A

Major Project

On

# License Plate Image Analysis Empowered by Generative Adversarial Neural Networks (GANs)

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

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**CMR TECHNICAL CAMPUS**

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**2019-2023**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**


# CERTIFICATE

This is to certify that the project entitled **"License Plate Image Analysis Empowered by Generative Adversarial Neural Networks (GANs)"** being submitted by **M. MANAS REDDY (187R1A05L1) K. SHASHIDER (187R1A05P1)** in partial fulfillment 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 and supervision during the year 2022-23.

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

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**Submitted for viva voice Examination held on** _____

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# ABSTRACT

License Plate Image Analysis system is one of the smart transportation methods that provides a safe medium of transportation and monitoring planning used by many two-wheeler vehicles as well as four-wheeler vehicles to boost traffic controlling, routing, parking system, toll collection, and governance and insuring highway law. There are various techniques and algorithms has been developed so that we can identify and recognize Number plates. This project shows a various deep learning approach for recognizing and detecting number plate. This system is divided into three parts, i.e., number plate detection, segmentation, and character recognition. In our proposed system for number plate detection Yolo method is used, after that some filters are applied and then characters are segmented. Finally, the Convolutional Neural Network is used to recognize all the segmented characters.

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# 1. INTRODUCTION

# 1. INTRODUCTION

## 1.1 PROJECT SCOPE

License Plate Image Analysis system became one of the simplest ways for identifying cars. It can be used in many countries for many applications like keeping traffic administration, vehicle tax, car parking, Toll collection etc. The ANPR algorithm is divided into four categories: Vehicle image acquiring, number plate detection, character segmentation and recognition.

## 1.2 PROJECT PURPOSE

The number plate is detected and the extracted number plate contains numbers and alphabets. And then the various image processing algorithms are used to analyze the image and find the numbers, alphabets from the image. After which second part is recognition, in this case after finding the exact number, this number is searched in the database for owner information. Thus, we can verify whether a user is authenticated or not.

## 1.3 PROJECT FEATURES

In this project Number Plate recognition, also called License Plate realization or recognition using image processing methods is a potential research area in smart cities and Internet of Things. Many of the existing automated number plate recognition systems work only in a controlled environment where images are captured from a straight angle with good illumination, clarity and standard fonts. This paper presents a novel image processing system for Indian number plate detection and recognition that can deal with, noisy, low illuminated, cross angled, non-standard font number plates. This work employs several image processing techniques such as, morphological transformation, Gaussian smoothing, and Gaussian thresholding in the pre-processing stage.

# 2. SYSTEM ANALYSIS

# 2. SYSTEM ANALYSIS

## SYSTEM ANALYSIS

System Analysis is the important phase in the system development process. The System is studied to the minute details and analyzed. The system analyst plays an important role of an interrogator and dwells deep into the working of the present system. In analysis, a detailed study of these operations performed by the system and their relationships within and outside the system is done. A key question considered here is, “what must be done to solve the problem?” The system is viewed as a whole and the inputs to the system are identified. Once analysis is completed the analyst hasa firm understanding of what is to be done.

## 2.1 PROBLEM DEFINITION

Number Plate recognition, also called License Plate realization or recognition using image processing methods is a potential research area in smart cities and Internet of Things. Many of the existing automated number plate recognition systems work only in a controlled environment where images are captured from a straight angle with good illumination, clarity, and standard fonts.

## 2.2 EXISTING SYSTEM

Rapid road traffic requires a large amount of traffic monitoring and management skills. In this case, you will not be able to manually track vehicles moving at high speeds on the road. Also, human energy and time is wasted. It is having been operated manually, that will cause a lot of difficulty and many mistakes. Hence there is a necessary to make an automated system that assist in tracking vehicles by tracking their number plate in a more efficiently.

### 2.2.1 DISADVANTAGES OF EXISTING SYSTEM

- Requires more man power
- Time consuming

## 2.3 PROPOSED SYSTEM

This paper shows a various deep learning approach for recognizing and detecting number plate. This system is divided into three parts, i.e., number plate detection, segmentation, and character recognition. In our proposed system for number plate detection Yolo method is used, after that some filters are applied and then characters are segmented.

### 2.3.1 ADVANTAGES OF THE PROPOSED SYSTEM

- Recognize all the segmented characters.
- No contents can be missed

## 2.4 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and a business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. Three key considerations involved in the feasibility analysis:

- Economic Feasibility
- Technical Feasibility
- Behavioral Feasibility

### 2.4.1 ECONOMIC FEASIBILITY

The developing system must be justified by cost and benefit. Criteria to ensure that effort is concentrated on a project, which will give best, return at the earliest. One of the factors, which affect the development of a new system, is the cost it would require.

The following are some of the important financial questions asked during preliminary investigation:

- The costs conduct a full system investigation.
- The cost of the hardware and software.
- The benefits in the form of reduced costs or fewer costly errors.

Since the system is developed as part of project work, there is no manual costto spend for the proposed system. Also, all the resources are already available, it give an indication that the system is economically possible for development.

### 2.4.2 TECHNICAL FEASIBILITY

This project is carried out to check the technical feasibility, that is, the technical requirements of 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.

### 2.4.3 BEHAVIORAL FEASIBILITY

This includes the following questions:

- Is there sufficient support for the users?
- Will the proposed system cause harm?

