A REPORT ON

"AUTOMATED VEHICLE NUMBER PLATE DETECTION AND RECOGNITION"

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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2022-2023

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CERTIFICATE

This is to certify that the project report entitles

"AUTOMATED VEHICLE NUMBER PLATE DETECTION AND RECOGNITION"

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PROJECT APPROVAL SHEET

A Project Title

"AUTOMATED VEHICLE NUMBER PLATE DETECTION AND RECOGNITION"

Is successfully completed by

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ACKNOWLEDGEMENT

This has been the light of the day due to invaluable contribution of certain individuals whose constant guidance, support and encouragement resulted in the realization of our project.

We are grateful to our Guide ***Prof. Swapnali R. Bhujbal*** *and HOD of Computer Engineering,* ***Prof. Swapnali R. Bhujbal*** *for providing us the necessary help and encouragement whenever we needed, which has resulted in the success of our project.*

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Last but not the least, we are grateful to all our friends and our parents for their direct or indirect constant moral support throughout the course of this project.

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Abstract

In this project, a Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is preprocessing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principle of OCR with help of Tesser act engine. It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot. So, in order to make the entire process autonomous, we can install this system so as to automatically detect the vehicle which breaks the traffic rules, take a picture of it and store the number in the database so as to fine the respective owner afterwards. The system can be used in parking so as to take the picture of the vehicle and log the vehicle number in the database (or the cloud, if connected to the internet). This technology reduces the unnecessary hectic manual work if connected to the internet).

This technology reduces the unnecessary hectic manual work number of any vehicle once obtained as text, can be displayed, saved in the database or can be searched through the entire database for the details. This project is so versatile that it can be used as an entire application once converted to a software or can be used as a part of any big project.

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CHAPTER 1

INTRODUCTION

Automatic vehicle license plate detection and recognition is a key technique in most of traffic related applications and is an active research topic in the image processing domain. Different methods, techniques and algorithms have been developed for license plate detection and recognition.

A Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is pre-processing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principle of OCR with help of Tesseract engine. It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot. So, in order to make the entire process autonomous, we can install this system so as to automatically detect the vehicle which breaks the traffic rules, take a picture of it and store the number in the database so as to fine the respective owner afterwards. The system can be used in parking so as to take the picture of the vehicle and log the vehicle number in the database (or the cloud, if connected to the internet). This technology reduces the unnecessary hectic manual work if connected to the internet). This technology reduces the unnecessary hectic manual work number of any vehicle once obtained as text, can be displayed, saved in the database or can be searched through the entire database for the details. This project is so versatile that it can be used as an entire application once converted to a software or can be used as a part of any big project.

1.1 MOTIVATION OF THE PROJECT

In countries where ANPR systems have been implemented required availability of funds and human labor to cover streets and highways with specialized cameras.Some of the cameras perform in-lane processing and send only the text to a remote server to store. Ordinary CCTV cameras in India record and store the entire video feed in a remote storage. Hence we have designed a program which can utilize the video feed previously recorded by a camera to detect and store the number plate in text format in the local machine where the detection was performed.

1.2 PROBLEM DEFINITION

Automatic Number Plate Recognition System is the identification system of vehicles. It is an image processing technology used to identify the vehicles only by their license plates. Automatic Number Plate Recognition ANPR plays am major role in management of parking areas, and surveillance of illegally parked vehicles. Since every vehicle has a unique number plate so it can be identified by its number plate. The classification is utilized for the electronic toll-collection system (ETC) and to display available parking spaces to vehicles. The identification is also employed for managing parking and security systems such as observation of stolen vehicles and monitoring of unauthorized vehicles entering private areas.

1.3 OBJECTIVE STATEMENTS

- Image Acquisition using the computer’s primary camera.
- Image Enhancement and pre-processing to improve the quality of the image and convert the image to binary scale so as to use it in contour extraction.
- Extract the number plate region from the binary image and display it separately

CHAPTER 2

LITERATURE SURVEY

Automated Vehicle Number Plate Detection and Recognition,(ANPR) is a technology that uses optical character recognition on images of vehicle registration plates to read the vehicle's registration number. An automatic license plate recognition system applies different image processing techniques to quickly and automatically identify vehicles in video or photo footage.

2.1 SUMMARY OF LITERATURE REVIEW

Sr.No.	Title	Authors	Approach	Advantages	Challenges
1	Vehicle Number Plate Detection System for Indian Vehicles	Hanit Karwal, Akshay Girdhar [3]	Proposed an efficient algorithm for the recognition of position of characters.	Algorithm was quite efficient, addressed the problems of scaling with decent amount of accuracy.	Less number of sample taken.
2	Characters feature based Indian vehicle license plate detection and recognition	Sudhir K. Ingole, Shital B. Gundre [2]	Based on recognising the characters on the license plate, using an adaptive pre-processing method.	Robust in extricating single line number plate.	Failed to segment double row number plate
3	Automatic Number Plate Recognition (ANPR) system for Indian conditions	Prathamesh Kulkarni, Ashish Khatri, Prateek Banga, Kushal Shah [4]	Comprised of a mixture of algorithms, for example, Feature- based number plate Localization for finding the tag, Image Scissoring for character division and factual element extraction forcharacter acknowledgment.	The system recognized single and double row license plates with an accuracy of 82per.	The major restrictions faced by them in their work were attributed to parameter such as speed of the vehicle and skew in the image.
4	Indian car Number Plate Recognition using Deep Learning	R Naren Babu, V Sowmya, K P Soman [5]	Proposed an efficient license plate recognition model for different illumination and camera angle views Training of the manually collected number plate dataset was carried out by employing the YOLO V3.	Overcame the previous restrictions that were faced by people in their work done prior.	Failed to deal with the similarity problem between 0 and o and realized the need to apply image processing techniques for better character recognition.

Table 2.1: SUMMARY OF LITERATURE REVIEW

CHAPTER 3

SOFTWARE REQUIREMENTS SPECIFICATION

3.1 DETAILS OF PROCESSING

3.1.1 Basics of Digital Image Processing

The image of a vehicle whose number plate is to be recognised is taken from a digital camera which is then loaded to a local computer for further processing. Open CV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. In simple language it is a library used for Image Processing. It is mainly used to do all the operations related to Images. Python, being a versatile language, is used here as a programming language. Python and its modules like Numpy, Scipy, Matplotlib and other special modules provide the optimal functionality to be able to cope with the flood of pictures. To enhance the number plate recognition further, we use a median filter to eliminate noises but it not only eliminates noise. It concentrates on high frequency also. So it is more important in edge detection in an image, generally rectangular plate. Image Processing mainly involves the following steps:

3.1.2 Image Processing mainly involves the following steps

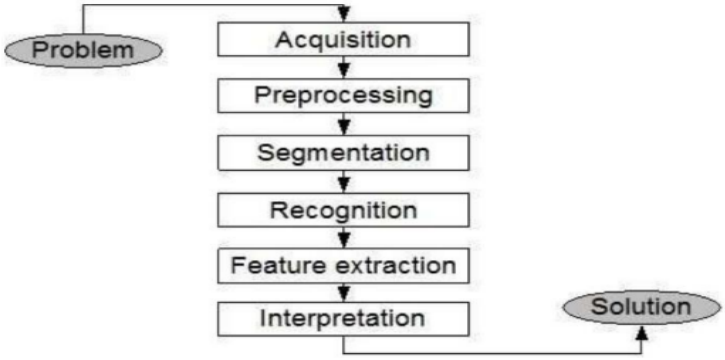

Figure 3.1: Details of Processing

- 1. Image acquisition: This is the first step or process of the fundamental steps of digital image processing. Image Acquisition is the capturing of an image by any physical device (in this case the primary camera of the computer) so as to take the input as a digital image in the computer.

- 2. Image Enhancement: Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. Such as, changing brightness and contrast etc. In this step the quality or rather the clarity of the input image is enhanced and the image is made clear enough to be processed.

- 3. Morphological Processing: Morphological operations apply a structuring element to an input image, creating an output image of the same size. The image is converted to a Automatic Number Plate Recognition Using Deep Learning. Binary image, making it more to apply structural extraction to the image and extract any structure related to a particular mathematical model from it, in this case a license plate.

- 4. Segmentation: Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward a successful solution of imaging problems that require objects to be identified individually.

- 5. Representation: Representation and description almost always follow the output of a segmentation stage, which usually is raw pixel data, constituting either the boundary of a region or all the points in the region itself. Choosing a representation is only part of the solution for transforming raw data into a form suitable for subsequent computer processing. Description deals with extracting attributes that result in some quantitative information of interest or are basic for differentiating one class of objects from another.

- 6. Recognition: Recognition is the process that assigns a label, such as, “Plate” to an object based on its descriptors Optical Character Recognition: Optical character recognition or optical character reader, often abbreviated as OCR, is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example from a television broadcast).

3.1.3 Project Scope

As a future work the developed system would be concentrated upon increasing the accuracy of text localization and graphics removal in caption text images. It can be evaluated using various other available image data bases and using various other classifiers

3.1.4 Methodologies of Problem Solving And Efficiency Issues

It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can’t catch a vehicle which broke traffic rules.

