

AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM FOR VEHICLE IDENTIFICATION USING OPTICAL CHARACTER RECOGNITION

A Project Report Phase - II

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Electronics and Communication Engineering

By

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **KOLLA JAI SAI NAGA TEJA (Reg.No. 39130232)** and **KARNATI JASHWANTH REDDY (Reg.No. 39130210)**, who carried out the project entitled "**AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM FOR VEHICLE IDENTIFICATION USING OPTICAL CHARACTER RECOGNITION**" under our supervision from November 2022 to April 2023.

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ABSTRACT

Automatic Number Plate Recognition (ANPR) is a mass surveillance system that captures the image of vehicles and recognizes their license number. ANPR can be assisted in the detection of stolen vehicles. The detection of stolen vehicles can be done in an efficient manner by using the ANPR systems located in the highways. Our proposed system is based on a recognition method in which the vehicle plate image is obtained by the digital cameras and the image is processed to get the number plate information. A rear image of a vehicle is captured and processed using various algorithms.

In this context, the number plate area is localized using a novel feature-based number plate localization method which consists of many algorithms. In the existing system, Convolution Neural Network (CNN) algorithm is used and the accuracy and efficiency is very low. In the proposed system, Optical Character Recognition (OCR) is implemented. The proposed system is done in real time and also the accuracy is high in the proposed system, The proposed system loading speed and execution speed is really fast when compares with the existing system. The proposed system is highly efficient and scalable and also further improved for complex use cases.

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LIST OF ABBREVIATIONS

ANPR	Automatic Number Plate Recognition
CNN	Convolution Neural Network
OCR	Optical Character Recognition
AI	Artificial Intelligence
LPR	License Plate Recognition
ITS	Intelligent Transportation System
BRTA	Bangladesh Road Transport Authority
ALPR	Automatic License Plate Character Recognition
LC2G	Learning-Based Color-To-Gray
RFID	Radio Frequency Identification
GSM	Global System For Mobile Communication
EDR	Enhanced Data Rate
UART	Universal Asynchronous Receiver Transmitter
EDR	Enhanced Data Rate
GFSK	Gaussian Frequency Shift Keying
ISM	International Safety Management
SPP	Serial Port Profile
HID	Human Interface Device
IDE	Arduino Integrated Development Environment
ISP	In-System Programming
UI	User Interfaces
OPENCV	Open-Source Computer Vision
SCP	Serial Communication Protocol

CHAPTER 1

1.1 INTRODUCTION

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.

The process of learning begins with observations or data, such as examples, direct experience, or introduction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

1.2 SOME MACHINE LEARNING METHODS

Machine learning algorithms are often categorized as supervised or unsupervised. Supervised algorithms require a data scientist or data analyst with machine learning skills to provide both the input and desired output, in addition to furnishing feedback about the accuracy of predictions during algorithm training. Data scientists determine which variables, or features, the model should analyze and use to develop predictions. Once training is complete, the algorithm will apply what was learned to new data. Unsupervised algorithms do not need to be trained with desired outcome data. Instead, they use an iterative approach called deep learning to review data and arrive at conclusions. Unsupervised learning algorithms also called neural networks are used for more complex processing tasks than supervised learning systems, including image recognition, speech-to-text and natural language generation. These neural networks work by combing through millions of examples training data and automatically identifying often subtle correlations between many variables. Once

trained, the algorithms have only become feasible in the age of big data, as they require massive amounts of training data.

Machine learning algorithms are often categorized as supervised or unsupervised.

1. Supervised machine learning algorithms can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.
2. In contrast, unsupervised machine learning algorithms are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.
3. Semi-supervised machine learning algorithms fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it. Otherwise, acquiring unlabeled data generally doesn't require additional resources.
4. Reinforcement machine learning algorithms is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement

learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

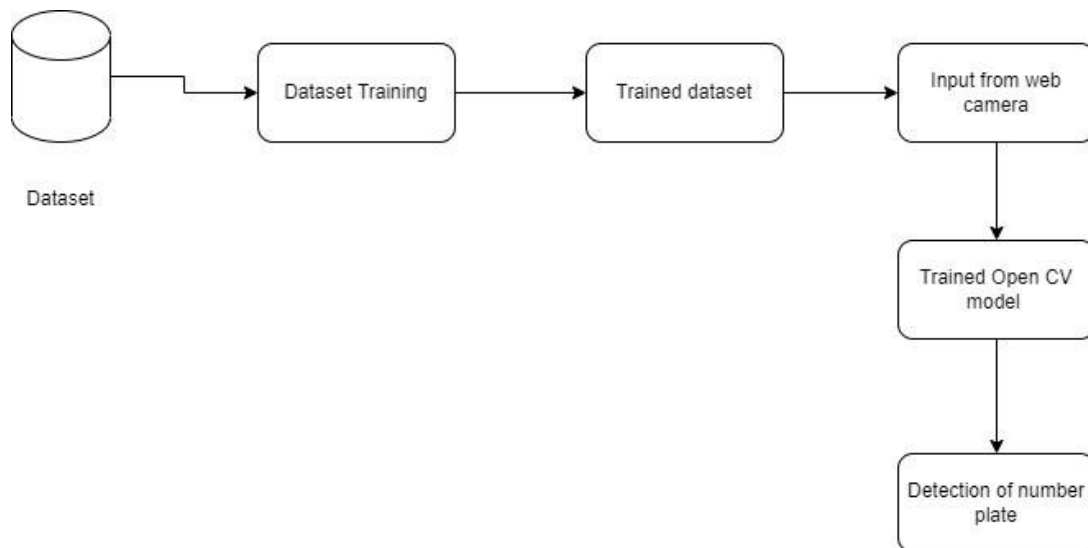


Fig1.1: System Architecture

1.3 IMAGE PROCESSING

1. In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to

the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

2. Images are also processed as three-dimensional signals with the third-dimension being time or the z-axis. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging. Closely related to image processing are computer graphics and computer vision.
3. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).
4. In modern sciences and technologies, images also gain much broader scopes due to the ever-growing importance of scientific visualization (of often large-scale complex scientific/experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance. Image analysis is the extraction of meaningful information from images; mainly from digital images by means of digital image processing techniques. Image analysis tasks can be as simple as reading bar coded tags or as sophisticated as identifying a person from their face.
5. Computers are indispensable for the analysis of large amounts of data, for tasks that require complex computation, or for the extraction of quantitative information. On the other hand, the human visual cortex is an excellent image analysis apparatus, especially for extracting higher-level information, and for many applications — including medicine, security, and remote sensing — human analysts still cannot be replaced by computers.

6. For this reason, many important image analysis tools such as edge detectors and neural networks are inspired by human visual perception models. Image editing encompasses the processes of altering images, whether they are digital photographs, traditional photochemical photographs, or illustrations. Traditional analog image editing is known as photo retouching, using tools such as an airbrush to modify photographs, or editing illustrations with any traditional art medium. Graphic software programs, which can be broadly grouped into vector graphics editors, raster graphics editors, and 3D modelers, are the primary tools with which a user may manipulate, enhance, and transform images. Many image editing programs are also used to render or create computer art from scratch.
7. Raster images are stored in a computer in the form of a grid of picture elements, or pixels. These pixels contain the image's color and brightness information. Image editors can change the pixels to enhance the image in many ways. The pixels can be changed as a group, or individually, by the sophisticated algorithms within the image editors. Many graphics applications are capable of merging one or more individual images into a single file. The orientation and placement of each image can be controlled. When selecting a raster image that is not rectangular, it requires separating the edges from the background, also known as silhouetting. This is the digital analog of cutting out the image from a physical picture.

Clipping paths may be used to add silhouetted images to vector graphics or page layout files that retain vector data. Alpha compositing, allows for soft translucent edges when selecting images. There are a number of ways to silhouette an image with soft edges, including selecting the image or its background by sampling similar colors, selecting the edges by raster tracing, or converting a clipping path to a raster selection. Once the image is selected, it may be copied and pasted into another section of the same file, or into a separate file. The selection may also be saved in what is known as an alpha channel. A popular way to create a composite image is to use transparent layers. The background image is used as the bottom layer, and the

image with parts to be added are placed in a layer above that. Using an image layer mask, all but the parts to be merged are hidden from the layer, giving the impression that these parts have been added to the background layer. Performing a merge in this manner preserves all of the pixel data on both layers to more easily enable future changes in the new merged image.

Steps of Image Processing

1.3.1 Image Acquisition

This is the first step or process of the fundamental steps of digital image processing. Image acquisition could be as simple as being given an image that is already in digital form. Generally, the image acquisition stage involves preprocessing, such as scaling etc.

