

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
“Jnana Sangama”, Belgaum 590014, KARNATAKA, INDIA



An Internship Report On
“Automated Parking System using ML”

An Internship report submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Engineering in Artificial Intelligence and Machine Learning of Visvesvaraya Technological University, Belgaum.

Submitted by:

FIDA SAROSH(1AM20AI012)



Conducted at :
Compsoft Technologies



Department of Artificial Intelligence And Machine Learning
AMC Engineering College,
18th K.M, Bannerghatta Main Road, Bangalore-560 083 2022-2023

AMC Engineering College,
18th K.M, Bannerghatta Main Road, Bangalore-560 083

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING



CERTIFICATE

This is to certify that the internship project entitled “AUTOMATED PARKING SYSTEM USING ML” has been successfully carried out by **FIDA SAROSH(1AM20AI012)**, bonafide student of **AMC Engineering College** in partial fulfilment of the requirements for the award of degree in Bachelor of Engineering in Artificial Intelligence and Machine Learning of Visvesvaraya Technological University, Belgaum during academic year 2023-2024. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report.

The internship project report has been approved as it satisfies the academic requirements in respect

of project work for the said degree.

Project Guide

Department of AIML

HOD

Dr. Rajesh E
Professor & Head
Department of AIML

Principal

Dr. Nagaraja R
Principal,
AMCEC

External Examiners:

Signature
with Date:

DECLARATION

I, **FIDA SAROSH(1AM20AI012)** a student of Artificial Intelligence and Machine Learning, at AMC Engineering College, declare that the Internship has been successfully completed, at Compsoft Technologies. This report is submitted in partial fulfillment of the requirements for award of bachelor's degree in Branch name, during the academic year 2023-2024.

Date:

19th September 2023

Place: Bengaluru

USN: 1AM20AI012

NAME: Fida Sarosh

OFFER LETTER



Date: 17th August, 2023

Name: **Fida sarosh**
USN: **1AM20AI012**
Placement ID: **17mlwp016**

Dear Student,

We would like to congratulate you on being selected for the **Machine Learning with Python (Research Based)** Internship position with **Compsoft Technologies**, effective Start Date **17th August, 2023**, All of us are excited about this opportunity provided to you!

This internship is viewed as being an educational opportunity for you, rather than a part-time job. As such, your internship will include training/orientation and focus primarily on learning and developing new skills and gaining a deeper understanding of concepts of **Machine Learning with Python (Research Based)** through hands-on application of the knowledge you learn while you train with the senior developers. You will be bound to follow the rules and regulations of the company during your internship duration.

Again, congratulations and we look forward to working with you!.

Sincerely,

Nithin K. S
Project Manager
COMPSSOFT TECHNOLOGIES
No. 363, 19th main road,
1st Block Rajajinagar
Bangalore - 560010

ACKNOWLEDGEMENT

This Internship is a result of accumulated guidance, direction and support of several important persons. I take this opportunity to express my gratitude to all who have helped me to complete the Internship.

I would like to extend my special thanks to Dr. RAJESH E Professor and HOD, Department of AIML, for his support and encouragement and suggestions given to me in the course of my project work.

I express my sincere thanks and gratitude to our Principal Dr. Nagaraja R for providing me all the necessary facilities for successful completion of my project.

I have a great pleasure in expressing my deep sense of gratitude to founder Chairman Dr. K.R. Paramahansa for having provided me with a great infrastructure and well-furnished labs for successful completion of my seminar.

Last but not the least, I wish to thank all the teaching & non-teaching staffs of department of AIML for their support, patience and endurance shown during the preparation of this project.

FIDA SAROSH(1AM20AI012)

ABSTRACT

The application of “machine learning” and “artificial intelligence” has become popular within the last decade. Both terms are frequently used in science and media, sometimes interchangeably, sometimes with different meanings. In this work, we aim to clarify the relationship between these terms and to specify the contribution of machine learning to artificial intelligence. We review relevant literature and present a conceptual framework which clarifies the role of machine learning to build (artificial) intelligent agents. Hence, we seek to provide more terminological clarity and a starting point for (interdisciplinary) discussions and future research.

The integration of machine learning (ML) algorithms in automated systems has revolutionized various domains, including transportation and security. This research focuses on the development of a robust and efficient system for automated number plate detection and car parking utilizing ML techniques. The proposed system leverages state-of-the-art deep learning architectures and image processing methods to achieve accurate and real-time number plate recognition, enabling efficient management of parking spaces and enhancing security measures. The integration of ML algorithms in the system allows for automated processing of visual data obtained from surveillance cameras. Convolutional neural networks (CNNs) and object detection algorithms play a pivotal role in this framework, aiding in the detection, localization, and recognition of number plates.

The proposed system's efficiency is evaluated through extensive experimentation with diverse datasets and real-world scenarios. Performance metrics such as accuracy, processing time, and detection rate are thoroughly analyzed to validate the effectiveness and reliability of the system. The results demonstrate the system's capability to accurately detect and recognize number plates, enabling efficient car parking management and enhanced security measures. The integration of ML in automated number plate detection and car parking systems presents a promising avenue for improving urban traffic management and security while optimizing resource utilization. Future research may focus on expanding the system's capabilities, integrating with smart city frameworks, and exploring novel techniques to further enhance performance and scalability.

TABLE OF CONTENTS

Sl. no	Description	Page no
1	Company Profile	1
2	About the Company	3
3	Introduction	7
4	Technology Learnt	9
5	System Analysis	16
6	Requirement Analysis	19
7	Design Analysis	25
8	Implementation	27

9	Results	29
10	Conclusion	31
	References	32

CHAPTER - 1

COMPANY PROFILE



1.1 History of the Organization

Compsoft Technologies is founded by a group of Enterprise Architects having over two decades of experience in software architecture, design and development of mission critical systems for some of the Fortune 500 companies. We hire some of the best talents in the market to deliver quality software on your aggressive milestone dates. Being in the industry and having hands on experience, we fully understand the entire Software Development Life Cycle and we only hire resources who meet our high standards. All of our resources go through our rigorous interview process based on your requirements and we only select the candidates who not only technically strong but also they are fully dedicated to deliver on your promise, the success of your organization.

