**SAVITRIBAI PHULE PUNE UNIVERSITY**

**A PROJECT REPORT ON**

# MULTINATIONAL AUTOMATIC VEHICLE NUMBER PLATE RECOGNITION SYSTEM

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE

OF

## BACHELOR OF ENGINEERING (COMPUTER ENGINEERING)

SUBMITTED BY


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Under The Guidance Of

**Prof Swapnil Chaudhari**

"Towards Ubiquitous Computing Technology"

## DEPARTMENT OF COMPUTER ENGINEERING

"Techno – Social Excellence"


**MARATHWADA MITRA MANDAL'S INSTITUTE OF TECHNOLOGY (MMIT)**
**LOHGAON, PUNE-411047**


**2021-22**

**SAVITRIBAI PHULE PUNE UNIVERSITY**
**2021 -2022**


# CERTIFICATE

This is to certify that the project report entitles

**"MULTINATIONAL AUTOMATIC VEHICLE NUMBER PLATE RECOGNITION SYSTEM"**

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**PROJECT APPROVAL SHEET**

A Project Title

# MULTINATIONAL AUTOMATIC VEHICLE NUMBER PLATE RECOGNITION SYSTEM

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## DEPARTMENT OF COMPUTER ENGINEERING

Marathwada Mitra Mandal's
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**SAVITRIBAI PHULE PUNE UNIVERSITY**
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# ACKNOWLEDGEMENT

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*We would like to express our gratitude to all those who helped us to complete this work. We want to thank our guide **Prof. Swapnil Chaudhari sir** for his continuous help and generous assistance. He helped in a broad range of issues from giving us direction, helping to find the solutions, outlining the requirements and always having the time to see us.*

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# ABSTRACT

Automatic Vehicle Number Plate Recognition is a key technique in most traffic-related applications and is an active research topic in the domain of image processing. Automatic Number plate recognition (ANPR) is generally considered a solved problem in the computer vision and image processing community. But most of the current works on ANPR are designed to work on license plates for specific country and use country specific information which limits their practical applicability. Such ANPR systems require changes in the algorithm to work on other countries license plates. Previous works on multinational license plates recognition are tested on datasets from various countries that share the same license plate layouts. To overcome this issue, this study presents a deep Multinational Automatic Vehicle Number Plate Recognition System is designed to be applicable to multinational license plates. Automatic number-plate recognition (ANPR) is a technology that uses optical character recognition (OCR) on images to read vehicle registration plates to create vehicle location data as well as time at that location. It can use existing road-rule enforcement cameras, or cameras specifically designed for the task of recognition. The process of identifying particular objects in an image plays a crucial part in the fields of Deep learning and computer vision or digital image processing. Optical Character Recognition is also applied in this for reading the image of vehicle number plate. Firstly, we the camera will capture the image of number plate then process it with the help of deep learning image processing technique i.e. using neural networks and read each and every character present in the number plate for their perfect recognition. This concept of ANPR system is based on the matching of templates. Vehicle plate detection and recognition appear in vast variety of applications from including travel time estimation, car counting on highways, traffic violations detection, speed calculation and surveillance applications. As on the other hand, number plate is the only trustworthy identity of a vehicle in Intelligent Transportation Systems (ITS) and correct vehicle identification depends highly on the accuracy of such ANPR systems. Because of recent developments of highway and the increased utilization of vehicles, significant interest has been paid towards the latest, effective, and precise intelligent transportation system (ITS).

# INDEX

# LIST OF ABBREVATIONS

| ABBREVIATION | ILLUSTRATION |
|---|---|
| ANPR | Automatic Number Plate Recognition |
| DP | Deep Learning |
| CV | Computer Vision |
| LP | License Plate |
| OCR | Optical Character Recognition |
| TFOD | Tensorflow Object Detection |
| GPU | Graphical Processing Unit |
| SSD | Single Shot Multibox Detection |
| IDE | Integrated Development Environment |
| AWS | Amazon web services |

# CHAPTER 1

# SYNOPSIS

**GROUP ID**

Group No. 15

## 1.1 PROJECT TITLE

Multinational Automatic License Plate Recognition

## 1.2 PROJECT OPTION

Internal project

## 1.3 INTERNAL GUIDE

Prof. Swapnil Chaudhari Sir

## 1.4 SPONSORSHIP AND EXTERNAL GUIDE

No.

## 1.5 TECHNICAL KEYWORDS (AS PER ACM KEYWORDS)

1. Automatic number plate recognition (ANPR)
2. Image Processing
3. multinational license plate recognition
4. License Plate(LP)
5. Optical Character Recognition (OCR)
6. Character Segmentation
7. Intelligent transportation system (ITS)
8. Image segmentation
9. Tensorflow Object Detection (TFOD)

## 1.6 PROBLEM STATEMENT

1] To build AI based solution that should recognize vehicle number plate form real-time as well as image using deep learning and computer vision.

2] It should detect and recognize the multinational vehicle number plate and these results for future analysis and research.

3]If over-speeding occurs, extract license number of vehicle and send alert to the concerned authorities to charge fine.

4] Store the images captured by the cameras as well as the text from the license plate

5] To propose the end to end delivery of AI solution for multinational vehicle plate recognition

## 1.7 ABSTRACT

Automatic vehicle license plate detection and recognition is a key technique in most traffic-related applications and is an active research topic in the image processing domain. Automatic license plate recognition (ALPR) is generally considered a solved problem in the computer vision community. However, most of the current works on ALPR are designed to work on license plates (LP) from specific countries and use country-specific information which limits their practical applicability. Such ALPR systems require changes in the algorithm to work on other countries' LPs. Previous works on multinational LP recognition are tested on datasets from various countries that share the same LP layout. To address this issue, this study presents a deep ALPR system designed to be applicable to multinational LPs. Automatic number-plate recognition (ANPR) is a technology that uses optical character recognition on images to read vehicle registration plates to create vehicle location data. It can use existing closed-circuit television, road-rule enforcement cameras, or cameras specifically designed for the task. The process of identifying particular objects in an image plays a crucial part in the fields of computer vision or digital image processing. OCR (Optical Character Recognition) scheme is also applied in this for reading the image of vehicle number plate. Firstly we capture the image of number plate then process it and read each and every character present in the number plate for their perfect recognition. The concept of ANPR system is based on the matching of templates.

Methods used include roadside speed traps set up and operated by the police and automated roadside 'speed camera' systems which may incorporate the use of an automatic number plate recognition system. Traffic monitoring cameras are mounted four to seven meters above the street level. Plate recognition range, where the cameras are able to capture the vehicles plates with sufficient resolution, starts from 20 to more than 50 meters away from the camera location. Automatic number-plate recognition can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Vehicle plate detection

and recognition appear in vast variety of applications, including travel time estimation, car counting on highways, traffic violations detection, and surveillance applications.

On the other hand, number plate is the only trustworthy identity of a vehicle in Intelligent Transportation Systems (ITS) and correct vehicle identification depends highly on the accuracy of automatic number plate recognition (ANPR) systems. Due to recent developments of highway and

the increased utilization of vehicles, significant interest has been paid on the latest, effective, and precise intelligent transportation system (ITS).

## 1.8 GOALS AND OBJECTIVES

1. To build a solution that should recognize license plate with uttermost clarity in any circumstances.
2. With a varying distance and colour combination, it should work for across all the continents.
3. The main goal is to automate the whole system which reduces manual work.
4. With everyday increase in number of vehicles on roads ,the problems faced like identification of stolen cars, invalid license plates, usage of cars in illegal activities it would be very useful.

## 1.9 RELEVANT MATHEMATICS ASSOCIATED WITH THE PROJECT

System Description:

Input: Image of vehicle with number plate as a input

Output: Recognized number plate data.

Functions: Tensorflow Object Detection

1. The TensorFlow object detection API is the framework for creating a deep learning network that solves object detection problems.
2. TensorFlow provides an accessible and readable syntax which is essential for making these programming resources easier to use.
3. These high-level operations are essential for carrying out complex parallel computations and for building advanced neural network models.
4. TensorFlow is a low-level library which provides more flexibility. Thus you can define your own functionalities or services for your models. This is a very important parameter for researchers because it allows them to change the model based on changing user requirements.

Distributed training:

1. Distribute the training time of a neural network model over many servers to reduce the training time.
2. Searching for good hyperparameters by running parallel experiments over multiple servers.

## NAMES OF CONFERENCES / JOURNALS WHERE PAPERS CAN BE PUBLISHED

1. **Gradiva Publications.(GRJ/3252)**
2. **IJARIIE: International Journal of Advance Research and Innovative Idea in Education**
3. **IJASER: International Journal of Applied Science and Engineering Review(ASER00177)**
4. **ICTACT Journal of Image recognition and Video Processing(IJIVP/1814)**
5. **Computer Vision and Image Understanding(CVIU-22-396)**
6. **IEEE**

# CHAPTER 2

# TECHNICAL KEYWORDS

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## 2.1 AREA OF PROJECT

## 2.2 TECHNICAL KEYWORDS

### IMAGE PROCESSING

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. There are five main types of image processing:

- Visualization - Find objects that are not visible in the image
- Recognition - Distinguish or detect objects in the image
- Sharpening and restoration - Create an enhanced image from the original image
- Pattern recognition - Measure the various patterns around the objects in the image
- Retrieval - Browse and search images from a large database of digital images that are similar to the original image

### SEGMENTATION

Segmentation is one of the most difficult steps of image processing. It involves partitioning an image into its constituent parts or objects.

### RECOGNITION

Recognition assigns a label to an object based on its description.

# CHAPTER 3

# INTRODUCTION

Due to the mass integration of information technology in all aspects of modern life, there is a growing demand for information systems for data processing in different domains. Automatic Vehicle Number Plate Recognition is a key technique in most traffic-related surveillance applications and is an active research topic in the domain of image processing. As a result, different methods, techniques and algorithms have been developed for license plate detection and recognition. In most of the cases, vehicles are identified by their number plate, which are easily readable by humans but not by the machines. For machines, a registration number plate is just like a dark spot that is within a region of an image with a certain intensity and luminosity. Because of this, it is necessary to design a robust mathematical system able to perceive and extract what we want from the captured image like in this system we want to capture the vehicle's license plate.

