SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be **University** *u/s 3 of UGC Act, 1956)*

18CSC206J- Software Engineering and Project Management

Topic- Automatic Number Plate Recognition System

NAME: Deepti Jaiswal (RA1811033010035)

Aishika Das (RA1811033010037)

Khushi Mundra (RA1811033010054)

FACULTY INCHARGE: Ms. B. Jothi

Index

ABSTRACT

Automatic Number Plate Recognition (ANPR) is simply the ability to automatically extract and recognition a vehicle’s number plate's characters from an image. In essence it consists of a camera or frame grabber that has the capability to grab an image, find the location of the number in the image and then extract the characters for character recognition tool to translate the pixels into numerically readable character. ANPR can be used in many areas from speed enforcement and tool collection to management of parking lots, etc.

It can also be used to detect and prevent a wide range of criminal activities and for security control of a highly restricted areas like military zones or area around top government offices. The presented ANPR system is aimed to be lightweight so that it can be run real time and recognizes standard number plate under normal conditions.

The ANPR system works in three steps:

1. The first step is the detection and capturing a vehicle image.
2. The second step is the detection and extraction of number plate in an image.
3. The third section use image segmentation technique to get individual character and optical character recognition (OCR) to recognize the individual character with the help of database stored for each and every alphanumeric character.

USER STORY TEMPLATE

S. No.	User Story	Success	Owner	Level of Difficulty
1)	As an Educational Institute/Residential Complex/Business Complex, I want to have a proper data of vehicles entering and exiting the campus, so that the security of vehicles as well as campus is ensured.	We would gather the data in an excel sheet and application would recognize whether the vehicle belongs to the institution or not. If the vehicle is not authorized then the barricades won't open.	Mr. X	Medium
2)	As a commercial complex, I want a paid parking system for the customers entering the complex and should charge on the basis of hours the vehicle is parked in the complex, so that revenue can be generated.	Our application would provide a slip on entering the complex. While exiting, a machine would ask for the slip and calculate the amount to be paid by the customer.	Mr. Y	High
3)	As a representative of Police Dept/Armed Forces, I want a system that would allow only authorized vehicles to enter and it should alarm for unauthorized vehicles, so that confidentiality of the place is maintained and no external factor could enter the place.	Our application would scan the number plate. It would open the gates for authorized vehicles. The database would be directly linked to the specific department. The data should be updated on a regular basis by the department head only.	Mr. Z	High

STAKEHOLDER'S REGISTER

Project Name: Automatic Number Plate Recognition System				
Prepared By: Deepti Jaiswal, Aishika Das, Khushi Mundra				
Date: 07/01/2020				
Project Stakeholder Name	**Specific Information Needs**	**Project Interest**	**Impact on project**	**Role**
	Types & frequency of Communication	Specific area of interest and participation	Positive, Negative, Influencer, Supporter, Roadblock	Decision Maker, Collaborator, Participant, Consultant, Information Recipient
Educational Institutes	Email, calls, Text messages, website	Surveillance & Security, Effective parking of buses	Positive	Participant
Residential Societies	Email, Calls, Text messages, website	Surveillance & Security, Effective parking of vehicles, Identification of intruders, Keep record of residents	Positive	Participant, Information Recipient
Business Complexes	Email, Calls, Text messages, website	Surveillance & Security, Effective parking of vehicles, Identification of intruders.	Positive	Collaborator and Consultant
Police Department	Email, website	Surveillance & Security, Traffic Monitoring, To keep record of criminal activities	Supporter	Consultant, Information Recipient
Armed Forces	Email, website	Surveillance & Security, Border security	Influencer	Decision Maker
Government Agencies(Toll Plaza etc)	Email, website	Surveillance & Security, Automatic toll collection, Reduced travel time.	Supporter	Decision Maker, Consultant, Information Recipient

INCREMENTAL MODEL

We chose this model for our project because of the following reasons –

1)The software will be generated quickly during the software life cycle.

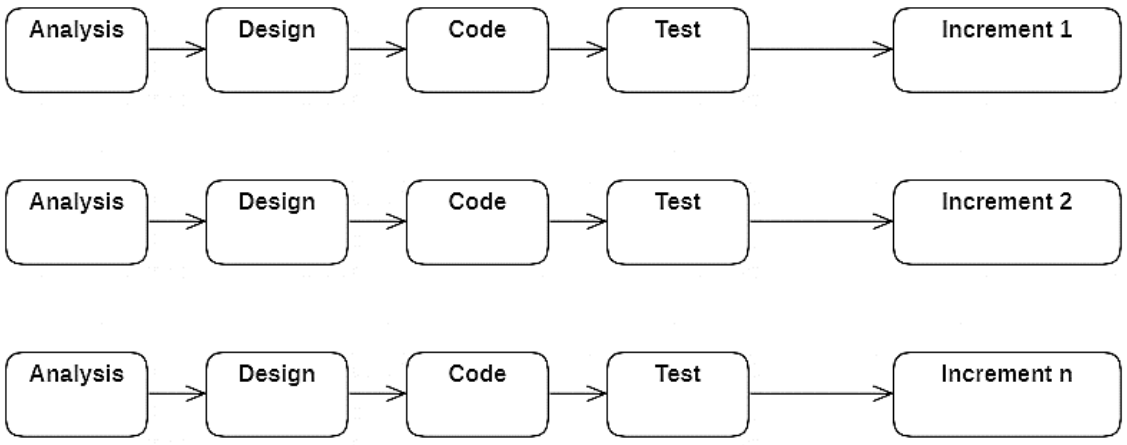
2)It is flexible and less expensive to change requirements and scope.

3)Throughout the development stages, changes can be done.