Our resources are expert in designing and developing applications using Agile and Scrum methodologies. Whatever your software development methodologies may be, our resources have experience in broad areas and they can pull any project successfully. We work hard to enhance continuously our reputation for accessibility, professionalism, performance, and the depth and quality of our long-term consultative relationships with our clients. We endeavor to be valued as an industry leader in client satisfaction, quality performance and reputation. All activities will be conducted to the highest ethical and professional standards.

To help our clients achieve their objectives by serving as their manpower consulting firm. Compsoft Technologies has one-to-one relationships with a number of clients, helping them benefit from all of the technologies available to them and build a better solution that exceeds client's expectation.

It is our goal that offers a full range of software, consulting, support, automation combined with a wide range of technologies that enable clients to consider how they could achieve their objectives.

CHAPTER - 2

ABOUT THE COMPANY

2.1 Objectives

We are committed to going the extra mile to bring success to the clients consistently. We are dedicated to delivering the right people, solutions, and services to the clients that they require to meet their technology challenges and business goals.

Delivering the most efficient and the best solution to our clients to every client leveraging leading technologies & industry best practices.

2.2 Operation of the Organization

The race for digital transformation is on. In this globally connected on-demand world with rapid advancements in internet technologies, businesses worldwide are under constant pressure to add innovative real-time capabilities to their applications to respond to market opportunities.

Every business worldwide is building event-driven, real-time applications - from financial services, transportation, and energy, to retail, healthcare, and Gaming companies.

Our endeavour is to make it easy to develop innovative real-time applications and efficient to operate them in production.

We have a proven record of building highly scalable, world-class consulting processes that offer tremendous business advantages to our clients in the form of huge cost-benefits, definitive results and consistent project deliveries across the globe.

We prominently strive to improve your business by delivering the full range of competencies including operational performance, developing and applying business strategies to improve financial reports, defining strategic goals and measure and manage those goals along with measuring and managing them.

2.3 Major Milestones

Compsoft Technologies is an Information Technology manpower consulting and product development firm specialized in bringing businesses and technologies together under the same umbrella. Our in-depth knowledge in developing mission critical systems for Fortune 500 companies has earned us the reputations in the marketplace. Whether you are building complex systems for your customers or migrating your legacy systems to cutting edge technologies, our resources are fully trained and equipped with the knowledge required to perform the job right, from the very first day. We serve on a wide variety of our clients including Banking, Accounting, Insurance, Healthcare, Retail, Trucking & Transportation.

We have proven record of evaluating the best candidates for your requirement and stand by on the quality throughout the project implementation. In today's competitive marketplace, it is important to bring the businesses and technologies together to deliver on your promise. More than ever, Compsoft Technologies is committed to deliver on our promise so that you can deliver on yours, the success of your organization.

2.4 Structure of the Organization

CSTs core strength lies in our super energetic and gigantic team, forming an excellent blend of IT minds along with a creative bent. Taking ownership of not only one's own task but also creating an enduring & contented customer is what every individual works together with. Our endeavour is to continuously improve and deliver maximum-enriching products & solutions. That's what we mean – doing IT better driving business transformation, digitally – Applying disruptive technologies for business transformations. CST brings great advantage to business space by bridging gaps, simplifying businesses and elevating competitive benefits by providing technologybased business solutions.

Leveraging the enormous talent of our passionate and proven individuals. We are hugely a customer-centric organization that is bent upon consummating the needs of the customers beyond their expectations. We successfully host a consortium of experienced

professionals who work in synergy in order to gain an edge over the market. we look at ourselves as a team where we cocreate with them.

Having delivered successful projects we pride ourselves on being a sought-after mobile application development. Through the years, and have been successfully delivering value to our customers.

We truly believe that our customer's success is our success We don't look at ourselves as a vendor for their projects instead. You would be excited to hear some of our stories and know to what extent we have gone in the interest of the success of our customers. and we work hard to make that happen. This philosophy and execution have resulted in a long-term partnership with most of our clients.

2.5 Services Offered by Compsoft Technologies

It is believed that service and quality is the key to success, enabling business success driven by technology. Harnessing the power of technology, we create a measurable difference for our clients across various industries & multiple geographies.

1. Development.

We develop responsive, functional and super-fast websites. We keep User Experience in mind while creating websites. A website should load quickly and should be accessible even on a small view-port and slow internet connection.

2. Branding and Design.

We offer professional Graphic design, Brochure design & Logo design. We are experts in crafting visual content to convey the right message to the customers. We also design custom wraps for your products (also known as package designing).

3. Search Engine Optimization

We help you manage your SEO campaign more efficiently and effectively. We help you gain market share by leveraging our expertise. our holistic approach to identify anything that may be hurting your traffic or rankings and show you just how to outrank the competition.

4. Content Writing

We provide content writing services for blogs and product descriptions, our team helps you generate content to Increase your Brand Recall. We can amplify your marketing needs & help you reach your potential customers.

5. Research

We equip business leaders with indispensable insights, advice and tools to achieve their goals, our main area of research is in sentimental analysis, having published multiple papers on the same, we are in the process of creating a virtual bot that is intended to use our sentimental analysis data to provide real time replies.

6. Embedded System and IOT

CST works with Consumer Electronics, Lighting, Home Automation, Metering, Sensor-Technology, Home Appliance and Medical Device companies to help them create smart and connected products. Through its integrated Embedded and IoT services, Techno soft helps build intelligent & connected devices that can be remotely monitored and controlled while leveraging edge and cloud computing for a host of intelligent applications and analytics.

7. Full Stack Web Development

Full stack web development is the practice of working on both the front-end and back-end of a program. Full Stack is a layer of software or web development consisting of the front-end and the back-end portions of an application. Front-end is what the users will see or interact with on your application. Back-end part is what users do not see, such as application's logic, database, server, etc. A full-stack web developer is comfortable working with both back-end and front-end technologies which make a website or application function properly.

CHAPTER – 3

INTRODUCTION

3.1 Automatic Number plate Recognition

Number Plate recognition, also called License Plate realization or recognition using image processing methods is a potential research area in smart cities and the Internet of Things. An exponential increase in the number of vehicles necessitates the use of automated systems to maintain vehicle information for various purposes. In the proposed algorithm an efficient method for recognition of Indian vehicle number plates has been devised. We are able to deal with noisy, low illuminated, cross angled, non-standard font number plates. This work employs several image processing techniques such as, morphological transformation, Gaussian smoothing, Gaussian thresholding and Sobel edge detection method in the pre-processing stage, after which number plate segmentation, contours are applied by border following and contours are filtered based on character dimensions and spatial localization. Finally, we apply Optical Character Recognition (OCR) to recognize the extracted characters. The detected texts are stored in the database, further which they are sorted and made available for searching. The project has its own drawbacks and limitations as we are not using higher machine learning or deep learning algorithms but it works efficiently for an average use case.