3.2 OUTCOME

The Automatic number plate recognition (ANPR) utilizes the character recognition on the pictures to read the license plates on vehicles, which is considered as a mass surveillance method. They can utilize the current closed-circuit television or road-rule enforcement cameras, or ones particularly framed for the task.

3.3 HARDWARE REQUIREMENT

- Disk space: 1 GB
- Operating systems: Windows 10 or later, MacOS, and Linux
- Processors: Intel Core i3 processor or later
- Camera set as primary camera

3.4 SOFTWARE REQUIREMENT

- Python versions: 3.9.6 and above
- Python and Java Code IDE
- Included Python packages: NumPy, SciPy, scikit-learn, pandas, Matplotlib, Numba, Intel Threading Building Blocks, pyDAAL, Jupyter, mpi4py, PIP, and others.
- Compatible tools: Microsoft Visual Studio, PyCharm

3.5 PROJECT RESOURCES

- Human Resources:
- Team of four people is working collaboratively.

3.6 REQUIRED PACKAGES

- Python 3.9.6 and above : Python is an interpreter, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python’s design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aims to help programmers write clear, logical code for small and large-scale projects. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is often described as a ”batteries included” language due to its comprehensive standard library.

- Python was conceived in the late 1980s as a successor to the ABC language. Python 2.0, released 2000, introduced features like list comprehensions and a garbage collection system capable of collecting reference cycles. Python 3.0, released 2008, was a major revision of the language that is not completely backward-compatible, and much Python 2 code does not run unmodified on Python 3. Due to concern about the amount of code written for Python 2, support for Python 2.7 (the last release in the 2.x series) was extended to 2020. Language developer Guido van Rossum shouldered sole responsibility for the project until July 2018 but now shares his leadership as a member of a five-person steering council.Python interpreters are available for many operating systems. A global community of programmers develops and maintains CPython, an open source reference implementation. A non-profit organizaxtion, the Python Software Foundation, manages Python and CPython.

3.7 LIBRARIES

Python's large standard library, commonly cited as one of its greatest strengths,provides tools suited to many tasks. For Internet-facing applications, many standard formats and protocols such as MIME and HTTP are supported. It includes modules for creating graphical user interfaces, connecting to relational databases, generating pseudo random numbers, arithmetic with arbitrary precision decimals, manipulating regular expressions, and unit testing Some of that:

3.7.1 Easy OCR

Optical character recognition or optical character reader (OCR) is the electronic or mechanical conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo). Widely used as a form of data entry from printed paper data records – whether passport documents, invoices, bank statements,computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation – it is a common method of digitizing printed texts so that they can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as cognitive computing, machine translation, (extracted) text-to speech, key data and text mining. OCR is a field of research in pattern recognition, artificial intelligence.

3.7.2 The whole process of OCR is depicted below:

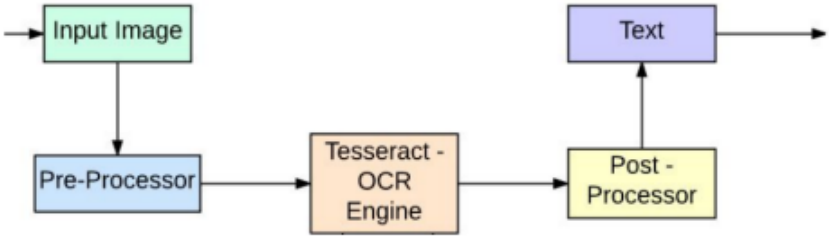

Figure 3.2: Working of OCR

3.7.3 Opencv

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

OpenCV is a Python library that allows you to perform image processing and computer vision tasks. It provides a wide range of features, including object detection, face recognition, and tracking.

OpenCV is a library of programming functions mainly for real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage, then Itseez. The library is cross-platform and licensed as free and open-source software under Apache License 2

3.7.4 Tensorflow

TensorFlow is an end-to-end open source platform for machine learning. TensorFlow is a rich system for managing all aspects of a machine learning system; however, this class focuses on using a particular TensorFlow API to develop and train machine learning models.TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. TensorFlow can be used in a wide variety of programming languages, including Python, JavaScript, C++, and Java.

TensorFlow is a free and open-source software library for machine learning

and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. TensorFlow is an open-source machine learning framework, and Python is a popular computer programming language. It's one of the languages used in TensorFlow. Python is the recommended language for TensorFlow, although it also uses C++ and JavaScript.

3.8 RISK MANAGEMENT

We start with the idea of a decision problem, a problem for which an algorithm can always answer yes or no.

3.9 RISK IDENTIFICATION

risks identification, review of scope document, requirements specifications and schedule is done. Answer to questionnaire revealed some risks. Each risk is categorized as per the categories mentioned in. Please refer table 4.1 for all the risks. You can referred following risk identification questionnaire.

3.10 TEAM ORGANIZATION

There is regular communication between the team members and the respective project guide. Meetings are conducted at regular time intervals. There is a good coordination between team members and the guide. Discussions and research are done at every stage

