VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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Mini Project Report

on

"VEHICLE NUMBER PLATE DETECTION"

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

in

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ENGINEERING

By

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MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

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Badaga Mijar, Moodabidri-574225, Karnataka

2022-23

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Department of Artificial Intelligence and Machine Learning

CERTIFICATE

This is to certify that the mini project entitled "**Vehicle Number Plate Detection**" is a bonafide work carried out by Ms. **SALWA IMTHIYAZ AHAMED(4MT20AI037)** in partial fulfillment for the requirement of 6th semester DIP Laboratory with mini project (18AIL66). It is certified that all the corrections/suggestions indicated for the Internal Assessment have been incorporated in the report. The mini project has been approved as it satisfies the academic requirement in respect of the 18AIL66 prescribed for the 6th Semester B.E in Artificial Intelligence & Machine Learning Engineering Program by the **Visvesvaraya Technological University, Belagavi**, for the academic year 2022 – 2023.

…….. ……..

Signature of the Guide
Ms. Radha EG

Signature of the HOD
Mr. Sunil Kumar S

Name of the Examiners	**Signature with Date**
1. ……	**……**
2. ……	**……**

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ABSTRACT

The ANPR (Automatic Number plate Recognition) system is based on image processing technology. It is one of the necessary systems designed to detect the vehicle number plate. In today's world with the increasing number of vehicle day by day it's not possible to manually keep a record of the entire vehicle. With the development of this system, it becomes easy to keep a record and use it whenever required. The main objective here is to design an efficient automatic vehicle identification system by using vehicle number plate. The system first would capture the vehicles image as soon as the vehicle reaches the security checking area. The captured images are then extracted by using the segmentation process. Optical character recognition is used to identify the characters. The obtained data is then compared with the data stored in their database. The system is implemented and simulated on MATLAB and performance is tested on real images. This type of system is widely used in Traffic control areas, tolling, parking area.etc. This system is mainly designed for the purpose of security system. However, the detection of the dynamic or moving object is a challenging part. In areas wherever automobile parking space is taken by a specific vehicle, the incorrectly parked vehicles are recognized. It is noted that the license plates of the vehicles are found in several forms, size and conjointly they're completely different in color. This makes the detection of the number plate of a vehicle, the foremost fascinating and difficult analysis topic. Number plate detection is useful in finding purloined cars, automobile parking management system and identification of the vehicle in traffic. The number plate decoded will be used further for identification, matching and documentation purpose of vehicle details.

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Chapter 1

INTRODUCTION

The goal of number plate detection is to locate the position of the license plate within an image or video frame accurately. This involves several steps, typically implemented using computer vision and image processing techniques:

1. **Image Acquisition:** The first step is to obtain a digital image or video frame that contains the vehicle of interest.

2. **Preprocessing:** The acquired image is preprocessed to enhance the quality and improve the detection accuracy. Common preprocessing techniques include noise reduction, image resizing, contrast adjustment, and image enhancement.

3. **Plate Localization:** In this step, the algorithm attempts to identify potential regions in the image that may contain a license plate. This is usually done by analyzing characteristics such as color, texture, and shape. Techniques like edge detection, color thresholding, morphological operations, and contour analysis are commonly employed.

4. **Character Segmentation:** Once the license plate region is identified, the next step is to separate individual characters within the plate. This can be achieved using various techniques like connected component analysis, projection profiles, or template matching.

5. **Character Recognition:** After segmenting the characters, optical character recognition (OCR) algorithms are applied to recognize and interpret the alphanumeric characters on the license plate. OCR techniques can include feature extraction, template matching, machine learning-based approaches, or a combination of these.

6. **Post-processing and Verification:** Finally, the recognized characters are typically subjected to post-processing techniques to refine the results and eliminate any errors. This may involve techniques such as spell-checking, pattern matching, or context-based verification.

Vehicle number plate detection in digital image processing (DIP) refers to the process of automatically identifying and extracting license plate information from images or video frames

Chapter 2

REQUIREMENTS

2.1. FUNCTIONAL REQUIREMENTS

Functional requirements describe what a system or software application should do or the specific functionalities it should provide. These requirements define the actions or services that the system must perform to meet the needs of its users. They focus on the system's behavior, features, and interactions with users or other systems. Examples of functional requirements for vehicle number plate detection could include:

1. Image Acquisition: The system should be able to acquire images or video frames from a camera or pre-recorded videos.

2. Preprocessing: The system should perform image preprocessing techniques to enhance the quality of the acquired images, including noise reduction, contrast enhancement, and image resizing.