The design of these systems is one of the areas of research in areas such as Artificial Intelligence, Computer Vision, Pattern Recognition and Deep Learning's Neural Networks. These systems require data to be captured or archived or by a human which is able to recognize vehicles by their number plates in real-time environment and reflect the reality in the information system. In this system we have manually made datasets to train the system. But in real time hardware will be used while it's application. System of automatic recognition of number plates are sets of hardware and software to process a signal that is converted into a graphical representation such as static images or sequences of them and recognize the pattern characters in the plate. The basic hardware of these systems is a camera. In our project we have relied on images of cars in which we can see their number plates. The license plate recognition systems have two main points that are must to be considered that is the quality of license plate recognition software with recognition algorithms used and the quality of imaging technology, including camera and lighting. The traffic monitoring cameras are mounted over 4 to 7 meters above the street level. Plate recognition range, where the cameras are able to capture the vehicles plates with sufficient resolution, starts from 20 to more than 50 meters away from the camera location. Automatic number plate recognition system can store the images captured by the cameras as well as the text from the license plate, and can generate the such report with the information. The system's transformation between the real environment is perceived and information systems need to store and manage all that information.

Automatic Number plate recognition (ANPR) is generally considered a solved problem in the computer vision and image processing community. But most of the current works on ANPR are designed to work on license plates for specific country and use country specific information which limits their practical applicability. Such ANPR systems require changes in the algorithm to work on other countries license plates. Previous works on multinational license plates recognition are tested on datasets from various countries that share the same license plate layouts. To

overcome this issue, this study presents a deep Multinational Automatic Vehicle Number Plate Recognition System is designed to be applicable to multinational license plates. We have

considered the maximum recognition accuracy, to achieve faster processing speed, handling as many types of plates from different countries, manage the broadest range of image qualities and achieve maximum distortion tolerance of input data. In most countries, they use Arabic and English letters, plus their national logo. Thus, it makes the localization of plate number, the differentiation between Arabic and English letters and logo's object and finally, the recognition of those characters become more challenging research task. The use of the artificial neural network has proved itself beneficial for plate recognition, but it has not been applied for plate detection. We have tried to build a solution that recognizes many places with uttermost clarity in any circumstances. With a varying distance and color combination of the license plates, it should work on vehicle.

In this system we have used Image preprocessing algorithm using Neural Network Tensorflow Object Detection (TFOD) zoo model i.e ssd_mobilenet_v2_coco for detection of vehicle license plate, after that the number plate is located and extracted from the image. Segmentation of individual characters is present in plate and then Optical Character Recognition (OCR) for each image we segmented individual character. The output of the recognition of each character is processed as ASCII code associated with image of the character. This is achieved through Deep learning which segregates vehicles based on certain patterns found in the dataset. Once the data is classified, labelled groups will be created. The application will have a GUI interface to check the number of vehicles violating different traffic rules. By recognizing all successive images of the characters are completely read the license plate and save the result information in the form of document.

## 3.1 MOTIVATION

The main idea is to to automate the whole system which reduces manual work. Law enforcement agencies are increasingly looking out for Real-time technology Automated Number Plate System technologies so to enhance the enforcement and investigate the capabilities. Expansion of the relevant information and expedite the tedious and time -consuming process of manually comparing the vehicle license plate's number with the stolen vehicle's license plate numbers list. Not only stolen vehicle's but also scans license plates to detect high-risk offenders or organized criminal groups is one of a range of measures being considered to keep police safe. With everyday increase in number of vehicles on roads, the problems faced like identification of stolen cars, invalid license plates, usage of cars in illegal activities. The system captures the LP's, track the location, time, keep the images for future references without any human interval.

## 3.2 LITERATURE SURVEY

### [1] CHIRAG PATEL, DIPTI SHAH, ATUL PATEL: AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM (ANPR): A SURVEY

A survey made why automatic number plate system is helpful in today's world. With various methods and algorithms used for number plate detection including edge detection , image binarization ,etc . They have also reviewed the prior ANPR systems in existence.

### [2]CHRIS HENRY, SUNG YOON AHA, SANG-WOONG LEE : MULTINATIONAL LICENSE PLATE RECOGNITION USING GENERALIZED CHARACTER SEQUENCE DETECTION

This paper study presents a deep ALPR system designed to be applicable to multinational LPs. The proposed approach consists of three main steps – LP detection, unified character recognition, and multinational LP layout detection. The system is mainly based on the you only look once (YOLO) networks.

### [3] ALEENA JACOB, AISWARYA MECHERY, GLIYA RAPHY,ANJUMARIA JOHNY: AUTOMATED NUMBER PLATE AND OVER-SPEED DETECTION

The paper proposes a system to automatically detect number plate and the speed of vehicles. And if over-speeding occurs, extract license number of vehicle and send alert to the concerned authorities to charge fine. The message alert will send to the owner, nearest police station and control room. So policemen can catch people having over speed within the next signal itself. The detection of a license plate from an image, corner features based on Harris algorithm is used.

**[4] ABHISHEK KASHYAP, B. SURESH, ANUKUL PATIL, SAKSHAM SHARMA, ANKIT JAISWAL: AUTOMATIC NUMBER PLATE RECOGNITION**

The objective of this segment is to provide a detailed information about how to find a number plate in the captured image? Generally a monochrome camera with colour camera is used in ANPR system. They combined the approaches used to trace the number plate's position or section in images into three processing categories. To recognize separated characters, some processes use pattern image, grayscale, and colour. Character separation method for recognition of separate out /matching of template or learning based classification.

**[5] IRINA VALERYEVNA PUSTOKHINA , DENIS ALEXANDROVICH PUSTOKHIN , JOEL J. P. C. RODRIGUES , DEEPAK GUPTA , ASHISH KHANNA , K.SHANKAR , CHANGHO SEO, GYANENDRA PRASAD JOSHI: AUTOMATIC VEHICLE LICENSE PLATE RECOGNITION USING OPTIMAL K-MEANS WITH CONVOLUTIONAL NEURAL NETWORK FOR INTELLIGENT TRANSPORTATION SYSTEMS.**

This paper presents effective deep learning based VLPR model using optimal K-means clustering based segmentation and convolutional neural network (CNN) based recognition, called OKM-CNN model. The proposed OKM-CNN model operates on three main stages, namely license plate (LP) detection, segmentation using (OKM) clustering technique, license plate number recognition using the CNN model. For LP detection and localization, Improved Bernsen Algorithm (IBA) and Connected component analysis (CCA) models are employed. An extensive experimental investigation takes place using three datasets namely Stanford Cars, FZU Cars and HumAIn 2019 Challenge dataset. The attained simulation outcome ensured the effective performance of the OKM-CNN model over the compared methods in a considerable way.

**[6] LUBNA, NAVEED MUFTI , AND SYED AFAQ ALI SHAH: AUTOMATIC NUMBER PLATE RECOGNITION:A DETAILED SURVEY OF RELEVANT ALGORITHMS**

This paper presents a detailed survey of current techniques and advancements in Automatic-Number-Plate-Recognition (ANPR) systems,with a comprehensive performance comparison of various real-time tested and simulated algorithms,including those involving computer vision (CV). This paper provides a systematic review of the existing ANPR techniques. It covers the main features of ANPR systems by analyzing their performance summary, pros and cons accordingly. This research aims to advance the state of knowledge in smart vehicle technologies for future researchers.

**[7] SARMAD MAJEED MALIK, HASSAN ZOHAIB: AUTOMATED OVER SPEEDING DETECTION AND REPORTING SYSTEM**

The aim of project is to design an automated speed detection system which can detect the speed of vehicles and if over-speeding occurs, extract the license number of vehicle and send it via email to Toll Plaza to charge fine.

# CHAPTER 4

# PROBLEM STATEMENT AND SCOPE

## 4.1 PROBLEM DEFINITION

To build an AI based solution that should recognize Vehicle number plate from real-time as well as image using Deep Learning and Computer Vision. It should detect and recognize the

multinational vehicle number plate and save these results for future analysis and research. If over-speeding occurs, extract license number of vehicle and send alert to the concerned authorities to charge fine.

### 4.1.1 GOALS AND OBJECTIVES

- To build a solution that should recognize license plate with uttermost clarity in any circumstances.
- With a varying distance and colour combination, it should work for across all the continents.
- The main goal is to automate the whole system which reduces manual work.
- With everyday increase in number of vehicles on roads ,the problems faced like identification of stolen cars, invalid license plates, usage of cars in illegal activities it would be very useful.

### 4.1.2 STATEMENT OF SCOPE

Project Scope: To overcome these problems, the in-depth analysis of causes such as number of traffic rules followed, is required. Therefore, continuous monitoring of traffic on highways and huge roads is mandatory. An application which will detect real time vehicle's number plate on the road and store the Vehicle Registration numbers as well as the image captured in the database automatically and also can detect the multiple types of vehicles on roads for better management of roads and safety in traffic.

Law enforcement agencies are increasingly looking out for Real-time technology Automated Number Plate System technologies so to enhance the enforcement and investigate the capabilities. Expansion of the relevant information and expedite the tedious and time -consuming process of manually comparing the vehicle license plate's number with the stolen vehicle's license plate numbers list.

# CHAPTER 5

# PROJECT PLAN

## 5.1 PROJECT ESTIMATES

### 5.1.1 ITERATIVE MODEL

As the requirements will be defined clearly by the client and easy to understand also software application and there will changes for requirement in future Iterative Model is used. So that Testing and debugging during smaller iteration is easy. Risks are identified and resolved during iteration.

Starting with some software specifications and developing the first version of the software. After the first version if there is a need to change the software, then a new version of the software will be created with a new iteration. Every release of the Iterative Model finishes in an exact and fixed period which is known as iteration. The final output of the project will be renewed at the end of the Software Development Life Cycle (SDLC) process.