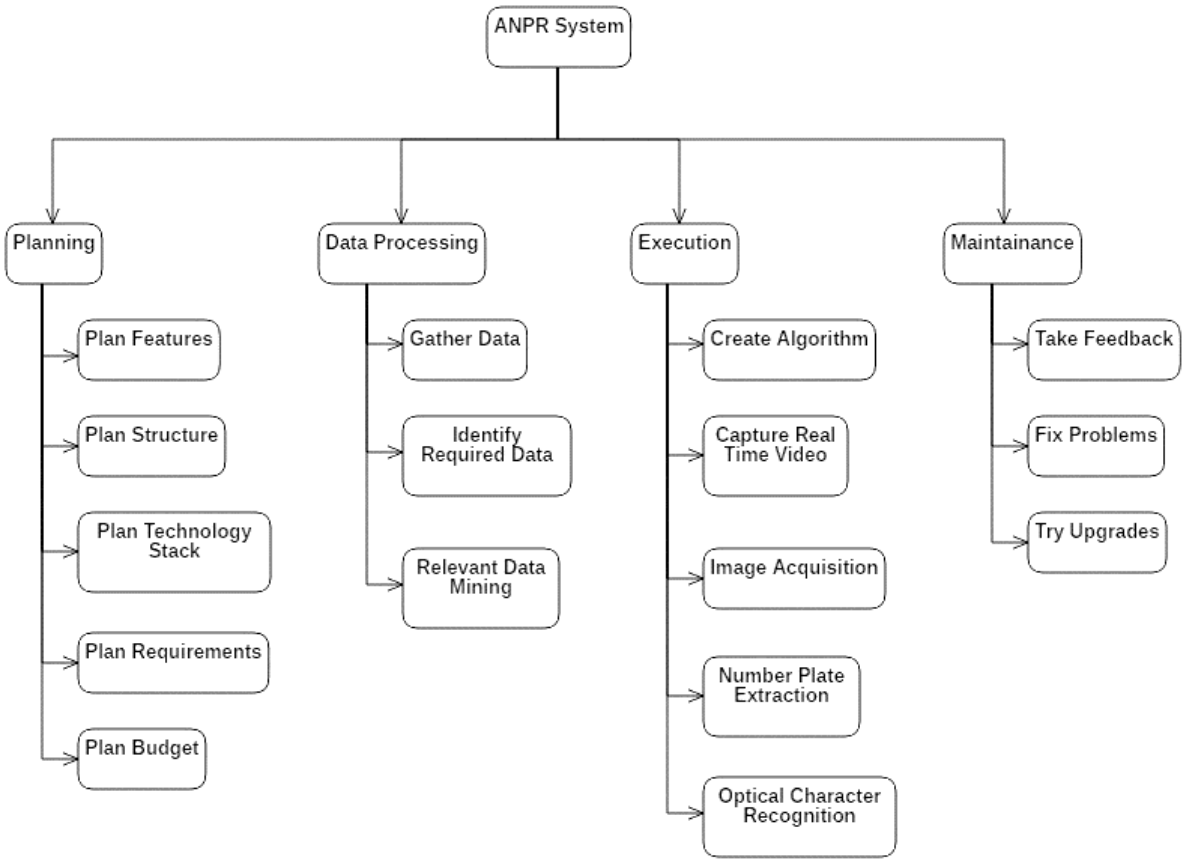
4)This model is less costly compared to others.

5)A customer can respond to each building.

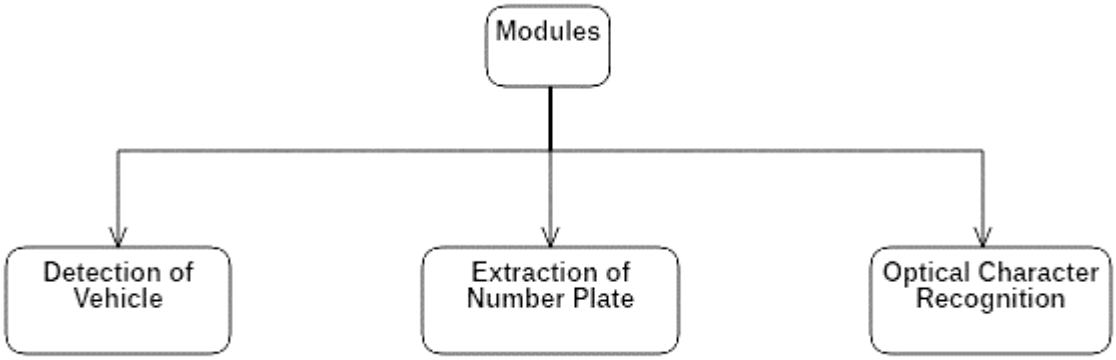
6)Errors are easy to be identified.



Work Breakdown Structure



Modularity



REQUIREMENTS

Functional Requirement	Non Functional Requirement
1. Real time video capture 2. Frame Extraction 3. Vehicle Detection 4. Image Acquisition 5. Number plate recognition 6. Number plate extraction 7. Character Segmentation 8. Character Recognition	1. Security 2. Portability 3. Durability 4. Accuracy 5. Execution Speed 6. High Resolution Image Capture

RISK ANALYSIS

Some risks associated with our project are -

- Poor recognition software
- Incorrect cameras used (i.e. conventional CCTV) with no fixed iris, high shutter speed or band pass filter
- System does not work at night
- ANPR does not work if vehicles are travelling over 30mph
- Plates not big enough to be read (incorrect camera, lens or location))
- Poor on-site Traffic Management resulting in missed plates / vehicles
- Excessive skew angles causing recognition issues
- Applications not delivering to the initial specification.

We have tried our best to address all these risks in our model.

Cost Estimation

In order to achieve efficient and effective management of software projects, it is important to estimate the size and cost of the project. For the size and cost estimation of ourAutomatic Number Plate Recognitionsystem, we will use COCOMO model to predict the development effort of the statistical analysis package. The COCOMO model is an accepted standard for the measurement of software size in software engineering.

COCOMO Model

The COCOMO model is a good measure for estimating the number of person-months required to develop software. My project, the Statistical analysis package is an application program.

According to Boehm's definition of different systems, our system can be recognised as an semi-detached system. Our project requires

- Not very large team size
- Moderate understanding of the problem
- Team members having average experience regarding the problem.

Basic Model:

Effort = a (KLOC)^{b}

The above formula is used for the cost estimation of for the basic COCOMO model, and also is used in the subsequent models. The constant values a and b for the Basic Model for the different categories of system:

SOFTWARE PROJECT	A	B	C	D
Semi detached	3.0	1.12	2.5	0.35

Lines of Codes = 100 KLOC

Effort = a (KLOC)^{b}

$= 3(100)^{1.12}$

$= 521.34$ PM

$= 521$ PM (approx.)

Development Time = c (effort)^{d}

$= 2.5(521)^{0.35}$

$= 22.327$ months

$= 22$ months (approx.)