3. Number Plate Localization: The system should accurately locate the number plate region within the acquired image or video frame.

4. Character Segmentation: The system should be able to segment individual characters within the number plate region.

5. Character Recognition: The system should employ optical character recognition (OCR) techniques to recognize and extract alphanumeric characters from the segmented regions.

6. Character Verification: The system should verify the recognized characters against a predefined database or pattern to ensure accuracy.

7. Output Display: The system should display the recognized number plate characters or provide an output file containing the recognized information.

2.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements specify the criteria that define the system's operation, performance, security, usability, and other qualities. They focus on the overall attributes of the system rather than its specific functionalities. Non-functional requirements help ensure that the system meets certain quality standards and user expectations. Examples of non-functional requirements for vehicle number plate detection could include:

1. Accuracy: The system should achieve high accuracy in localizing and recognizing number plates to ensure reliable results.

2. Speed and Efficiency: The system should process images or video frames in real-time or with minimal delay to enable timely detection and recognition of number plates.

3. Robustness: The system should be able to handle variations in lighting conditions, image quality, and number plate appearance, ensuring reliable performance in different scenarios.

4. Scalability: The system should be scalable to handle a large number of images or video frames for batch processing or continuous monitoring of traffic.

5. User-Friendly Interface: The system should provide a user-friendly interface for easy interaction, configuration, and control of the number plate detection process.

6. Compatibility: The system should be compatible with different types of cameras, image formats, and video sources commonly used in traffic surveillance systems.

7. Security and Privacy: The system should ensure the security and privacy of the captured images or video frames, complying with relevant data protection regulations.

8. Maintainability: The system should be easy to maintain and update, allowing for future improvements and modifications to adapt to changing requirements or technological advancements.

In summary, functional requirements focus on what the system should do, while non-functional requirements focus on how the system should perform and the quality attributes it should possess. Both types of requirements are essential for developing and evaluating an image background removal system effectively.

2.3 HARDWARE REQUIREMENTS

• Processor: Intel i3/i5,1.8GHz machine or above

• Main memory: 4GB RAM or more.

• Hard disk drive: 1TB

2.4 SOFTWARE REQUIREMENTS

• Operating System: Windows 7 or higher

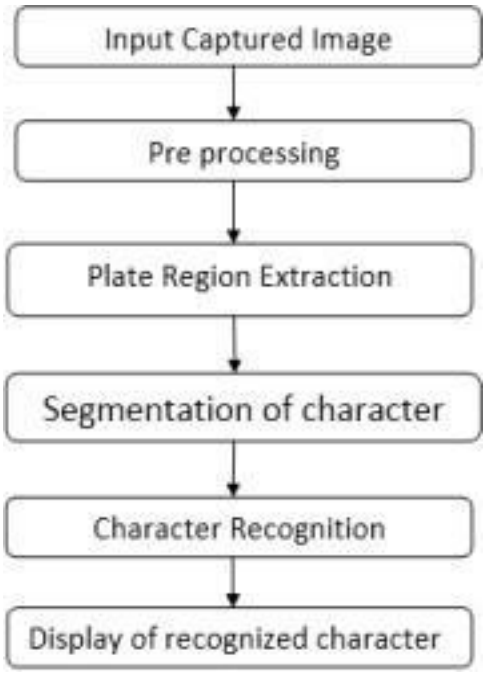
• System Type: 32-bit OS,x86 based processor

• Software: MATLAB R2023a

Chapter 3

SYSTEM DESIGN

In the system design of a vehicle number plate detection, several key components and considerations should be included. Here are some important aspects to consider:



3.1. Image Preprocessing:

- Load the input image containing the vehicle.
- Convert the image to grayscale.
- Apply noise removal techniques (e.g., Gaussian blur, median filter) to enhance the image quality.
- Perform image enhancement techniques (e.g., histogram equalization, contrast adjustment) to improve the visibility of the number plate.

3.2. Number Plate Localization:

- Apply edge detection algorithms (e.g., Canny edge detection) to detect edges in the preprocessed image.
- Identify potential regions of interest (ROI) using techniques like morphological operations (e.g., dilation, erosion), connected component analysis, or contour detection.
- Filter the potential ROIs based on their aspect ratio and dimensions to narrow down the search space for the number plate.

3.3. Character Segmentation:

- Once the number plate region is identified, perform further image processing techniques to isolate individual characters.

- Apply thresholding techniques (e.g., adaptive thresholding, Otsu's method) to separate characters from the background.