The project would be beneficial because it satisfies the objectives when developed and installed. All behavioral aspects are considered carefully and conclude that the project is behaviorally feasible

## 2.5 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.

- Operating system : Windows 10
- Processor : Intel i5
- Ram : 4 GB
- Hard disk : 250 GB

### 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 - Windows7/8
- Programming Language - Python 3.7

# 3. ARCHITECTURE

# 3. ARCHITECTURE

## 3.1 PROJECT ARCHITECTURE

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

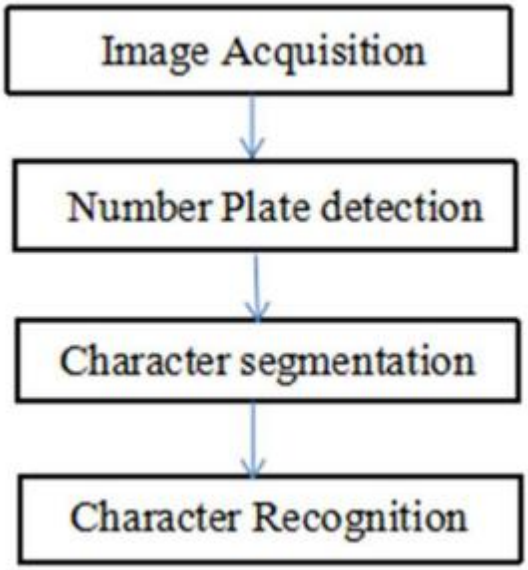



Figure 3.1: Project Architecture for License Plate Image Analysis Empowered by Generative Adversarial Neural Network

## 3.2 DESCRIPTION

The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.

The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

## 3.3 MODULES:

- Data exploration: Using this module we will load data into system
- Processing: Using the module we will read data for processing
- Splitting data into train & test: Using this module data will be divided into train & test
- Model generation: Build ANN, Template Matching, BP, FFBP, CNN & DNN, Algorithms accuracy calculated.
- User signup & login: Using this module will get registration and login
- User input: Using this module will give input for prediction
- Prediction: Final predicted displayed

## 3.4 USE CASE DIAGRAM

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

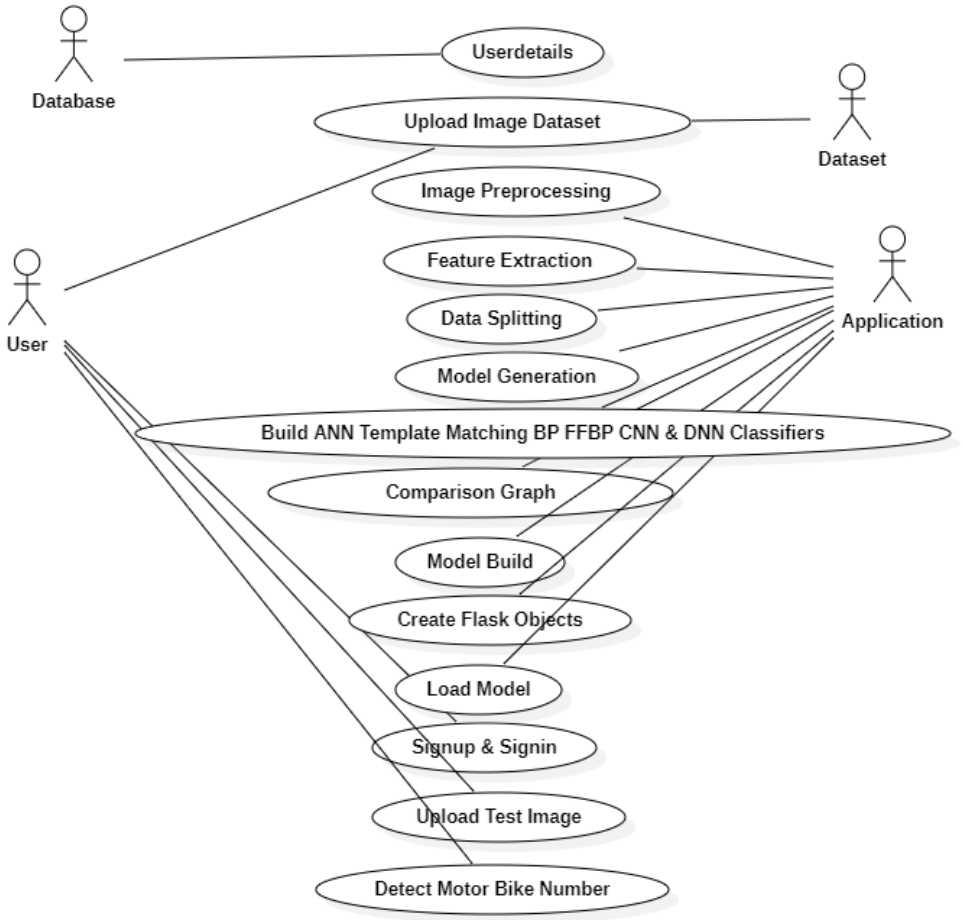



Figure 3.2: Use Case Diagram for License Plate Image Analysis Empowered by Generative Adversarial Neural Network

## 3.5 CLASS DIAGRAM

The class diagram is used to refine the use case diagram and define a detailed design of the system. The class diagram classifies the actors defined in the use case diagram into a set of interrelated classes. The relationship or association between the classes can be either an "is-a" or "has-a" relationship. Each class in the class diagram may be capable of providing certain functionalities. These functionalities provided by the class are termed "methods" of the class. Apart from this, each class may have certain "attributes" that uniquely identify the class.