Phases of Iterative model are as follows:

**Requirement gathering & analysis**: In this phase, requirements are gathered from clients and are analysed.

**Design**: Team design the software by the different diagrams like Data Flow diagram, activity diagram, class diagram, state transition diagram, etc. Which model to be used is decided as per the requirement. Implementation: Actual system is built as decided using the model used as per requirements.

**Testing:** After completing the model implementation phase, software testing starts using different test methods.

**Deployment**: After completing all the phases, software is deployed to its work environment. Review: In this phase, after the product deployment, review phase is performed with the clients to check the behaviour and validity of the developed system. And if there are any error found then the process starts again from the requirement gathering phase.

**Maintenance:** After deployment of the software in the working environment there may be some bugs, some errors or new updates are required. Maintenance involves debugging and new addition options

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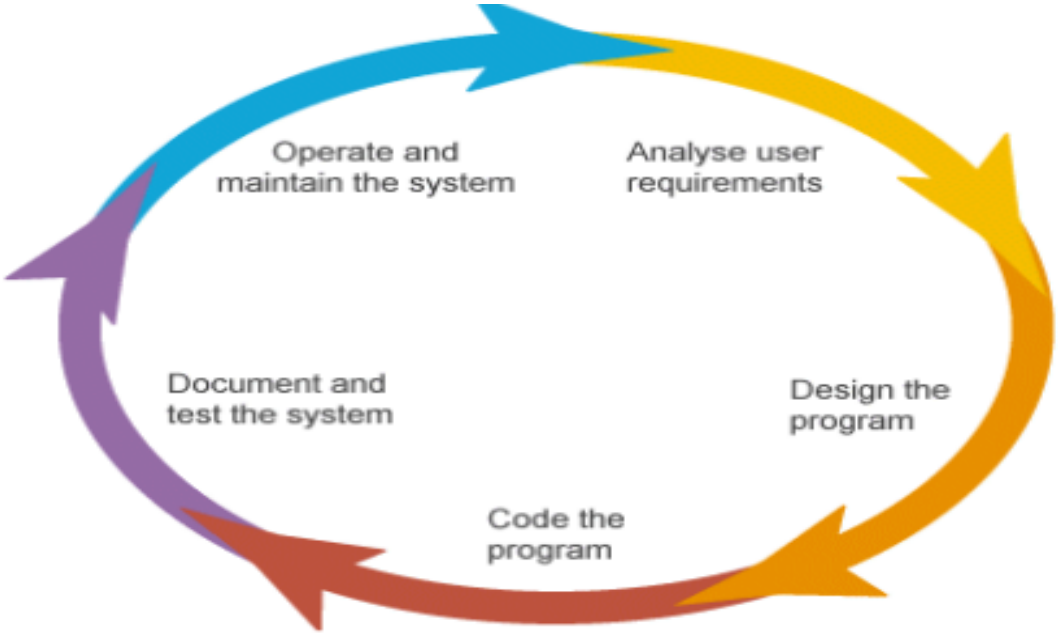



**Fig : Iterative Model**

## 5.2 RISK MANAGEMENT W.R.T. NP HARD ANALYSIS

This section discusses Project risks and the approach to managing them.

### 5.2.1 Risk Identification

For risks identification, review of scope document, requirements specifications and schedule is done. Answers to questionnaire revealed some risks. Each risk is cate gorized as per the categories mentioned in. Please refer table for all the risks. You can refereed following risk identification questionnaire.

1. Have top software and customer managers formally committed to support the project?

2. Are end-users enthusiastically committed to the project and the system/product to be built?

3. Are requirements fully understood by the software engineering team and its customers?

4. Have customers been involved fully in the definition of requirements?

3. Do end-users have realistic expectations?

6. Does the software engineering team have the right mix of skills?

7. Are project requirements stable?

8. Is the number of people on the project team adequate to do the job?

9. Do all customer/user constituencies agree on the importance of the project and

on the requirements for the system/product to be built?

### 5.2.2 Risk Analysis

The risks for the Project can be analyzed within the constraints of time and quality

## 5.3 PROJECT SCHEDULE

### 5.3.1 Project task set

Major Tasks in the Project stages are:

Task 1: Initiation

Task 2: Requirement Gathering

Task 3: Design

Task 4: Implementation

Task 5: Testing

Task 6: Evolution

### 5.3.2 Task network

Project tasks and their dependencies are noted in this diagrammatic form.

### 5.3.3 Timeline Chart

A project timeline chart is presented. This may include a time line for the entire project. Above points should be covered in Project Planner as Annex C and you can mention here Please refer Annex C for the planner

## 5.4 TEAM ORGANIZATION

Whatever activities are done related to the project that we all showing all details log to our guide. All the reporting are noted to the guide.

### 5.4.1 Team structure

The team structure for the project is identified. Roles are defined. Our team have four members. We select this topic after discussing with each other. All the members performing all the task whatever tasks are assign to the members.

### 5.4.2 Management reporting and communication

For developing this project, first finalize the project topic after reviewing

the multiple project topics. After that we gather the requirements about this project.. Then we make the synopsis, SRS, PPT and report for sem1. For all above requirements, our team member and our guide discuss with each other. Every time we maintain all the details about whatever activities are performed by us. Mechanisms for progress reporting and inter/intra team communication are identified as per assessment sheet and lab timetable.

## 5.5 SYSTEM IMPLEMENTATION PLAN

**1. Data Collection** -It is the process of collecting images from multiple sources like Google's Open image dataset, Kaggle, Shutterstock.

**2. Data Labelling** - It is the process of annotating the objects present in the image so we can train our model accordingly eg. Cars, taxis, Ambulance, etc.

**3. Data Augmentation & Pre-processing** - It is the process of applying some augmentation and pre-processing techniques like rotation, cropping, saturation

and others which makes the images more generalized and provide more variations in images.

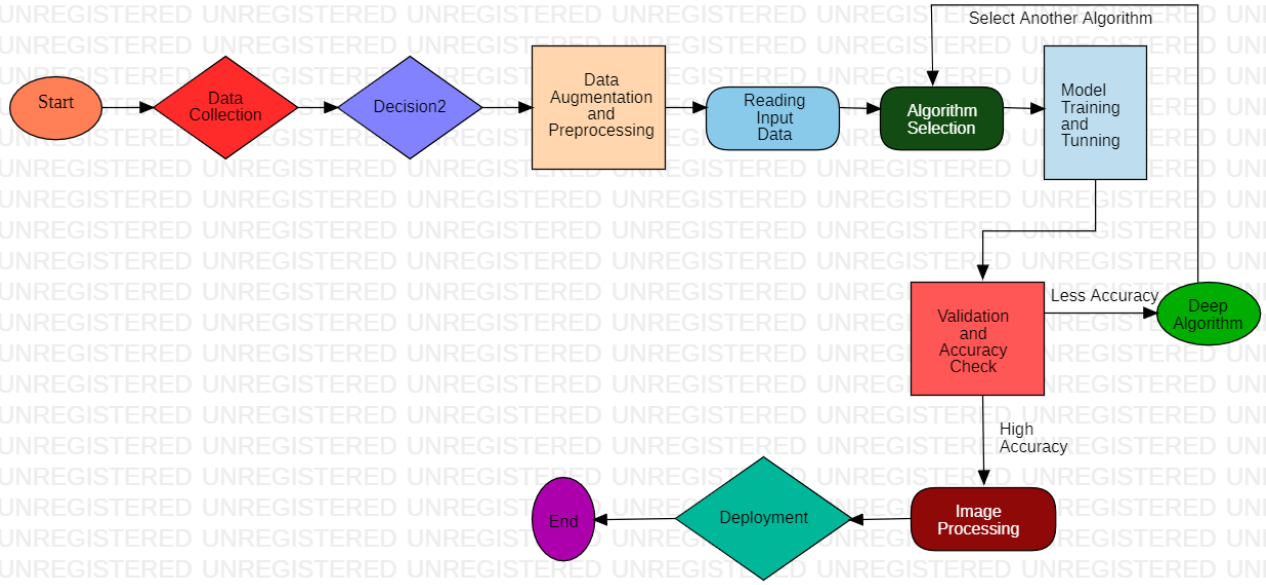
**4. Model Training and Tuning** – It is the process of training input images on different object detection algorithms and tuning the parameters of algorithm for getting better result. In this case, tuned model such that model learned high-level features specific to the dataset. This is usually recommended when the training dataset is large and very similar to the original dataset that the pre-trained model was trained on.

**5**. **Validation & Accuracy Check** –In this process accuracy of the model obtained is checked and validated on validation images.

**6. Image Processing** –In this process after getting high accuracy on validation images, image processing is applied on images and videos for using it in different use cases.

**7. Deployment** –Deployment of the model means integration of model into production environment which will take input and provide us output that can be used in real-time scenarios

System needs to store every request into database and we need to store in such a way that if we want to retrain a model it should be easy to retrain model with new data as well.



# CHAPTER 6

# HARDWARE/ SOFTWARE REQUIREMENT SPECIFICATION

Detecting the number plate of the vehicles license plate. We will be going to divide into 6 to 7 classes of vehicles that usually runs on highway i.e. Mini Car, Truck, Van, Motorbike etc. and we will be going to detect number plate of every vehicles and put the data in the certain column that fits the type of vehicle. So, first we need to detect the vehicles into those 6 to 7 classes and them count them category wise and store it on a database. To identify the vehicle and detect number plate of each moving vehicle we will use ROI (Region Of Interest) concept. Our main aim in this section is to focuses on Cropping of the images as per ids and store them temporarily in stack. Through the stored images we used Google-Optical Character Recognition (OCR) technique to read each and every number of the no. plate and keep it in a Proper database with respective current time-stamp, also focuses on predicting speed of all vehicles categorised such as bus, truck, van, bikes etc. This can further be used to analyse the number of vehicles crossing above speed limit and fall under vehicles to be fined.