Average staff size= Effort/development time

$= 521/22$

$= 23.68$

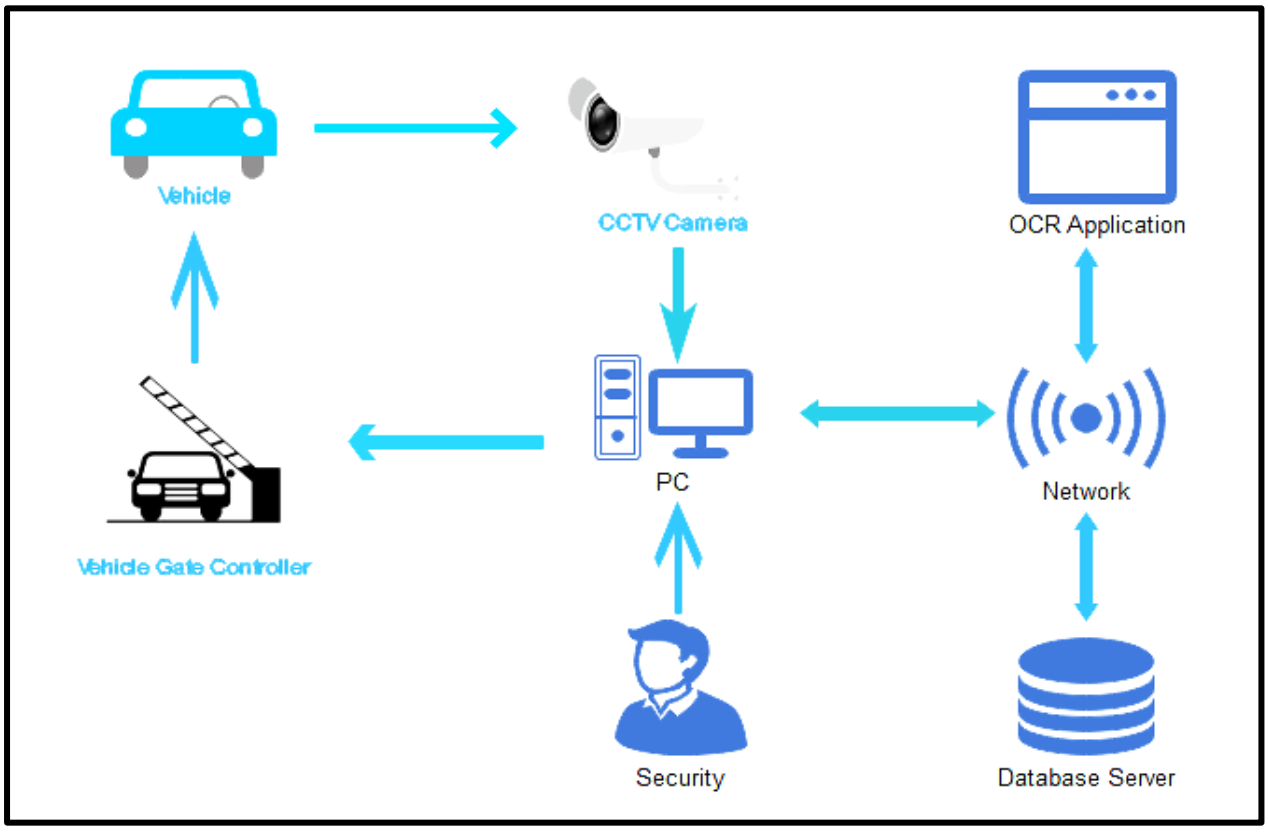
$= 24$ persons

Productivity= KLOC/Effort

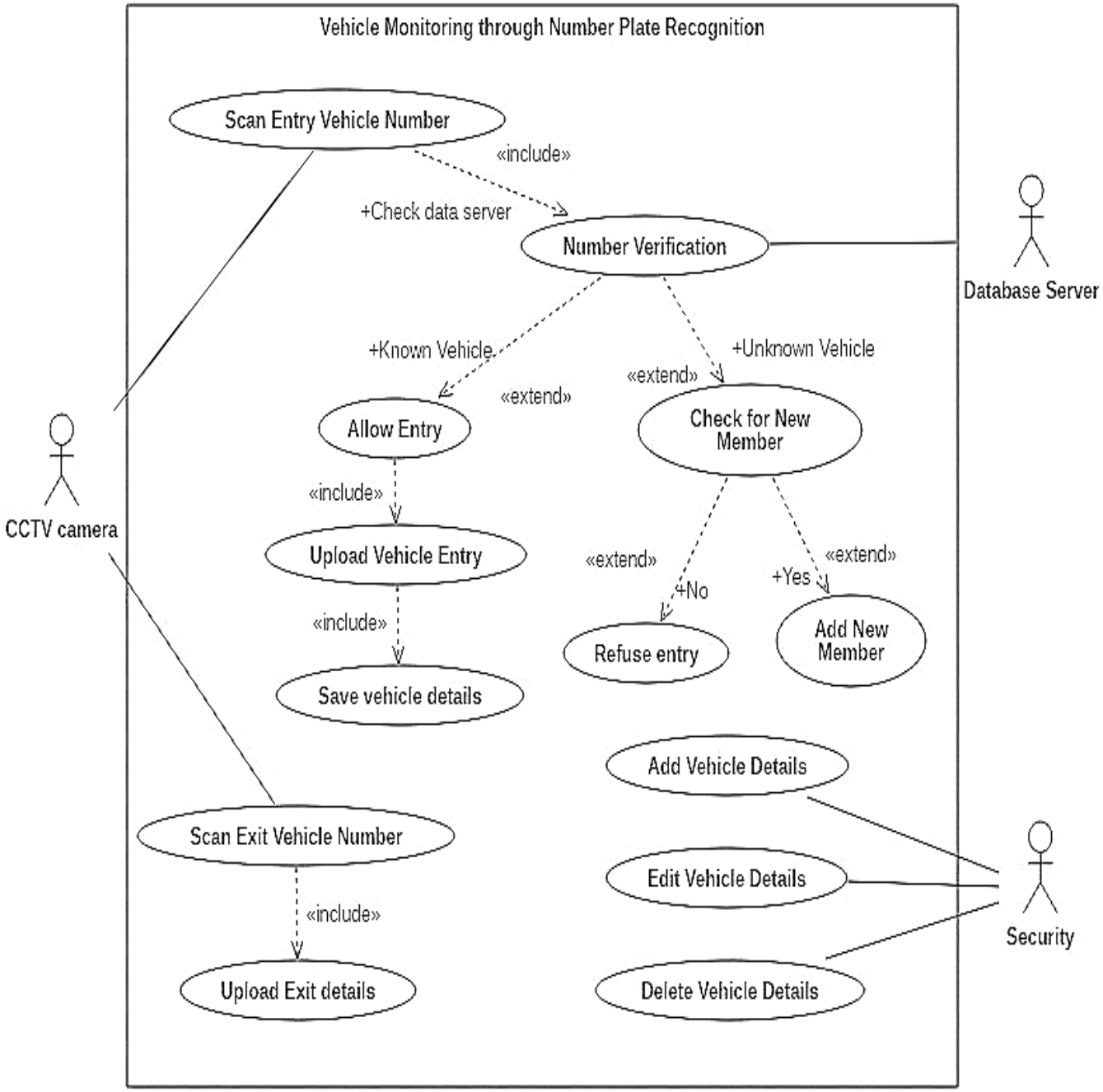
$= 100/521$

$=0.1919$ KLOC/PM

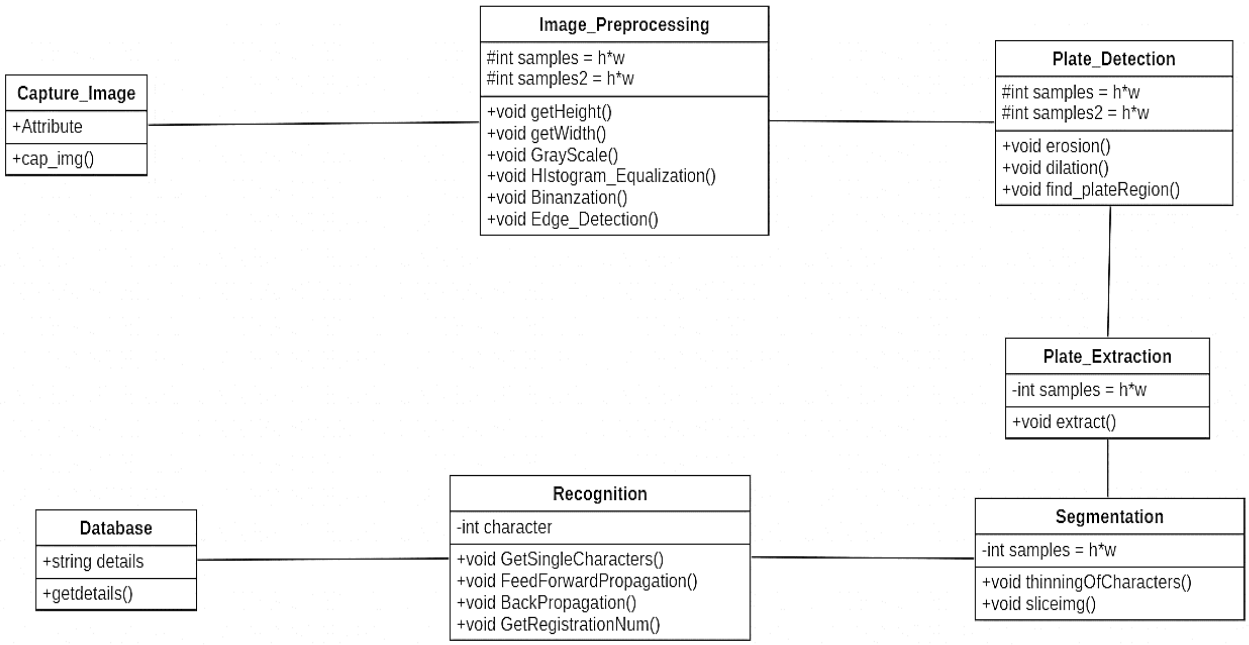
Architecture Diagram