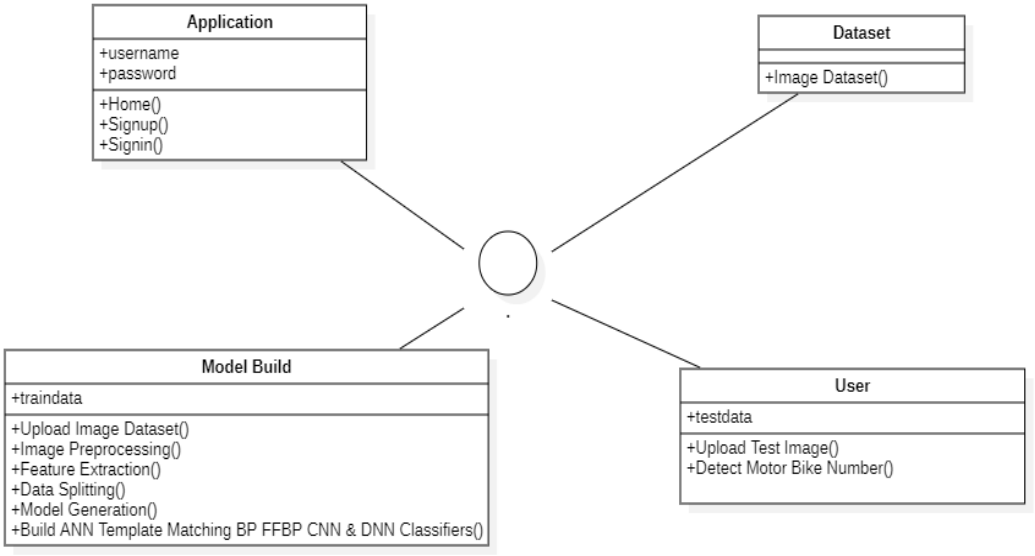



Figure 3.3: Class Diagram for License Plate Image Analysis Empowered by Generative Adversarial Neural Network

## 3.6 SEQUENCE DIAGRAM

A sequence diagram represents the interaction between different objects in the system. The important aspect of a sequence diagram is that it is time-ordered. This means that the exact sequence of the interactions between the objects is represented step by step. Different objects in the sequence diagram interact with each other by passing "messages".

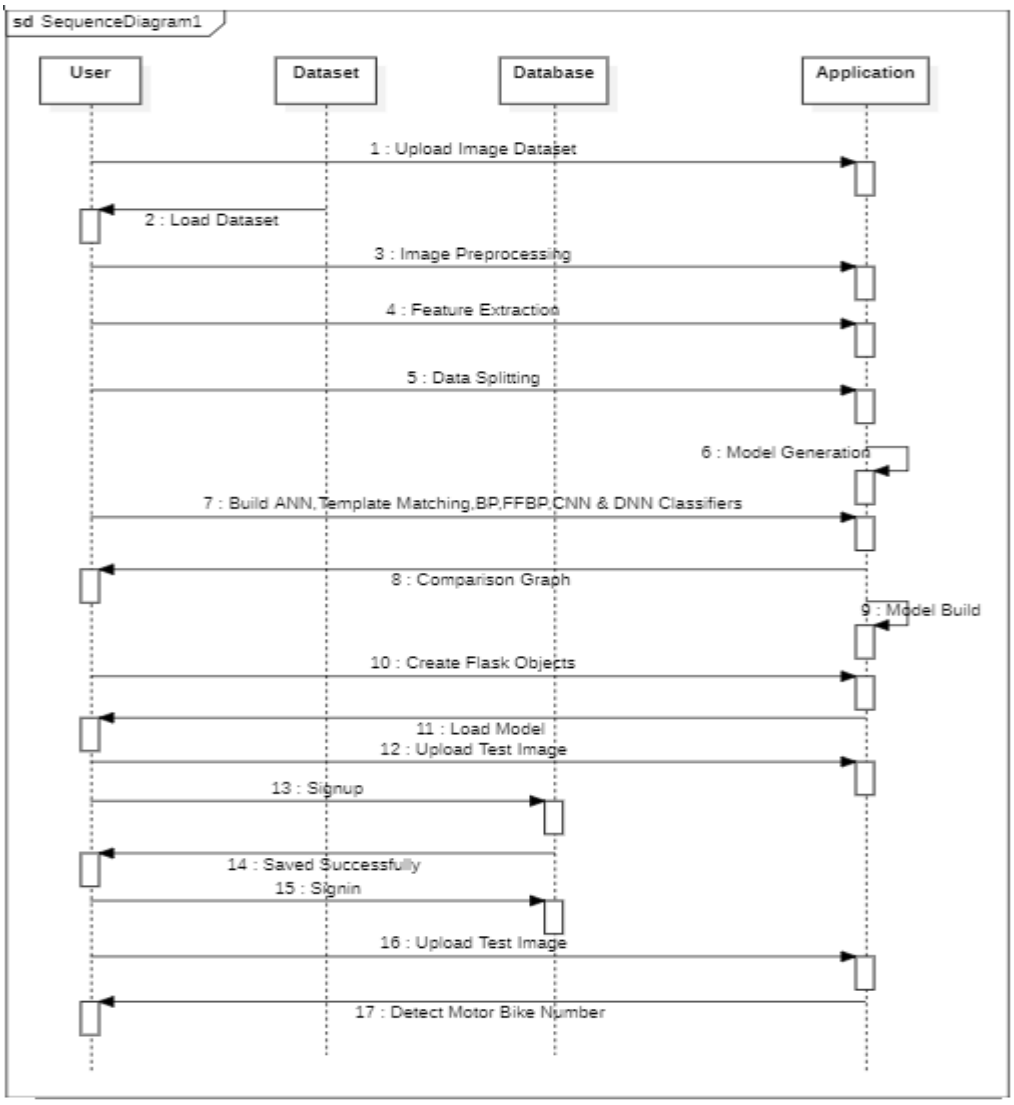



Figure 3.4: Sequence Diagram for License Plate Image Analysis Empowered by Generative Adversarial Neural Network

## 3.7 ACTIVITY DIAGRAM

The process flows in the system are captured in the activity diagram. Similar to a state diagram, an activity diagram also consists of activities, actions, transitions, initial and final states, and guard conditions.