3.11 TEAM STRUCTURE

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CHAPTER 4

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

4.1.1 Architectural Design

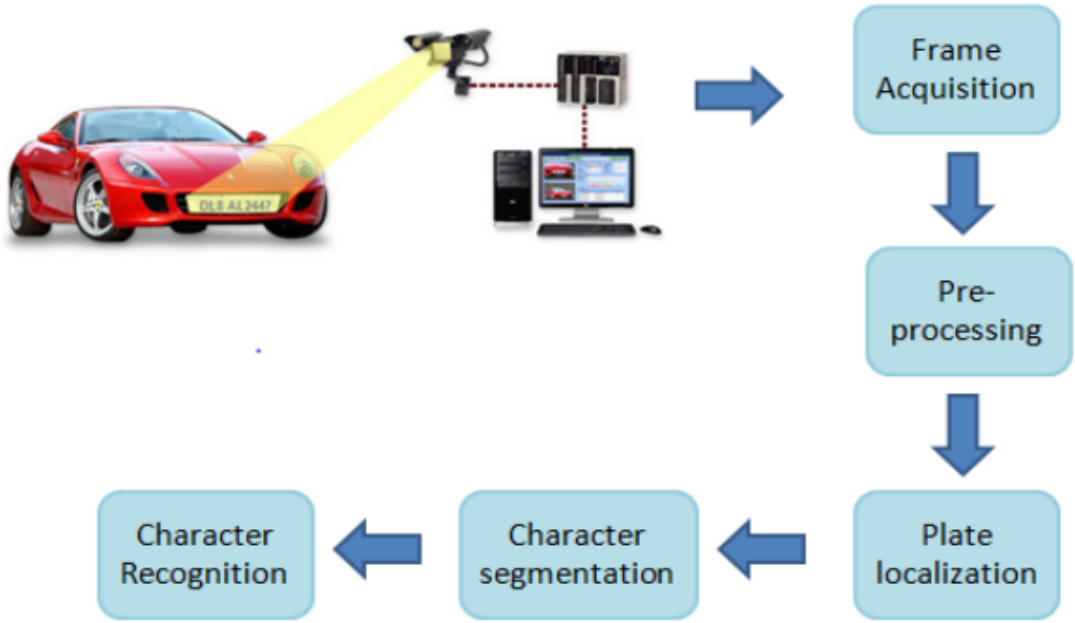

Figure 4.1: System Architecture

4.1.2 Data Flow Diagrams

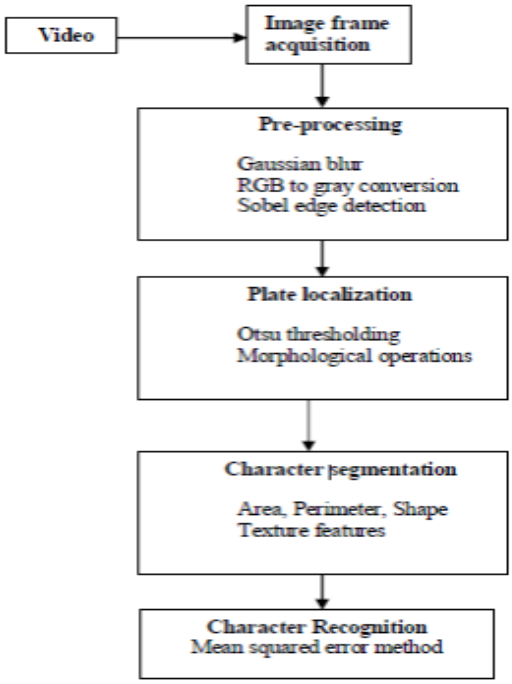

Figure 4.2: Data Flow Diagrams

4.2 UML DIAGRAMS

4.2.1 Activity Diagram

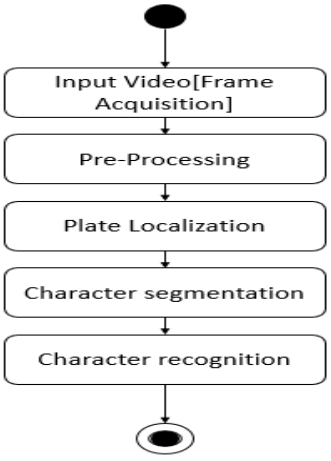

Figure 4.3: Activity Diagram

4.2.2 Class Diagram

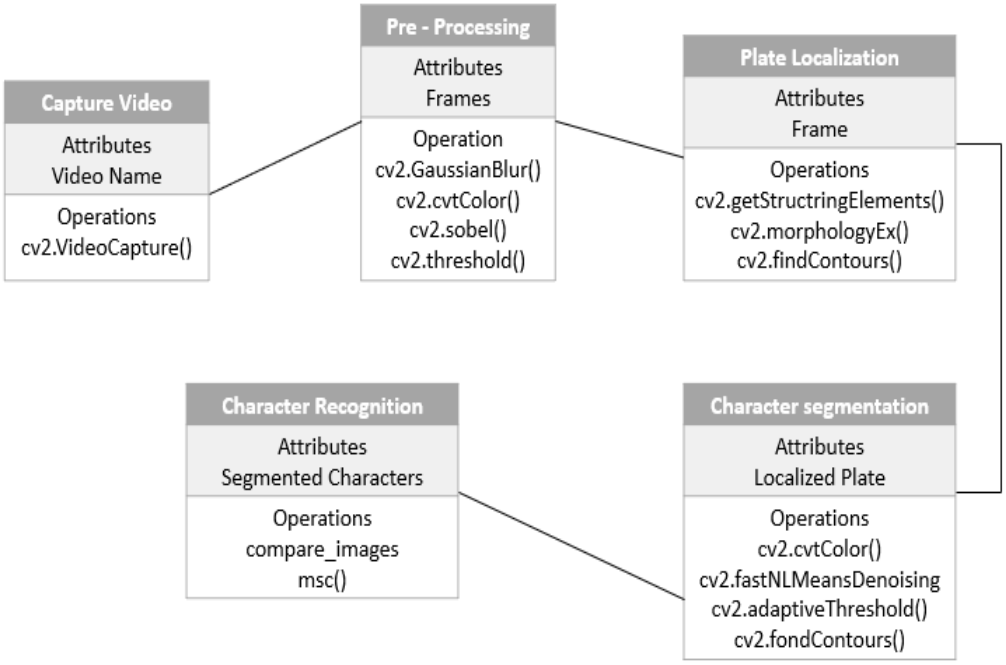

Figure 4.4: Class Diagram

CHAPTER 5

OTHER SPECIFICATIONS

5.1 ADVANTAGES

- Automatic number plate recognition cameras are used to measure the average vehicle speed over longer distances.
- Used to identify a motorist when he/she drives away without paying for their fuel.
- Targeted advertisement.
- Automatic number plate recognition cameras are used for Traffic management systems.
- Used to analyse the behaviour (route choice, origin-destination etc.) of a motorist for transport planning purposes.
- ANPR camera solutions automatically recognize customers based on their license plate and provide them the complete information about the items that they ordered the last time they used the service.
- Automatic license plate recognition camera solutions are used to recognize the guest vehicles in order to assist visitor management systems.

5.2 APPLICATIONS

Automatic Number Plate Recognition has a wide range of applications since the license number is the primary, most widely accepted, human readable, mandatory identifier of motor vehicles. ANPR provides automated access to the content of the number plate for computer systems managing databases and processing information

of vehicle movements. Below we indicated some of the major applications, without the demand of completeness:

- Parking: One of the main applications of ANPR is parking automation and parking.
- Security: ticket less parking fee management, parking access automation, vehicle location guidance, car theft prevention, "lost ticket" fraud, fraud by changing tickets,simplified, partially or fully automated payment process, amongst many others.
- Access Control: Access control in general is a mechanism for limiting access to areas and resources based on users' identities and their membership in various predefined groups. Access to limited zones, however, may also be managed based on the accessing vehicles alone, or together with personal identity. License plate recognition brings automation of vehicle access control management, providing increased security, car pool management for logistics, security guide assistance, event logging, event management, keeping access diary, possibilities for analysis and data mining.
- Border Control: Border Control is an established state-coordinated effort to achieve operational control of the country's state border with the priority mission of supporting the homeland's security against terrorism, illegal cross border traffic, smuggling and criminal activities. Efficient border control significantly decreases the rate of violent crime and increases the society's security. Automatic number plate recognition adds significant value by event logging, establishing investigate-able databases of border crossings, alarming on suspicious passing, at many more.

5.3 LIMITATIONS OR CHALLENGES

5.4 FUTURE SCOPE

As a future work the developed system would be concentrated upon increasing the accuracy of text localization and graphics removal in caption text images. It can be evaluated using various other available image data bases and using various other classifiers.