### 6.1 HARDWARE REQUIREMENTS:

1. Functioning CCTV camera
2. Infra-Red - Light source at night may be provided by Infrared in order to provide illumination for the camera
3. PC /Laptop- Pentium 3 onwards
4. RAM – minimum 4GB
5. HDD/SSD – minimum 250GB
6. GPU (Graphical Processing Unit): A good GPU is indispensable for deep learning. Training models is a hardware intensive task, and a decent GPU (Nvidia/AMD Radeon) will make sure the computation of neural networks goes smoothly without taking much time. Compared to CPUs, GPUs are way better at handling deep learning tasks, due to their several thousand cores.

### 6.2 SOFTWARE REQUIREMENTS (PLATFORM CHOICE):

1. When any task is performed, it will likely use all the processing power available until that function is finished.
2. Google Colab was used instead of PyCharm/Jupiter Notebook.
3. For visualization of the plots, Matplotlib, Pyplot used.

4. EasyOCR for extraction of characters.
5. TFOD zoo model for detection. (ssd_mobilenet_v2_coco)
6. AWS is used for deployment of the model.
7. MongoDB is used to retrieve, insert, delete, and update the database.
8. Front end development is done using React, HTML, CSS
9. GitHub is used as version control system.
10. OpenCV is used for making logics.
11. Flask is used for backend development.

Database Requirements:

System needs to store every request into database and we need to store in such a way that if we want to retrain a model it should be easy to retrain model with new data as well. Initial Step-By-Step Description:

1. The User choose the problem-statement.
2. For proper detection user can give the ROI (Region Of Interest) of the frames.
3. The system store each and every data given by user or received in request to the database.

### 6.1.2 Overview Of Responsibilities Of Developer

- Check the all boundary value for project.
- What are the dead line provided by costumer and code for that it helpful to test cases.
- Developer should code according to risk analysis.
- Ensure that project is completed within allotted budget and timelines.
- Developer should provide proper GUI according to user can handle easily.
- Research and recommend new technologies to carry out project development tasks.
- Develop cost reduction initiatives while maintaining quality and productivity.

## 6.3 USER CLASSES AND CHARACTERISTICS:

1. Software should process the image and extract characters.
2. User should have facility to save extracted data in format of his interest.

### 6.3.1 User profiles

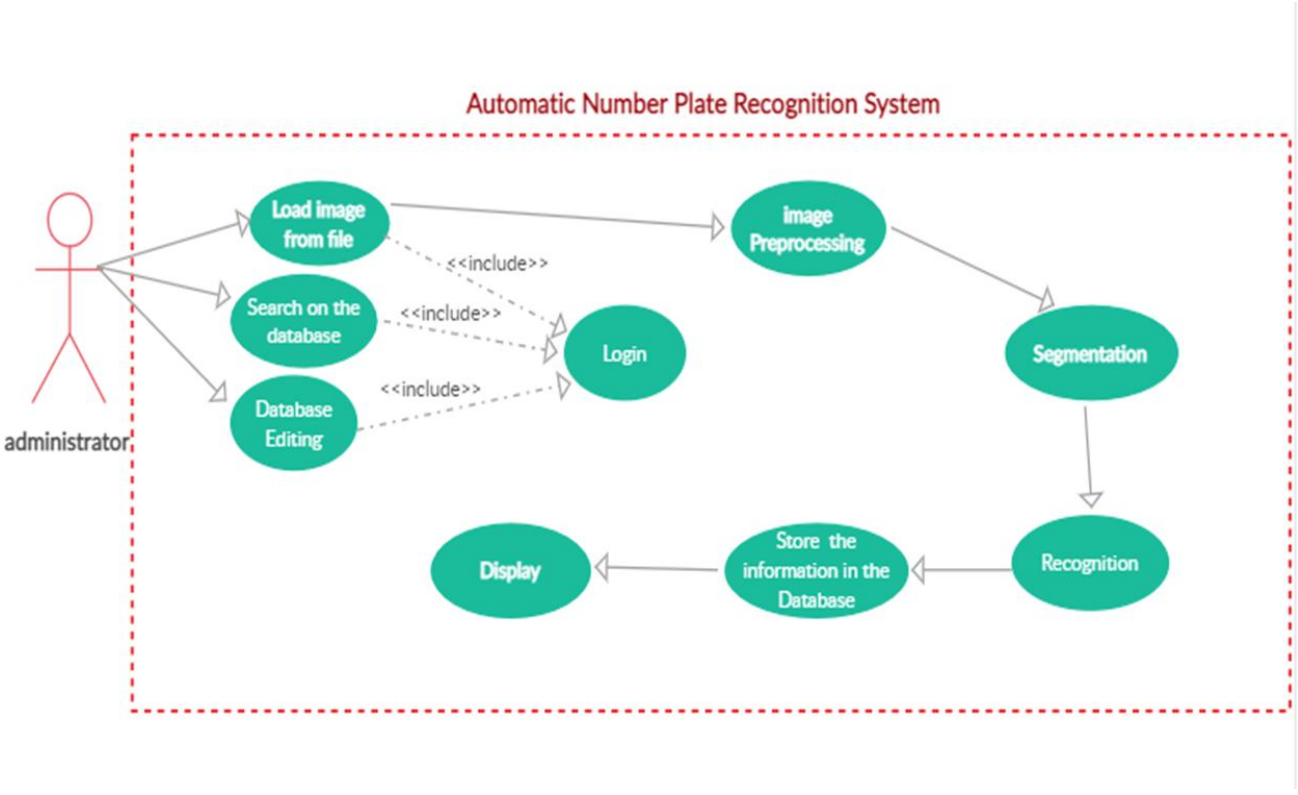
The profiles of all user categories are described here.(Actors and their Description)

### 6.3.2 Use-cases

All use-cases for the software are presented. Description of all main Use cases using use case template is to be provided.

### 6.3.3 Use Case View

Use Case Diagram.



## 6.4 DATA MODEL AND DESCRIPTION

### 6.4.1 Data Description

Data objects that will be managed/manipulated by the software are described in this section. The database entities or files or data structures required to be described. For data objects details can be given as below

### 6.4.2 Data objects and Relationships

Data objects and their major attributes and relationships among data objects are de scribed using an ERD-like form.

## 6.5 FUNCTIONAL MODEL AND DESCRIPTION

A description of each major software function, along with data flow (structured anal ysis) or class hierarchy (Analysis Class diagram with class description for object oriented system) is presented.

### 6.5.1 Description of functions

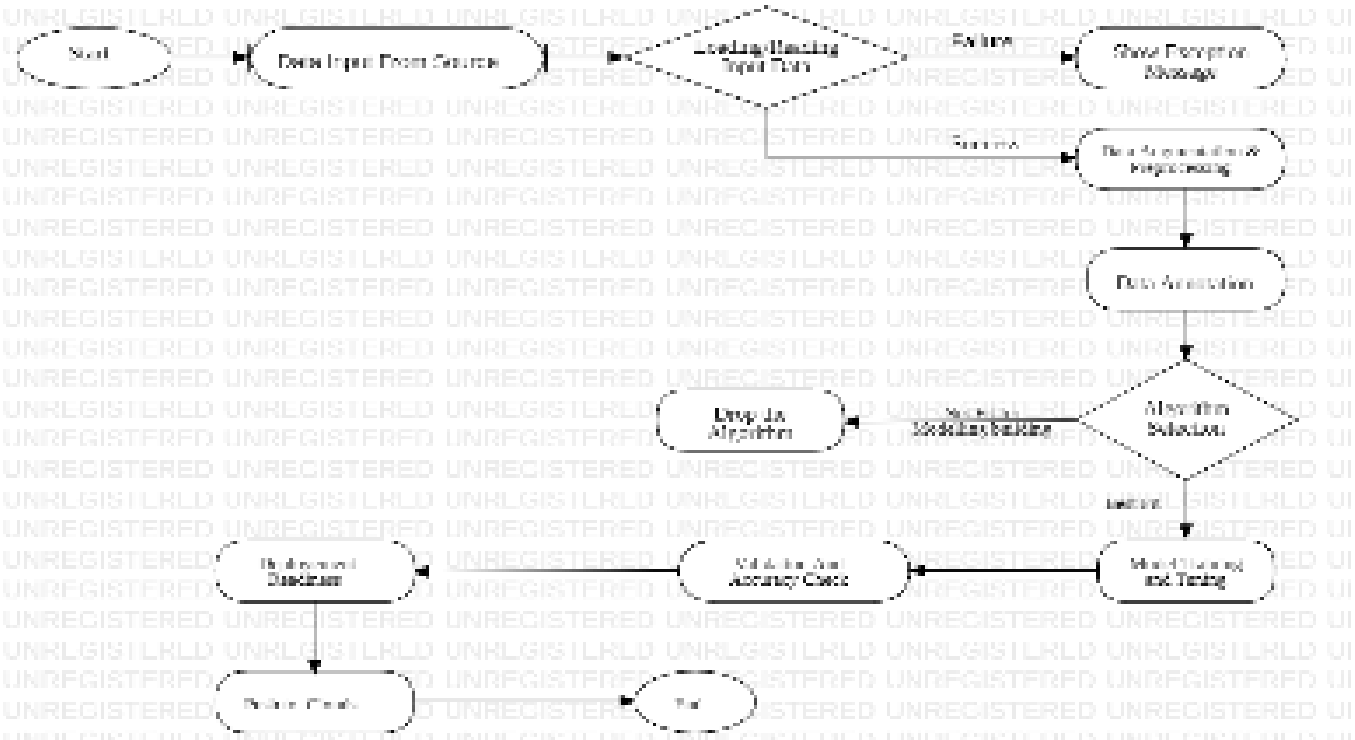
A description of each software function is presented. A processing narrative for function n is presented.(Steps)/ Activity Diagrams. For Example Refer diagram.

### 6.5.2 Activity Diagram:

The Activity diagram represents the steps taken.

### 6.5.3 State Diagram:

**State Transition Diagram**



### 6.5.3 NONFUNCTIONAL REQUIREMENTS:

**Performance Requirements:**

1] Reliability: The system is highly reliable because we will be testing it on multiple phases and accuracy rate with respect to Frame Per Second will be very high

2] Efficiency: Resource consumption for given load is quite low.

3] Robustness: Our system is capable to cope with errors during execution

4] Accuracy: accurate as possible. So that it will not mislead the user. Also, time to time model retraining is very important to improve the performance.