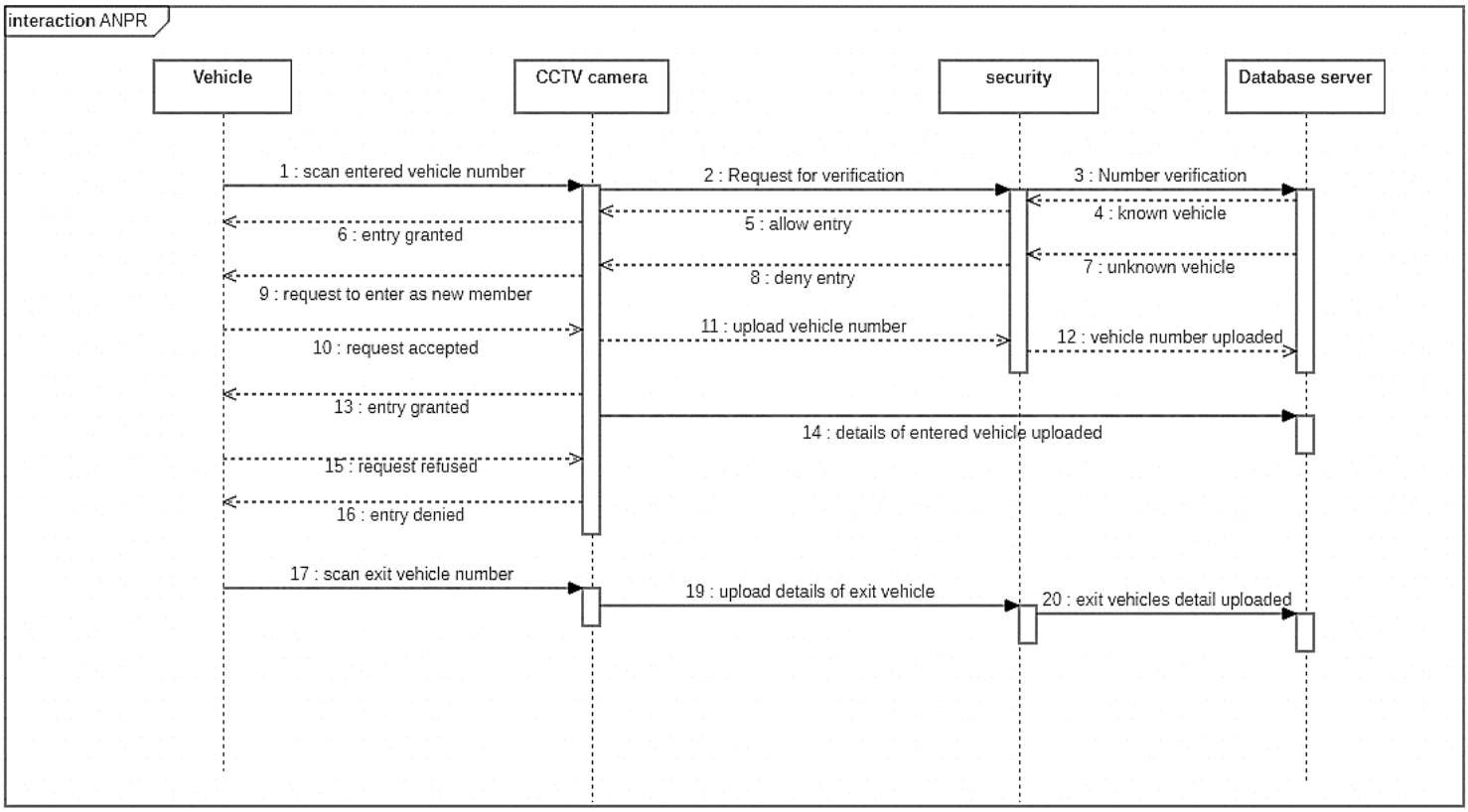
USE CASE DIAGRAM



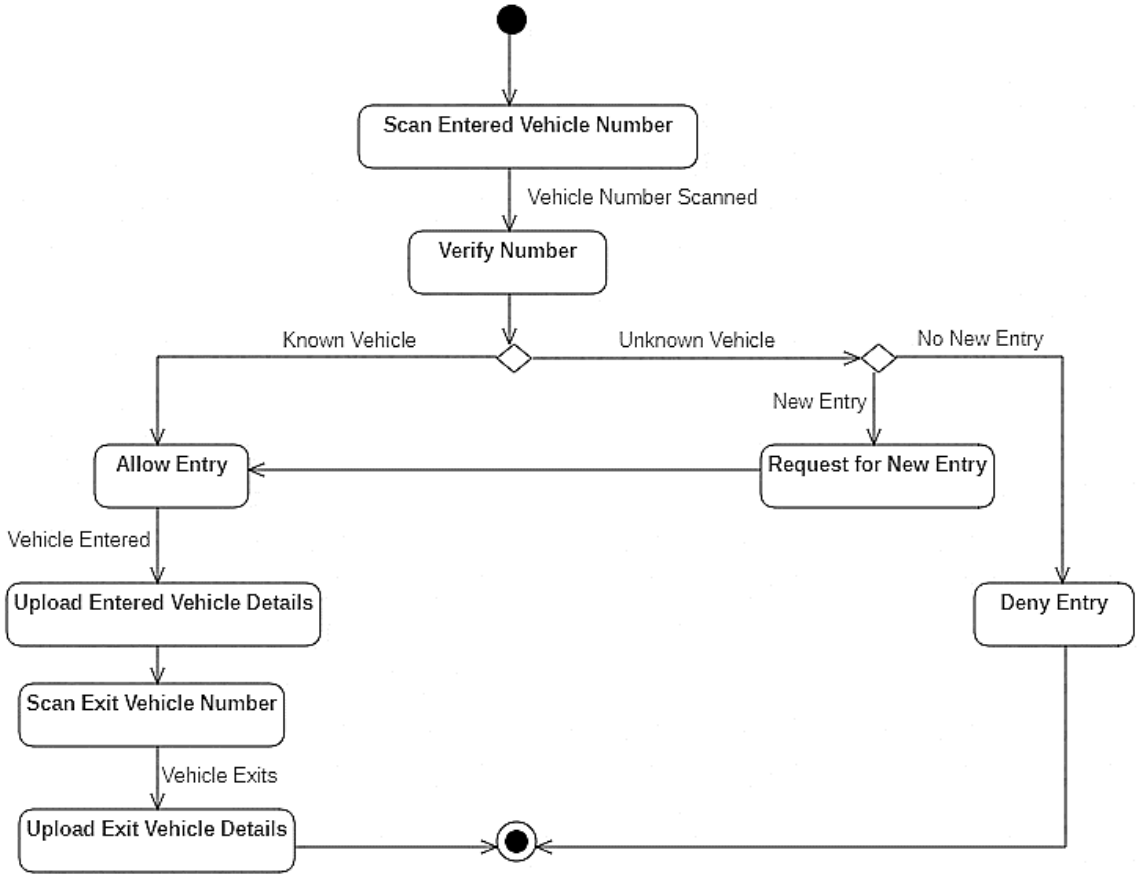
CLASS DIAGRAM



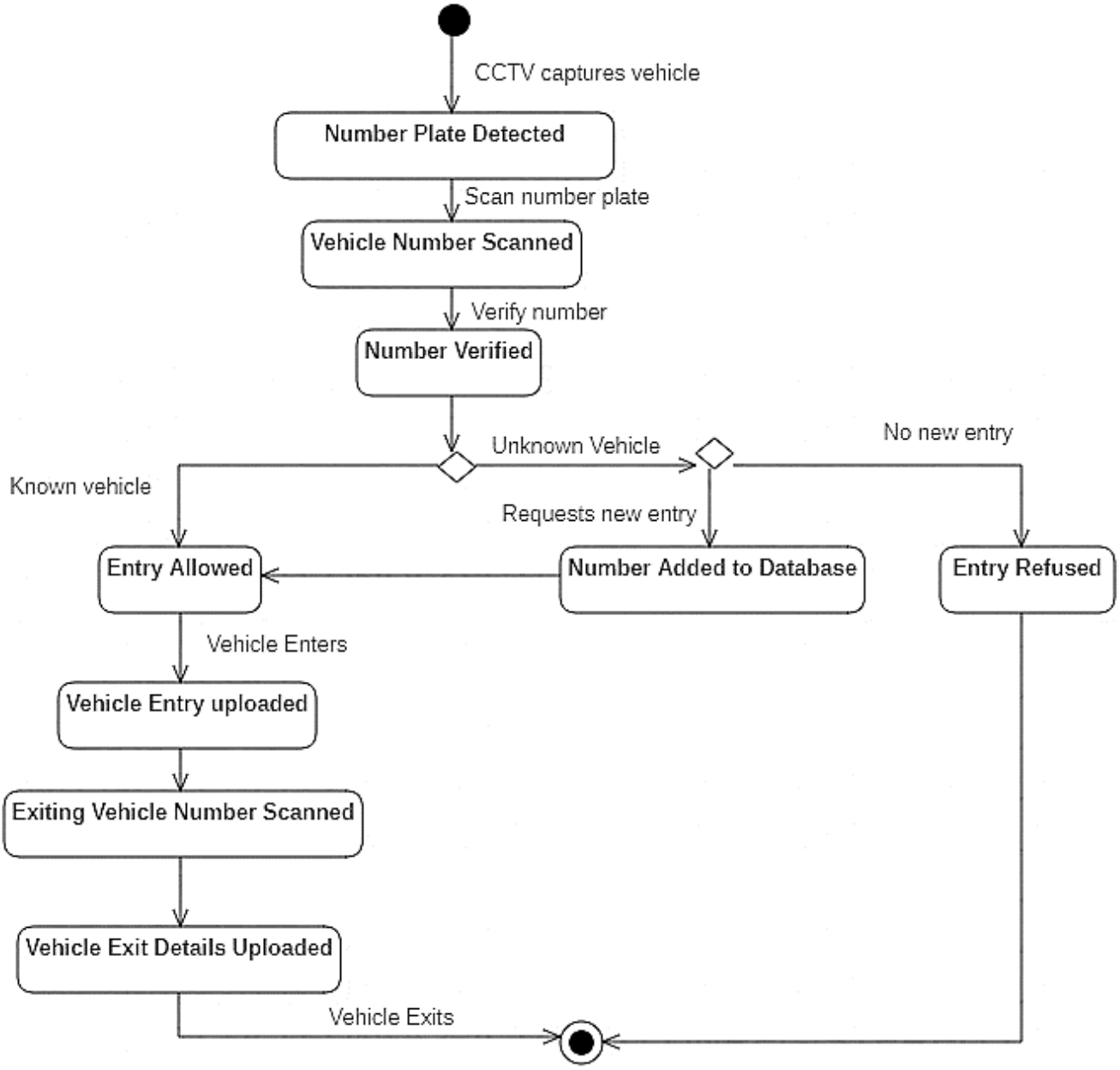
SEQUENCE DIAGRAM



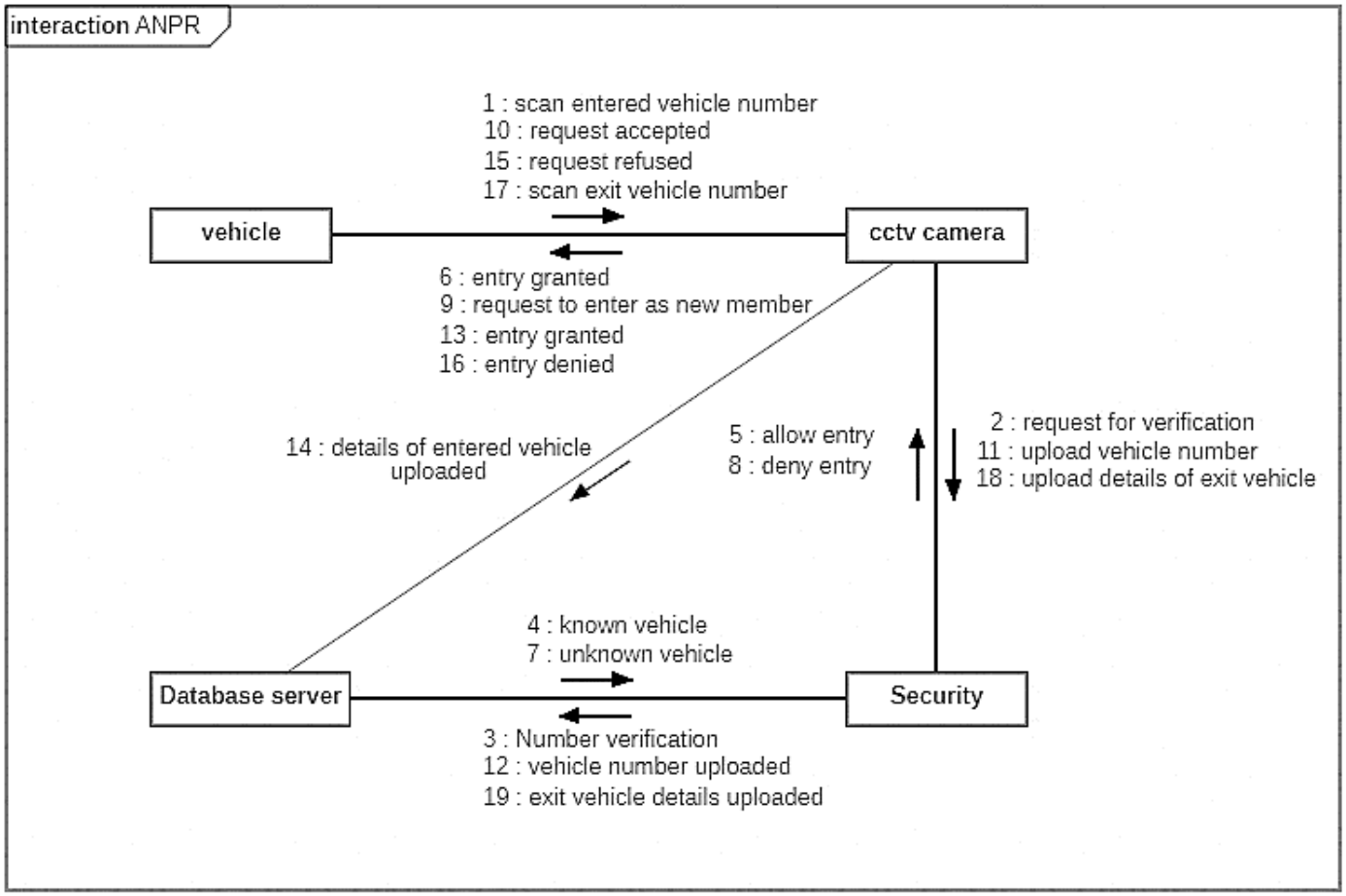
ACTIVITY DIAGRAM



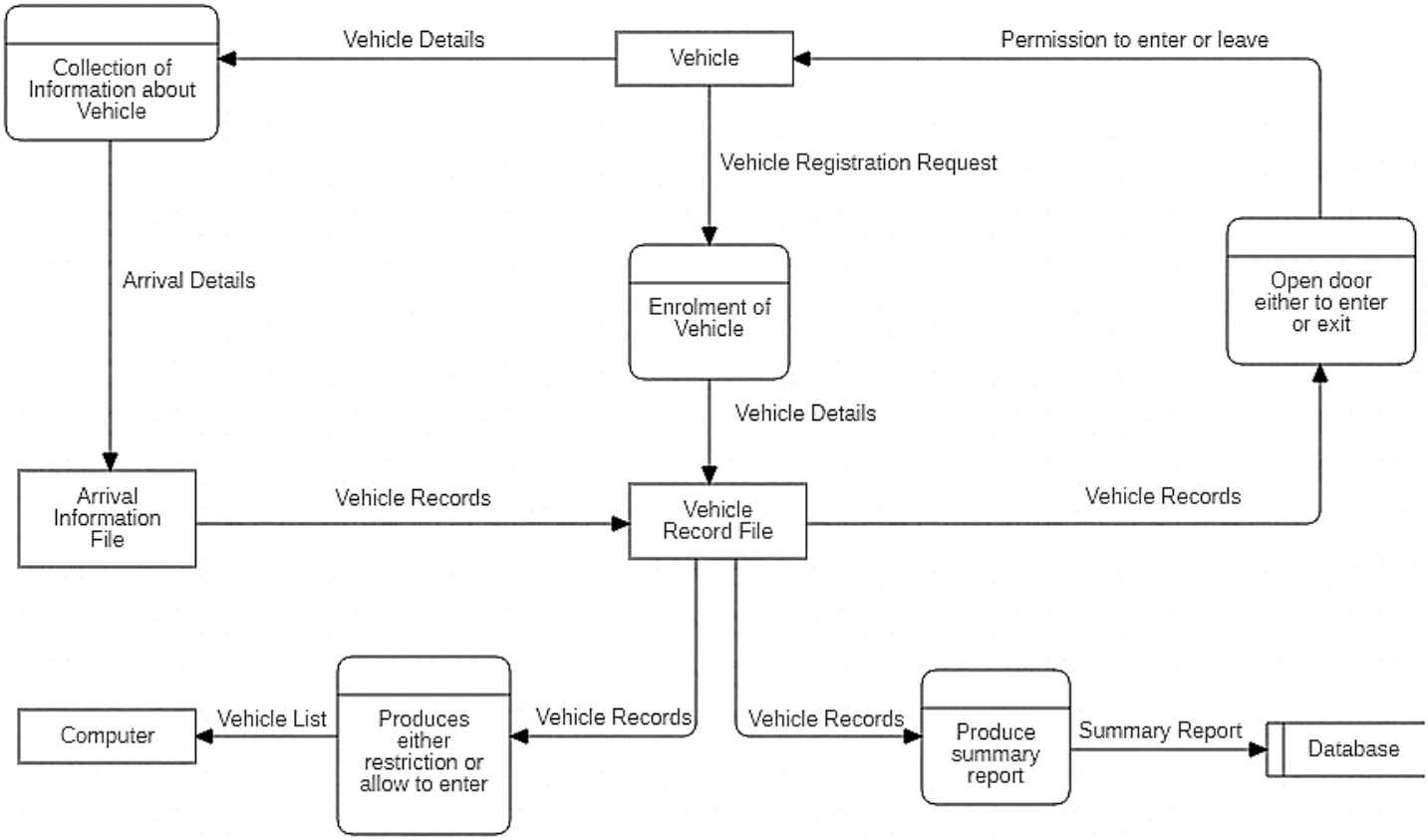
STATE DIAGRAM



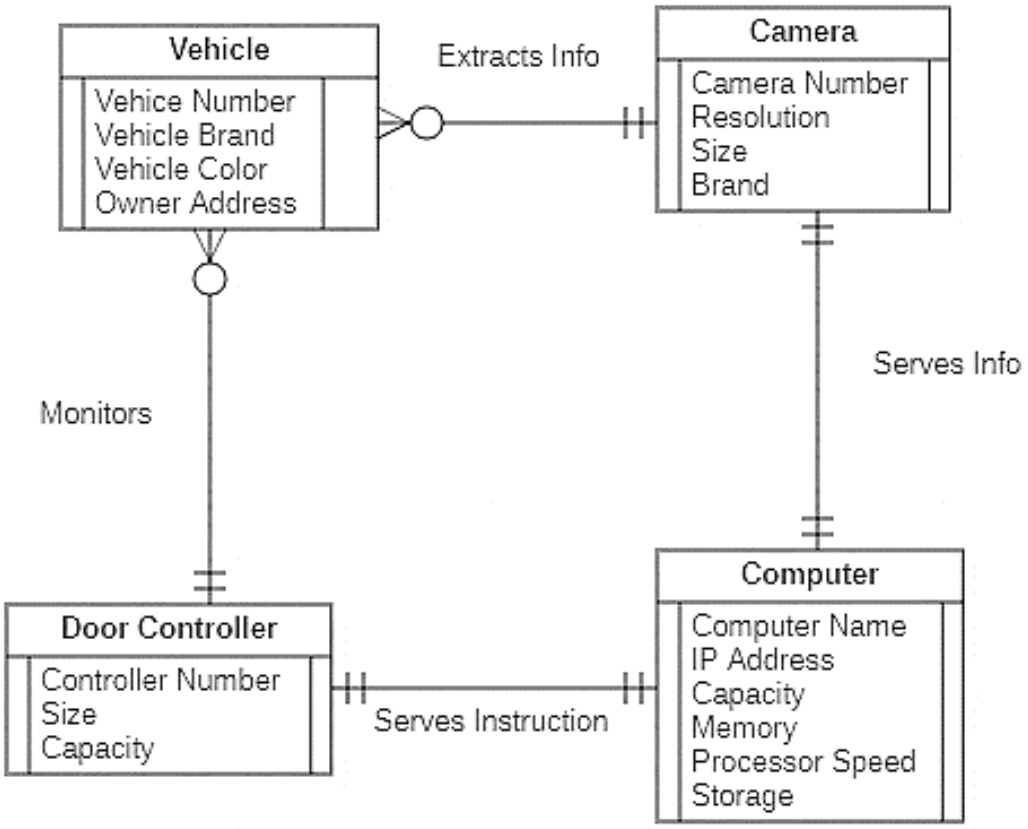