3.2 Analysis

The scientific world is deploying research in intelligent transportation systems which have a significant impact on peoples' lives. Automatic License Plate Recognition (ALPR) is a computer vision technology to extract the license number of vehicles from images. It is an embedded system which has numerous applications and challenges. Typical ALPR systems are implemented using proprietary technologies and hence are costly. This closed approach also prevents further research and development of the system. With the rise of free and open-source technologies the computing world is lifted to new heights. People from different communities interact in a multi-cultural environment to develop solutions for man's never ending problems. One of the notable contributions of the open-source community to the scientific world is Python.

Intel's researches in Computer Vision bore the fruit called Open Computer Vision (OpenCV) library, which can support computer vision development.

3.3 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.

Approach: Due to the varying characteristics of the license plate from country to country like numbering system, colors, language of characters, style (font) and sizes of license plate.

CHAPTER – 4

TECHNOLOGY LEARNT

4.1 Introduction to AI and Machine Learning

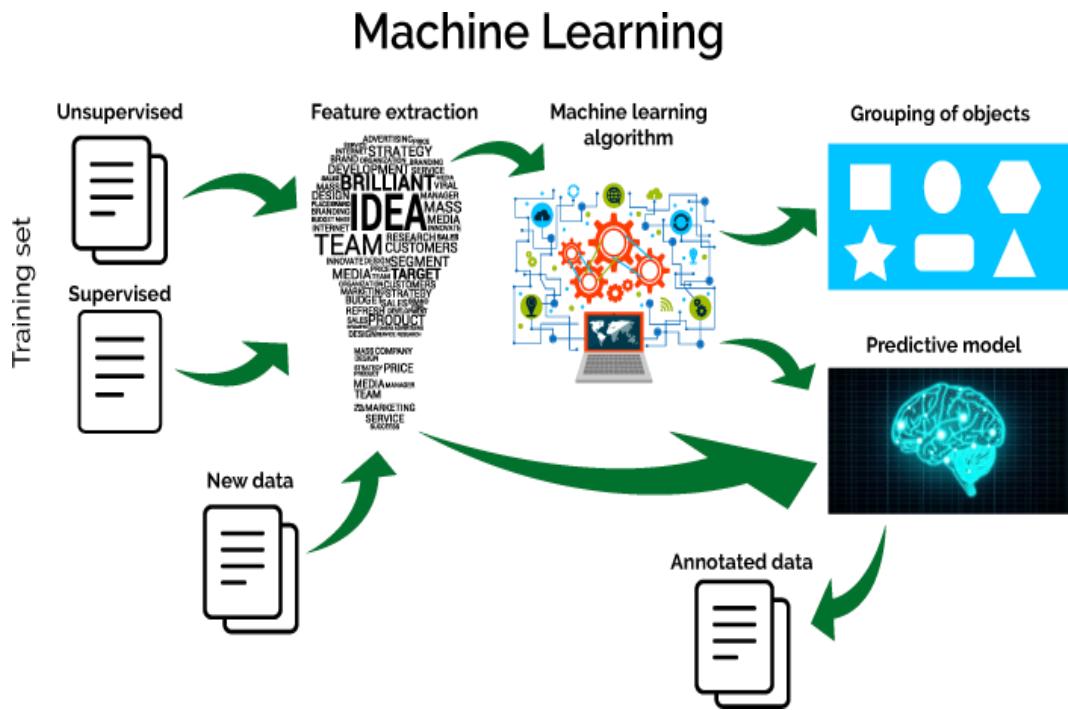


Fig.4.1 Visualization of ML concepts

Definition of Artificial Intelligence:

Artificial intelligence refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

Definition of Machine Learning:

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.

4.2 Relationship between AI and ML

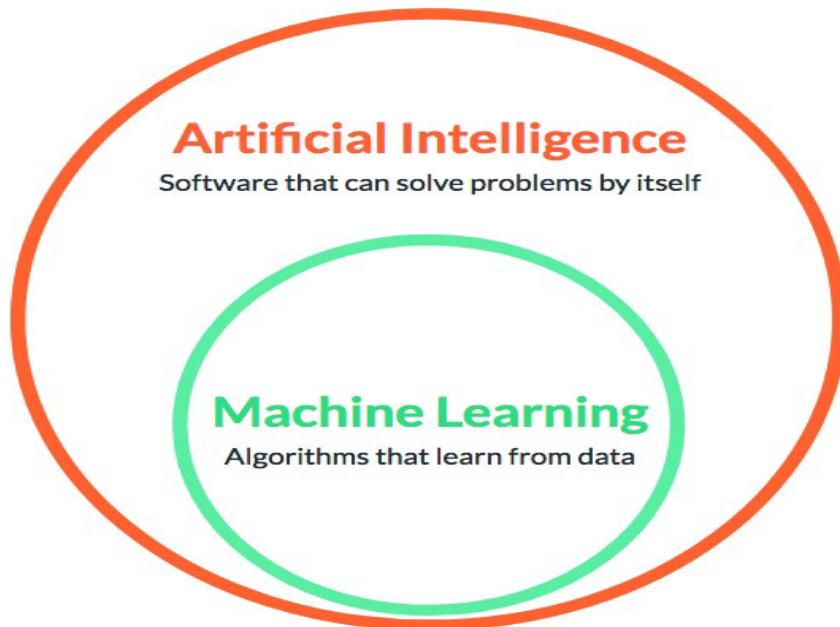


Fig.4.2 Relationship Between AI and ML

Machine Learning is an approach or subset of Artificial Intelligence that is based on the idea that machines can be given access to data along with the ability to learn from it.