**Safety Requirements:**

1] Even we can set up our product application over user's existing Camera itself, which they are using for security and surveillance purpose. This will increase the resource utilization more effectively.

**Security Requirements:**

1] From security point of view, it's totally safe. We are using cloud which is very difficult to intercept. Also, our data will remain safe, since in cloud we have option to store multiple copy of it on different location and time zone
2] Since system has all the information about vehicle and related details so, the information should be secured.

**Software Quality Attributes:**
1] Fault tolerance: Our system is not fault tolerant due to insufficient hardware.
2] Scalability: Our project is scalable i.e. we can add more resources to our project without disturbing the current scena.
3] Accessibility: It can be easily accessible i.e click &run.

### 6.5.5 Software Interface Description

**PyCharm:** PyCharm is dedicated python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive python, web, and data science development.

### 6.6. Assumptions and Dependencies:

The main objective of the project is to detect the vehicles who break the traffic rules using Computer Vision and Deep Learning techniques. It is also assumed that all aspects of this project have the ability to work together in the way the designer is expecting.

Dependencies:

1. 64 bit operating system
2. OS - windows XP or higher
3. AWS is used for deployment of the model.
4. Python is an interpreted high-level general-purpose programming language. It is a very common tool, for some basic computations, and is one of the most userfriendly tools.
5. Keras is a Framework that has been developed on the top of TensorFlow 2.0 and has a wide range of models available that can be exported as and when needed.
6. Pandas is a software library written for the Python programming language for data manipulation and analysis. It offers data structures and operations for manipulating numerical tables and time series.
7. The TensorFlow object detection API is the framework for creating a deep learning network that solves object detection problems. These high-level operations are essential for carrying out complex parallel computations and for building advanced neural network models.
8. OCR for recognition of characters from number plate

# CHAPTER 7

# SYSTEM ARCHITECTURE

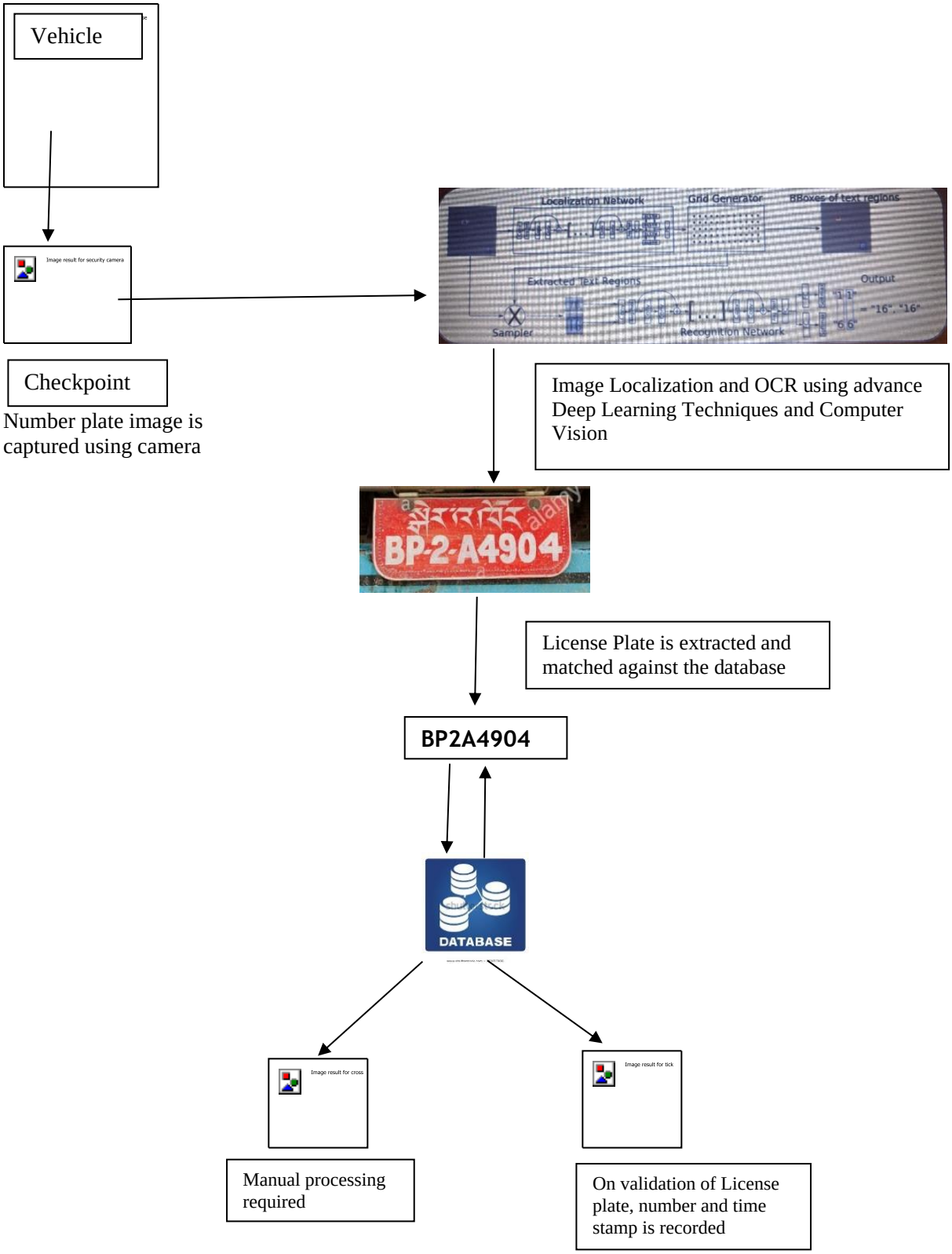

Vehicle
Image result for security camera
Checkpoint
Number plate image is captured using camera
Localization Network
Grid Generator
BBoxes of text regions
Extracted Text Regions
Output
Sampler
Recognition Network
Image Localization and OCR using advance Deep Learning Techniques and Computer Vision
BP-2-A4904
License Plate is extracted and matched against the database
BP2A4904
DATABASE
Image result for cross
Manual processing required
Image result for tick
On validation of License plate, number and time stamp is recorded

**Fig : System Architecture**

# CHAPTER 8

# SYSTEM IMPLEMENTATION PLAN

## 8 .1 SYSTEM DESIGN:

### A] Prerequisites:

1. Python
2. TensorFlow
3. Protobuf v3.4 or above

### B] Setup of Path:

1. Downloaded TensorFlow and TensorFlow GPU
2. For all the other libraries were installed, used pip to install them like opencv, pillow,etc.
3. Download Tensorflow Model zoo ssd_mobilenet_v2_coco which is pretrained model on coco dataset.
4. Creating a project directories:

```
Tensorflow/
└─ protoc/
   ├─ bin/
   ├─ include/
   ├─ readme.txt
└─ tf2_api_env/
   ├─ bin/
   ├─ include/
   └── …
└─ models/
   ├─ community/
   ├─ official/
   ├─ orbit/
   └── …
```

5. Installation of COCO API and object detection API

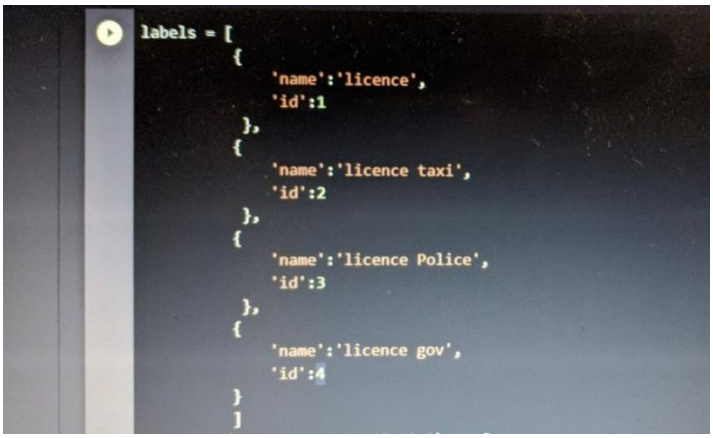
Data Augmentation: To make the model more robust to various input object sizes and shapes, each training image is randomly sampled by one of the following options: – Use the entire original input image, Sample a patch so that the minimum jaccard overlap with the objects is 0.1, 0.3, 0.5, 0.7, or 0.9., Randomly sample a patch.

### C] Data Preparation and creation of Tfrecord :

Images of License plates from different countries was collected. This is the data that feed into your custom object detection model later. Models based on the TensorFlow object detection API need a special format for all input data, called TFRecord.
Our goal at this step is to transform each of your datasets (training, validation and testing) into the TFrecord format. And according to the images xml files were created for every license plate with dimensions. So Images are annotated in the xml file for object detection. These images were split into Train(80%) and test(20%) records.

**D] Creation of Label map:**

A Label Map is a simple .txt file (.pbtxt to be exact). It links labels to some integer values. The TensorFlow Object Detection API needs this file for training and detection purposes. Manually labelling the input data so that the deep learning algorithm can eventually learn to make the predictions on its own.




**E] Model Selection, Configuration and Training:**

Tensorflow 2 Detection Model Zoo which consist of set of different pretrained models on coco 2017 dataset. They are also useful for initializing your models when training on the novel dataset. From this SSD algorithm is used.