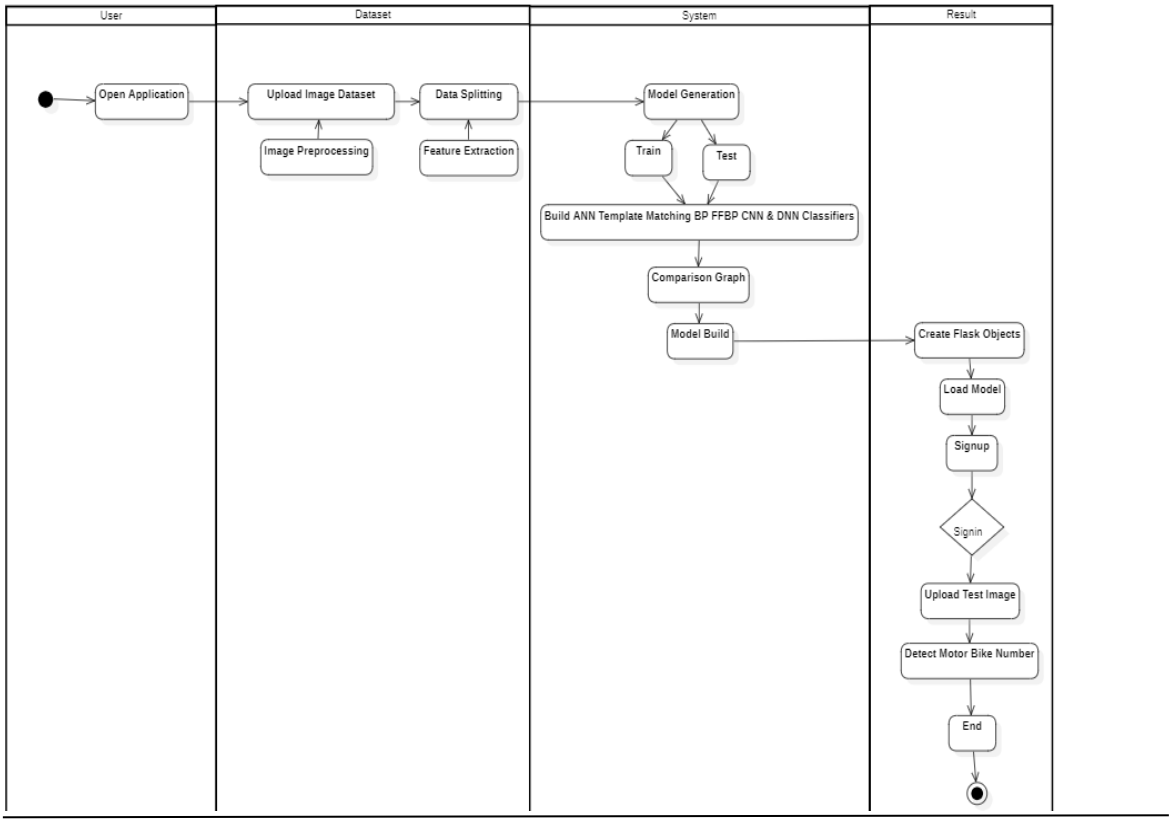



Figure 3.5: Activity diagram for License Plate Image Analysis Empowered by Generative Adversarial Neural Network