- Utilize morphological operations (e.g., dilation, erosion) to improve character connectivity and remove noise.

3.4. Character Recognition:

- Extract features from each segmented character, such as Hu moments, Zernike moments, or HOG descriptors.

- Train a classification model (e.g., SVM, k-nearest neighbors, deep learning networks) using a dataset of labeled characters.

- Use the trained model to recognize and classify the segmented characters in the number plate.

3.5. Output Visualization:

- Overlay the bounding boxes or contours around the detected number plate and segmented characters on the original image.

- Display the final output image with the recognized number plate and characters.

It's worth noting that the implementation details and specific algorithms may vary depending on the complexity of the problem and your specific requirements. MATLAB provides a comprehensive set of image processing functions and machine learning tools that can be utilized to accomplish these steps.

CHAPTER 4

TESTING

Software testing is the process of evaluating a software system or application to determine if it satisfies the specified requirements and to identify any defects or issues that need to be addressed. It is an essential step in the software development process, as it helps to ensure that the software is of high quality and that it functions as intended. There are many different types of software testing, each with its own specific purpose and methodology.

1. Preprocess the input image

Read the image containing the vehicle and perform any necessary preprocessing steps such as resizing, noise removal, and contrast enhancement.

2. Detect regions of interest (ROI)

Apply an appropriate method to identify potential regions of interest where the number plates are located. This can be done using techniques like edge detection, color thresholding, or template matching.

3. Perform morphological operations

Use morphological operations such as dilation, erosion, and morphological filtering to refine the detected regions and remove any unwanted noise or artifacts.

4. Extract individual characters

If necessary, segment the characters within the detected regions to obtain individual character images. This step may require techniques like connected component analysis, contour detection, or character recognition algorithms.

5. Apply character recognition

If the characters are not separated during the previous step, you can utilize Optical Character Recognition (OCR) techniques to recognize the characters directly from the detected regions. MATLAB provides built-in functions for OCR, such as the `ocr` function.

6. Validate and filter results:

Validate the extracted characters by applying any necessary rules or constraints on their format or patterns (e.g., specific character set, size, or position). You can also use heuristics or machine learning techniques for further validation.

When testing a vehicle number plate detection system using MATLAB, you can perform several types of tests, including unit tests, integration tests, system tests, and performance tests as well.

Chapter 5

RESULT AND DISCUSSION:

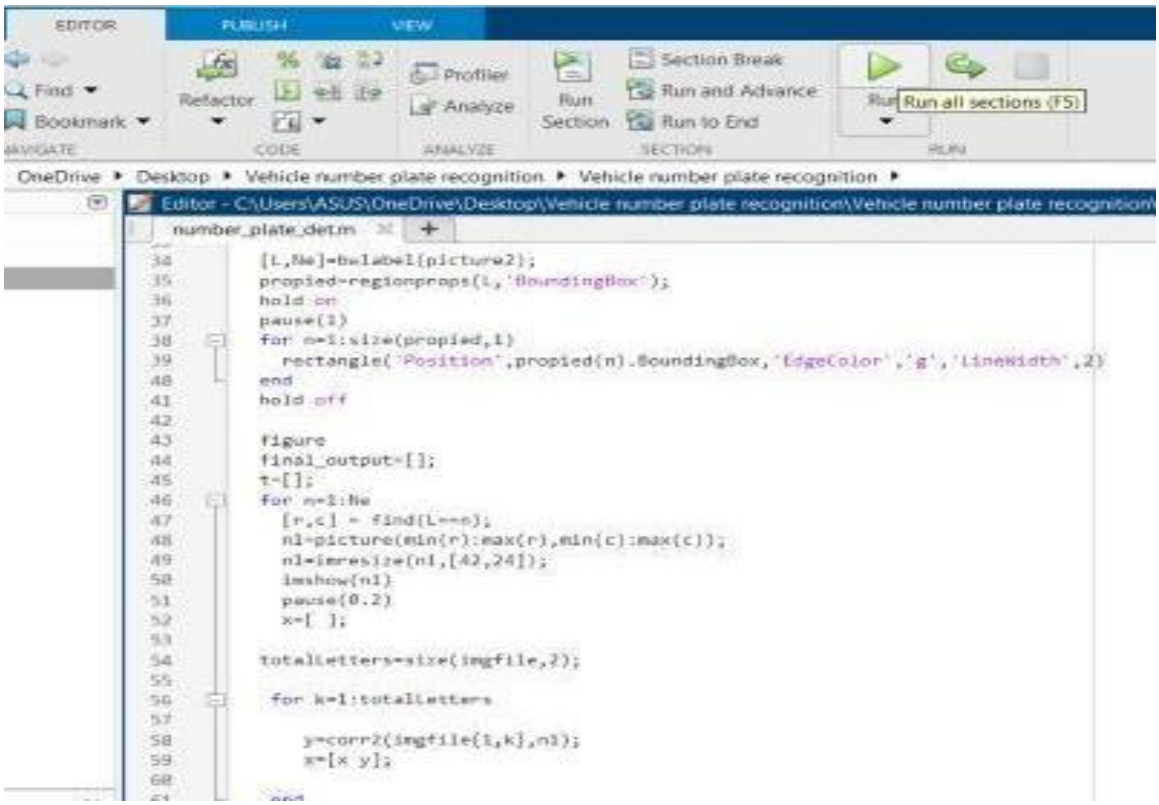


Fig 5.1. Run the program

Fig 5.1. depicts the snapshot of the application where we click on the Run button form the Editor's toolbar to run the code.

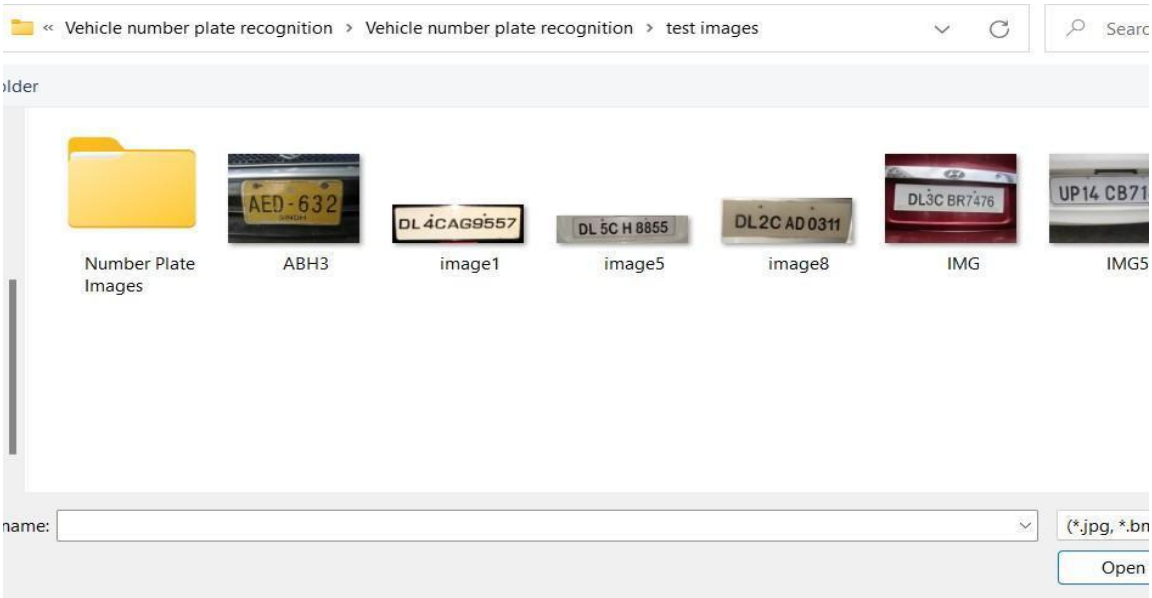


Fig 5.2. Image selection from the device

Fig 5.2. shows the dialog box that appeared on the screen when the run button is clicked which allows to select any particular captured image for which the number plate needs to be detected.

Fig 5.3. Previewing the selected image

Fig 5.3. represents the preview of the original image that has been selected for the system to perfom the number plate detection.