1.3.2 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 & contrast etc.

1.3.3 Image Restoration

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

1.3.4 Color Image Processing

Color image processing is an area that has been gaining its importance because of the significant increase in the use of digital images over the Internet. This may include color modeling and processing in a digital domain etc.

1.3.5 Wavelets And Multi-Resolution Processing

Wavelets are the foundation for representing images in various degrees of resolution. Images subdivision successively into smaller regions for data compression and for pyramidal representation.

1.3.6 Compression

Compression deals with techniques for reducing the storage required to save an image or the bandwidth to transmit it. Particularly in the uses of internet it is very much necessary to compress data.

1.3.7 Morphological Processing

Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape.

1.5 SEGMENTATION

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical

imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like marching cubes. Segmentation is the most important part in image processing. Fence off an entire image into several parts which is something more meaningful and easier for further process. These several parts that are rejoined will cover the entire image. Segmentation may also depend on various features that are contained in the image. It may be either color or texture. Before denoising an image, it is segmented to recover the original image. The main motto of segmentation is to reduce the information for easy analysis. Segmentation is also useful in Image Analysis and Image Compression.

Segmentation can be classified as follows:

- Region Based
- Edge Based
- Threshold
- Feature Based Clustering
- Model Based

1.5.1 Region Based

In this technique pixels that are related to an object are grouped for segmentation. The thresholding technique is bound with region based segmentation. The area that is detected for segmentation should be closed. Region based segmentation is also termed as “Similarity Based Segmentation”. There won’t be any gap due to missing edge pixels in this region-based segmentation. The boundaries are identified for segmentation. In each and every step at least one pixel is related to the region and is taken into consideration. After identifying the change in the color and texture, the edge flow is converted into a vector. From this the edges are detected for further segmentation.

1.5.3 Edge Based

Segmentation can also be done by using edge detection techniques. In this

technique the boundary is identified to segment. Edges are detected to identify the discontinuities in the image. Edges on the region are traced by identifying the pixel value and it is compared with the neighboring pixels. For this classification they use both fixed and adaptive feature of Support Vector Machine (SVM). In this edge-based segmentation, there is no need for the detected edges to be closed. There are various edge detectors that are used to segment the image. In that Canny edge detector has some step-by-step procedure for segmentation, which is as follows:

1. To reduce the effect of noise, the surface of the image is smoothened by using Gaussian Convolution.
2. Sobel operator is applied to the image to detect the edge strength and edge directions.
3. The edge directions are taken into considerations for non-maximal suppression i.e., the pixels that are not related to the edges are detected and then, they are minimized.
4. Final step is removing the broken edges i.e.; the threshold value of an image is calculated and then the pixel value is compared with the threshold that is obtained. If the pixel value is high than the threshold then, it is considered as an edge or else it is rejected.

The technique that is used for segmenting the remote sensing image has high spatial resolution. The two step procedures for segmentation are extracting the edge information from the edge detector and then the pixels are labeled. The advantage of this technique is retrieving information from the weak boundary too. Spatial resolution for segmentation improves positional accuracy. Based on the edge flow, the image is segmented. It identifies the direction of the change in color and texture of a pixel in an image to segment. Segmentation can also be done through edges. There will be some gap between the edges as it is not closed. So, the gap is filled by edge linking. The broken edges are extended in the direction of the slope for the link to get the

connectivity for segmentation.

1.5.3 Threshold

Thresholding is the easiest way of segmentation. It is done through that threshold values which are obtained from the histogram of those edges of the original image. The threshold values are obtained from the edge detected image. So, if the edge detections are accurate then the threshold too. Segmentation through thresholding has fewer computations compared to other techniques. Segmentation is based on "his ton". For a particular segment there may be set of pixels which is termed as "his ton". Roughness measure is followed by a thresholding method for image segmentation. Segmentation is done through adaptive thresholding. The gray level points where the gradient is high, is then added to thresholding surface for segmentation. The drawback of this segmentation technique is that it is not suitable for complex images.

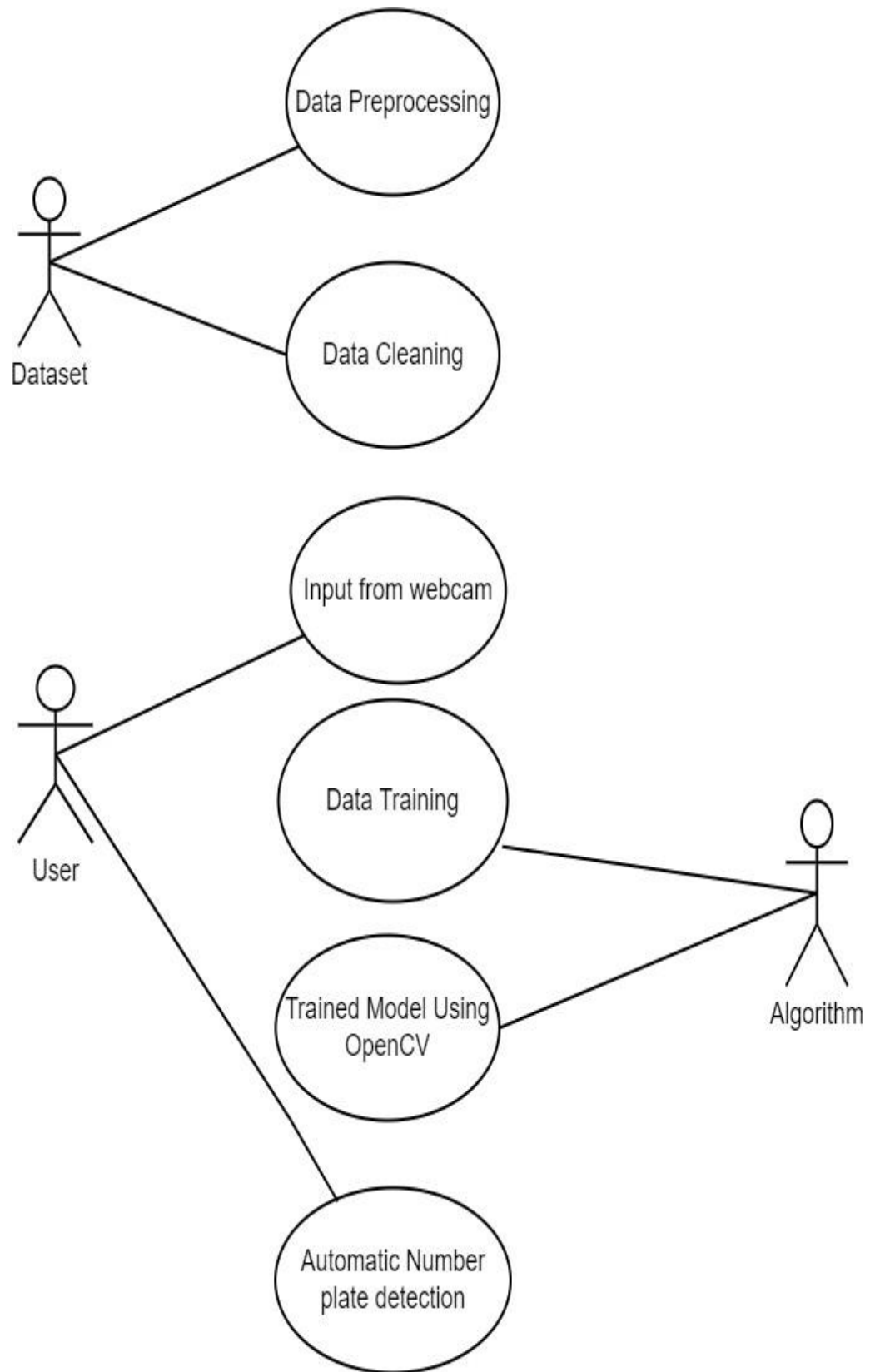


Fig 1.2: Flow diagram

CHAPTER 2

LITERATURE REVIEWS

This project describes the both software and hardware based 'Automatic Number Plate Recognition System For Vehicle Identification Using Optical Character Recognition' helps to identified the number plate which reads the numbers on vehicles, making it easier and fast way to captured Cam action before essential is done.