# 4. IMPLEMENTATION

# 4. IMPLEMENTATION

## 4.1 SAMPLE CODE

```
import os
from flask import Flask, render_template, request, send_file
import io
import os
from PIL import Image
import cv2
import numpy as np
from torchvision.models import detection

import torch
from torchvision import models
from flask import Flask, render_template, request, redirect, Response
import sqlite3
from dl_prediction.predictor import Predictor
from flask import Flask, request, jsonify, render_template
import os
from flask_cors import CORS, cross_origin
from com_in_ineuron_ai_utils.utils import decodeImage
from Detector import Detector
from logger import getLog

app = Flask(__name__)
app.config['SEND_FILE_MAX_AGE_DEFAULT'] = 0

CORS(app)

logger=getLog('clientApp.py')
class ClientApp:

    def __init__(self):

        try:

            self.filename = "inputImage.jpg"
            self.obj_detect = Detector()
            logger.info("ClientApp object initialized")

        except Exception as e:

            logger.exception(f"Failed to initialize App Object : \n{e}")
            raise Exception("Failed to initialize App Object")

predictor = Predictor()
output_car_file = 'static/output_car.jpg'
output_license_file = 'static/output_license.jpg'
output_license_original_file = 'static/output_license_original.jpg'
```

```
output_video_file = 'static/output_video.mp4'


@app.route('/')
@app.route('/home')
def home():
        return render_template('home.html')

@app.route('/logon')
def logon():
        return render_template('signup.html')

@app.route('/login')
def login():
        return render_template('signin.html')

@app.route("/signup")
def signup():

    username = request.args.get('user','')
    name = request.args.get('name','')
    email = request.args.get('email','')
    number = request.args.get('mobile','')
    password = request.args.get('password','')
    con = sqlite3.connect('signup.db')
    cur = con.cursor()
    cur.execute("insert into `info` (`user`,`email`, `password`,`mobile`,`name`) VALUES (?,
?, ?, ?, ?)",(username,email,password,number,name))
    con.commit()
    con.close()
    return render_template("signin.html")

@app.route("/signin")
def signin():

    mail1 = request.args.get('user','')
    password1 = request.args.get('password','')
    con = sqlite3.connect('signup.db')
    cur = con.cursor()
    cur.execute("select `user`, `password` from info where `user` = ? AND `password` =
?",(mail1,password1,))
    data = cur.fetchone()

    if data == None:
        return render_template("signin.html")

    elif mail1 == 'admin' and password1 == 'admin':
        return render_template("index.html")

    elif mail1 == str(data[0]) and password1 == str(data[1]):
        return render_template("index.html")
    else:
        return render_template("signup.html")
```

```
@app.route('/yolo')
def yolo():
    return render_template("yolo.html")



@app.route('/yolo-upload', methods=['POST'])
def yolo_upload():
    isImage = request.args.get('type') == 'image'
    isVideo = request.args.get('type') == 'video'
    file = request.files['file']
    file.save(file.filename)
    license_txt = predictor.predict(file.filename, output_car_file, output_license_original_file,
output_license_file)

    os.remove(file.filename)
    return render_template("yolo.html")


@app.route('/cnn')
def cnn():
    return render_template("cnn.html")



@app.route('/cnn-upload', methods=['POST'])
def cnn_upload():
    isImage = request.args.get('type') == 'image'
    isVideo = request.args.get('type') == 'video'
    file = request.files['file']
    file.save(file.filename)

    license_txt = predictor.predict(file.filename, output_car_file, output_license_original_file,
output_license_file, is_cnn=True)

    os.remove(file.filename)
    return render_template("cnn.html")

model = torch.hub.load("ultralytics/yolov5", "custom", path = "best.pt", force_reload=True)

model.eval()
model.conf = 0.5
model.iou = 0.45

from io import BytesIO

def gen():
    """
    The function takes in a video stream from the webcam, runs it through the model, and
returns the
    output of the model as a video stream
```

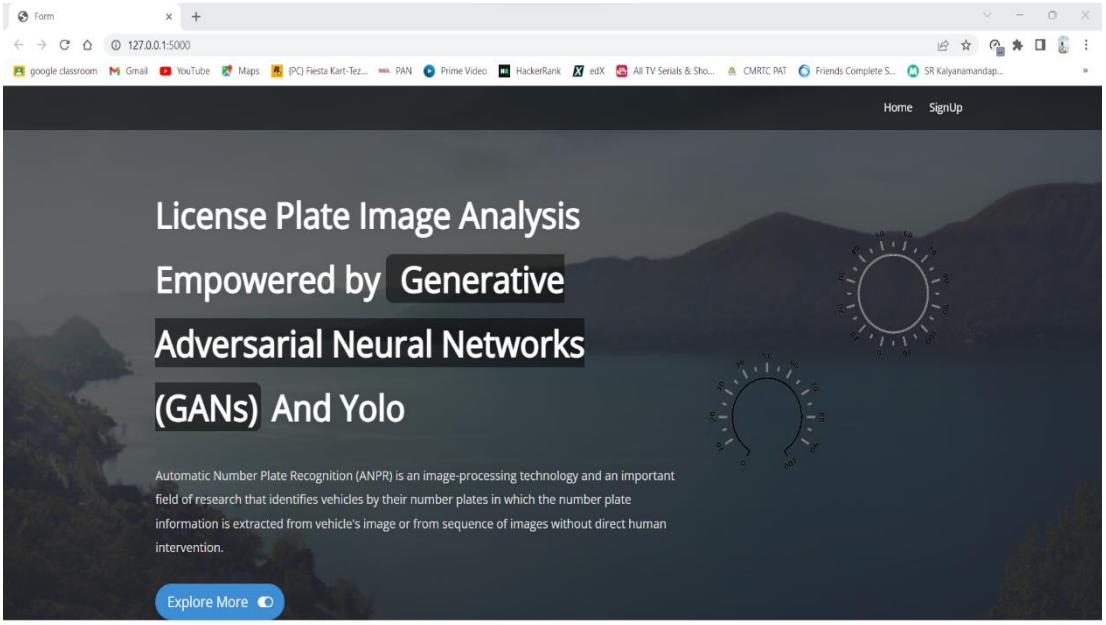
```
    """
    cap=cv2.VideoCapture(0)
     while(cap.isOpened()):
        success, frame = cap.read()
        if success == True:
            ret,buffer=cv2.imencode('.jpg',frame)
            frame=buffer.tobytes()
            img = Image.open(io.BytesIO(frame))
            results = model(img, size=640)
            results.print()
            img = np.squeeze(results.render())
            img_BGR = cv2.cvtColor(img, cv2.COLOR_RGB2BGR)
        else:
            break
        frame = cv2.imencode('.jpg', img_BGR)[1].tobytes()
        yield(b'--frame\r\n'b'Content-Type: image/jpeg\r\n\r\n' + frame + b'\r\n')

@app.route('/video')
def video():
    """
    It returns a response object that contains a generator function that yields a sequence of
images
    :return: A response object with the gen() function as the body.
    """
    return Response(gen(),
                    mimetype='multipart/x-mixed-replace; boundary=frame')



@app.route("/predict1", methods=["GET", "POST"])
def predict():
    """
    The function takes in an image, runs it through the model, and then saves the output image
to a
    static folder
    :return: The image is being returned.
    """
    if request.method == "POST":
        if "file" not in request.files:
            return redirect(request.url)
        file = request.files["file"]
        if not file:
            return
        img_bytes = file.read()
        img = Image.open(io.BytesIO(img_bytes))
        results = model(img, size=640)
        results.render()
        for img in results.render():
            img_base64 = Image.fromarray(img)
            img_base64.save("static/image0.jpg", format="JPEG")
        return redirect("static/image0.jpg")
    return render_template("index.html")
```

```
@app.route("/index")
def index():
    return render_template("index.html")

@app.route("/about")
def about():
    return render_template("about.html")

@app.route("/notebook")
def notebook():
    return render_template("Notebook.html")

@app.route("/notebook1")
def notebook1():
    return render_template("Notebook1.html")

@app.route("/charyolo")
def charyolo():

    return render_template("index1.html")

@app.route("/predict", methods=['POST'])
@cross_origin()
def predictRoute():

    try:

        image = request.json['image']
        logger.info("Image loaded")
        clApp = ClientApp()
        decodeImage(image, clApp.filename)
        result = clApp.obj_detect.run_inference()
        return jsonify(result)

    except Exception as e:

        return jsonify(e)

if __name__ == '__main__':
    app.run(debug=False)
```