4.3 Machine Learning Algorithms

Traditional Programming vs. Machine Learning Approach

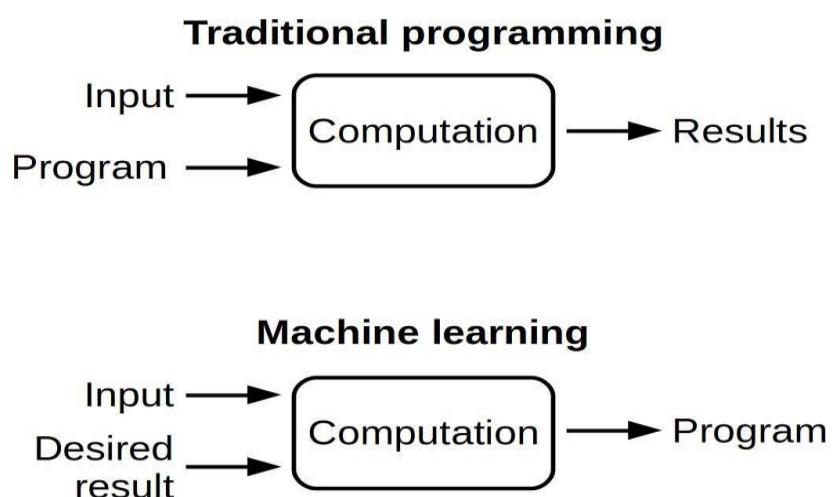


Fig.4.3 Traditional and Machine Learning Algorithm

a. Traditional approach

Traditional programming relies on hard-coded rules.

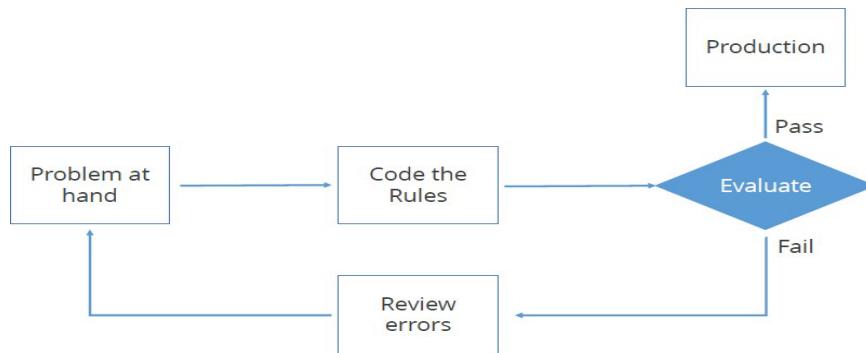


Fig.4.4 Block Diagram of traditional approach

b. Machine Learning Approach

Machine Learning relies on learning patterns based on sample data.

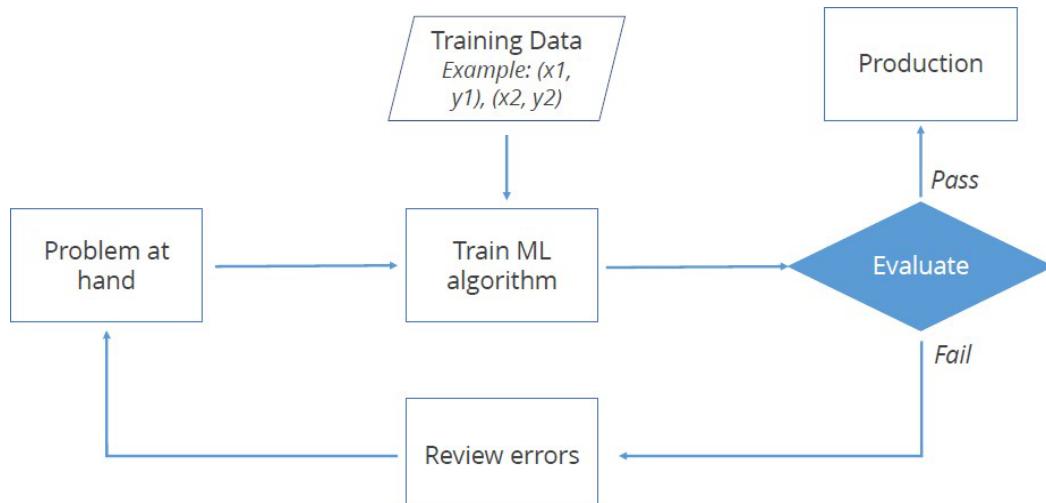


Fig.4.5 Diagram of Machine Learning Approach

4.4 Machine Learning Techniques

Machine Learning uses a number of theories and techniques from Data Science.

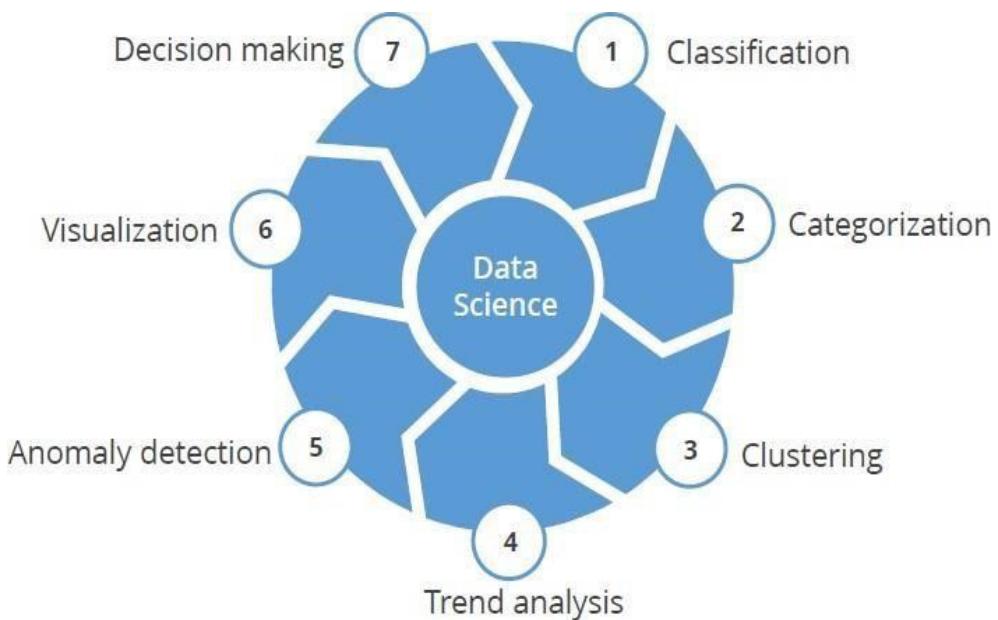


Fig.4.6 Techniques of Machine Learning

Types of Machine Learning

As with any method, there are different ways to train machine learning algorithms, each with their own advantages and disadvantages. To understand the pros and cons of each type of machine learning, we must first look at what kind of data they ingest. In ML, there are two kinds of data – labeled data and unlabeled data.