[1] G.L. CORNETO, NEW METHOD FOR AUTOMATIC VEHICLE LICENSE PLATE DETECTION. IEEE 2018, License plate recognition has been widely studied, and the advance in image capture technology helps enhance or create new methods to achieve this objective. In this work is presented a method for real time detection and segmentation of car license plates based on image analyzing and processing techniques. The results show that the computational cost and accuracy rate considering the proposed approach are acceptable to real time applications, with an execution time under 1 second. The proposed method was validated using two datasets (A and B). It was obtained over 92% detection success for dataset A, 88% in digit segmentation for datasets A and B, and 95% digits classification accuracy rate for dataset B. The memory requirements are uniquely designed to be extremely low, which enables usage of smaller FPGAs. The resulting hardware is suitable for applications where cost, compactness, and efficiency are system design constraints. The other advantage is its compactness and its offline computation feature without the added cost of a DSP. The design will be preferred in remote locations, where bulky acquisition devices are not feasible. This low-cost dedicated hardware device can be used to forward only the extracted text information rather than bulky image data through wireless data links, thus reducing operational costs

[2] CHENG-HUNG LIN, AN EFFICIENT LICENSE PLATE RECOGNITION SYSTEM USING CONVOLUTION NEURAL NETWORKS, IEEE 2018, License Plate Recognition (LPR) has been widely used in many traffic applications, such as smart parking system, traffic toll system, and security system. In recent years, LPR has played a crucial role in the development of smart cities as a surveillance system for vehicle management, investigation of stolen vehicles and traffic monitoring. Although LPR has been successfully applied to environment-controlled smart parking systems, it still faces

many challenging in the surveillance system such as congested traffic with multiple plates, ambiguous signs and advertisements, tilting plates, as well as obscure images taken in bad weather and nighttime. In recent years, license plate recognition system has become a crucial role in the development of smart cities for vehicle management, investigation of stolen vehicles, and traffic monitoring and control. License plate recognition system has three stages, including license plate localization, character segmentation, and character recognition. Although the license plate recognition system has been successfully applied to the environment-controlled smart parking system, it still faces many challenging in the surveillance system such as congested traffic with multiple plates, ambiguous signs and advertisements, tilting plates, as well as obscure images taken in bad weather and nighttime. In this paper, we propose an efficient license plate recognition system that first detects vehicles and then retrieves license plates from vehicles to reduce false positives on plate detection. Then, we apply convolution neural networks to improve the character recognition of blurred and obscure images. The experimental results show the superiority of the performance in both accuracy and performance in comparison with traditional license plate recognition systems.

[3] ANIMESH CHANDRA ROY, LICENSE PLATE DETECTION AND CHARACTER RECOGNITION SYSTEM FOR COMMERCIAL VEHICLES BASED ON MORPHOLOGICAL APPROACH AND TEMPLATE MATCHING, IEEE 2019, License Plate Detection and Recognition is the first step of LPR technology to automatically read license plate characters. It is the foremost modules of Intelligent Transportation System (ITS). A fully operative LPR system is consists of three major steps such as, Detection of plate region, Segmentation and classification of characters and digits. LPR system is well-known over the world but it is very new for our country. Bangladesh is one of the most densely populated countries in the world and since the number of automobiles increases, it means the number of Plates delivered by BRTA (Bangladesh Road Transport Authority) also increases. The fraudulent Plates also give opportunity to increase vehicles related crimes. Thus recognition is the only solution to investigate the unique number plates. Though license plate detection and recognition system has a lot of applications but a very little work has been done on Bangla license plate

recognition. Variations among the license plate patterns and complex background of Bangladeshi license plates make it more difficult to use the existing algorithms. Because of this, we propose a solution for Bangla license plate detection and recognition. Firstly, the position of the vehicle is determined. In our country, commercial License Plates have the unique color (green) of its own. That's why; we select the portions of green color with the matching RGB intensity of the plate. A boundary-based contour algorithm, area and aspect ratio have been proposed to track down the license plate in the vehicle region. License plate rows containing registration information have been separated by using horizontal projection with threshold.

[4] NEHA RANA, LOCALIZATION TECHNIQUES IN ANPR SYSTEMS: A-STATE-OF-ART , IEEE 2021, The application of computer image processing increased efficiency and security in different image analysis applications. Automatic license plate character recognition (ALPR) is one of them. ALPR system is used to detect, recognize a vehicle license plate. ALPR systems have been used in parking lots, security control of restricted areas and traffic surveillance. Vehicles have unique license plate to be recognized. Therefore, image processing-based algorithm is suitable to develop a vehicle license plate recognition system. The aim of this thesis is to compare various localization techniques. ALPR comprises of three stages namely localization, segmentation and character recognition. In this paper, various localization techniques are compared. Localization is a process of identifying license plate from the image captured. License plate is characterized by its dimensions and high contrast. Restrictions on the technique is due to variations in size and characters of number plate, font used and background and foreground colors. The novel approach localizes license plate with accuracy of 91%. Genetic algorithm, based on Darwin's theory of survival of the fittest localizes with an accuracy of 90%. The system is implemented using MATLAB and tested on various samples. Morphological operators localize with an accuracy of 91%. The method is used on database of UK number plates.

[5] RACHID HEDJAM, INFLUENCE OF COLOR-TO-GRAY CONVERSION ON THE PERFORMANCE OF DOCUMENT IMAGE BINARIZATION: TOWARD NOVEL OPTIMIZATION PROBLEM, IEEE 2020, Historical documents are of great interest to scholars in the social sciences and humanities. They are the memory of human

cultures, their history, their achievements, their lifestyles and their individual and social behaviors. Therefore, the preservation of these documents has captured the attention of many archives around the world. The value of these historical documents is vastly improved for consultation by the general public and for research purposes through digitization, which involves acquisition, processing and dissemination of knowledge. A historical document is unique, i.e., it does not have multiple copies. It contains specific difficulties impeding access to its content, e.g. the presence of physical degradation caused by environmental conditions, dust, dirt, etc. Such phenomena continue to harm these precious objects, and thus there is an urgent need for a method of preserving and providing broader access to them. Digital archiving is a standard way to meet this need. This paper presents a novel pre-processing method of color-to-gray document image conversion. In contrast to the conventional methods designed for natural images that aim to preserve the contrast between different classes in the converted gray image, the proposed conversion method reduces as much as possible the contrast (i.e., intensity variance) within the text class. It is based on learning a linear filter from a predefined dataset of text and background pixels that: i) when applied to background pixels, minimizes the output response; and ii) when applied to text pixels, maximizes the output response, while minimizing the intensity variance within the text class. Our proposed method (called here LC2G for Learning-based Color-to-Gray) is conceived to be used as pre-processing for document image binarization.

Sl.no.	TITLE	AUTHORS	ALGORITHMS	ADVANTAGES	DISADVANTAGES
1	New method for automatic vehicle license plate detection. iee 2018	G.L. CORNETO	CNN	Identifying number plate	Only detect the number plate.
2	An Efficient License Plate Recognition System Using Convolution Neural Networks	CHENG-HUNG LIN	CNN	High accuracy in character recognition	Character only recognized
3	License Plate Detection and Character Recognition System For Commercial Vehicles Based On Morphological Approach And Template MATCHING	ANIMESH CHANDRA ROY	Segmentation	Plate regions can be detected	Need more training data
4	Localization Techniques In Anpr Systems: A-State-Of-Art	NEHA RANA	Character Recognition and Segmentation techniques	Localize with an accuracy of 91%.	Improper illumination and blurring.

5	Influence Of Color-To-Gray Conversion On The Performance Of Document Image Binarization: Toward Novel Optimization Problem	RACHID HEDJAM	Learning Bases Color to Gray technique	Discriminant feature vectors.	Overlap between the background and the foreground classes.
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CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM OF THE PROJECT

The aim of the project for automatic number plate recognition system (ANPR) is to develop a computerized system that can automatically capture and recognize the characters on a vehicle's license plate using optical character recognition (OCR) technology. This system can be used for vehicle identification in a variety of applications, such as law enforcement, toll collection, parking management, and traffic control.

The ANPR system works by capturing an image of the license plate using a camera, and then processing the image to extract the characters on the plate. The OCR technology is then used to recognize the characters and convert them into a digital format that can be stored and analyzed by the system. The system can then use this information to compare the license plate number against a database of known vehicles to identify the owner and other relevant information.



Fig 3.1 Picture of Traffic at the Toll Plaza

The main benefits of an ANPR system are its speed and accuracy. It can process large volumes of vehicles quickly and accurately, reducing the need for manual intervention and improving overall efficiency. Additionally, the system can be integrated with other technologies such as CCTV cameras and GPS systems to provide a comprehensive solution for vehicle identification and tracking.

3.2 PROBLEM STATEMENT

The problem statement for automatic number plate recognition (ANPR) system for vehicle identification using optical character recognition (OCR) is the need for a fast and reliable system that can accurately identify and track vehicles in real-time. Traditional manual methods of vehicle identification are time-consuming, inefficient, and prone to errors. ANPR system can provide a solution to these challenges, but there are several technical challenges that need to be addressed.