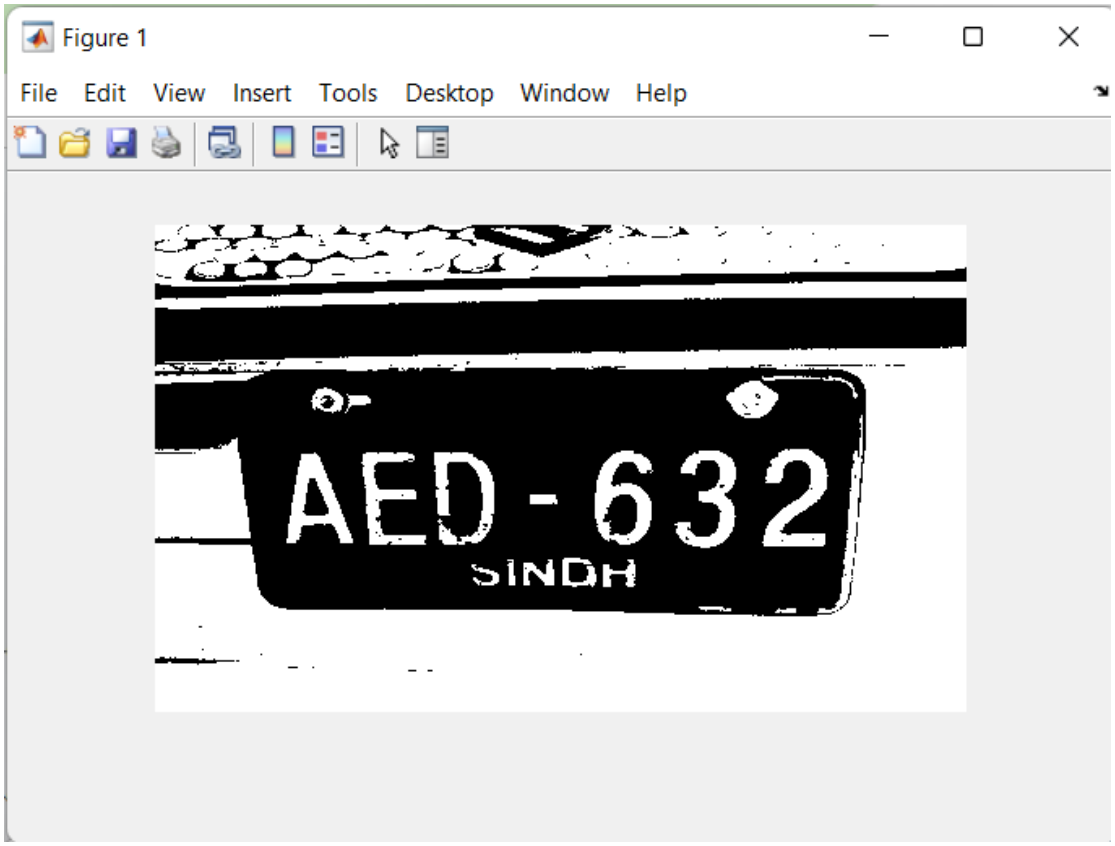


Fig 5.4. RGB to Gray conversion

Fig 5.4. represents the RGB to Gray conversion of the original image using MATLAB inbuilt functions.