# 5. RESULT

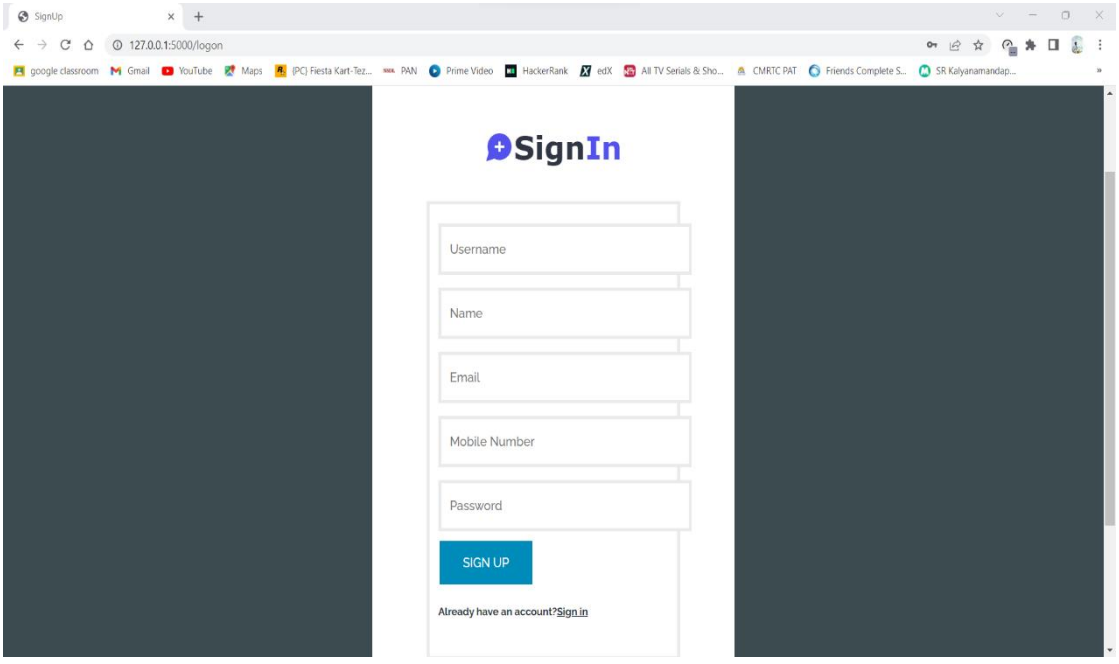
# 5. RESULT

## 5.1: HOME PAGE



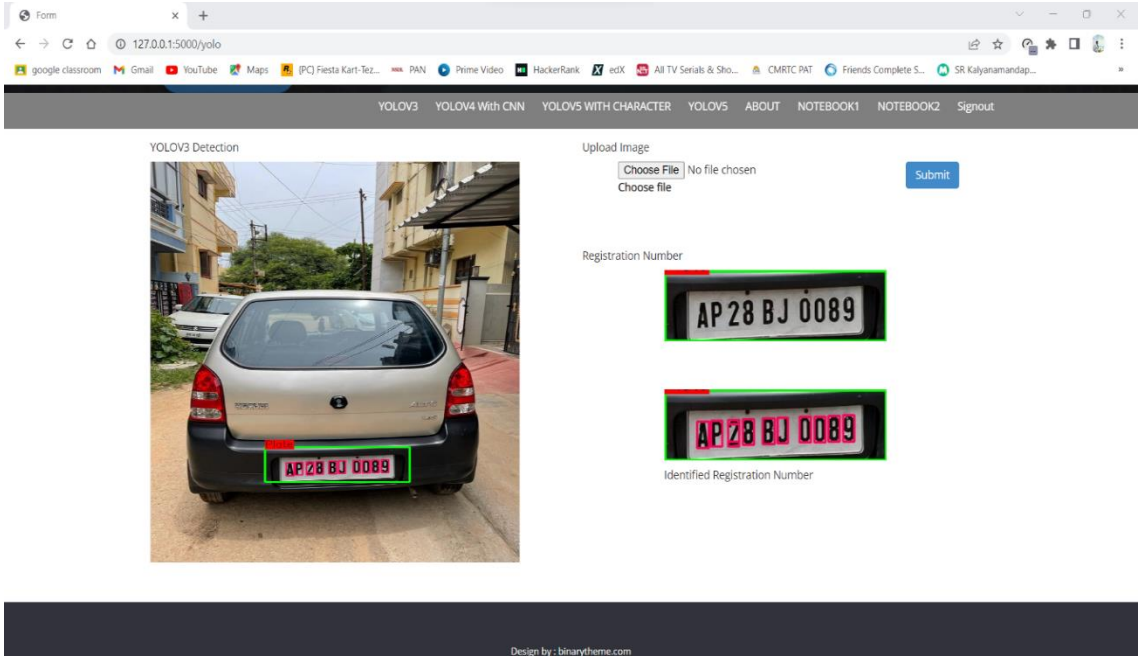

Screenshot 5.1: Home Page

## 5.2: SIGN IN PAGE



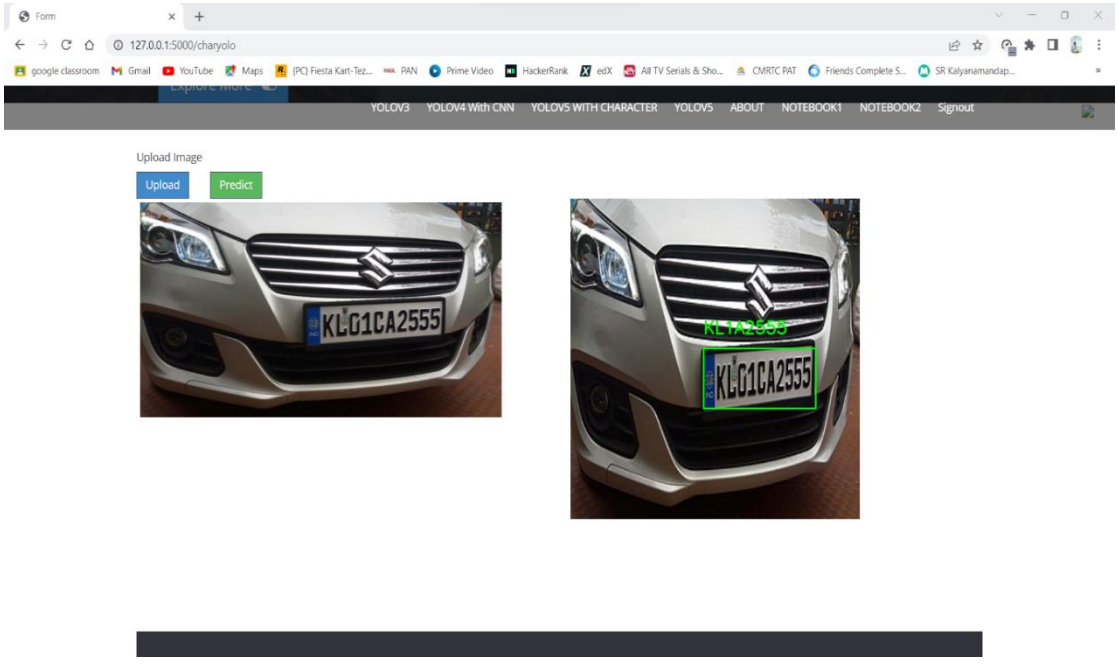

Screenshot 5.2: Sign In page

## 5.3: YOLO V3 DETECTION



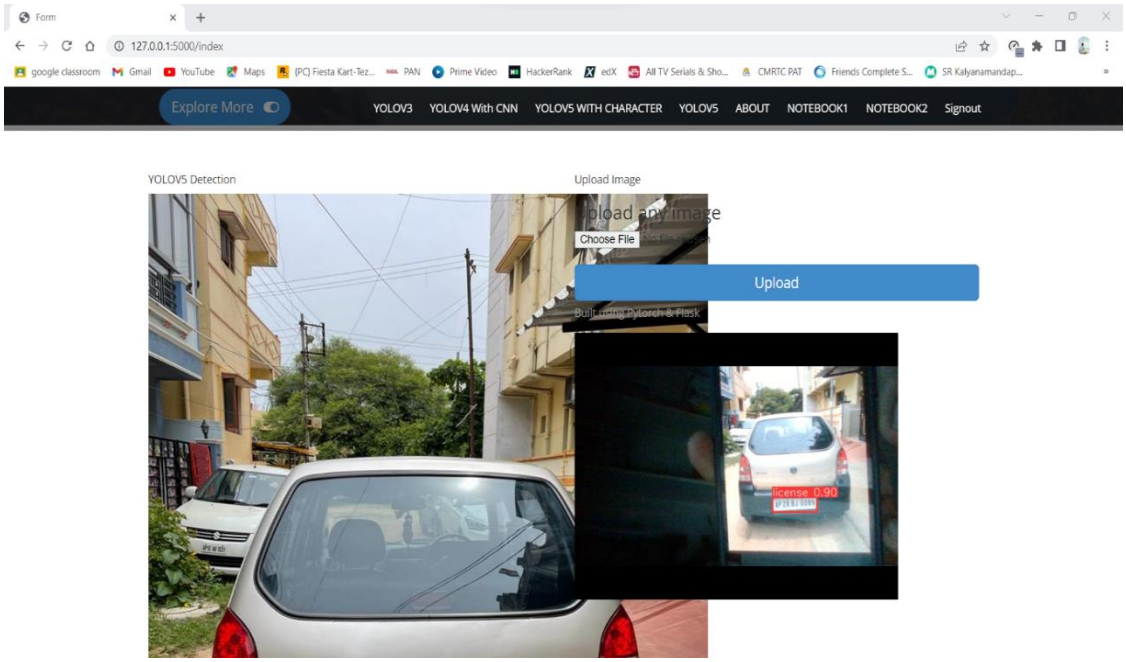

Screenshot 5.3: Yolo V3 Detection

## 5.4: YOLO V5 WITH CHARACTER




Screenshot 5.4: Yolo V5 with Character

## 5.5: YOLO V5




Screenshot 5.5: Yolo V5

# 6. TESTING

# 6.1 TESTING STRATEGIES

### 6.1.1 UNIT TESTING

Unit testing, a testing technique using which individual modules are tested to determine if there are issues by the developer himself. it is concerned with functional correctness of the standalone modules. The main aim is to isolate each unit of the system to identify, analyze and fix the defects.

Unit Testing Techniques:

Black Box Testing - Using which the user interface, input and output are tested.

White Box Testing –Used to test each one of those functions' behavior is tested.

### 6.1.2 DATA FLOW TESTING

Data flow testing is a family of testing strategies based on selecting paths through the program's control flow in order to explore sequence of events related to the status of Variables or data object. Dataflow Testing focuses on the points at which variables receive and the points at which these values are used.

### 6.1.3 INTEGRATION TESTING

Integration Testing done upon completion of unit testing, the units or modules are to be integrated which gives raise too integration testing. The purpose of integration testing is to verify the functional, performance, and reliability between the modules that are integrated.

### 6.1.4 BIG BANG INTEGRATION TESTING

Big Bang Integration Testing is an integration testing Strategy wherein all units are linked at once, resulting in a complete system. When this type of testing strategy is adopted, it is difficult to isolate any errors found, because attention is not paid to verifying the interfaces across individual units.