COLLABORATION DIAGRAM



DATA FLOW DIAGRAM



ENTITY RELATIONSHIP DIAGRAM

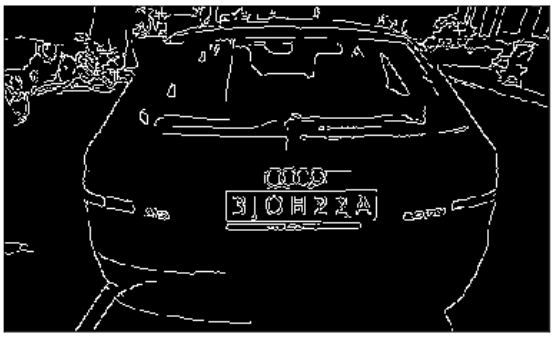


Code and Output

```
import cv2
import random
import os
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

images_dir = "C:/Users/Pc/Desktop/invictus-master/invictus-master/data/images"
image_files = os.listdir(images_dir)

image_path = "{}/{}".format(images_dir, "car_1.jpg")

image = cv2.imread(image_path)
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

def plot_images(img1, img2, title1="", title2=""):
    fig = plt.figure(figsize=[15,15])
    ax1 = fig.add_subplot(121)
    ax1.imshow(img1, cmap="gray")
    ax1.set(xticks=[], yticks=[], title=title1)

    ax2 = fig.add_subplot(122)
    ax2.imshow(img2, cmap="gray")
    ax2.set(xticks=[], yticks=[], title=title2)

plot_images(image, gray)
```


```
blur = cv2.bilateralFilter(gray, 11,90, 90)

plot_images(gray, blur)
```