5.5 WORKING MODULE

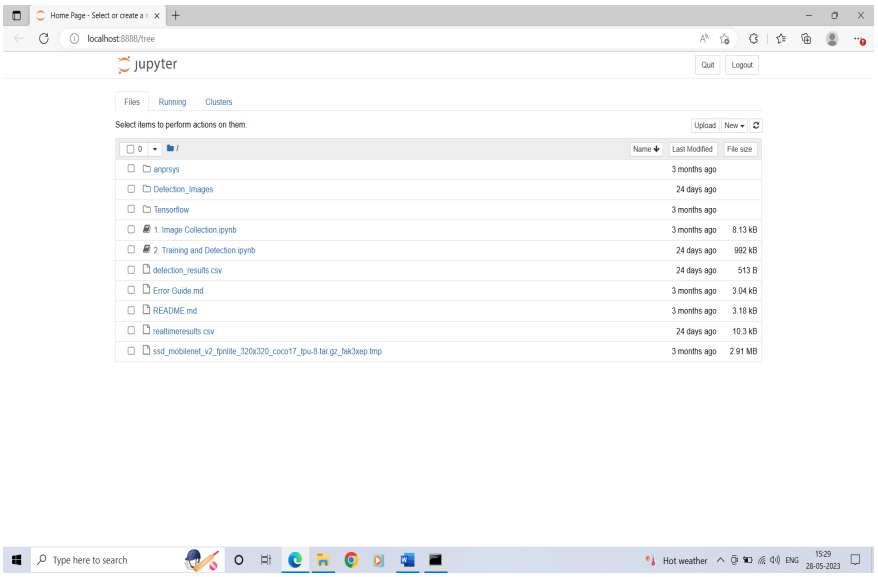

Figure 5.1: Module1

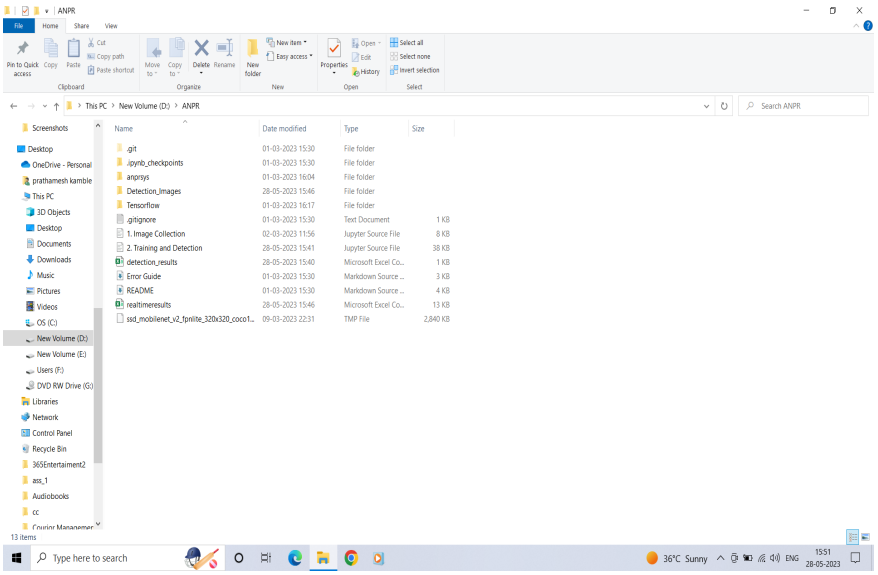

Figure 5.2: Module2

5.5.1 Output

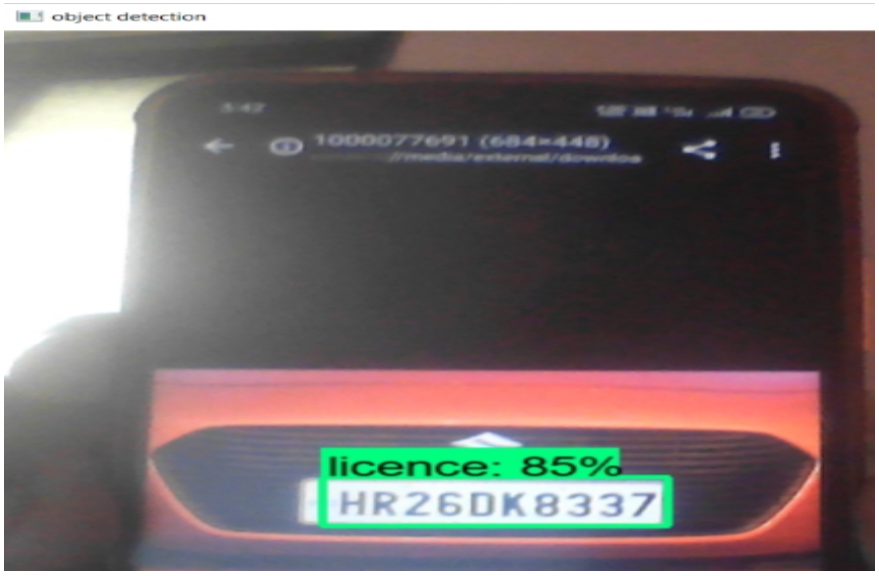

Figure 5.3: Output: Scanning and Saving to number plate

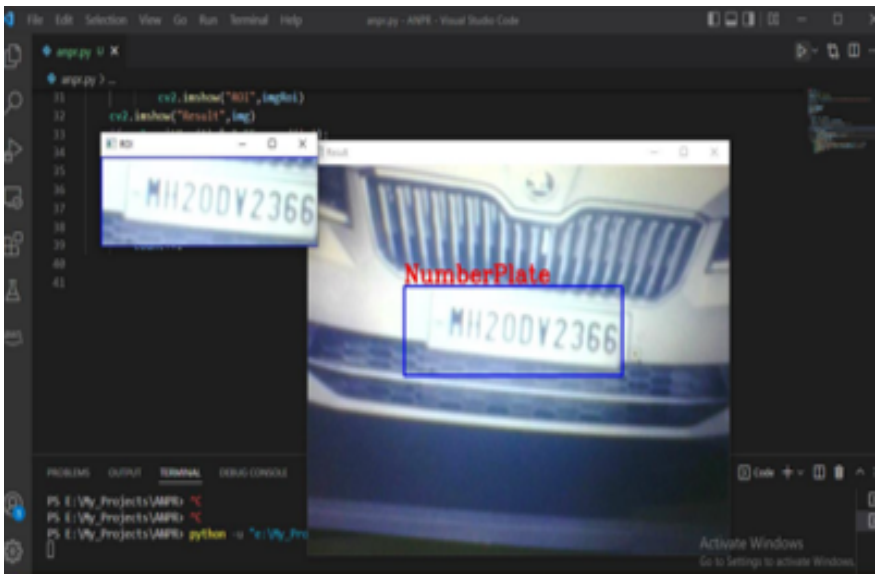

Figure 5.4: Recognizing Characters From Number Plate

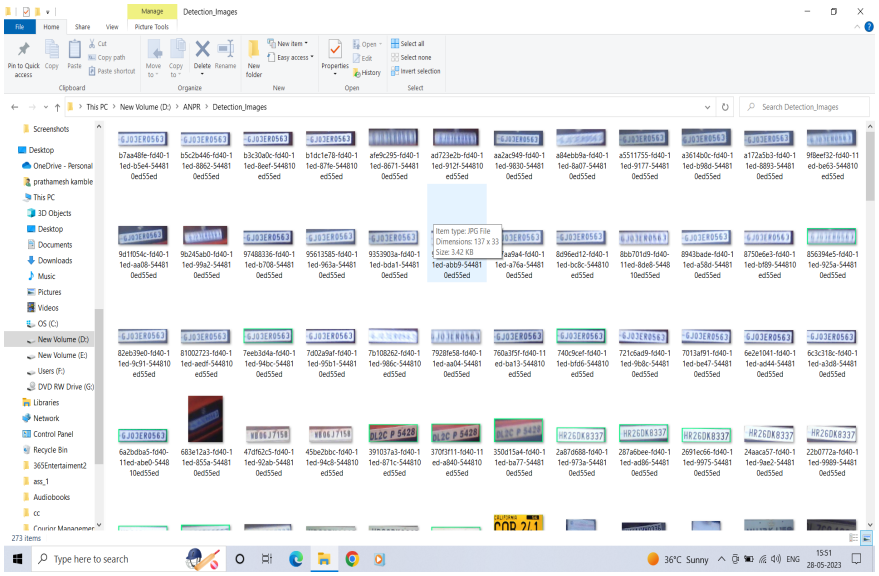

Figure 5.5: Stored Capture Image of Number Plate

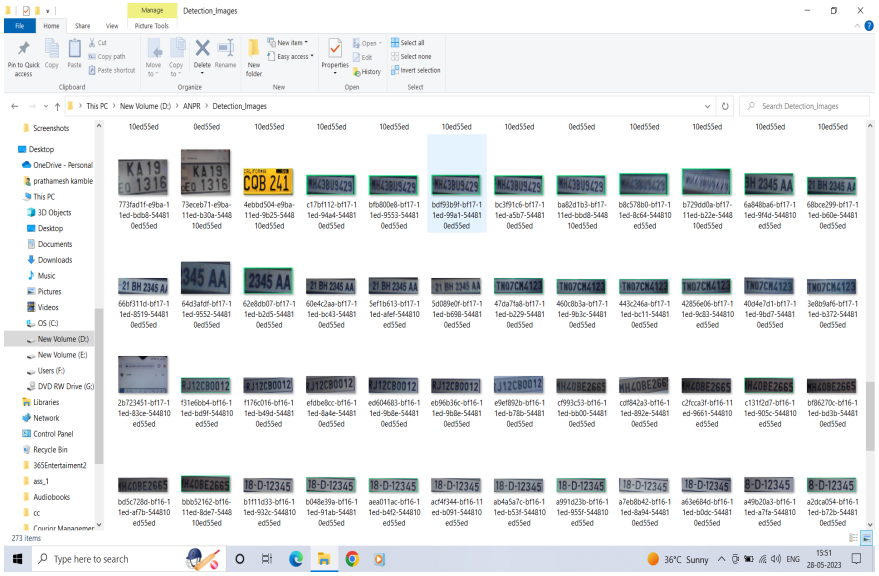

Figure 5.6: Stored Capture Image of Number Plate

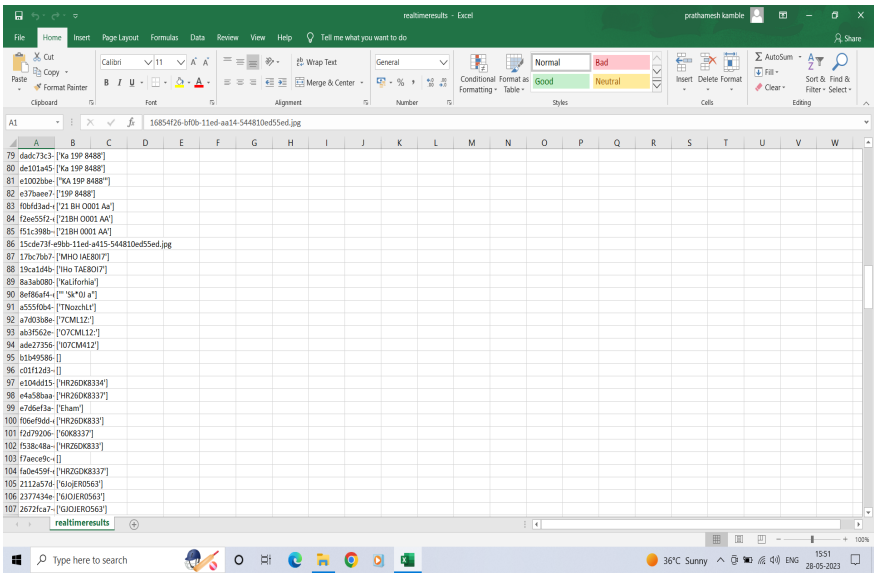

Figure 5.7: Stored Capture Text of Number Plate

CHAPTER 6

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Appendices

APPENDIX A

BASE PAPER

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Automated Vehicle Number plate Detection and Recognition

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***Abstract*—With the emergence of information technology in the last decade, and the ever growing population, several approaches have been implemented and thought of regarding building an information system about Vehicle Number plate Detection. Among the 7.6 billion people living on this planet, approximately 1.4 billion own a vehicle that accounts for 18% of the world's total population, which calls for an intelligent information system that provides meaning out of the collected data and has useful applications in the domain of quotidian problems. The concept of Vehicle Number plate Detection and Recognition (VNDR) is an application of the computer vision domain entailing phases like detection, image processing and character recognition. This paper reviews the numerous methodologies which have been employed for better accuracy in recognition of vehicle number plates.**

Keywords*—Number plate Detection and Recognition, Image Processing, Character Recognition, Computer Vision

I. INTRODUCTION

National Highways comprise the essential arrangement of road transportation in India [1]. They are the fundamental expressways going through length and expansiveness of the nation, associating capitals of States and UT's, significant ports, rail intersections, modern and places of interest and connection up with fringe streets and thruways of neighboring countries. National Highways encompass 1.94% of entire road network of the nation [1]. With the increase in the population and as a result in the number of vehicles in India, vehicle surveillance proves to be the need of the hour. Vehicle Number plate Detection is an automated vehicle monitoring system that fetches the images of on-going traffic and detects using the extracted number plate. As of late, the idea of automated number plate detection promises to play a vital part in the development of smart cities as an oversight framework for a vehicle following the traffic guidelines. VNDR has been enormously utilized in automated security frameworks across numerous nations. Many popularized VNDR frameworks have utilized Deep Learning (DL) Algorithms. Automated VNDR is still an open issue because of the immense variety in picture Acquisition state and the Number plate design, which differs in various nations.