### 6.1.5 USER INTERFACE TESTING

User interface testing, a testing technique used to identify the presence of defects is a product/software under test by Graphical User interface [GUI].

## 6.2 TEST CASES:

| S.NO | INPUT | OUTPUT | RESULT |
|---|---|---|---|
| **Test Case 1**<br>**(Unit testing of Dataset)** | The user gives the input in the form of upload Image Dataset. | An output is Detect motor Bike Number Result. | A result is Detect motor Bike Number Result. |
| **Test Case 2**<br>**(Unit testing of Accuracy)** | The user gives the input in the form of<br>Skin Disease Dataset | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |
| **Test Case 3**<br>**(Unit testing of Machine Learning Algorithms)** | The user gives the input in the form of<br>Skin Disease Dataset | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |
| **Test Case 4**<br>**(Integration testing of Dataset)** | The user gives the input in the form of<br>patient test data. | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |
| **Test Case 5**<br>**(Big Bang testing)** | The user gives the input in the form of test image data. | An output is Detect motor Bike Number Result. | A result Detect motor Bike Number using DL algorithm like ANN, Template Matching, BP, FFBP, CNN & DNN. |
| **Test Case 6**<br>**(Data Flow Testing)** | The user gives the input in the form of<br>Image Dataset. | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |

| | | | |
|---|---|---|---|
| **Test Case 7 (User interface Testing)** | The user gives the input in the form of Image Dataset. | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |
| **Test Case 8 (User interface Testing-Event based)** | The user login in to application using username and password. | An output is user login successfully. | A result is user successfully login to application. |
| **Test Case 9 (User interface Testing-Event based)** | The user uploads dataset in to application. | An output is user upload dataset Successfully. | A result is user successfully upload dataset in to application. |