One of the main challenges is to develop an ANPR system that can accurately recognize license plate characters under different lighting and weather conditions. The system should be able to recognize characters even when the license plate is dirty, damaged, or partially obstructed. Additionally, the system should be able to distinguish between different types of license plates used in different countries, which may have different formats and character sets.

Another challenge is to ensure the security and privacy of the data collected by the ANPR system. The system must comply with data protection regulations and ensure that the collected data is not misused or accessed by unauthorized personnel. The system must also ensure that the data is stored securely and can be easily retrieved and analyzed when needed.

Lastly, there is a challenge of cost-effectiveness and scalability. The ANPR system should be affordable and scalable to meet the needs of different applications

and organizations. It should be easy to install and maintain, and the operating costs should be reasonable.

Addressing these challenges will require a multidisciplinary approach, combining expertise in computer vision, image processing, machine learning, and data security. A well-designed ANPR system can provide significant benefits in terms of increased efficiency, improved security, and enhanced traffic management.

3.3 EXISTING SYSTEM

Nowadays, increasing traffic volume causes congestions commonly around the toll gate of highway. Therefore, the new technique is urgently required to reform the problem of congestions. Automated toll collection system is one of the methods to solve the above conditions. The automated system is composed of several subsystems. The Radio Frequency Identification (RFID) technology, computer database, power supply, microcontroller, motor and inferred device are included. Automated system can bring the several sectors for toll gates as saving time and reducing the human workers. Develop the prototype model, which reproduces the operation states of various toll gate systems: passing time and waiting time. There are two ways of collecting toll tax being in practice at present. First is the traditional manual method where one person collects the money and issues a receipt. The other one is Smart Card system where the person needs to show the smart card to the system installed at the toll tax depot to open the barrier. The existing system consists of a microcontroller, RFID reader, RFID Tag and bill printer. The reader retrieves the information about the ID number and identifies the vehicle. Then for the tax to be collected the bill is printed at the time of exit. The motor here is used to open and close the gate automatically. The existing system includes automated system using RFID technology can be classified into two modules. They are vehicle module and base module. The vehicle module consists of passive RFID tag. The RFID reader, host computer system and gate control system are composed as the base module.

3.4 PROPOSED SYSTEM

Each vehicle will be provided by license plate number which containing a unique ID. This license plate is captured by an image. When the vehicle will reach at the toll booth web camera capture the license plate with number. This image is passed to the system. Now, with the help of PC interface unit the data collected is passed to PC through serial port. In the proposed system we can convert license plate number into text format. ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. License plate recognition technology tends to be region-specific, owing to plate variation from place to place. Software developed will show all the details about the vehicle on the screen. Details like date time and id will be stored in the access database. The system will check whether the user is valid or not, if valid the system generates the bill in online transaction. The vehicle details regarding the deducted amount and the main account balance are intimated to the user's mobile through GSM technology. License Plate Recognition is an image-processing technology that is used to identify vehicles by their license plates. A license plate reviewer mechanism works by extracting the characters from an image. This image processing technology is used for various applications such as toll plaza, parking lots, border control, and traffic law enforcement. As a result to the problem of observing the enormous number of vehicles for law enforcement and security, this work concentrates to design a license plate recognition system to make the work more practical. Our system is designed to detect and identify license plates without constant human intervention. This will provide benefit of saving the cost and time to the organization.

3.5 DIFFERENCE BETWEEN PROPOSED AND EXISTING SYTEM

The existing systems are not very robust in prediction. They have not evolved according to technological advancements and time. The results are also unsatisfactory and may lead to erroneous number plate detection. The proposed system performs

better than all previous ones in terms of accuracy and time effectiveness.

3.6 BLOCK DIAGRAM FOR PROPOSED SYSTEM

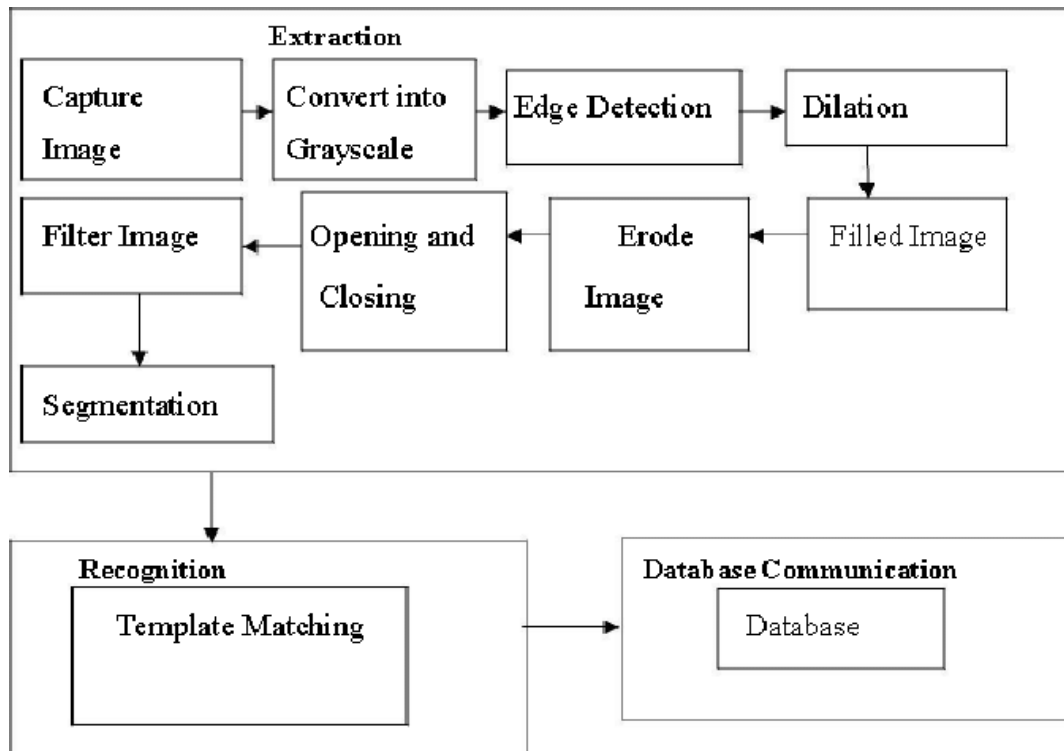


Fig 3.2 Block Diagram of Proposed System

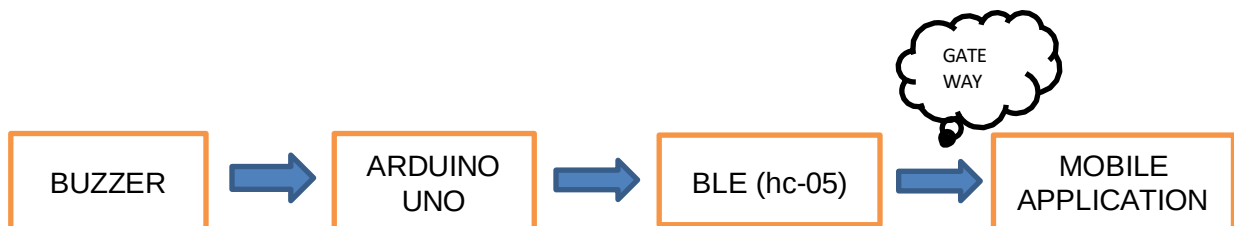


Fig 3.3 Hardware Block Diagram

CHAPTER 4

HARDWARE COMPONENTS

- ARDUINO
- HC-05 BLUETOOTH MODULE
- BUZZER

4.1 ARDUINO

Arduino-An Overview

Arduino is a tool for making computers that can smell and control further of the physical world than your desktop computer. It's an open- source physical computing platform predicated on a simple microcontroller board, and a development terrain for notation software for the board.

Arduino systems can be stand- alone, or they can communicate with software running on your computer (e.g., Flash, Processing, MaxMSP.) The boards can be assembled by hand or bought preassembled; the open- source IDE can be downloaded for free.

The Arduino programming language is an performance of Wiring, a similar physical computing platform, which is predicated on the Processing multimedia programming terrain.

