Internship Report On

"Car Number Plate Identification and to Display Letters and Numbers Using MATLAB"

Submitted by

S. NAGA SAVITHA - (21691A31A9)

In partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ARTIFICIAL INTELLIGENCE

MADANAPALLE INSTITUTE OF TECHNOLGY & SCIENCE
(UGC – AUTONOMOUS)

(Affiliated to JNTUA, Ananthapuramu)
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE

BONAFIDE CERTIFICATE

This is to certify that the internship work entitled **"Car Number Plate Identification and to Display Letters and Numbers Using MATLAB"** is a bonafide work carried out by

S. NAGA SAVITHA - (21691A31A9)

Submitted in partial fulfillment of the requirements for the award of degree **Bachelor of Technology** in the Department of **Artificial Intelligence**, **Madanapalle Institute of Technology and Science, Madanapalle,** affiliated to **Jawaharlal Nehru Technological University Anantapur, Ananthapuramu** during the academic year 2023-2024

Faculty	**Internship Co-ordinator**	**Dr. K. Chokkanathan**
R. Dhanalakshmi	**R.Ashok Kumar**	**Head & Associate Professor**
Assistant Professor	**Assistant Professor**	**Department of AI**
Department of AI	**Internship Coordinator**	
	Department of AI	

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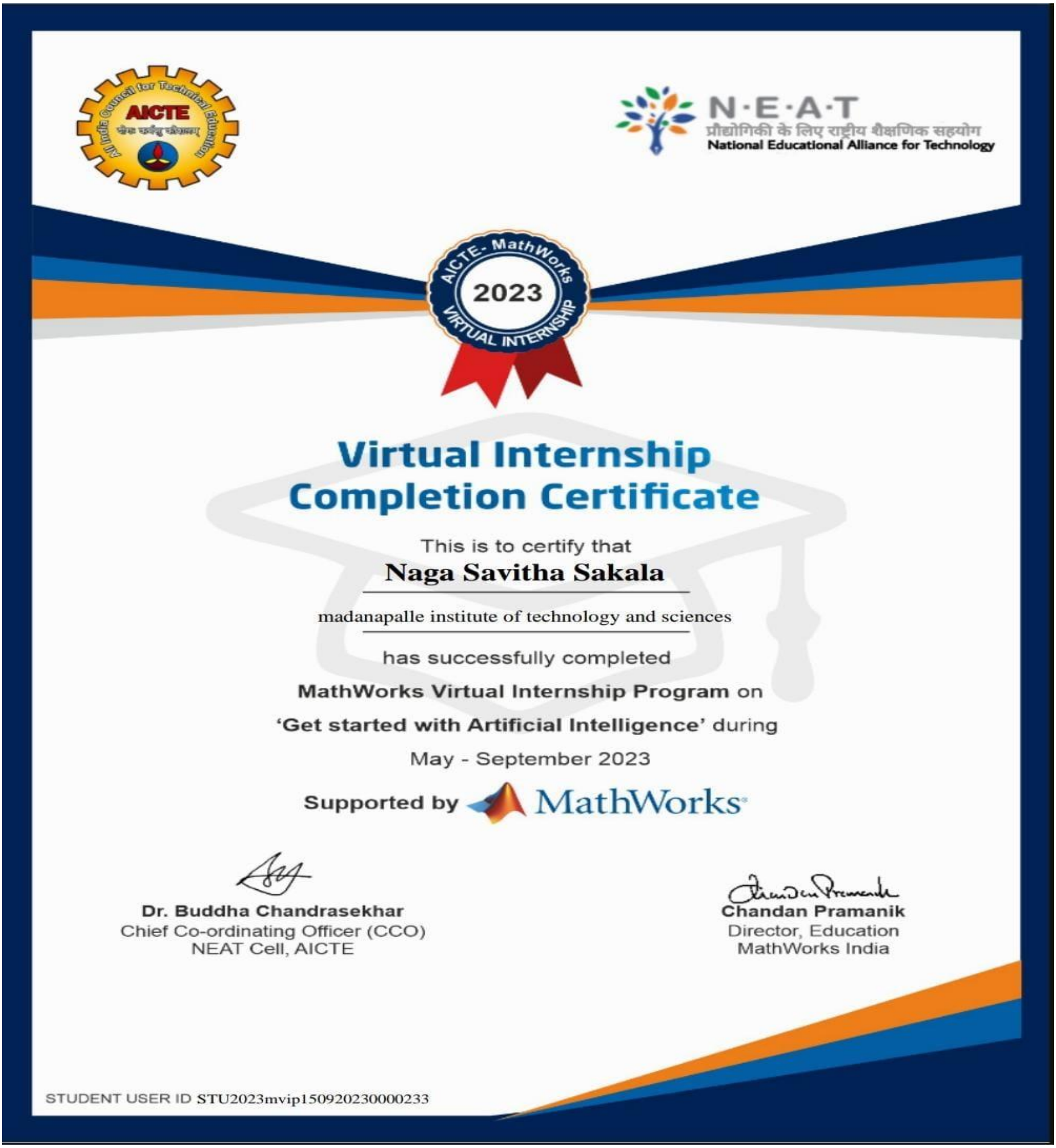
I also wish to place on record my gratefulness to other **Faculty members of Department of AI** and also to our friends and our parents for their help and cooperation during our internship.