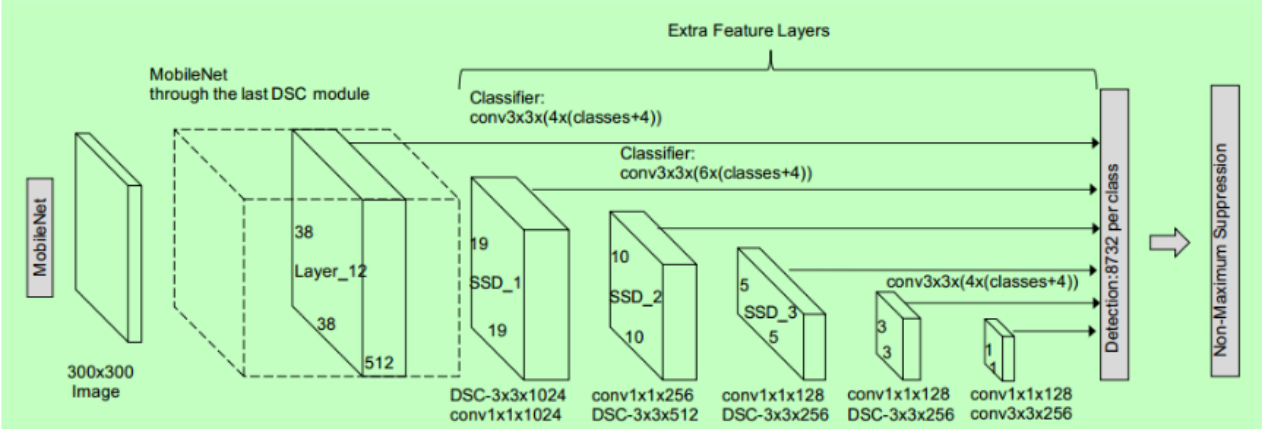



Figure 6. Mobile-Det: SSD-based detection with MobileNet as backbone, modified based on [14]

**SSD (Single Shot MultiBox Detector) :**

Popular algorithm in object detection. It's generally faster than Faster RCNN. The SSD architecture is a single convolution network that learns to predict bounding box locations and classify these locations within one pass. So for tracking the license plate of vehicles this algorithm is best suited as it can capture image of vehicle passing with single shot.

The SSD network consists of base architecture followed by several convolution layers. By using SSD, we only need to take one single shot to detect multiple objects within a image, while regional proposal network (RPN) based approaches such as R-CNN series that need to take two shots, one for generating region proposals, one for detecting the object of each proposal.

Thus, SSD is much faster compared with two-shot RPN-based approaches.

Compared with Faster RCNN,it has a clear speed advantage and it it has YOLO obvious mAP advantage. Features of SSD algorithm:

1] Inherited the idea of converting detection to regression from YOLO and completed network training at one time.

2] Based on anchor in Faster RCNN,a similar priority box is proposed.

3] Adding a detection method based on the Pyramidal Feature Hierarchy, which is equivalent to half a FPN idea.

For Model Configuration we have a different number of objects classes to detect, the objects we try to detect might be completely different from what a pre-trained model was supposed to detect, probably have less computational power to train a model, and this also should be taken into account, so this is why we need to configure the model.

Model configuration is a process that lets us tailor model-related artifacts e.g. hyperparameters, loss function, etc so that it can be trained (fine-tuned) to tackle detection for the objects.

**F] Evaluation and Load the train model:**

Evaluation can be run in parallel with training. The eval.py script checks the train directory for progress and evaluate the model based on the most recent checkpoint. Function is created to load model.

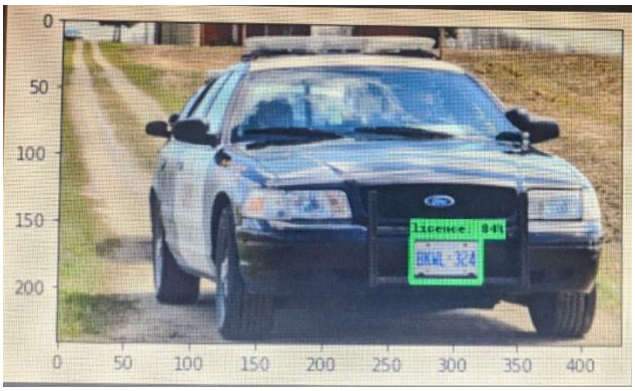
**G] Detection of License plate and text from the image:**

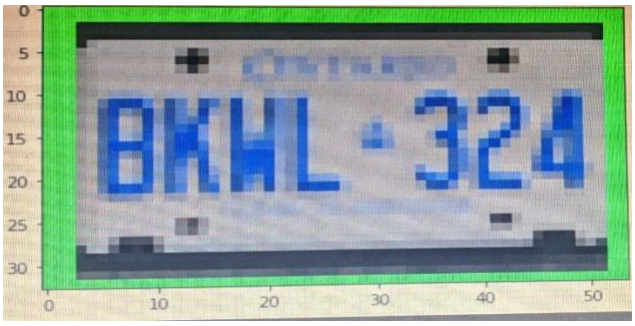
**Localization of license plate:**

License Plate image varies as the rule of a plate and the impact of the lighting platform. As the binary model which has global threshold is not capable of producing convinced outcome from adaptive local binary technique has been employed. The local binary techniques are referred to as an image would be classified into m × n blocks, and every block is computed using binary model. The SSD training objective is derived from the MultiBox objective but is extended to handle multiple object categories. Let x^p ij= {1, 0} be an indicator for matching the i-th default box to the j-th ground truth box of category p. In the matching strategy above, we can have summation of i x^ p ij ≥ 1. The overall objective loss function is a weighted sum of the localization loss (loc) and the confidence loss (conf):

$$L(x, c, l, g) = \frac{1}{N}(L_{conf}(x, c) + \alpha L_{loc}(x, l, g))$$

where N is the number of matched default boxes. If N = 0, wet set the loss to 0. The localization loss is a Smooth L1 loss between the predicted box (l) and the ground truth box (g) parameters.




The Text detected from the license plate :

```
['BKML : 324']
```

**H] Text Detection:**

Here EasyOCR is used which is actually a python package that holds PyTorch as a backend handler. It is the most straightforward way to detect text from images also when high end deep

learning library (PyTorch) is supporting it in the backend which makes it accuracy more credible. EasyOCR supports 42+ languages for detection purposes.

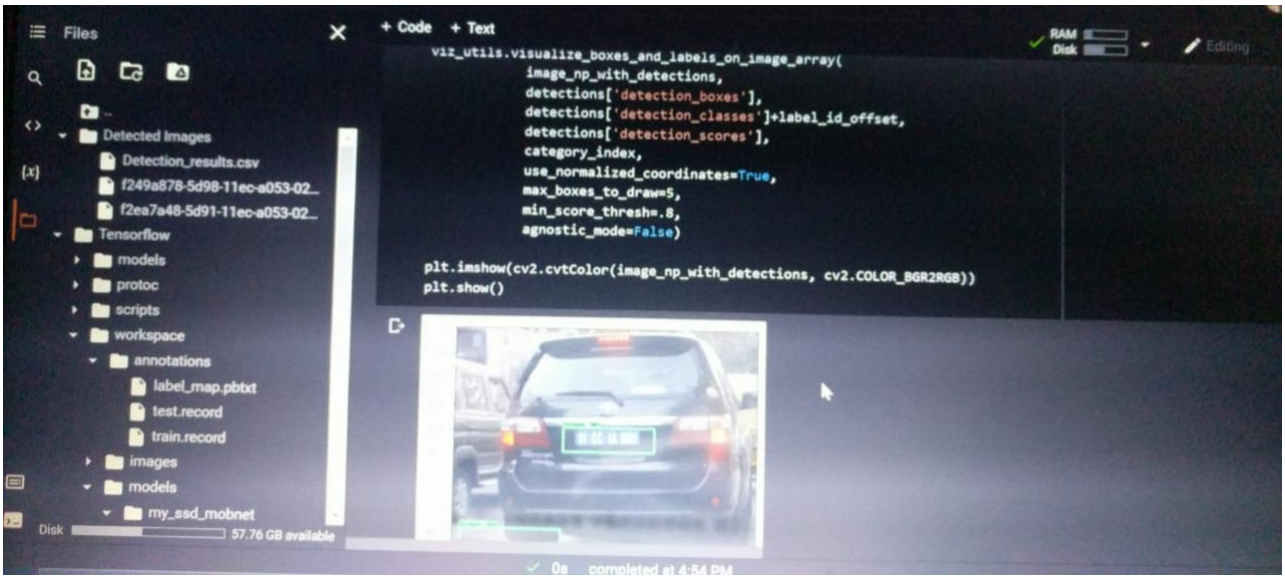
**E] KPI's (Key Performance Indicators):**

1] Time and workload reduction using the UGV based surveillance,
2] On time alert to nearest hospital on medical emergency (accident),
3] Get the exact location of vehicle