Arduino is a popular platform for DIY electronics and programming because it is easy to use and versatile. Here are some reasons why people choose to use Arduino:

1. Easy to learn: Arduino is a beginner-friendly platform that is easy to learn, even for those without prior programming or electronics experience. The IDE is user-friendly and the programming language is simple and easy to understand.
2. Open-source: Arduino is an open-source platform, which means that the hardware and software designs are freely available to everyone. This allows for a large community of users to collaborate and share ideas and projects.
3. Low cost: Arduino boards are relatively inexpensive, making them accessible to people with limited budgets.
4. Versatile: Arduino can be used for a wide range of projects, from simple LED blinking to complex robotics and automation systems.
5. Extensible: Arduino boards can be extended with additional shields, which are add-on boards that provide additional functionality such as Wi-Fi, GPS, or sensors.
6. Community support: Arduino has a large and active community of users who are willing to help each other with technical support, troubleshooting, and sharing project ideas and resources.
7. Arduino can be used in ANPR (Automatic Number Plate Recognition) systems as a control unit or a processing unit. ANPR systems use optical character recognition (OCR) technology to read the license plates of vehicles and convert them into machine-readable text.
8. Arduino boards can be used to control the cameras, lights, and sensors used in ANPR systems, as well as to process the data generated by the OCR software. Arduino boards can be programmed to control the timing of the lights and cameras, adjust the focus and zoom of the cameras, and trigger the OCR

software to process the images and extract the license plate information.

9. Arduino boards are also relatively low-cost and easy to use, making them an attractive option for ANPR system developers and hobbyists. They can be easily programmed using the Arduino IDE, and there is a large community of users who share code libraries and project ideas.

Overall, Arduino can be a useful component in ANPR systems, providing a flexible and customizable platform for controlling and processing the data generated by the system.

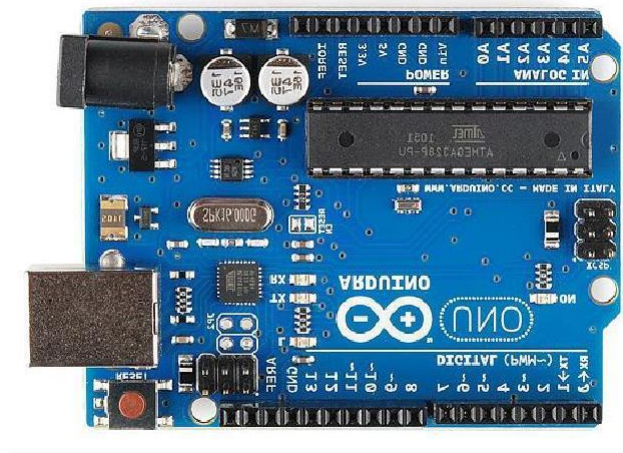


Fig 4.1 Arduino UNO

4.2 BLUETOOTH MODULE HC-05

1. The HC-05 is a Bluetooth module that can be used for wireless communication between devices. It is commonly used in Arduino and other microcontroller projects, as well as in robotics and automation systems.
2. The HC-05 module is based on the Bluetooth 2.0 EDR (Enhanced Data Rate) standard, which supports a maximum data rate of 2.1 Mbps. It operates on the 2.4 GHz frequency band and has a range of up to 10 meters (33 feet) in open space.
3. The HC-05 module can be configured as a master or slave device, allowing it to

communicate with other Bluetooth devices such as smartphones, tablets, or PCs. It uses the serial communication protocol (SCP) to exchange data with the host device, making it easy to interface with microcontrollers such as Arduino.

4. The HC-05 module is easy to use and comes with a default baud rate of 9600. It can be configured using AT commands, which are sent over the serial interface. These commands can be used to set the device name, the PIN code, the operating mode, and other parameters.
5. The HC-05 Bluetooth module can be used in ANPR (Automatic Number Plate Recognition) systems as a wireless communication module. ANPR systems use optical character recognition (OCR) technology to read the license plates of vehicles and convert them into machine-readable text.
6. The HC-05 module can be used to wirelessly transmit the license plate information from the ANPR camera to the processing unit or the control unit, eliminating the need for a wired connection between the camera and the unit.
7. For example, the HC-05 module can be connected to the Arduino board, which acts as the processing unit in an ANPR system. The module can be configured to communicate with the Bluetooth module of the camera, which captures the license plate image. The license plate information can then be transmitted wirelessly to the Arduino board, which processes the data and triggers an action based on the application requirements.
8. The HC-05 module can also be used to wirelessly communicate with a smartphone or a tablet, allowing the user to remotely monitor the ANPR system or receive alerts based on certain events, such as the detection of a specific license plate.

Overall, the HC-05 Bluetooth module can be a useful component in ANPR systems, providing a flexible and convenient way to wirelessly transmit data between different

components of the system.

HC-05 FC-114

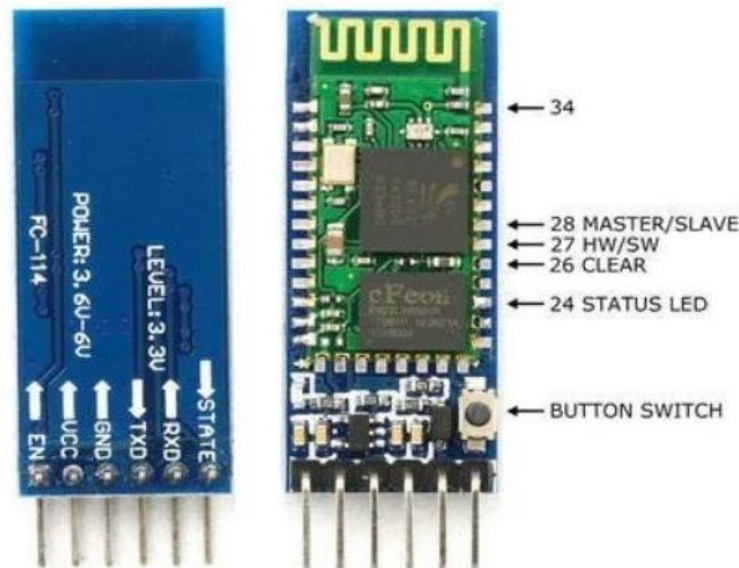


Fig 4.2 Bluetooth module HC-05

Specification of HC-05 Bluetooth Module

- Bluetooth version: 2.0 + EDR (Enhanced Data Rate)
- Frequency: 2.4 GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Transmit power: Class 2 (up to 4 dBm)
- Sensitivity: -80 dBm typical
- Range: approximately 10 meters (or 33 feet) in open air
- Profiles supported: SPP (Serial Port Profile), HID (Human Interface Device) and others
- Operating voltage: 3.3V to 5V DC
- Operating current: less than 50mA

- Standby current: less than 2.5mA
- Sleep current: less than 1mA
- Interface: UART (Universal Asynchronous Receiver/Transmitter)

4.3 BUZZER

A buzzer is a device that produces a loud, usually harsh, buzzing or humming sound. It is often used as an alarm or warning signal in various electronic devices, such as alarm clocks, doorbells, timers, and game show buzzers. The sound is typically generated by an electromechanical mechanism that converts electrical energy into mechanical vibrations, which in turn produce the sound. Buzzers can be designed to produce different frequencies and intensities of sound depending on the application.

In Arduino, a buzzer can be easily connected to a digital pin to produce different sounds and tones. The most common type of buzzer used with Arduino is the piezo buzzer, which produces sound by vibrating a piezoelectric crystal.

To use a buzzer with Arduino, you can follow these steps:

1. Connect the positive leg of the buzzer to a digital pin on the Arduino board (e.g., pin 8) and the negative leg to ground.
2. In your Arduino sketch, use the `tone()` function to generate sound on the buzzer. The `tone()` function takes two arguments: the pin number and the frequency of the sound you want to generate.



Fig 4.3 Buzzer

4.4 SOFTWARE DESCRIPTION

Software tools being used to interface the hardware system to software system are:

- Arduino IDE

4.4.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a software application used to program and upload code to Arduino boards. The Arduino IDE is open-source and available for free download on the official Arduino website. It is designed to be user-friendly and accessible to beginners, while also providing advanced features for more experienced users. The Arduino IDE includes a code editor, compiler, and uploader all in one program. It supports a variant of the C++ programming language and comes with a range of libraries and examples to help users get started. The IDE also has a serial monitor that allows users to send and receive data between their computer and the Arduino board.

One of the key features of the Arduino IDE is its simplicity. The interface is easy to navigate, and the code editor includes features such as syntax highlighting and autocompletion to make programming easier. Additionally, the IDE has a large community of users who share their code and provide support through forums and other resources.

The Arduino Integrated Development Environment (IDE) is a software application that facilitates the development of applications for the Arduino microcontroller platform. The IDE provides a set of tools for writing, compiling, and uploading code to the Arduino board. It also includes a serial monitor that allows developers to communicate with the board and debug their code. The IDE is available for Windows, macOS, and Linux operating systems and is free to download from the Arduino website. It is based on the Processing IDE, which is a similar software application used for developing graphics and interactive applications.