Automated Vehicle Number plate Detection system has many applications some of which are, computerized traffic following and tallying framework, mechanized parking framework, robotized cost assortment frameworks, and vehicle classification. The system of Vehicle Number plate Detection and Recognition consists of 3 phases- Number Plate Detection, Image Processing (IP) and Recognition of characters. The following paper presents an in-depth review of various image processing algorithms and other methods which have been used to provide results with a better accuracy at different points in time. The paper is organized to present a literature review on existing works in automated VNDR systems.

II. VEHICLE NUMBERPLATE DETECTION AND RECOGNITION

Problems such as image noise, sensor noise, weather disturbances, varying illumination conditions, hardware challenges, lack of standardization in number plates, usage of different languages on number plates, speed of vehicle and image skew, etc., have been dominating this system for years now and some of these have been effectively handled in today's world. In Fig. 1, we have illustrated a general framework to solve the VNDR problem using latest Computer Vision (CV) techniques available.

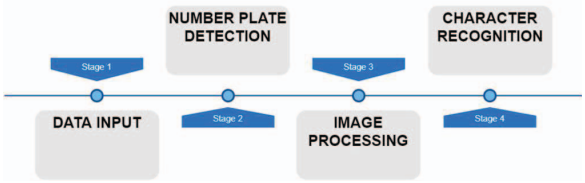

Fig. 1. General flow of VNDR problem solution

Latest development in automated VNDR consists of above mentioned three phases of detection, image processing and recognition of characters. Image processing is done to clean and pre-process the real-time traffic frames, to improve the accuracy of results in later stages, before these are used to detect and localize the coordinates of number plates within an input frame. The detection and localization can even be performed before, followed by the image pre-processing. After this, the characters are extracted from the localized or recognized number plates, and then some form of Optical Recognition Technique (OCR) is applied to match these extracted characters. The image processing phase can be divided into various sub-stages, each of which individually deals with one factor or aspect of the image. This results into designing a robust sequence of steps under IP phase to extract useful number plate information from real-time traffic frames even in varying situations or from damaged and sheared number plates.

III. COMPARATIVE STUDY

Sudhir K. Ingole and Shital B. Gundre introduced a methodology dependent on perceiving the characters on the

license plate by utilizing a versatile pre-handling strategy and division of character was done by utilizing vertical and level projection of the removed number plate [2]. Character acknowledgment was done utilizing K-nearest neighbor classifier dependent on feature vector which was removed from the boundary examination of the character. They neglected to section the twofold line vehicle plate as the proposed division technique didn't work for it [2].

Hanit Karwal and Akshay Girdhar proposed a proficient algorithm which tended to the issues of scaling and recognition of position of characters with a good measure of exactness [3].

Prathamesh Kulkarni, Ashish Khatri, Prateek Banga and Kushal Shah presented their work which consisted of an amalgamation of algorithms such as - Feature-based number plate Localization for locating the license plate, Image Scissoring for character division and statistical feature extrication for character recognition [4]. The major restrictions faced by them in their work were attributed to parameter such as speed of the vehicle and skew in the image.

R Naren Babu, V Sowmya and K P Soman proposed a learning based approach for the license plate recognition system [5]. The main objective of their paper was to overcome the previous restrictions that were faced by people in their work done prior. The paper presents an efficient vehicle plate detection model that works well with varied illuminations and camera angle views. Training of the manually collected number plate dataset was carried out by employing the YOLO V3. Biggest takeaways from their study were the realisation to deal with the similarity problem between 0 and o and to apply image processing techniques for better character recognition [5].

B. Sachin Prabhu, Subramaniam Kalambur and Dinkar Sitaram compared the accurateness of three pathways to recognize vehicle license plates [6]. They chose OpenALPR, k-NN and Convolutional Neural Networks (CNN) based pathways and compared their results. Their results demonstrated that the CNN based pathway is better for detecting license plates in India [6].

Jaskirat Singh and Bharat Bhushan planned a productive methodology for License Plate Recognition in the images using deep neural networks. They pre-processed the detected license plates and performed License Plate Recognition (LPR) using LSTM Tesseract OCR Engine and achieved a precision of 99% with LPR exactness of 95%. Future objective incorporates upgrading the size of the picture dataset [7].

Many other state-of-the-art researches have been carried out globally by different enthusiasts in this domain of automated vehicle classification and license or number plate detection [8][9][10][11][12][13][14][15]. A review of the above mentioned works is summarized, along with their respective advantages and challenges, in Table I as depicted below.

TABLE I. REVIEW OF EXISTING WORKS

S.No.	*Title*	*Authors*	*Approach*	*Advantages*	*Challenges/Future Goals*
1.	Characters feature based Indian vehicle license plate detection and recognition	Sudhir K. Ingole, Shital B. Gundre [2]	Based on recognising the characters on the license plate, using an adaptive pre-processing method.	Robust in extricating single line number plate.	Failed to segment double row number plate.
2.	Vehicle Number Plate Detection System for Indian Vehicles	Hanit Karwal, Akshay Girdhar [3]	Proposed an efficient algorithm for the recognition of position of characters.	Algorithm was quite efficient, addressed the problems of scaling with decent amount of accuracy.	Less number of sample taken.
3.	Automatic Number Plate Recognition (ANPR) system for Indian conditions	Prathamesh Kulkarni, Ashish Khatri, Prateek Banga, Kushal Shah [4]	Comprised of a mixture of algorithms, for example, Feature-based number plate Localization for finding the tag, Image Scissoring for character division and factual element extraction for character acknowledgment.	The system recognized single and double row license plates with an accuracy of 82%.	The major restrictions faced by them in their work were attributed to parameter such as speed of the vehicle and skew in the image.

4.	Indian Car Number Plate Recognition using Deep Learning	R Naren Babu, V Sowmya, K P Soman [5]	Proposed an efficient license plate recognition model for different illuminations and camera angle views. Training of the manually collected number plate dataset was carried out by employing the YOLO V3.	Overcame the previous restrictions that were faced by people in their work done prior.	Failed to deal with the similarity problem between 0 and o and realized the need to apply image processing techniques for better character recognition.
5.	Recognition of Indian license plate number from live stream videos	B. Sachin Prabhu, Subramaniam Kalambur, Dinkar Sitaram [6]	Selected OpenALPR, k-NN and Convolutional Neural Networks (CNN) based procedures, adjusted them for neighborhood conditions and analyzed their exactness on both still pictures and live transfer recordings.	CNN based approach was found to be better than the k-NN based approach.	Indian Number plates were not consistent and the model needs to be fed with multiple fonts for better accuracy.
6.	Real Time Indian License Plate Detection using Deep Neural Networks and Optical Character Recognition using LSTM Tesseract	Jaskirat Singh, Bharat Bhushan [7]	Planned a model for Number Plate Detection and Recognition from the pictures utilizing deep neural networks. Pre-prepared the distinguished number plates and performed License Plate Recognition (LPR) utilizing LSTM Tesseract OCR Engine.	Accomplished great outcomes with LPD precision of 99% and LPR exactness of 95%.	Future goal includes enhancing the size of the dataset and to incorporate number plate datasets of different nations.

IV. Conclusion and Future Scope

Vehicle Number plate Detection is developed using a vehicle number plate dataset. Camera captures real-time images of the traffic, from various locations, angles and distances from which the number plates were detected. The reviewed and proposed systems were successful in correctly detecting the number plates and some of them were also robust in detecting damaged and sheared number plates. These systems worked well under different illumination conditions, as some of these employed several image processing algorithms, which helped their models to yield satisfactory results and form a good balance between recognition time and performance accuracy. Fig. 2 and Fig. 3 illustrate a bar graph [16] [17] [18] and a pie chart [19] [20] [21] respectively, showing the average number of works or publications in some Vehicle Number plate Detection techniques (VNDR) between the years 2016 to 2020 [15].