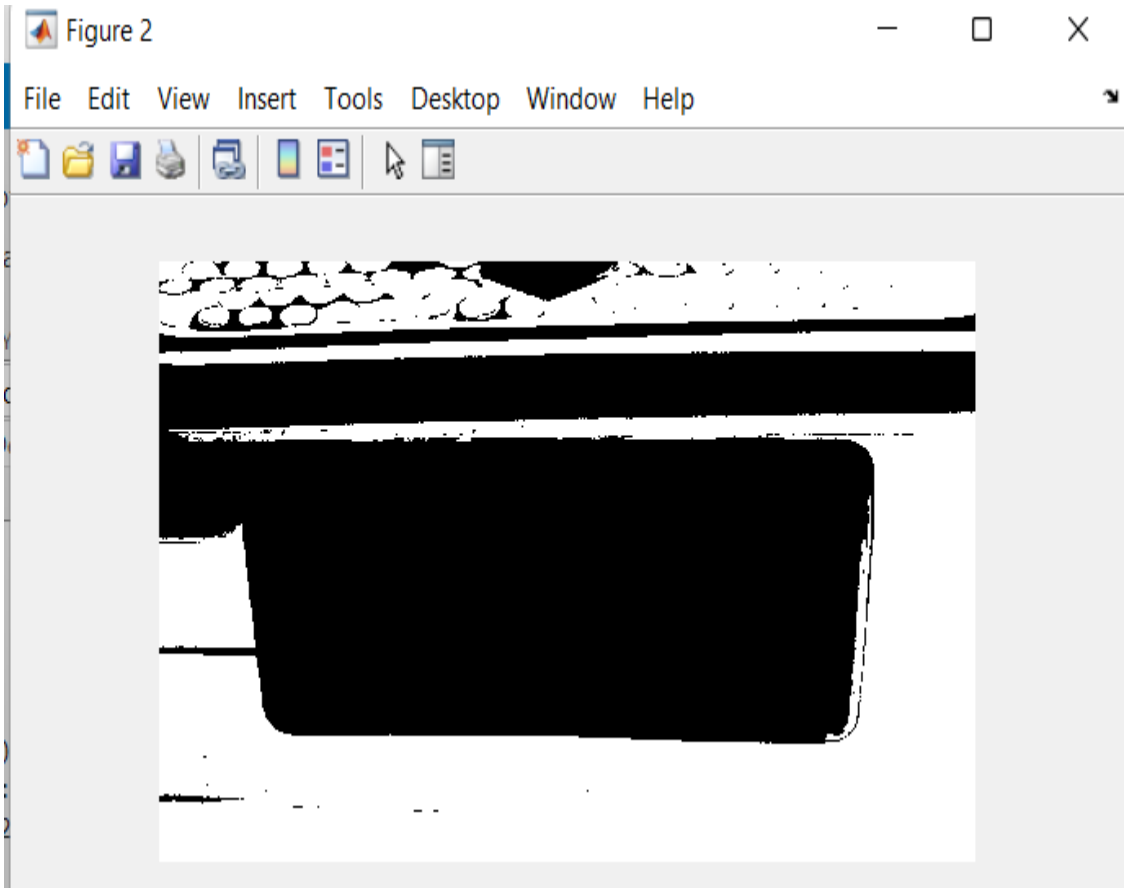


Fig 5.5. Edge Detection

Fig 5.5. displays the successful application of edge detection techniques to detect and extract the number plate region from an image.

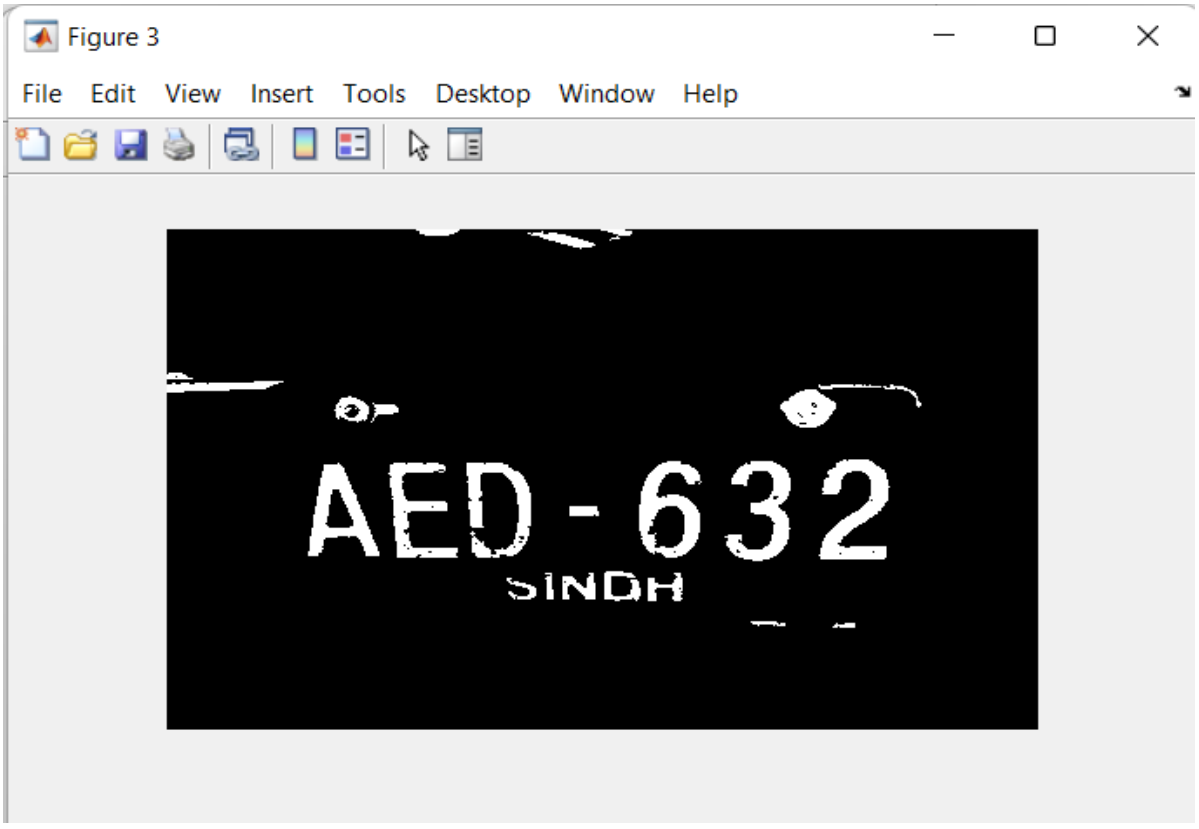


Fig 5.6. Morphological Processing

Fig 5.6. illustrates the process of morphological processing applied to a number plate which involves analyzing the structure and shape of the number plate to extract relevant information.