Labeled data has both the input and output parameters in a completely machine-readable pattern but requires a lot of human labor to label the data, to begin with. Unlabeled data only has one or none of the parameters in a machine-readable form. This negates the need for human labor but requires more complex solutions.

There are also some types of machine learning algorithms that are used in very specific use-cases, but three main methods are used today.

a. Supervised Learning:

Definition: Supervised learning is the machine learning task of learning a function that maps an input to an output based on example input-output pairs. It infers a function from labeled training data consisting of a set of training examples.

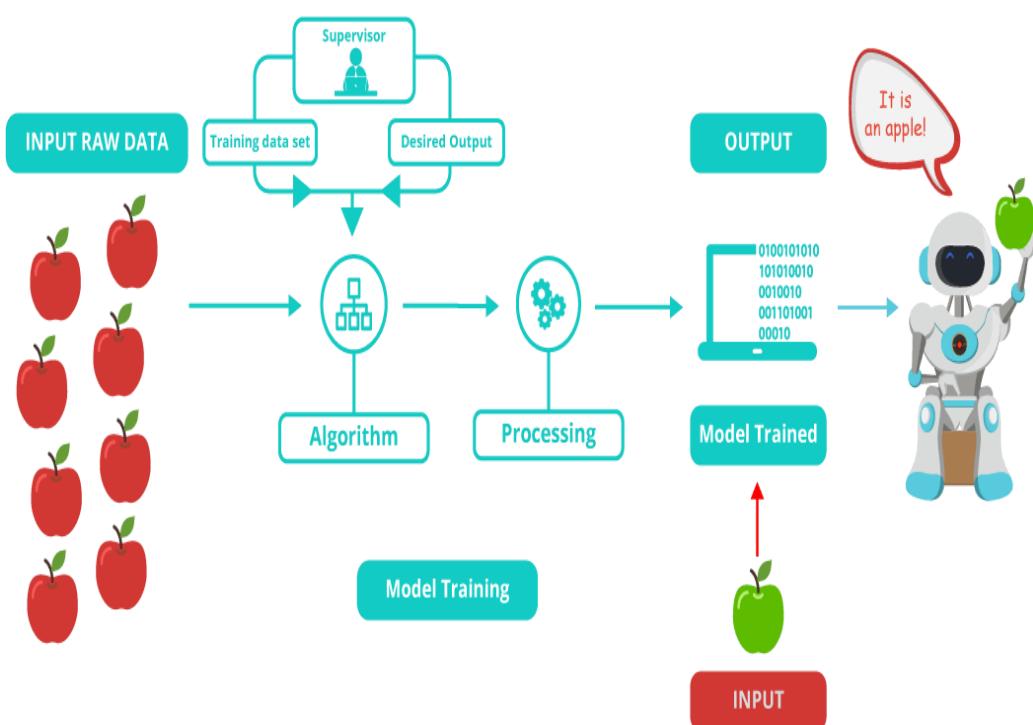


Fig.4.7 Supervised Learning

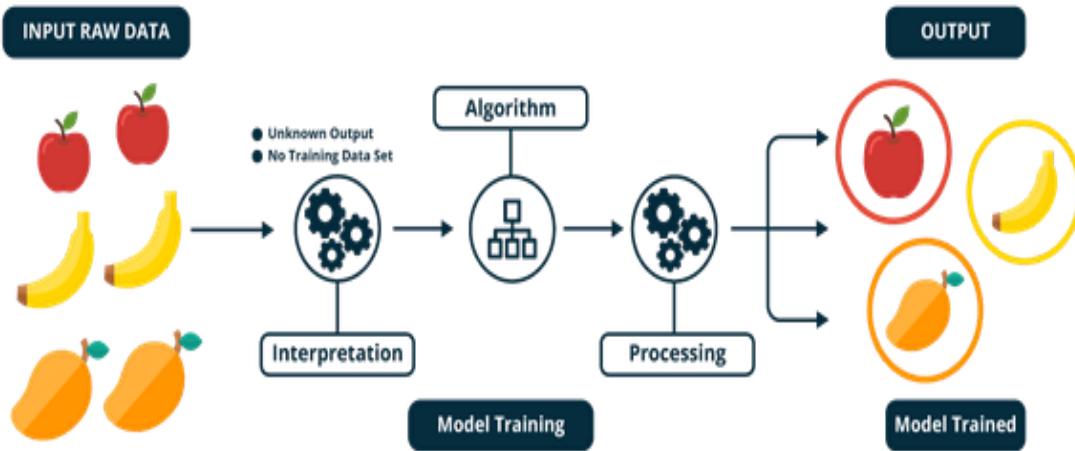
In supervised learning, each example is a pair consisting of an input object (typically a vector) and a desired output value (also called the supervisory signal). In supervised learning, the ML algorithm is given a small training dataset to work with.

This training dataset is a smaller part of the bigger dataset and serves to give the algorithm a basic idea of the problem, solution, and data points to be dealt with. The training dataset is also very similar to the final dataset in its characteristics and provides the algorithm with the labeled parameters required for the problem. The algorithm then finds relationships between the parameters given, essentially establishing a cause-and-effect relationship between the variables in the dataset. At the end of the training, the algorithm has an idea of how the data works and the relationship between the input and the output. This solution is then deployed for use with the final dataset, which it learns from in the same way as the training dataset. This means that supervised machine learning algorithms will continue to improve even after being deployed, discovering new patterns and relationships as it trains itself on new data.

b. Unsupervised Learning

Definition: Unsupervised learning is the training of machine using information that is neither classified nor labeled and allowing the algorithm to act on that information without guidance.

Fig.4.8 Unsupervised Learning



provides Here the task of a machine is to group the unsorted information according to the similarities, patterns and differences without any prior training of data.

Unsupervised machine learning holds the advantage of being able to work with unlabeled data. This means that human labor is not required to make the dataset machine-readable, allowing much larger datasets to be worked on by the program.

In supervised learning, the labels allow the algorithm to find the exact nature of the relationship between any two data points. However, unsupervised learning does not have labels to work off of, resulting in the creation of hidden structures.