One of the main advantages of the Arduino IDE is its simplicity. It is designed to be user- friendly and easy to use, even for those with little or no programming experience. The interface is intuitive and straightforward, with a menu bar at the top and a code editor at the center of the screen. The code editor includes features such as syntax highlighting, interface is intuitive and straightforward, with a menu bar at the top and a code editor at the center of the screen. The code editor includes features such as syntax highlighting, auto-completion, and error highlighting, which help developers write clean and error-free code.

The Arduino IDE is also highly customizable. Developers can choose from a range of board types and configurations, and the IDE will automatically adjust its settings accordingly. It also supports a wide range of programming languages, including C and C++, which are the primary programming languages used for Arduino development.

One of the most powerful features of the Arduino IDE is its ability to interface with other software applications and devices. For example, developers can use the IDE to communicate with external sensors, actuators, and other hardware components, allowing them to create complex and sophisticated applications. The IDE also includes a library manager, which makes it easy to add new libraries and functionality to the platform.

The Arduino IDE is also open-source, which means that developers can access the source code and modify it as needed. This provides a high degree of flexibility and enables developers to customize the IDE to their specific needs. In addition to the standard IDE, the Arduino platform also includes a range of other tools and resources for developers. These include a hardware design editor, which allows developers to create custom Arduino boards, and a web-based IDE, which enables developers to work on their projects from any computer with an internet connection.

Overall, the Arduino IDE is a powerful and versatile tool that makes it easy for developers of all skill levels to create applications for the Arduino platform. Its simplicity, customizability, and wide range of features make it an essential tool for anyone interested in electronics and programming.

The Arduino IDE also allows users to upload code to a wide range of Arduino boards, including the popular Arduino Uno and Arduino Nano. It also supports many Arduino-compatible and Arduino-derived boards. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent, but change the form factor, sometimes retaining compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility. Arduino Mini and the unofficial Arduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods. standard AVR in-system programming (ISP) is used.

Microcontrollers, such as the ESP32 and the ATmega328P. Overall, the Arduino IDE is a powerful and accessible tool for programming and uploading code to Arduino boards. Its user-friendly interface and wide range of features make it an excellent choice for beginners and experienced users alike.

4.4.2 STREAMLIT

Streamlit is an open-source Python library used for building web applications

with interactive user interfaces (UIs). It allows users to quickly and easily create data-driven applications by writing simple Python scripts. Streamlit provides a variety of built-in UI components and widgets such as sliders, dropdowns, and checkboxes, which can be used to interact with data and create visualizations.

Streamlit provides a real-time preview of changes made to the application code, which makes the development process much faster and easier. The library also supports data caching, which helps reduce the time needed to load and process large datasets.

Streamlit can be used to build a wide variety of applications, including data dashboards, machine learning models, and interactive visualizations. It has gained popularity in the data science community for its simplicity and ease of use.

4.4.3 OPENCV-PYTHON

OpenCV (Open-Source Computer Vision) is a popular open-source library of computer vision and image processing algorithms. OpenCV-Python is the Python API for OpenCV, which allows developers to use OpenCV algorithms in their Python applications.

OpenCV-Python provides a large number of image processing and computer vision functions, including image and video I/O, image filtering and transformation, feature detection, object detection and recognition, and machine learning.

Some of the common tasks that OpenCV-Python can be used for include image and video processing, object detection and tracking, face detection and recognition, motion detection, and augmented reality.

OpenCV-Python is widely used in various fields, including robotics, computer

vision research, image and video analysis, and machine learning. It is easy to install and use, and there are numerous tutorials and examples available online to help developers get started.

4.4.4 TORCH

PyTorch is a popular open-source machine learning library based on the Torch library. It provides two high-level features: tensor computation (like NumPy) with strong GPU acceleration support and a deep neural network module which is designed to be flexible and efficient.

PyTorch is built to support dynamic computational graphs, which allows developers to change the network architecture on-the-fly during runtime. This feature is especially useful in deep learning, where models are often very complex and require extensive trial-and-error to get optimal performance.

PyTorch provides a rich set of tools and functions for building and training deep learning models, including neural network layers, loss functions, optimization algorithms, and data loaders. It also includes support for distributed training, which allows users to train models on multiple GPUs or even multiple machines.

4.4.5 TIMEIT

Timeit is a built-in Python module used to measure the execution time of small code snippets. It provides a simple way to measure the execution time of small Python code blocks and functions, with high accuracy.

Timeit works by executing the code repeatedly and measuring the time taken to execute it. The module provides several methods for measuring execution time,

including:

`timeit.timeit (stmt, setup, timer, number)`: This function runs the `stmt` code snippet number times and returns the average execution time. The `setup` parameter is optional and is used to set up the environment for `stmt`. The `timer` parameter is also optional and specifies the timer function to use for measuring time.

`timeit.repeat (stmt, setup, timer, repeat, number)`: This function runs the `stmt` code snippet number times and repeats the measurement repeat times. It returns a list of execution times for each repeat.

`timeit.default_timer ()`: This function returns the default timer function used by `timeit`.

Timeit is often used to compare the performance of different implementations of the same task or to measure the impact of different algorithmic choices on the execution time of a program.

4.4.6 DIFFLIB

`diffib` is a built-in Python module used to compare the differences between two sequences of strings. It provides a range of methods for comparing and displaying the differences between two sequences, including generating difference reports and computing differences using several algorithms.

The `diffib` module is a C extension of `diffib` that provides faster performance than the pure Python implementation. It is particularly useful when comparing large sequences of strings, as it can handle large datasets more efficiently than the pure Python implementation.

4.4.7 FACE-RECOGNITION

Face recognition is the process of identifying or verifying the identity of an individual using their facial features. It involves capturing an image or video of a person's face, extracting features such as the distance between the eyes, the shape of the nose, the contours of the face, etc., and comparing those features to a database of known faces to find a match.

Face recognition technology has been used in various applications, such as security systems, surveillance, and authentication. However, the use of face recognition technology has also raised concerns regarding privacy and potential misuse.

There are different approaches to face recognition, including traditional methods such as eigenface, Fisherface, and LBPH, as well as deep learning-based methods using convolutional neural networks (CNNs). Deep learning-based face recognition methods have achieved state-of-the-art performance and are widely used in real-world applications.

4.4.8 EASY OCR

EasyOCR is a Python library that provides a simple and convenient way to perform optical character recognition (OCR) on images. With EasyOCR, you can extract text from images and convert them to editable formats such as plain text or searchable PDFs.

EasyOCR uses deep learning algorithms to perform OCR, which means it can recognize text in multiple languages and a variety of fonts with high accuracy. It also provides an easy-to-use API that requires only a few lines of code to perform OCR on an image.

EasyOCR is an open-source library that is freely available and can be installed using Python's package manager, pip. It is a popular choice for many developers and researchers who need to perform OCR on images for various applications, such as document processing, text recognition, and natural language processing.

4.4.9 NUMPY

NumPy is a Python library for numerical computing that provides support for large, multi-dimensional arrays and matrices, along with a wide range of mathematical functions to operate on these arrays.

Some of the crucial features of NumPy include:

Efficient array operations: NumPy's array operations are significantly faster than traditional Python lists because they are implemented in optimized C code.

Multi-dimensional arrays: NumPy provides support for multi-dimensional arrays (ndarrays) that can be used to represent vectors, matrices, and higher-dimensional data.

Broadcasting: NumPy allows for arithmetic operations between arrays of different shapes and sizes by broadcasting the smaller array to match the larger one.

Mathematical functions: NumPy provides a wide range of mathematical functions that can be used to perform operations on arrays, including trigonometric functions, logarithms, and exponentials.

Overall, NumPy is a powerful library that is widely used in scientific computing, data analysis, and machine learning.

4.4.10 PANDAS

Pandas is an open-source data analysis and manipulation library for the Python programming language. It provides data structures for efficiently storing and manipulating large datasets, as well as tools for working with various data formats such as CSV, Excel, SQL databases, and more.

The primary data structures in Pandas are Series and DataFrame. A Series is a one-dimensional array-like object that can hold any data type, while a DataFrame is a two-dimensional table-like structure that consists of rows and columns, with each column being a Series.

Pandas provides a wide range of functions and methods for working with data, including filtering, grouping, aggregating, merging, and pivoting data. It also supports various operations for handling missing or null values, time series data, and categorical data.