# CHAPTER 9

# RESULTS

## 9.1 SCREENSHOTS



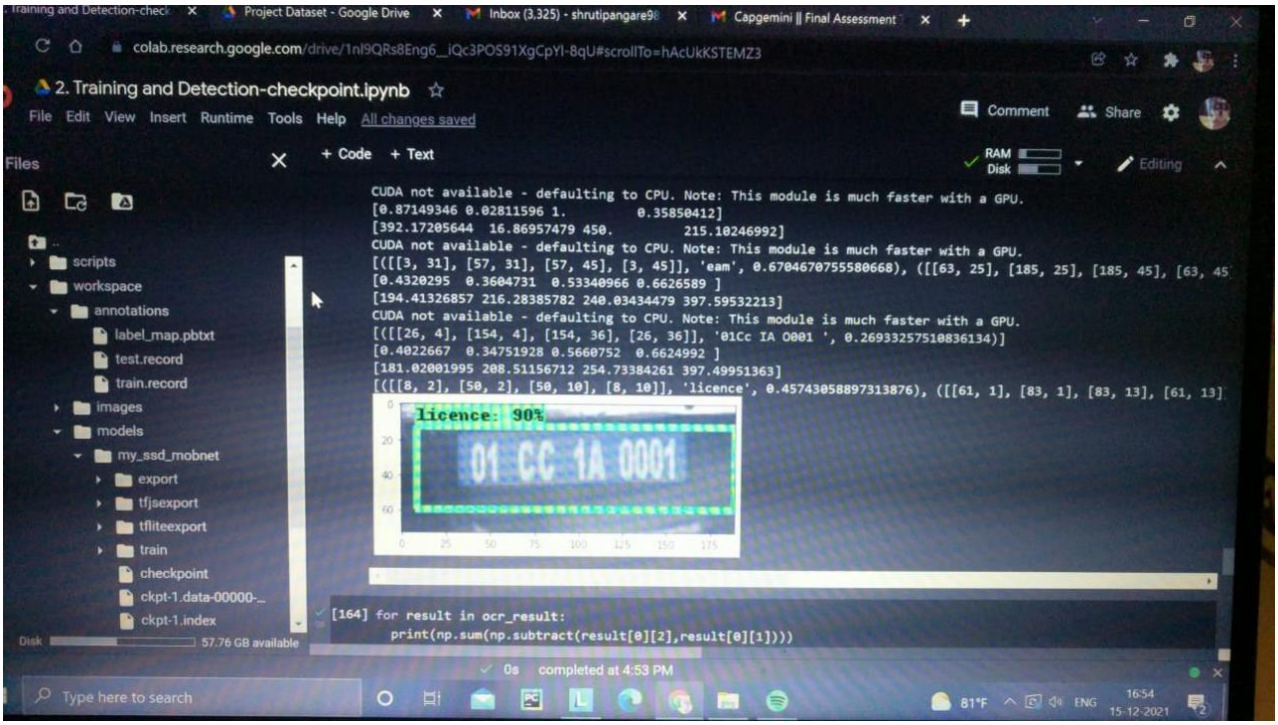




**Fig: Detection of Number Plate**

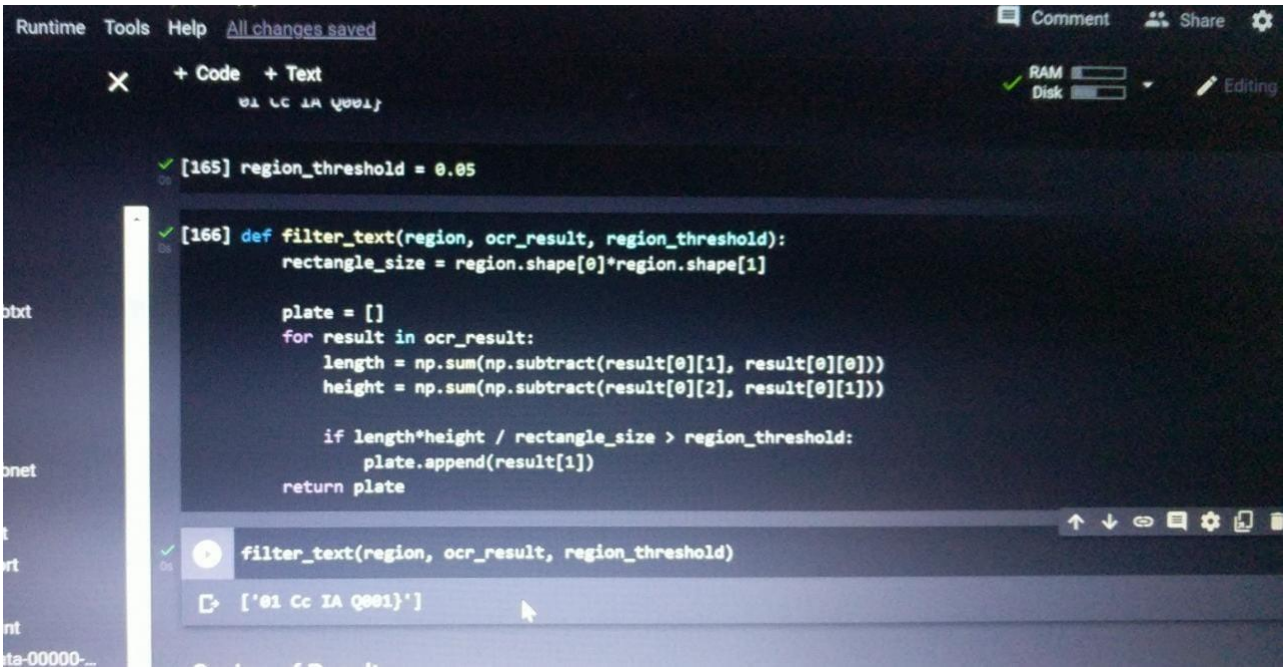



**Fig: Recognition of Characters using EasyOCR**

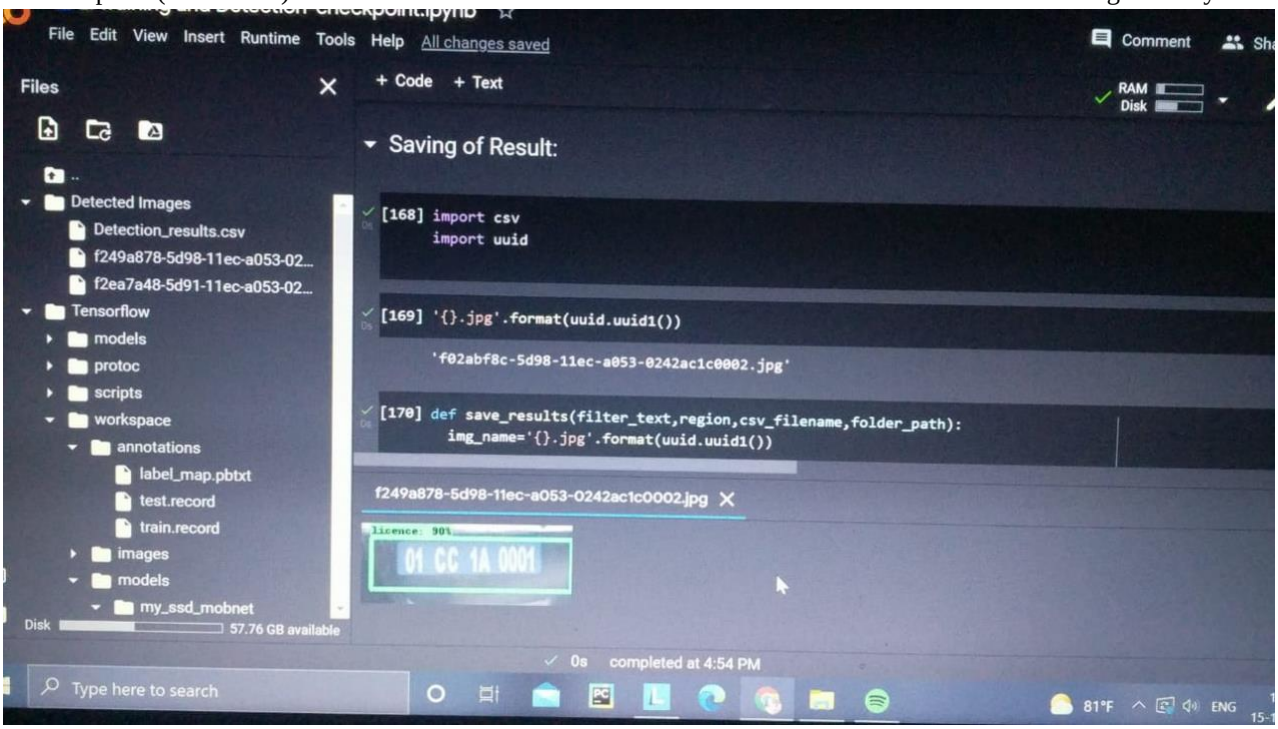



**Fig: Saving the results Captured**

# CHAPTER 10

# CONCLUSION AND APPLICATIONS

**CONCLUSION:**

Intelligence caters to machine learning and deep learning solutions and Vision caters to image and video analytic solution. In this project we have proposed the end-to-end delivery of AI solution for multinational vehicle plate recognition. This can further be used to analyze the number of vehicles crossing above speed limit and fall under vehicles to be fined. A good image preprocessing almost guarantees a successful recognition. Our main aim is to focuses on Cropping of the images as per ids and **S**tore them temporarily in stack. Through the stored images we used Google-Optical Character Recognition (OCR) technique to read every number of the number plate and keep it in a Proper database with respective current time-stamp. The System will analyze the incident based on the data trained using our algorithm. We can identify the incident and transmit the information, so that concerned authority can take necessary action in order to control the situation

## APPLICATION:

1. Identifying the vehicles which violate the traffic rules.
2. Identifying Emergency Response vehicles and doing special provisions
3. Restricting the parking in offices and homes to only registered vehicles.
4. Automatic toll deduction on toll booths.
5. Identifying and loggssing the vehicles moving in and out of factories and warehouses.

# CHAPTER 11

# FUTURE SCOPE

**Future Work:**

1] Future work may include improving the robustness. By using the highly qualified camera, they operate the operation to urge more accurate results.

2] Speed Detection: It Can detect speed of a vehicle. Will be able to recognize between normal speed and overspeed of vehicle.

[3] Various Character Detection It can detect various characters and symbols of different styles and fonts on number plate.

[4] Alert System: A message or alert will be sent to admin and registered mobile number of the vehicle owner for over-speeding or for use of inappropriate design and characters of number plate. Such kind of data will be added to the record and will be stored in database for future references.

[5] KPI's (Key Performance Indicators) can be improved to show more details.

# CHAPTER 12

# REFERENCES

**REFERENCES:**

[1] A Review on Automatic Number Plate Recognition (ANPR)Technology International Conference on Intelligent Sustainable Systems (ICISS 2019) IEEE

[2] SSD: Single Shot MultiBox Detector Wei Liu1 , Dragomir Anguelov2 , Dumitru Erhan3 , Christian Szegedy3 , Scott Reed4 , Cheng-Yang Fu1 , Alexander C. Berg1

[3] Chris Henry , Sung Yooh ahn, Saang-wooh Lee W. Q. (2020) Multinational License Plate Recognition using Generalized Character Sequence.Pattern Recognition and machine learning laboratory .

[4] Irina Pustokhina, Denis Pustokhin, Deepak Gupta, Ashish Khanna. Automatic Vehicle license plate Recognition using CNN for Intelligent Transportation System Proceedings of 2020 IEEE International Conference.