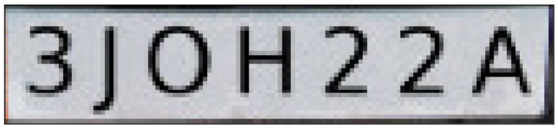

```
edges = cv2.Canny(blur, 30, 200)

plot_images(blur, edges)
```




```
cnts, new = cv2.findContours(edges.copy(), cv2.RETR_LIST,
cv2.CHAIN_APPROX_SIMPLE)

image_copy = image.copy()

_ = cv2.drawContours(image_copy, cnts, -1, (255,0,255),2)

plot_images(image, image_copy)
```

```
cnts = sorted(cnts, key=cv2.contourArea, reverse=True)[:30]

image_copy = image.copy()
_ = cv2.drawContours(image_copy, cnts, -1, (255,0,255),2)

plot_images(image, image_copy)
```


```
plate = None
for c in cnts:
    perimeter = cv2.arcLength(c, True)
    edges_count = cv2.approxPolyDP(c, 0.02 * perimeter, True)
    if len(edges_count) == 4:
        x,y,w,h = cv2.boundingRect(c)
        plate = image[y:y+h, x:x+w]
        break

cv2.imwrite("plate.png", plate)

plot_images(plate, plate)
```




```
pytesseract.pytesseract.tesseract_cmd = 'C:/Program Files/Tesseract-OCR/tesseract.exe'

import pytesseract
text = pytesseract.image_to_string(plate, lang="eng")

print(text)
```

3JOH22A

TESTING

Test Case Template								
TestCaseId	**TestCaseScenario**	**Component**	**Description/Test Summary**	**Pre-requisites**	**Test Data**	**Expected Result**	**Actual Result**	**Status**
TC_CASE_001	Login to organization's database	Login page	Verify that the user entered correct credentials.	User has login credentials	Valid username and Valid Pin	Login Successful	Login Successful	**Pass**
TC_CASE_001	Login to organization's database	Login page	Verify that the user entered correct credentials.	User has login credentials	Valid username and invalid Pin	Login Successful	Login Unsuccessful	**Fail**
TC_CASE_001	Login to organization's database	Login page	Verify that the user entered correct credentials.	User has login credentials	Invalid username and valid Pin	Login Successful	Login Unsuccessful	**Fail**
TC_CASE_001	Login to organization's database	Login page	Verify that the user entered correct credentials.	User has login credentials	Invalid username and invalid Pin	Login Successful	Login Unsuccessful	**Fail**
TC_CASE_002	Allowance of entering vehicle	Vehicle number plate	Verify that vehicle entering is known.	Number plate visible properly	Known vehicle.	Vehicle allowed to enter	Vehicle allowed to enter	**Pass**
TC_CASE_002	Allowance of entering vehicle	Vehicle number plate	Verify that vehicle entering is known.	Number plate visible properly	Unknown vehicle.	Vehicle allowed to enter	Vehicle not allowed to enter	**Fail**
TC_CASE_003	Registration of new vehicle	New vehicle number plate	Verify that the vehicle entering wants to register.	Vehicle is not already registered	Vehicle wants to register.	Vehicle registered and allowed to enter.	Vehicle registered and allowed to enter	**Pass**
TC_CASE_003	Registration of new vehicle	New vehicle number plate	Verify that the vehicle entering wants to register.	Vehicle is not already registered	Vehicle does not want to register.	Vehicle registered and allowed to enter.	Vehicle not registered and entry denied	**Fail**
TC_CASE_004	Camera position	Camera	Verify that the Camera is positioned correctly.	Camera functions properly	Full number plate captured	Camera positioned correctly	Camera positioned correctly	**Pass**
TC_CASE_004	Camera position	Camera	Verify that the Camera is positioned correctly.	Camera functions properly	Full number plate not captured	Camera positioned correctly	Camera positioned incorrectly	**Fail**
TC_CASE_005	Scanning of number plate	Vehicle number plate	Verify that the number plate is scanned successfully.	Camera points towards vehicle	Number plate extraction successful	Number plate scanned correctly	Number plate extraction successful	**Pass**
TC_CASE_005	Scanning of number plate	Vehicle number plate	Verify that the number plate is scanned successfully.	Camera points towards vehicle	Number plate extraction unsuccessful	Number plate scanned correctly	Number plate scanned incorrectly	**Fail**
TC_CASE_006	OCR performance	Extracted number plate picture	Verify that the OCR is perfomed correctly	Number plate extraction successful	Image converted to string succesfully	Character Recognition successful	Character Recognition successful	**Pass**
TC_CASE_006	OCR performance	Extracted number plate picture	Verify that the OCR is perfomed correctly	Number plate extraction successful	Image not converted to string succesfully	Character Recognition successful	Character Recognition unsuccessful	**Fail**
TC_CASE_007	Checking of vehicle number with database	Vehicle number database	Verify that the vehicle number is checked correctly.	Vehicle number is recognized.	Known vehicle number found in database.	Checked correctly	Checked correctly	**Pass**
TC_CASE_007	Checking of vehicle number with database	Vehicle number database	Verify that the vehicle number is checked correctly.	Vehicle number is recognized.	Known vehicle number not found in database.	Checked correctly	Checked incorrectly	**Fail**
TC_CASE_007	Checking of vehicle number with database	Vehicle number database	Verify that the vehicle number is checked correctly.	Vehicle number is recognized.	Unknown vehicle number not found in database.	Checked correctly	Checked correctly	**Pass**
TC_CASE_007	Checking of vehicle number with database	Vehicle number database	Verify that the vehicle number is checked correctly.	Vehicle number is recognized.	Unknown vehicle number found in database.	Checked correctly	Checked incorrectly	**Fail**

Conclusion

Automatic Number Plate Recognition (ANPR) is a technology that uses cameras and optical character recognition to match against a database of number plates. ANPR is often used in crime and road policing, but with the technology becoming more accessible, it is becoming increasingly popular as a car parking management and access control solution for businesses of all sizes. Using an ANPR system, you get around 99% accuracy when reading a number plate, giving you peace of mind that you can rely on the technology to spot unauthorized vehicles and deny them entry. ANPR can help you better manage traffic flow and parking on your premises. Should an employee or visitor need to move their car, ANPR backed with the number plate database makes it easier to identify the vehicle and the person it belongs to, meaning any issues get resolved much more quickly.

We have tried to solve as many issues as we could in this software.

References

- Shari Lawrence Peeger and Joanne M. Atlee Software Engineering
- Agile Software Development Principle, Patterns, and Practices by Robert C. Martin
- Rapid Development by Steve C. McConnel
- Applied Software Project Management by Andrew Stellman
- Software Project management in practice by Pankaj Jalote