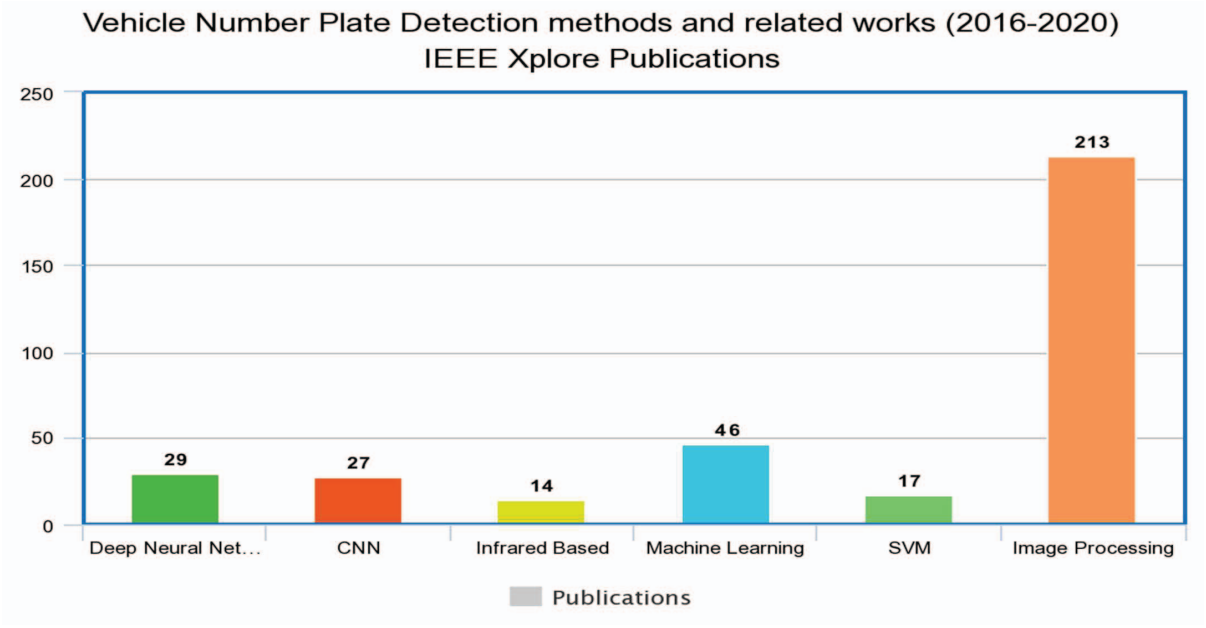

Fig. 2. Bar graph on VNDR techniques

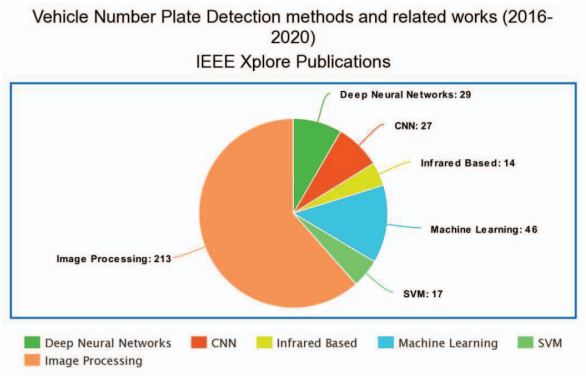

Fig. 3. Pie chart on VNDR techniques

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APPENDIX B

SYNOPSIS

A

PROJECT SYNOPSIS

ON

"AUTOMATED VEHICLE NUMBER PLATE DETECTION AND RECOGNITION"

SUBMITTED
FOR THE DEGREE OF

BACHELOR OF ENGINEERING
(Computer Engineering)
BY

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SAVITRIBAI PHULE PUNE UNIVERSITY
Year: 2022 – 23

ABSTRACT

In this project, a Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is pre-processing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principle of OCR with help of Tesseract engine. It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot. So, in order to make the entire process autonomous, we can install this system so as to automatically detect the vehicle which breaks the traffic rules, take a picture of it and store the number in the database so as to fine the respective owner afterwards.

The system can be used in parking so as to take the picture of the vehicle and log the vehicle number in the database (or the cloud, if connected to the internet). This technology reduces the unnecessary hectic manual work if connected to the internet). This technology reduces the unnecessary hectic manual work number of any vehicle once obtained as text, can be displayed, saved in the database or can be searched through the entire database for the details. This project is so versatile that it can be used as an entire application once converted to a software or can be used as a part of any big project.

INTRODUCTION

In Automated Vehicle Number Plate Detection and Recognition, ANPR is a technology that uses optical character recognition on images of vehicle registration plates to read the vehicle's registration number. An automatic license plate recognition system applies different image processing techniques to quickly and automatically identify vehicles in video or photo footage. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot. So, in order to make the entire process autonomous, we can install this system so as to automatically detect the vehicle which breaks the traffic rules, take a picture of it and store the number in the database so as to fine the respective owner afterwards. A Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is pre-processing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principle of OCR with help of Tesseract engine. It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules.

ANPR systems generally comprises of a camera, software to compare the transformed license plate characters to databases in the system and a user interface to display the images captured with results of transformation. A license plate recognition system generally works in four main parts namely image acquisition, license plate detection, character segmentation and character recognition.

The main purpose of this project is to detect a license plate from a video provided by a camera. An efficient algorithm is developed to detect a license plate in various luminance conditions. This algorithm extracts the license plate data from an image and provides it as an input to the stage of Car License Plate Recognition. Extracted image of the number plate can be seen on monitor. The scope of this project is to detect the license plate from the given image and observe the output on monitor. This project can work as a base for future improvements in the field of image processing, especially in license plate extraction and plate number recognition.

PROBLEM DEFINATION:

Automatic vehicle license plate detection and recognition is a key technique in most of traffic related applications and is an active research topic in the image processing domain. Different methods, techniques and algorithms have been developed for license plate detection and recognitions.

GOALS AND OBJECTIVES:

- Image Acquisition using the computer's primary camera.
- Image Enhancement and pre-processing to improve the quality of the image and convert the image to binary scale
- so as to use it in contour extraction.
- Extract the number plate region from the binary image and display it separately.

SCOPE OF STATEMENTS:

- As a future work the developed system would be concentrated upon increasing the accuracy of text localization and graphics removal in caption text images. It can be evaluated using various other available image data bases and using various other classifiers.
- The proposed methods can be further improvised and applied for automatic mixed mail sorting.
- The implementation of the proposed system can be extended for the recognition of number plates of multiple vehicles in a single image frame.
- User friendly android applications can be developed for traffic surveillance management systems.

METHODOLOGIES OF PROBLEM SOLVING AND EFFICIENY ISSUES:

It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can’t catch a vehicle which broke traffic rules.

OUTCOME:

The Automatic number plate recognition (ANPR) utilizes the character recognition on the pictures to read the license plates on vehicles, which is considered as a mass surveillance method. They can utilize the current closed-circuit television or road-rule enforcement cameras, or ones particularly framed for the task.

LITERATURE SURVEY:

Author /Year of Publication	Title	Strength	Weakness
Mahesh Kini M Karthik Pai Department of Computer Science and Engi neering Department of Computer Science and Engineering NMAM Institute of Technology, India, 2019	A Survey on Video Sum marization Techniques	Deliver video sum maries of high visual quality.	The accuracy of the result depends on the extracted feature, when wrong features are selected then the accuracy decreases.
Sandra E. F. de Avila† , Antonio da Luz Jr,Arnaldo de A. Araujo ´,and Matthieu Computer Science Department — Federal University of Minas Gerais	VSUMM: An Approach for Automatic Video Summa rization and Quantitative Evaluation	Presented a simple and efficient ap proach for video summarization, good quality summaries.	Nothing is said about the running time of the method.
Mrs. Poonam S. Jadhav, Department of Information Tech nology, Ramrao Adik Institute Of Tech nology,Navi Mum bai,400706,India,2015	Video Summa rization using Higher Order Color Moments	Image histogram, skewness and kurto sis	Not tested on differ ent genres of videos (cartoons, sports, Tv-Technologies) Enhanced is required for video skimming
Muhammad Bagus Andra Department of Computer Science and Kumamoto Uni versity Kumamoto, Japan	Automatic Lecture Video Content Sum marization with Attention- based Recurrent Neu ral Network	Natural and able to capture the impor tant words and con vey the key topic of the lecture.	Convolution network needs large data for training.

APPLICATIONS:

- The proposed system overcomes the above Disadvantages and apart from them has the beneath specified benefits.
- Automated framework requiring less labour.
- Number is displayed and with some modification can be stored in a database or be searched or processed.

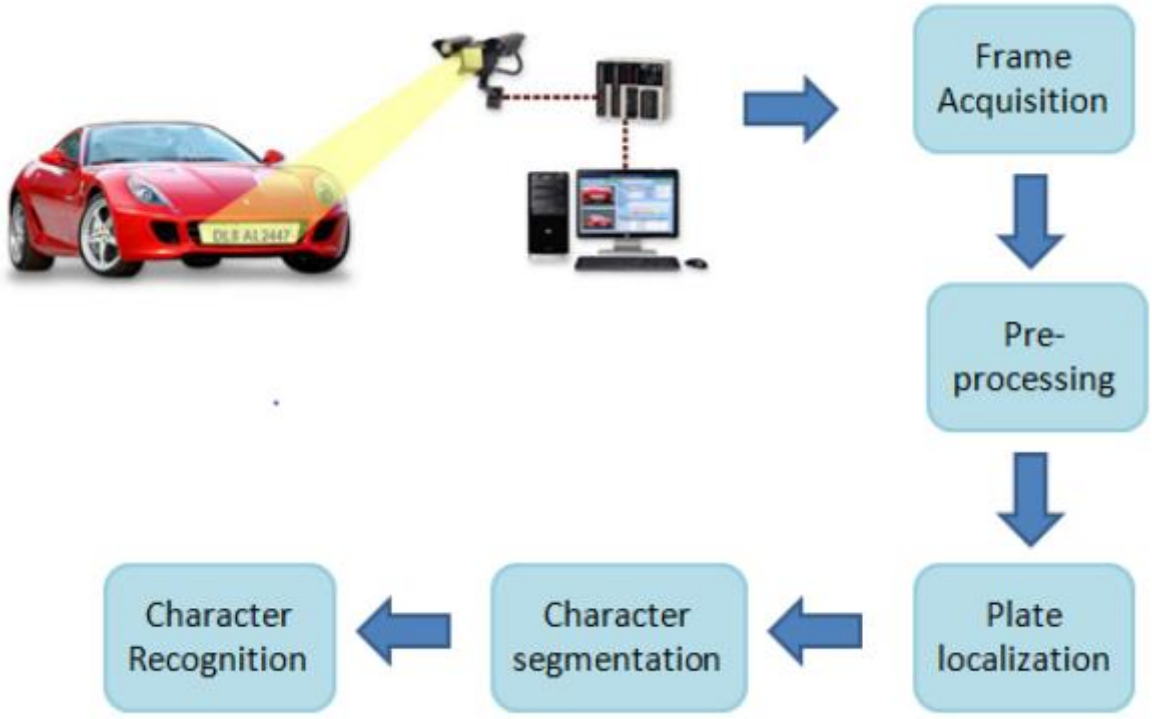
HARDWARE REQUIREMENTS:

- Disk space: 1 GB • Operating systems: Windows 10 or later, MacOS, and Linux
- Processors: Intel Core i3 processor or later
- Camera set as primary camera

SOFTWARE REQUIREMENTS:

- Python versions: 3.9.6 and above
- Python and Java Code IDE
- Compatible tools: Microsoft Visual Studio, PyCharm

SYSTEM ARCHITETURE:



FUTURE SCOPE:

As a future work the developed system would be concentrated upon increasing the accuracy of text localization and graphics removal in caption text images. It can be evaluated using various other available image data bases and using various other classifiers.