CERTIFICATE



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DECLARATION

I, the undersigned hereby declare that the results embodied in this Internship **"Car Number Plate Identification and to Display Letters and Numbers Using MATLAB"** is a bonafide record of the work done by me in partial fulfillment of the award of **Bachelor of Technology** in **Artificial Intelligence** from **Jawaharlal Nehru Technological University Anantapur, Ananthapuramu. The content of this report is** not submitted to any other University/Institute for award of any other degree.

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	Department of Artificial Intelligence
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	Madanapalle.

ABSTRACT

In India, a car number plate is not just a means to identify a vehicle but is also a legal requirement. The number plate is a unique identifier for a vehicle that helps the authorities keep track of it. Let's dive into the details of car number plates in India. Number plate detection (NPD) is one such innovative mechanism that identifies a specific part on the vehicle license plate and understands the characters using advanced technologies. It is one of the key functions of intelligent transportation systems.

Known as Registration Plate Recognition (RPR), or License Plate Recognition (LPR), the latest system of Vehicle Number Plate Recognition (NPR) uses AI, ML, deep learning, and computer vision-powered approaches to read such license plates on vehicles without human interaction.

Tracking the number plate of the vehicle is an important task in traffic surveillance. Here MATLAB is used for number plate extraction from an input image and for recognizing the number plate characters. Here as an input, an RGB image is taken. After extracting the number plate region from the input image, edge detection is used to identify each character in the number plate.

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LIST OF ABBRIVATIONS

OCR	Optical Character Recognition
RGB	Red Green Black
ANPR	Automatic number plate detection
HVS	Human Visual System

CHAPTER 1

INTRODUCTION

1.1 Problem Statement:

Due to the increasing number of vehicles nowadays, the modern city needs to establish the effective and efficient automatic traffic system for the management of the traffic law enforcement. Number plate recognition plays a significant role in this condition. The number plate recognition is an image processing technique to extract the image of license plate on vehicle taken by digital camera or taken by either a color or a grayscale digital camera, as well as an infrared camera in order to identify the vehicles using their number plate.

Problem Definition We considered the vehicle number plate as input image, system should extract that number from the image and should search the database for that recognized number plate. It should recognize the number plates even in the low light or shadow like conditions.