Pandas is widely used in data science, machine learning, finance, and many other fields for data analysis, data cleaning, data visualization, and data manipulation tasks. It can be installed via pip, and the documentation is available on the Pandas website.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULTS AND ANALYSIS

The result and discussion of the proposed system are given below

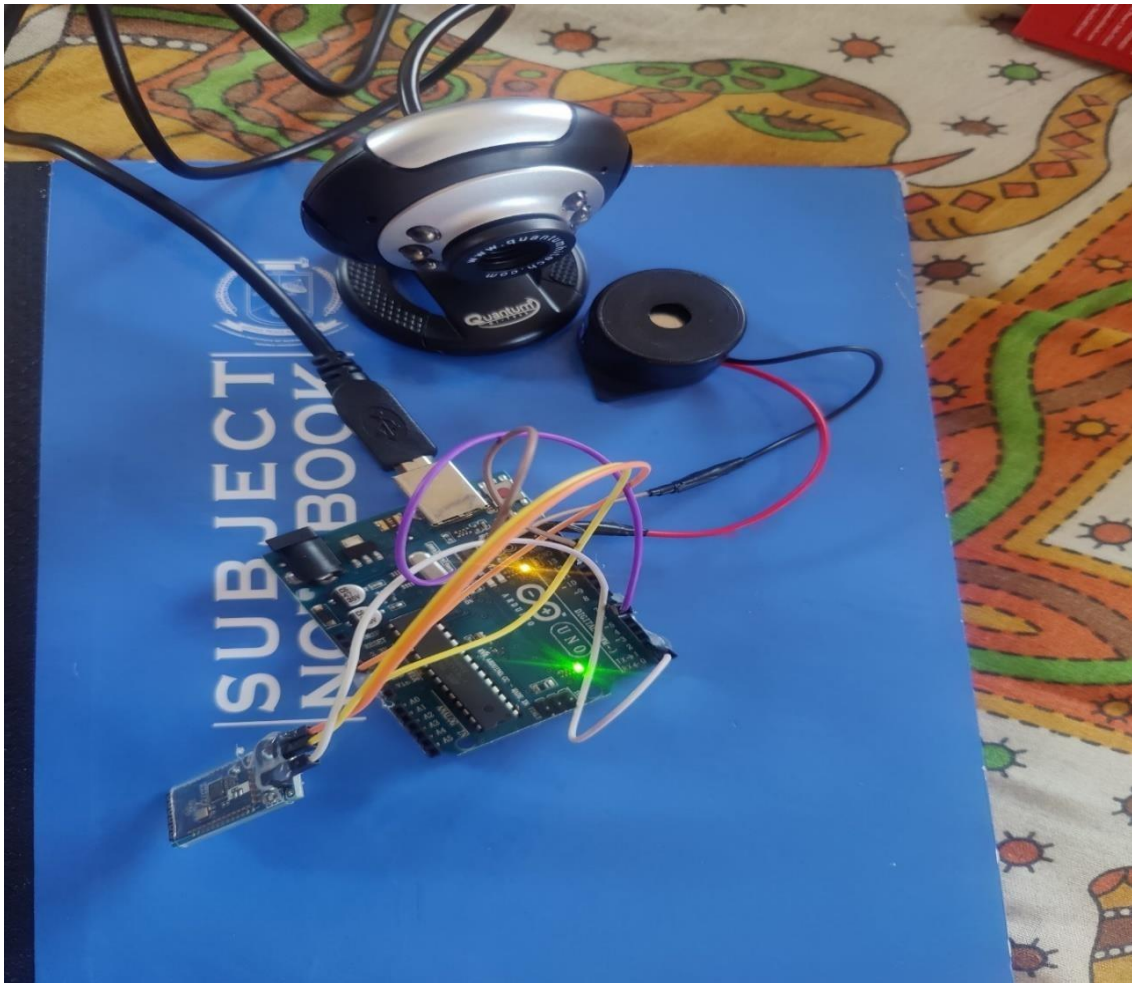


Fig 5.1 Connections

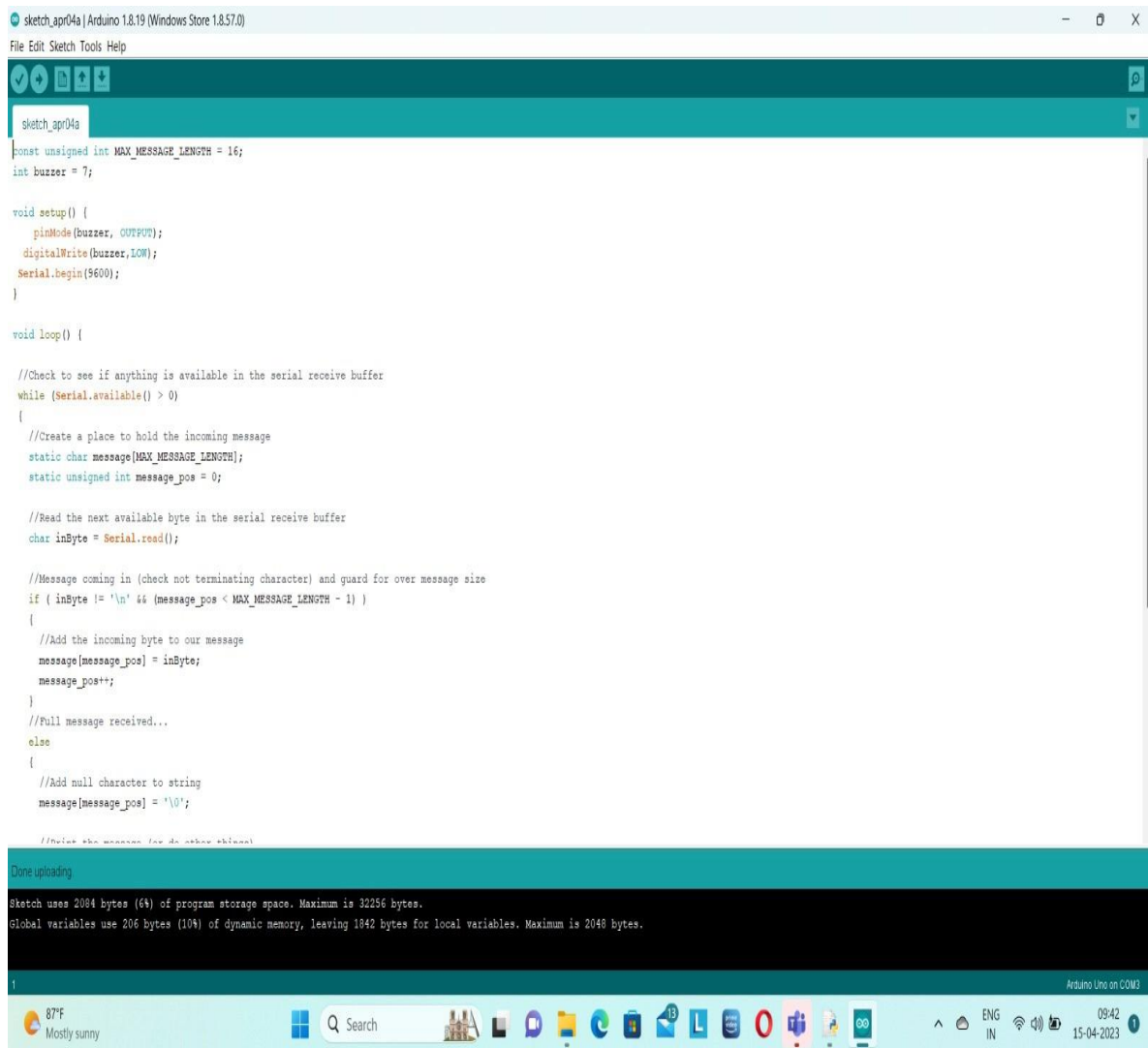


Fig 5.2 Code of Arduino.