CONCLUSION

This project performs mainly four tasks. The first task is to input an image of the car and this will happen with help of the webcam of the computer for the prototype. When the image is fed the image is enhanced in quality. The enhancement is done in the resolution and the thresholding. The image is constraint to a fixed image frame size.

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APPENDIX C

PUBLISHED PAPER AND CERTIFICATES

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Automated Vehicle Number Plate Detection and Recognition

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Abstract: ***In this project, a Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is pre-processing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principle of OCR with help of Tesseract engine.***
It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot.
Keywords: Deep Learning, Number Plate Detection, Optical Character Detection, Real Time Object Detection, Machine Learning.

I. INTRODUCTION

In this project, a Digital Image Processing-based prototype is developed. Actions such as Image Acquisition, enhancement that is pre-processing, Segmentation of the license plate and then application of OCR (Optical Character Recognition) is applied to store the number on text form. The plate number is displayed as text on the terminal using the principal of OCR with help of pytesseract and Tesseract engine.

It is seen that the security forces and authorities face problems whenever security forces chase a vehicle or they can't catch a vehicle which broke traffic rules. Authorities find it very hectic on a busy day to log the vehicle numbers manually in a parking lot. So, in order to make the entire process autonomous, we can install this system so as to automatically detect the vehicle which breaks the traffic rules, take a picture of it and store the number in the database so as to fine the respective owner afterwards. The system can be used in parking so as to take the picture of the vehicle and log the vehicle number in the database (or the cloud, if connected to the internet).

This technology reduces the unnecessary hectic manual work required on any busy day, saves the labour cost and is far more efficient than humans. The number of any vehicle once obtained as text, can be displayed, saved in the database or can be searched through the entire database for the details.

II. PROBLEM STATEMENT

Automatic vehicle license plate detection and recognition is a key technique in most of traffic related applications and is an active research topic in the image processing domain. Different methods, techniques and algorithms have been developed for license plate detection and recognitions.

The main purpose of this project is to detect a license plate from a video provided by a camera. An efficient algorithm is developed to detect a license plate in various luminance conditions.

This algorithm extracts the license plate data from an image and provides it as an input to the stage of Car License Plate Recognition. Extracted image of the number plate can be seen on monitor. The scope of this project is to detect the license plate from the given image and observe the output on monitor.

It is the oldest system adopted for drainage of toilet. The use of having a sunken slab is to conceal all the pipes below the floor. The pipes that carry water are concealed below the floor, care has to be taken to avoid leakages. It is cast below normal floor level. A sunken slab is done basically to conceal/hide drainage line and floor traps of a bath unit. The depth of sunken slab is about 200 – 450 mm, it depends on sanitary fittings and drainage pipe line.

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III. DESIGN AND ANALYSIS

A. Architecture

System architecture is the conceptual model that defines the structure, behaviour and views of a system. The below figure is an architectural design for the Automatic Number Plate Recognition (ANPR) system. ANPR system is a system that reads and process video that consists of vehicle number plate as input and recognizes the number plate as output automatically.

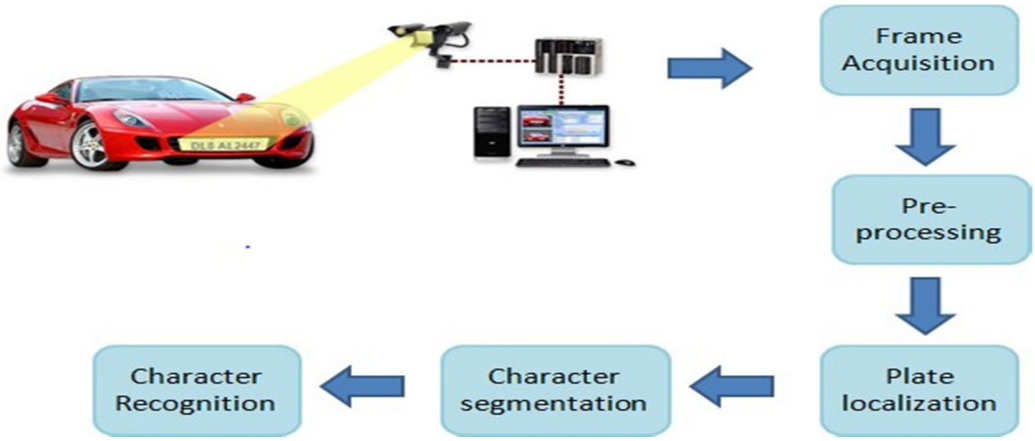

Fig 1: Design Architecture

B. Detail Of Processing

Basics of Digital Image Processing: The image of a vehicle whose number plate is to be recognised is taken from a digital camera which is then loaded to a local computer for further processing Open CV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. In simple language it is a library used for Image Processing. It is mainly used to do all the operations related to Images, Python, being a versatile language, is used here as a programming language. Python and its modules like Numpy, Scipy. Matplotlib and other special modules provide the optimal functionality to be able to cope with the flood of pictures. To enhance the number plate recognition further, we use a median filter to eliminate noises but it not only eliminates noise. It concentrates on high frequency also. So it is more important in edge detection in an image, generally rectangular plate.

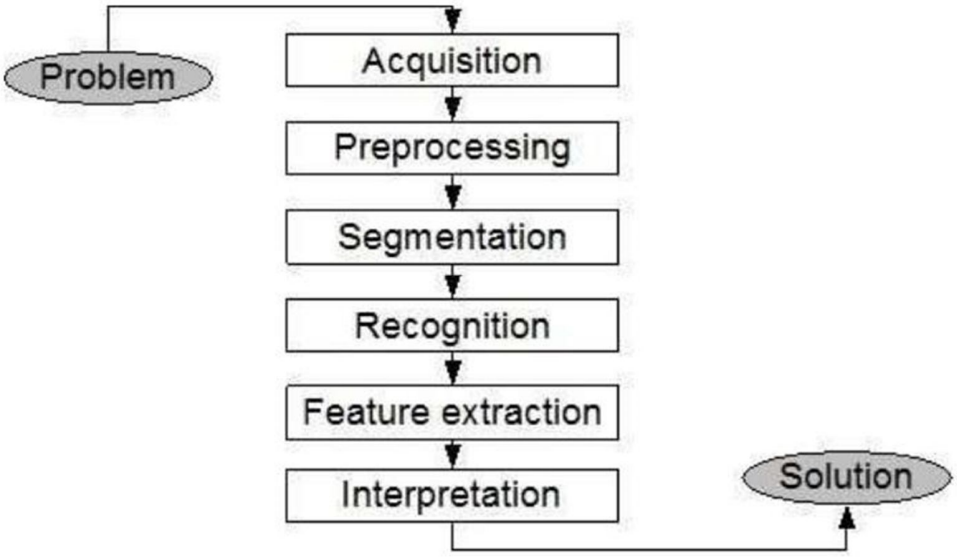

Fig 2: Detail of Processing

IV. LITERATURE REVIEW

S. No	Title	Author	Approach	Advantages	Challenge
1	Vehicle Number Plate Detection System for Indian Vehicles	Hanit Karwal, Akshay Girdhar[3]	Proposed an efficient algorithm for the recognition of position of characters .	Algorithm was quite efficient, addressed the problem of scaling with decent amount of accuracy.	Less number of sample taken.
2	Characters feature based Indian vehicle license plate detection and recognition	Sudhir K. Ingole, Shital B. Gundre[2]	Based on recognising the characters on the license plate, using an adaptive pre-processing method.	Robust in extricating single line number plate.	Failed to segment double row number plate
3	Automatic Number Plate Recognition (ANPR) system for Indian conditions	Prathamesh Kulkarni, Ashish Khatri, Prateek Banga, Kushal Shah[4]	Comprised of a mixture of algorithms, for example, Feature based number plate Localization for finding the tag, Image Scissoring for character division and factual element extraction for character acknowledgement.	The system recognized single and double row license plates with an accuracy of 82%.	The major restrictions faced by them in their work were attributed to parameter such as speed of the vehicle and slew in the image.
4	Indian car Number Plate Recognition using Deep Learning	R Naren Babu, V Sowmya, K P Soman [5]	Proposed an efficient license plate recognition model for different illumination and camera angle views. Training of the manually collected number plate dataset was carried out by employing the YOLO V3.	Overcame the previous restrictions that were faced by people in their work done prior.	Failed to deal with the similarity problem between 0 and o and realized the need to apply image processing techniques for better character recognition.