Relationships between data points are perceived by the algorithm in an abstract manner, with no input required from human beings. The creation of these hidden structures is what makes unsupervised learning algorithms versatile. Instead of a defined and set problem statement, unsupervised learning algorithms can adapt to the data by dynamically changing hidden structures. This offers more post-deployment development than supervised learning algorithms.

c. Reinforcement Learning

Reinforcement learning directly takes inspiration from how human beings learn from data in their lives. It features an algorithm that improves upon itself and learns from new situations using a trial-and-error method. Favorable outputs are encouraged or 'reinforced', and non-favorable outputs are discouraged or 'punished'.

Based on the psychological concept of conditioning, reinforcement learning works by putting the algorithm in a work environment with an interpreter and a reward system. In every iteration of the algorithm, the output result is given to the interpreter, which decides whether the outcome is favorable or not.

In case of the program finding the correct solution, the interpreter reinforces the solution by providing a reward to the algorithm. If the outcome is not favorable, the algorithm is forced to reiterate until it finds a better result. In most cases, the reward system is directly tied to the effectiveness of the result. In typical reinforcement learning use-cases, such as finding the shortest route between two points on a map, the solution is not an absolute value. Instead, it takes on a score of effectiveness, expressed in a percentage value. The higher this percentage value is, the more reward is given to the algorithm. Thus, the program is trained to give the best possible solution for the best possible reward.

CHAPTER – 5

SYSTEM ANALYSIS

5.1 Objective

This project aims to recognize license number plates. In order to detect license number plates, we will use OpenCV to identify number plates and python pytesseract to extract characters and digits from the number plates.

5.2 Existing System

In existing system there are rfid tags to detect vehicle number which is not so accurate if rfid tags are replaced. In many countries ANPR methods have been implemented such as Australia, Korea and a few other countries. In the development of ANPR system in many countries the number plate standards are strictly implemented. These systems use standard features for license plates such as: panel dimensions, panel borders, color and letter characters, etc., which help to easily localize the number pad and specify the car license number.

In India, plate number standards are rarely followed. There are wide variations in font types, text, size, position, and colors of number plate. In a few cases, there are other undesirable decorations on the number panel. Also, different other countries, there are no special features on Indian number panel to facilitate recognition. Thus, only manual recording systems are currently being used and ANPR has not been commercially developed in India.

5.3 Proposed System

In India, basically, there are two kinds of license-plates, black characters in white plate and black characters in yellow plate. The former for private vehicles and latter for commercial, public service vehicles. The system tries to address these two categories of plates.

5.4 Methodology

a. License Plate Extractor:

This is most critical process in License Plate Recognition System. In this process we apply different techniques on image to detect and extract license plate. This process is divided in two parts.

License Plate Detection through Edge Detection In the other case, if our proposed system has to recognize license plates, then the binary image is created from the image. After that following steps are performed to extract license plate from binary image:

1. Four Connected Points are searched from binary image.
2. Width/Height ratio is matched against those connected points.
3. License Plate region is extracted from image.
4. Transformation of extracted license plate is performed. Then the extracted license plate is passed to next component for further processing. This approach is quick and takes less execution time and memory with high efficiency ratio. That's why we have adopted this technique in our project Character Segmentation In this part further image processing is done on extracted license plate to remove unnecessary data. After character segmentation, the extracted license plate has only those characters that belong to license number. This is also achieved with the width height ratios matching with the contours detected on extracted number plate.

b. Capturing Input Image

The car's number pad is taken from high resolution camera. The resolution of the number plate recognition system depends on the captured image. The image captured in RGB format must be converted to a gray image.

c. Pre-Processing

Pre-processing is a set of algorithms applied to the image to improve the quality by which the gray image is converted to a binary image. Before converting to a binary image, the image is smoothed to reduce noise. Pre-processing can be done by the threshold algorithm. There is a different kind of threshold like:

- Global threshold
- Adaptive mean threshold
- Adaptive Gaussian threshold

Global threshold: The threshold is a nonlinear process where two levels are assigned to pixels lower or bigger than the threshold value specified. The threshold value is constant. The grayscale picture is converted to convert the binary image according to the formula:

Binary

$$dst(x, y) = \begin{cases} maxval & \text{if } src(x, y) > thresh \\ 0 & \text{otherwise} \end{cases}$$

Inverted Binary

$$dst(x, y) = \begin{cases} 0 & \text{if } src(x, y) > thresh \\ maxval & \text{otherwise} \end{cases}$$

Truncated

$$dst(x, y) = \begin{cases} threshold & \text{if } src(x, y) > thresh \\ src(x, y) & \text{otherwise} \end{cases}$$

To Zero

$$dst(x, y) = \begin{cases} src(x, y) & \text{if } src(x, y) > thresh \\ 0 & \text{otherwise} \end{cases}$$

To Zero Inverted

$$dst(x, y) = \begin{cases} 0 & \text{if } src(x, y) > thresh \\ src(x, y) & \text{otherwise} \end{cases}$$

Average adaptive threshold: The value of the threshold is the average area of the neighborhood. Gaussian Adaptive Threshold: Threshold value is the sum of the values of the values of the neighborhood where the weights are a Gaussian window. The gray picture is then converted to a binary picture by the adaptive threshold method. The threshold is the simplest way to divide objects from the background. If the background is relatively same, the global threshold can be used. For large change in background intensity the adaptive threshold is used.

CHAPTER – 6

REQUIREMENT ANALYSIS

6.1 Tools

6.1.1 Python

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python Web site, <https://www.python.org/>, and may be freely distributed. The same site also contains distributions of and pointers to many free third-party Python modules, programs and tools, and additional documentation. The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications. It helps to have a Python interpreter handy for hands-on experience, but all examples are self-contained, so the tutorial can be read offline as well.

6.1.2 NumPy

NumPy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.

At the core of the NumPy package, is the ndarray object. This encapsulates n -dimensional arrays of homogeneous data types, with many operations being

performed in compiled code for performance. There are several important differences between NumPy arrays and the standard Python sequences.