| **Test Case 10 (User interface Testing-Event based)** | The user gives the input in the form of test image data. | An output is Detect motor Bike Number Result. | A result is using CNN algorithm got Accuracy up to 100%. |

# 7. CONCLUSION

# 7. CONCLUSION & FUTURE SCOPE

## 7.1 PROJECT CONCLUSION

License Plate Image Analysis system is a significant execution of artificial intelligence solutions for numerous aspects. It is generally helpful for security purposes, keeping vehicle record, toll collection, improved traffic monitoring, better parking system, vehicle tracking, etc. Many studies have been conducted on automatic number plate detection as well as character recognition. In reality, a variety of researchers have been done on many methods and techniques for this process. From the survey we can understand that there are different methods and techniques used and it has advantages and disadvantages, and the effectiveness of technique is different from each other. Each country has its own number plate numbering system, different number plate sizes and colors, and character language. The above survey can give you that Valuable understanding and instructions for the approach use. We have proposed a deep learning technique represented by the CNN model for both number plate detection and character recognition for ensuring a decent function of automatic Number Plate Recognition system.

## 7.2 FUTURE SCOPE

The proposed algorithm gives higher accuracy than the existing algorithms also, it improves the complexity issues throughout the dataset. Also, we have planned to integrate the web server and the application. Also, the things algorithms will be further improved to much higher accuracy.

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## 8.2 GITHUB LINK

https://github.com/Manasreddy506/LicencePlateAnalysis

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