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V. DATAFLOW DIAGRAM

In this Data Flow Diagram, we show how the flow of data in our system.

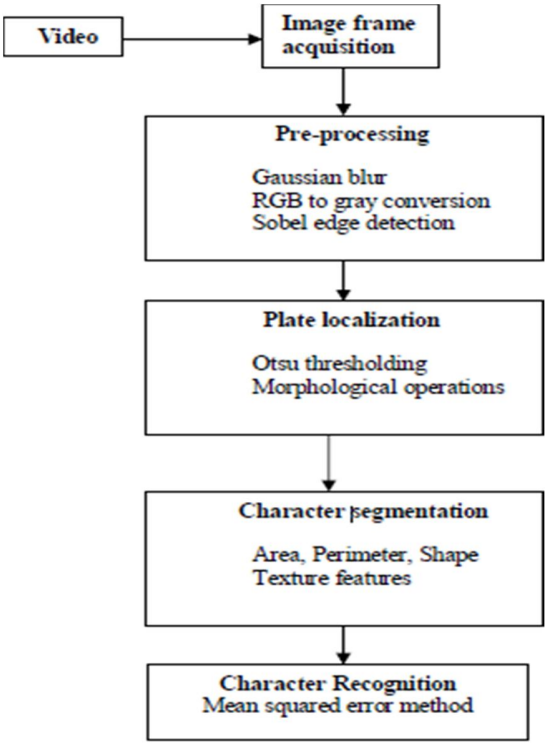

Fig3**:** Data Flow Diagram of Automated Vehicle Number Plate Detection System

VI. CLASS DIAGRAM

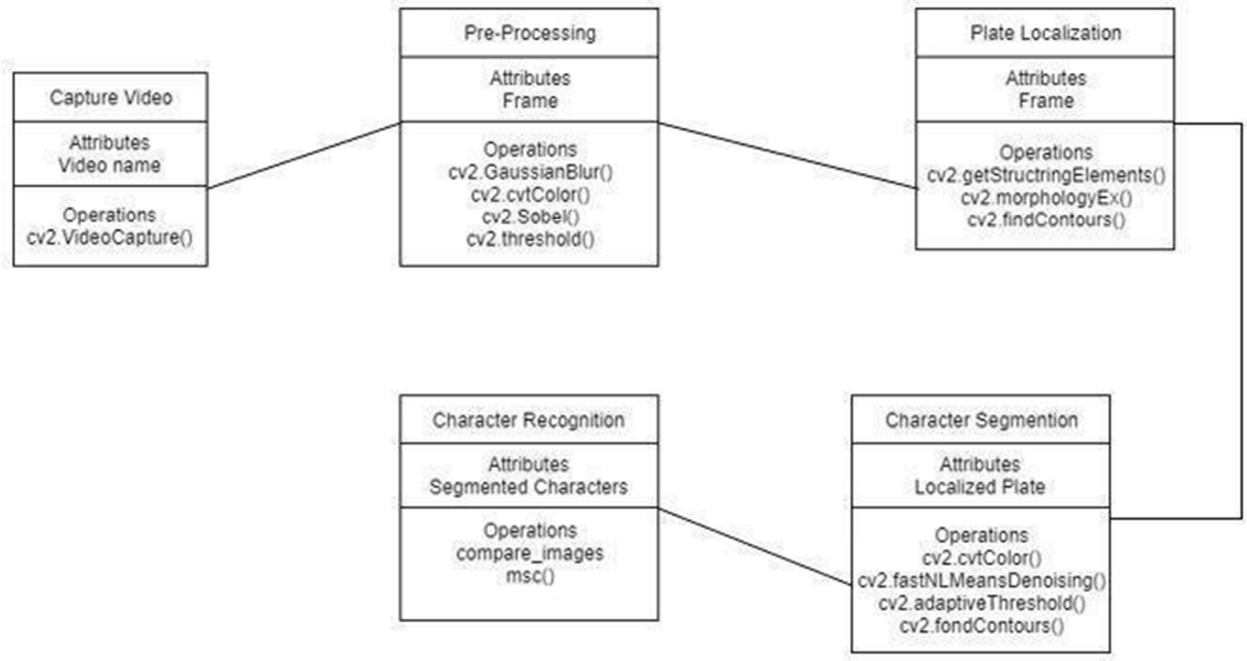

Fig4: Class Diagram

VII. CONCLUSION

This project performs mainly four tasks. The first task is to input an image of the car and this will happen with help of the webcam of the computer for the prototype. When the image is fed the image is enhanced in quality. The enhancement is done in the resolution and the thresholding. The image is constraint to a fixed image frame size. After the enhancement the image is processed to segment the number plate from the full to segment all the characters in the picture in the form of Text and then it can be stored in a database or can be displayed as in this prototype. The project is designed so that we can understand the technology used in now-a-days Automatic license plate systems and OCR systems used in most of the developed countries like Germany, France, Singapore, Japan, etc.

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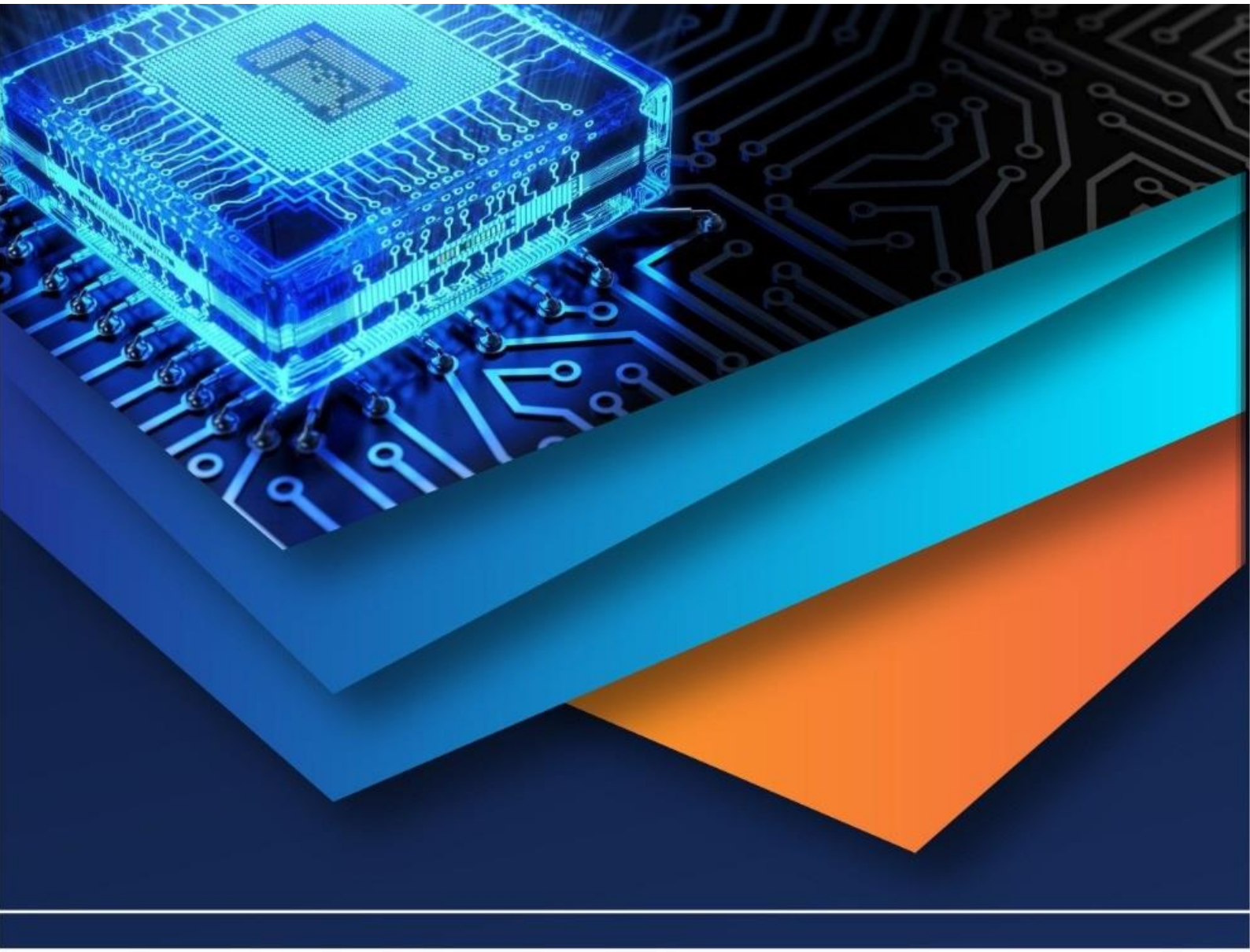

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APPENDIX D

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