6.1.3 OpenCV

Open Source Computer Vision Library is a common platform and set of programming functions for real-time applications [2]. The open CV library contains several algorithms for more than 500 optimized algorithms. Used mostly around the world, with forty thousand people in the user group. The first languages used in C-C ++ are mainly written in C, making them portable to certain platforms such as the digital signal processor. Now the language that is called Python is being used recently, has been developed to encourage adoption by a wider audience. These languages recent versions have interfaces for C ++. Open CV is a multi-platform library, containing C++, Python, and Java interfaces. Open CV is designed to achieve computational efficiency with a strong focus on real-time applications.

For now; open CV supports many of the improved algorithms for computer vision and automated learning, which are spread daily [2]. Open CV currently supports a vast programming languages such as C ++, Python, Java and others, and is available on different platforms such as Windows, Linux, OS X, Android, iOS, and so on. Here in this system, we used Python as a code language. It is called Open CV Python. We choose the snake because it is easier to understand and more effective. The proposal combines the good qualities in Open CV and Python.

OpenCV was started at Intel in 1999 by Gary Bradsky and the first release came out in 2000. Vadim Pisarevsky joined Gary Bradsky to manage Intel's Russian software OpenCV team. In 2005, OpenCV was used on Stanley, the vehicle who won 2005 DARPA Grand Challenge. Later its active development continued under the support of Willow Garage, with Gary Bradsky and Vadim Pisarevsky leading the project. Right now, OpenCV supports a lot of algorithms related to Computer Vision and Machine Learning and it is expanding day-by-day. Currently OpenCV supports a wide variety of programming languages like C++, Python, Java etc and is available on different platforms including Windows, Linux, OS X, Android, iOS etc. Also, interfaces based on CUDA and OpenCL are also under active

development for high-speed GPU operations. OpenCV-Python is the Python API of OpenCV. It combines the best qualities of OpenCV C++ API and Python language. OpenCV-Python Python is a general purpose programming language started by Guido van Rossum, which became very popular in short time mainly because of its simplicity and code readability. It enables the programmer to express his ideas in fewer lines of code without reducing any readability.

Compared to other languages like C/C++, Python is slower. But another important feature of Python is that it can be easily extended with C/C++. This feature helps us to write computationally intensive codes in C/C++ and create a Python wrapper for it so that we can use these wrappers as Python modules. This gives us two advantages: first, our code is as fast as original C/C++ code (since it is the actual C++ code working in background) and second, it is very easy to code in Python. This is how OpenCV-Python works, it is a Python wrapper around original C++ implementation. And the support of Numpy makes the task more easier. Numpy is a highly optimized library for numerical operations. It gives a MATLAB-style syntax. All the OpenCV array structures are converted to-and-from Numpy arrays. So whatever operations you can do in Numpy, you can combine it with OpenCV, which increases number of weapons in your arsenal. Besides that, several other libraries like SciPy, Matplotlib which supports Numpy can be used with this. So OpenCVPython is an appropriate tool for fast prototyping of computer vision problems.

6.1.4 OCR Tesseract

OCR = Optical Character Recognition. In other words, OCR systems transform a twodimensional image of text, that could contain machine printed or handwritten text from its image representation into machine-readable text. OCR as a process generally consists of several sub-processes to perform as accurately as possible.

The subprocesses are:

- Text Localization
- Character Segmentation
- Character Recognition
- Post Processing

The sub-processes in the list above of course can differ, but these are roughly

steps needed to approach automatic character recognition. In OCR software, it's main aim to identify and capture all the unique words using different languages from written text characters.

For almost two decades, optical character recognition systems have been widely used to provide automated text entry into computerized systems. Yet, all this time, conventional OCR systems (like zonal OCR) have never overcome their inability to read more than a handful of type fonts and page formats.

Proportionally spaced type (which includes virtually all typeset copy), laser printer fonts, and even many non-proportional typewriter fonts, have remained beyond the reach of these systems. And as a result, conventional OCR has never achieved more than a marginal impact on the total number of documents needing conversion into digital form.

Next-generation OCR engines deal with these problems mentioned above really good by utilizing the latest research in the area of deep learning. By leveraging the combination of deep models and huge datasets publicly available, models achieve state-of-the-art accuracies on given tasks. Nowadays it is also possible to generate synthetic data with different fonts using generative adversarial networks and few other generative approaches. Optical Character Recognition remains a challenging problem when text occurs in unconstrained environments, like natural scenes, due to geometrical distortions, complex backgrounds, and diverse fonts. The technology still holds an immense potential due to the various use-cases of deep-learning based OCR like

- Building license plate readers
- Digitizing invoices
- Digitizing menus
- Digitizing ID cards

6.1.5 VS Code

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, .NET). VS Code is a free code editor, which runs on the macOS, Linux, and Windows operating systems. VS Code is lightweight and should run on most available hardware and platform versions. Visual Studio Code combines the

simplicity of a source code editor with powerful developer tooling, like IntelliSense code completion and debugging.

First and foremost, it is an editor that gets out of your way. The delightfully frictionless edit-build-debug cycle means less time fiddling with your environment, and more time executing on your ideas.

At its heart, Visual Studio Code features a lightning fast source code editor, perfect for day-to-day use. With support for hundreds of languages, VS Code helps you be instantly productive with syntax highlighting, bracket-matching, auto-indentation, box-selection, snippets, and more. Intuitive keyboard shortcuts, easy customization and community contributed keyboard shortcut mappings let you navigate your code with ease.

For serious coding, you'll often benefit from tools with more code understanding than just blocks of text. Visual Studio Code includes built-in support for IntelliSense code completion, rich semantic code understanding and navigation, and code refactoring.

And when the coding gets tough, the tough get debugging. Debugging is often the one feature that developers miss most in a leaner coding experience, so we made it happen. Visual Studio Code includes an interactive debugger, so you can step through source code, inspect variables, view call stacks, and execute commands in the console.

VS Code also integrates with build and scripting tools to perform common tasks making everyday workflows faster. VS Code has support for Git so you can work with source control without leaving the editor including viewing pending changes diffs.

