce carbon emission, the noise produced due to the transportation system, and the efficiencyof on-road traffic management with an autonomous system. This paper presents vision-based real-time vehicle detection and VSM using different morphological and binary logical operations for an unplanned traffic scenario with a computer vision method. The different typesof vehicles cannot be detected.

8. BIBLIOGRAPHY

8. BIBLIOGRAPHY

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2. Z. Wei, et al., "Multilevel Framework to Detect and Handle Vehicle Occlusion, Intelligent Transportation Systems, IEEE Transactions on, vol. 9, pp. 161-174. Transactionson, vol. 9, pp. 161-174, 2008.

3. Nishu Singla, "Motion Detection Based on Frame Difference Method", International Journal of Information & Computation Technology. ISSN 0974-2239 Volume 4, Number15 (2014), pp.

4. Pranith Kumar Thadagoppula, Vikas Upadhyaya, "Speed Detection using vehicleImage Processing".

8.2 GITHUB LINK

https://github.com/yerramshreya/VehicleDetection-And-SpeedDetection/tree/main