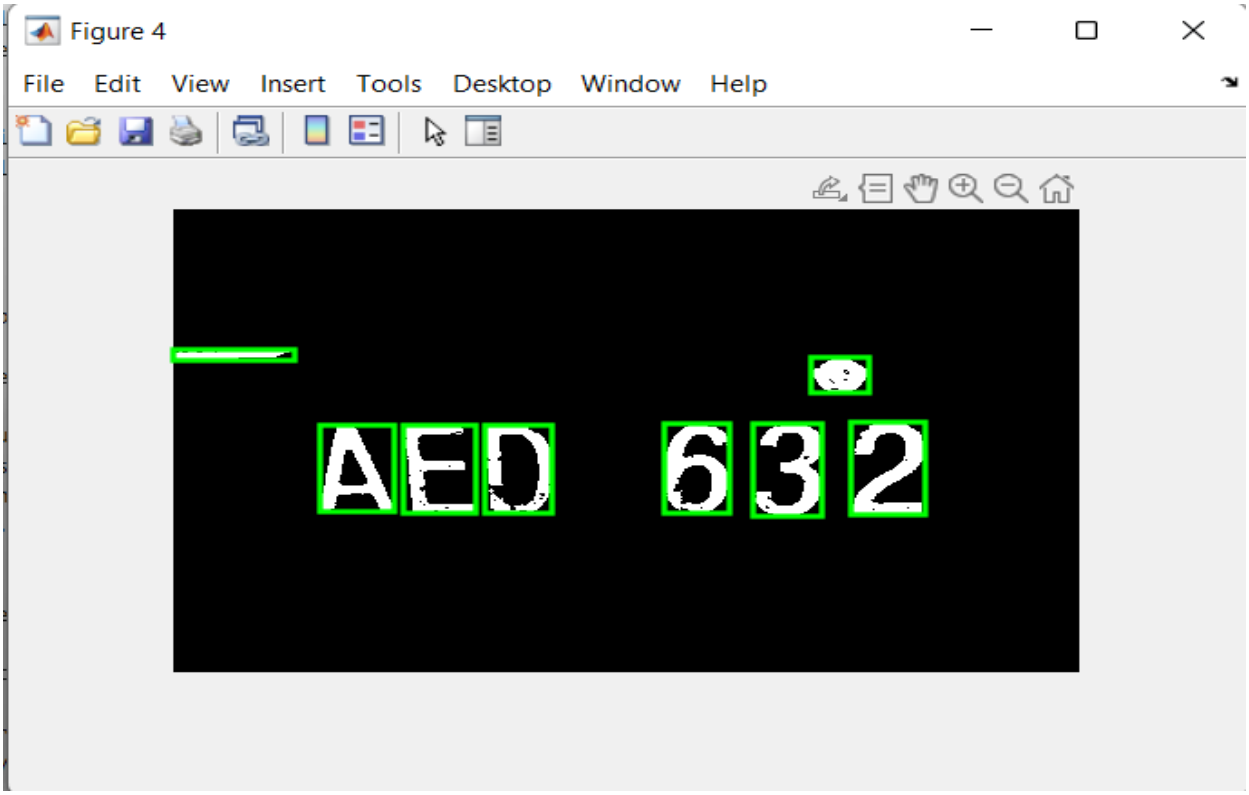


Fig 5.7. Character Segmentation

Fig 5.7. illustrates the process of character segmentation for a number plate that is employed to extract individual characters from the number plate image, enabling the recognition and interpretation of the of alphanumeric characters present in it.