6.2 Source Code

```
//new_detect.py import  
cv2 import numpy  
as np  
# Load a pre-trained car detection model (e.g., Haar Cascade or YOLO)  
  
car_cascade = cv2.CascadeClassifier('haarcascade_car.xml')
```

```

# Initialize the camera or video feed
cap = cv2.VideoCapture('video.mp4')

while True:

    # Read a frame from the video feed

    ret, frame = cap.read()

    # Convert the frame to grayscale for car detection

    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # Detect cars in the frame    cars = car_cascade.detectMultiScale(gray,
scaleFactor=1.1, minNeighbors=5,
minSize=(30, 30))

    # Draw rectangles around detected

    cars for (x, y, w, h) in cars:
        cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 0, 255), 2)

    # Display the frame with detected cars

    cv2.imshow('Parking Spot Detection', frame)

    # Break the loop if the 'q' key is

    pressed if cv2.waitKey(1) & 0xFF ==
ord('q'):

        break

    # Release the video capture and close OpenCV

    windows cap.release() cv2.destroyAllWindows()

```

CHAPTER – 7

DESIGN ANALYSIS

7.1 General View

Number plate recognition (NPR) using machine learning (ML) offers multiple advantages, including efficient traffic monitoring, automated toll collection, enhanced security, stolen vehicle detection, access control, traffic analysis, retail optimization, vehicle inventory management, and urban planning. ML-powered NPR contributes to smart cities, public safety, insurance, and accident analysis, making it a versatile tool for automation, security, and efficiency in diverse scenarios.

7.2 The Problem and the Approach

The license plate is extracted using either a shape analysis or a color analysis method. In the General License Panel has in form of a rectangular shape. Thus, algorithms look for geometrical shapes of a rectangular proportion. In India, most license plates are white or yellow, and therefore can also use color analysis. Before you find the rectangle in an image, the image must be in a binary image or the edges of the image should be detected. Then you should find and connect to the relevant rectangular corners. Finally, the areas connected to the box are connected and all rectangular areas of interest are extracted.

7.3 Connect Component Analysis

To remove the unwanted image space, the algorithm of the component connected to the binary filter is applied first. The parsing of the connected component is done to determine the characters in the image. The basic proposal is to pass through the image and find a connected pixel. Each component (dots) is distinguished and extracted.

7.4 Segmentation

Once the license plate has been extracted, each character must be fragmented. For component division, the component label is used to see the computer in order to discover the connected areas in binary digital images. The label of connected components works by scanning a pixel-in-pixel image from top to down to find connected pixels and connected pixel cards.



CHAPTER – 8

IMPLEMENTATION

Implementation is the stage where the theoretical design is turned into a working system. The most crucial stage in achieving a new successful system and in giving confidence in the new system for the users that it will work efficiently and effectively.

The system can be implemented only after thorough testing is done and if it is found to work according to the specification. It involves careful planning, investigation of the current system and its constraints on implementation, design of methods to achieve the changeover and an evaluation of change over methods apart from planning.

Two major tasks of preparing the implementation are education and training of the users and testing of the system. The more complex the system being implemented, the more involved will be the system analysis and design effort required just for implementation.

The implementation phase comprises of several activities. The required hardware and software acquisition is carried out. The system may require some software to be developed. For this, programs are written and tested. The user then changes over to his new fully tested system and the old system is discontinued.

8.1 Testing

The testing phase is an important part of software development. The Information Zed system will help in the automated process of finding errors and missing operations and also a complete verification to determine whether the objectives are met, and the user requirements are satisfied.

Software testing is carried out in three steps:

1. The first includes unit testing, where each module is tested to provide its correctness, validity and also determine any missing operations and to verify whether the objectives have been met.

Errors are noted down and corrected immediately.

2. Unit testing is an important and major part of the project. So, errors are rectified

easily in particular modules and program clarity is increased. In this project the entire system is divided

into several modules and is developed individually. So, unit testing is conducted on individual modules.

3. The second step includes Integration testing. It need not be the case, the software whose modules when run individually and showing perfect results, will also show perfect results when run as a whole.

CHAPTER – 9

RESULTS

The Figures 9.1-9.6 represent the result of the internship project.

1. Detection and Isolation



Fig. 9.1 Detection and Isolation

2. Segmentation



Fig. 9.2 Segmentation

3. Outcome



The car number to search is:- MH20EJ0365



The car number to search is:- TN21AQ1114

(New image)

(Searched - output)

Fig. 9.3 Outcome

CHAPTER – 10

CONCLUSION

This project uses OpenCV and Python and detects number plates that can be

incorporated into an Automated Car Park System. It is a powerful and versatile solution for extracting and interpreting license plate information from images or video streams. By leveraging OpenCV's image processing capabilities and combining them with Python's flexibility, developers can build efficient ANPR systems that have applications in various domains. These include traffic management, law enforcement, toll collection, security, and more.

OpenCV provides the necessary tools for image preprocessing, contour detection, character segmentation, and optical character recognition (OCR), making it an ideal library for ANPR development. With Python, developers can easily integrate these functionalities, handle OCR results, and interface with other components of the ANPR system. The combination of OpenCV and Python allows for the creation of robust, accurate, and efficient ANPR systems that contribute to improved automation, security, and overall efficiency in diverse real-world scenarios.

In the future, Automated Number Plate Recognition (ANPR) models are poised to advance through deep learning improvements, end-to-end training for optimization, enhanced multi-language support, real-time processing for on-road applications, video stream integration, efficient transfer and few-shot learning techniques, advanced data augmentation approaches, multi-modal integration, privacy-preserving strategies, and contextual analysis for a more comprehensive understanding of license plate information. These developments aim to improve accuracy, efficiency, and applicability across various domains.

REFERENCES

Articles:

- N. Abirami¹, Dr. J.S.Leena, Jasmine² Accurate vehicle number plate recognition and Real time Identification using Raspberry Pi International Research Journal of Engineering and Technology (IRJET) Automatic Number Plate Recognition (ANPR) System for Indian conditions
- Pratiksha Jain, Neha Chopra, and Vaishali Gupta, "Automatic License Plate Recognition using OpenCV", International Journal of Computer Applications Technology and Research Volume 3– Issue 12, 756 - 761, 2014. [2] Ankit Sharma, Dipti R Chaudhary,
"Character Recognition Using Neural Network", IJETT, ISSN: 2231- 5381 Vol.4 Issue

4, pp 662-667, April 2013 [3] Youngwoo Yoon, Kyu-Dae Ban, Hosub Yoon, and Jaehong Kim," Blob Extraction based Character Segmentation Method for Automatic License Plate Recognition System" Robot/Cognition System Research Department, IEEE.

Websites:

1. https://en.wikipedia.org/wiki/Automatic_number-plate_recognition#
2. <https://github.com/>
3. <https://chat.openai.com/>
4. <https://stackoverflow.com/>