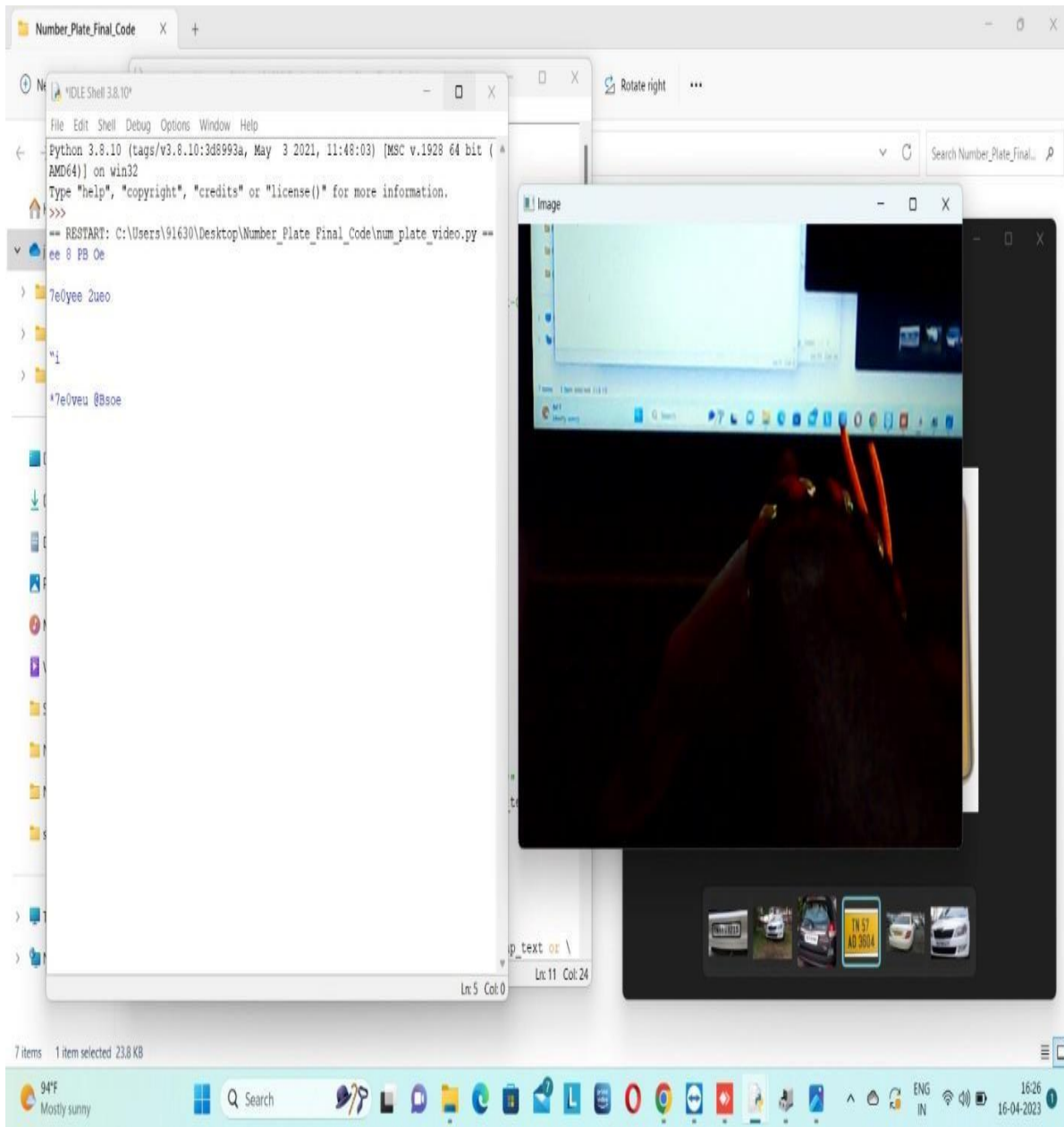


Fig 5.3 Opening of Camera

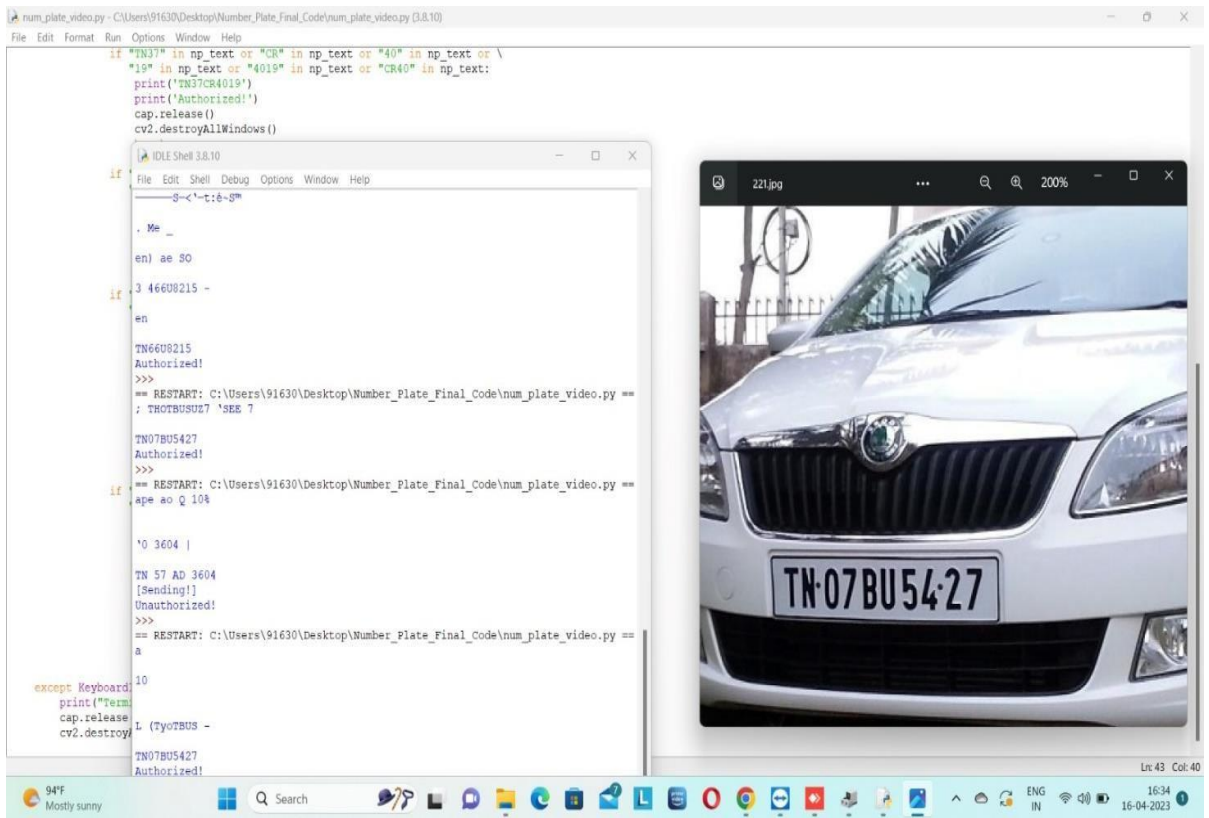


Fig 5.4 Output of Authorized Vehicle



Fig 5.5 Input of Vehicle



Fig 5.7 Screenshot of listed vehicles

Thus, the vehicles are identified whether they are Authorized or Unauthorized.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

In conclusion, the Automatic Number Plate Recognition (ANPR) system is an effective technology that uses optical character recognition (OCR) to automatically recognize and read license plates of vehicles. The ANPR system uses specialized cameras and software to capture an image of the license plate, preprocess the image, locate the plate, segment the characters, perform OCR, and make decisions based on the output.

ANPR systems have a wide range of applications, including law enforcement, toll collection, parking management, and border control. ANPR technology has been proven to improve the efficiency and accuracy of vehicle identification, thereby enhancing the security and safety of roads and highways.

While ANPR technology has some limitations, such as its effectiveness in adverse weather conditions or low light environments, it remains a valuable tool for vehicle identification and surveillance. Overall, the use of ANPR technology with OCR has shown promising results in improving public safety and reducing crime rates.

6.2 FUTURE SCOPE

The future of Automatic Number Plate Recognition (ANPR) systems for vehicle identification using optical character recognition (OCR) is promising, with several potential areas for growth and development. Here are some of the future scopes of ANPR systems:

Integration with Artificial Intelligence: ANPR systems can be integrated with artificial intelligence (AI) technologies to improve their accuracy and efficiency. By leveraging machine learning algorithms, ANPR systems can learn from their past

mistakes and continuously improve their performance.

Cloud-based ANPR systems: Cloud-based ANPR systems can be used to store and process large volumes of data efficiently. Cloud-based ANPR systems can provide real-time alerts and notifications, enabling law enforcement agencies to act quickly in response to security threats.

Integration with other technologies: ANPR systems can be integrated with other technologies such as facial recognition and video analytics to improve their effectiveness and accuracy. By combining these technologies, law enforcement agencies can create a more comprehensive surveillance system.

Autonomous Vehicles: The development of autonomous vehicles is likely to increase the demand for ANPR systems. ANPR systems can be used to identify and track vehicles on the road, making it easier for autonomous vehicles to navigate and avoid collisions.

Smart Cities: The use of ANPR systems can be extended to smart city applications. ANPR systems can be used to monitor traffic flow, parking management, and toll collection, making cities more efficient and reducing congestion.

In conclusion, the future of ANPR systems for vehicle identification using OCR is promising, with the potential for integration with AI, cloud-based solutions, other technologies, and applications in autonomous vehicles and smart cities. As technology continues to evolve, ANPR systems will become even more accurate, efficient, and effective in improving public safety and reducing crime rates.

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