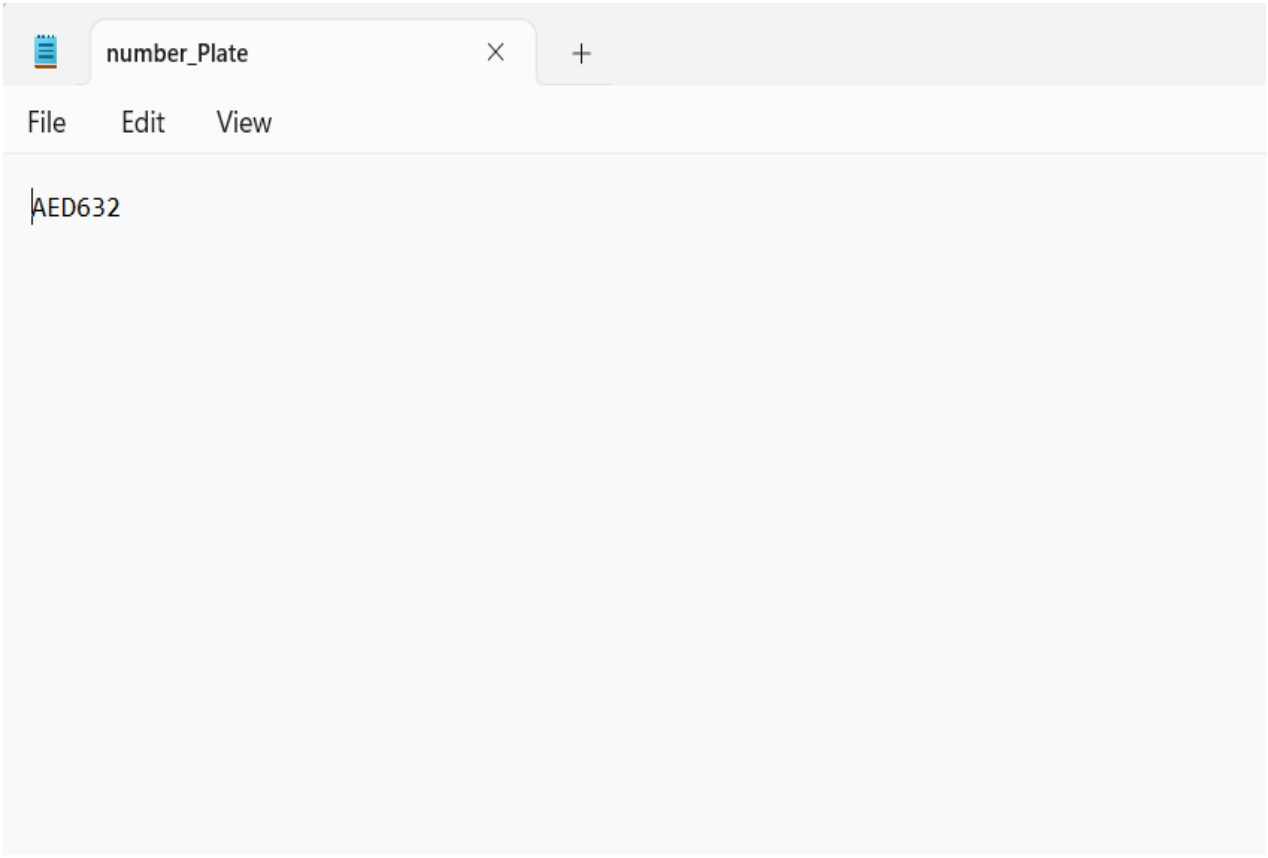


Fig 5.8. Output in textual format

Fig 5.8. provides the resultant output as textual representation of the number plate, revealing the alphanumeric characters.

Advantages:

Improving road safety.

Reduces crimes.

gives officers better information to work with.

Deterring terrorism.

Pre-paid members can be easily differentiated from non-members.

Giving a greater police presence.

Disadvantages:

Firstly, the images of the number plate or of any object which is taken by using the optical character reader technology may get blurred mainly due to the reason of motion blurring for which the picture seems to be hazy when uploaded in the database.

Secondly, the technology often uses low-resolution images for which the images are not actually visible properly in every case.

Applications:

Parking.

Access Control.

Motorway Road Tolling.

Border Control.

Journey Time Measurement.

Law Enforcement.

CONCLUSION

In NPR system, the picture of vehicle number plate is taken with the image capturing system and the license number of the vehicle is perceived with the goal that the data and information of the vehicle owner can be obtained. In our paper, we have performed a technique in which the picture of the vehicle plate is taken. At that point, the noise diminishment is performed on it to show signs of enhancement come about. After this, segmentation and identification of characters are done using the template matching technique. In any case, the system can be utilized just for binary pictures and not for RGB pictures. Because of shifting attributes of the number plate, additional research is as yet required in this area. Distinctive filtering procedures can be acquainted with the reducing of noise to a more noteworthy degree, so the image processing can be more productive. In future, the recognition of number plate should be possible from the video processing as well.

This thesis explains different recognition methodologies, their advantages and drawbacks and gives the best of all those to opt for a user friendly, efficient system that works in any climatic conditions unaffected. That system should not be affected by the factors like speed, light, font size and styles

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