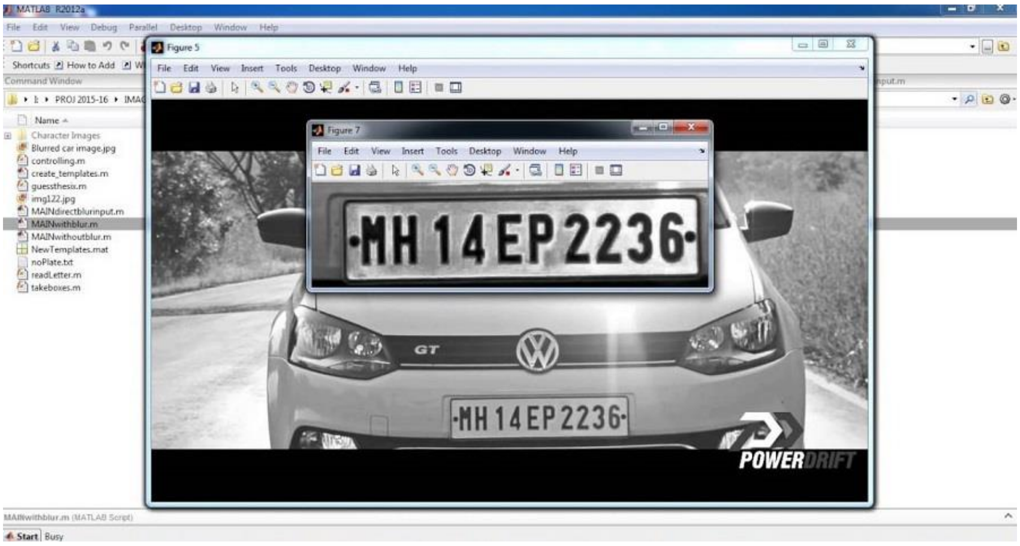


Fig 1.1 Car and car number plate detection

1.2 Objective:

The challenge is to recognize vehicle number plate detection so that the data segregated will be help for the estimation of the cases on the car and license verification even rash drivers identification.

Main challenges involved in the Number plate Recognition are:

- The inputs to the system were the images of vehicles captured by a camera. RGB to gray-scale conversion is adopted, in order to facilitate the plate extraction, and increase the processing speed.

- The image of the vehicle whose number plate is to be identified is captured using a digital camera of 3.2 megapixel.
- Here bounding box technique is used for segmentation. The bounding box is used to measure the properties of the image region. The basic step in recognition of vehicle number plate is to detect the plate size.
- In general number plates are in rectangular shape, hence it is necessary to detect the edges of the rectangular plate. Mathematical morphology is used to detect the region of intersect and Sobel operator are used to calculate the threshold value.
- Once the image is captured, the algorithm will process it by converting it into grayscale, followed by extracting the possible number plates and finally recognizing the registration number of the vehicle.

1.3 Domain Technology:

Artificial Intelligence:

Artificial intelligence (AI) is currently an innovator in several different sectors, changing how we tackle and handle difficult issues. The implementation of artificial intelligence inside Automatic Number Plate Recognization (ANPR) technologies represents one example of that. Due to their effectiveness for in-vehicle surveillance, fee collection, law enforcement, and safety purposes, ANPR technologies have become widely used in recent times. The combination of AI and ANPR technologies has improved both the speed and reliability of license plate identification while also unlocking new opportunities. In this section, we analyze artificial intelligence’s important impact on ANPR systems, as well as its advantages, drawbacks, and prospective future improvements.

MATLAB:

MATLAB Library comes with a set of many inbuilt functions. These functions mostly perform mathematical operations like sine, cosine and tangent. They perform more complex functions too like finding the inverse and determinant of a matrix, cross product and dot product.

Although MATLAB is encoded in C, C++ and Java, it is a lot easier to implement than these three languages. For example, unlike the other three, no header files need to be initialised in the beginning of the document and for declaring a variable, the data type need not be provided. It provides an easier alternative for vector operations. They can be performed using one command instead of multiple statements in a for or while loop.

Machine Learning:

Machine Learning (ML) has become one of most widely used AI techniques for several companies, institutions and individuals who are in the business of automation. This is because of considerable improvements in the access to data and increases in computational power, which allow practitioners to achieve meaningful results across several areas.

It is among rapidly growing technologies and has evolved widely over the years. Today, several companies and organizations of different sectors use image processing for several applications such as visualization, image information extraction, pattern recognition, classification, segmentation, and many more.

Image processing:

The main purpose of image processing is to gain useful information or to enhance the original image by applying some operations on it. It can be said that image processing is a signal dispensation because the input that is given to the program is the digital image, and the expected output is a new form of the image or the information about it.

When we look at the image processing or computer vision fields, the main purpose is to give the eye functions to machines. From this perspective, it's possible to state that image processing is the conversion of the human visual system (HVS) to digital images. To get the most realistic output from the digital images, we need to do some processing on them.