[5] Multiple Vehicles Monitoring and Security System Journal of Emerging Technologies and Innovative Research (JETIR 2020)

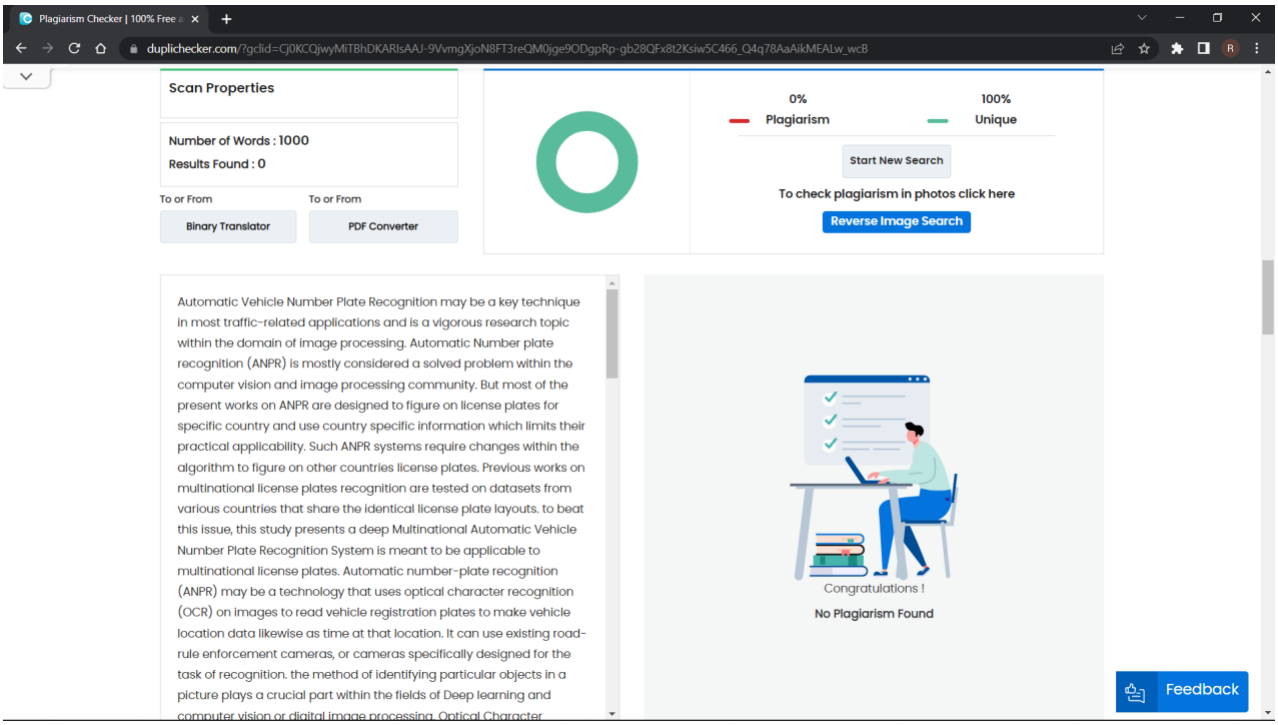
[6] Aleena Jacob, Aiswarya Mechery, Gliya Raphy,AnjuMaria Johny: Automated number plate and Over-speed Detection

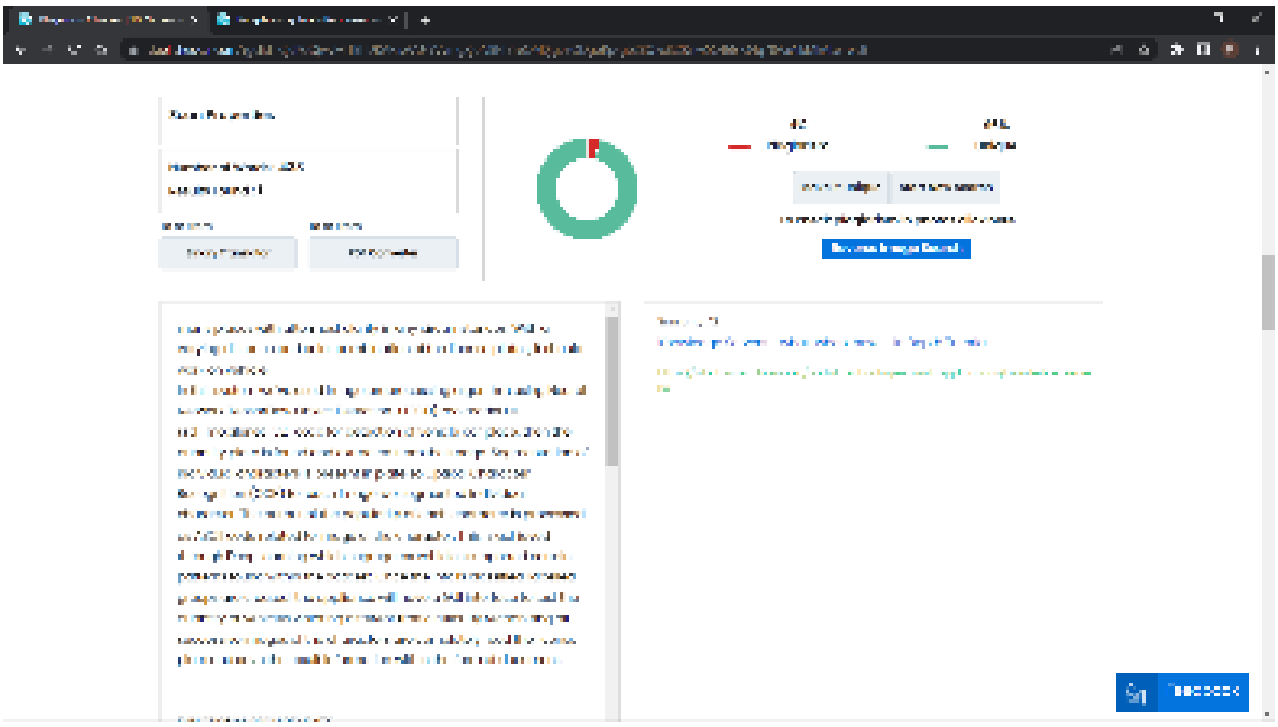
[7] An Automatic Number Plate Recognition System for Car Park Management International Journal of Computer Applications (0975 – 8887) Volume 175 – No.7, October 2017

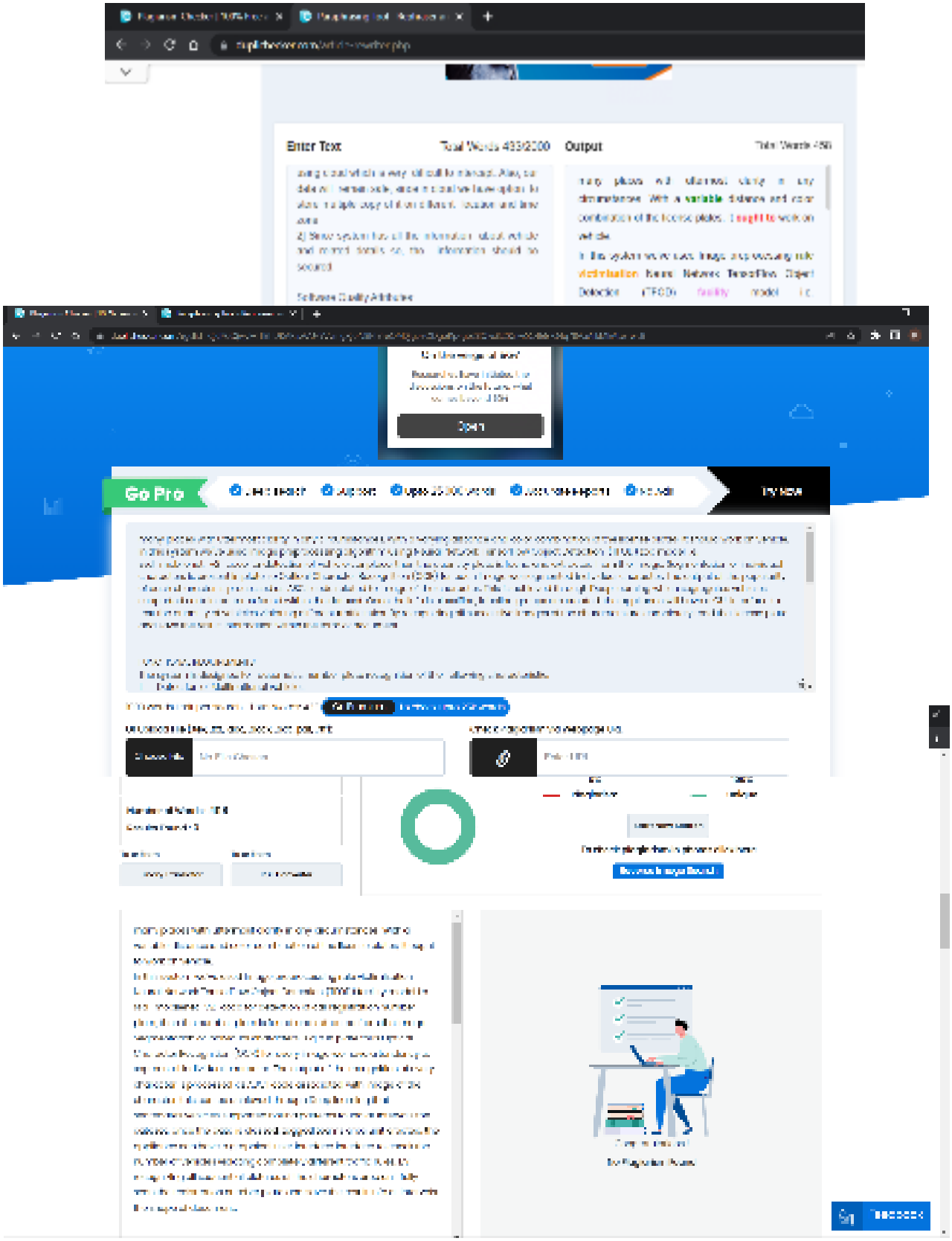
# CHAPTER 13

# PLAGIARISM REPORT

# Plagiarism Snapshot




Enter Text
Output
Go Pro

# CHAPTER 14

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# CHAPTER 15

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Mobile/Contact Number: 7058164043
Placement Details: Capgemini, Nagaroo