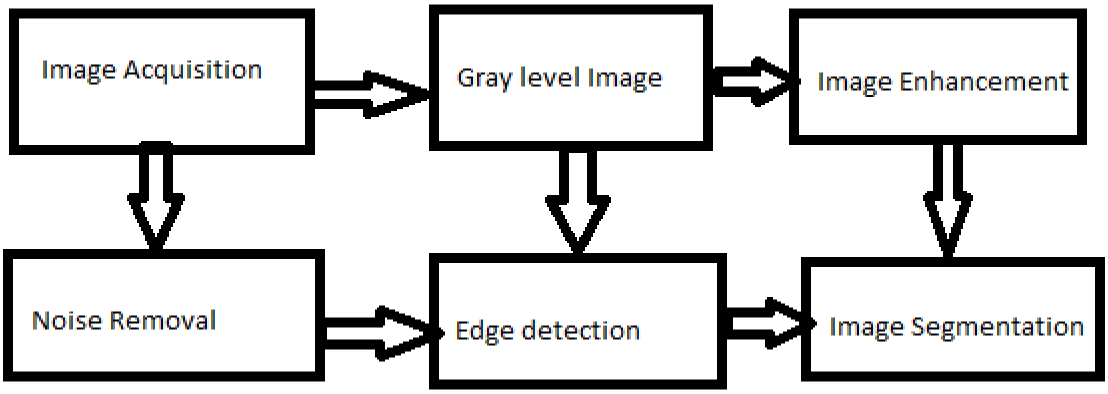


Fig 1.2 Image processing working

1.4 Industry Vertical:

Parking facility managers:

The proposed system captures and processes the rounded image drawn at parking lot and produces the information of the empty car parking spaces. In this work, a camera is used as a sensor to take photos to show the occupancy of car parks. The reason why a camera is used is because with an image it can detect the presence of many cars at once. Also, the camera can be easily moved to detect different car parking lots. By having this image, the particular car parks vacant can be known and then the processed information was used to guide a driver to an available car park rather than wasting time to find one.

Security agencies:

ANPR is a technology used to photograph license plates, scan them using optical character recognition software, identify the vehicle, and reference it against criminal and auto registration databases to catch vehicles reported stolen and motorists with outstanding warrants or expired registration.

Law Enforcement:

ANPR systems are used by law enforcement agencies to identify vehicles involved in illegal activities, such as stolen cars, unregistered vehicles, or those associated with criminal activity. When a vehicle with a flagged license plate is detected, the system alerts law enforcement officers.

Traffic Monitoring:

Traffic control agencies use ANPR to monitor traffic flow, track vehicle movements, and gather data on traffic patterns. This information helps in managing congestion, optimizing traffic signals, and planning road infrastructure improvements.

Toll Collection:

In some regions, ANPR is employed for automated toll collection on highways and bridges. The system identifies vehicles passing through toll booths and deducts the toll amount from linked accounts.

1.4 Data:

Characters Uploading:

The data required for this Experiment is to be in the form of **images**. To train the Machine Previously we need to update the **Numbers** and **Alphabets** so that the machine can used the images while recognize and then classify each character on the number plate.

To uplode the image we will use the method **imread().**

Ex: A=imread('alpha/A.bmp').

In the above example we are uploading the image of the character 'A' . Like wise we will uplode are the character from '**A-B**' and digits from '**0-9**' in the form of images having the extension .png/.jpg/.jpeg.

Image uploading:

The images will be uploaded/Give as input as images in the same format as the character uploaded.

We can uplode a single image, of each execution.

Ex: im = imread(' Number Plate Images/ image1.png');

In the above example we are uploading the image having the number plate of the vehicle.

I have collected randomly 10 images from my surroundings from the vehicles and tested .

1.6 Methods:

Basic commands used in above code are mentioned below:

imread() – This command is used to open the image into the MATLAB from the target folder.

rgb2gray() –This command is used to convert the RGB image into grayscale format.

imbinarize() – This command is used to Binarize 2-D grayscale image or simply we can say it converts the image into black and white format.

edge() – This command is used to detect the edges in the image, by using various methods like Roberts, Sobel, Prewitt and many others.

regionprops() – This command is used to measure properties of image region.

numel() – This command is used to calculate the number of array elements.

imcrop() – This command is used to crop the image in the entered size.

bwareaopen() – This command is used to remove small objects from binary image.

By using the above commands in the code, we are calling the input image and converting it into the grayscale. Then the grayscale is converted into the binary image, and the edge

of the binary images is detected by the **Prewitt method.**

CHAPTER 2

HARDWARE AND SOFTWARE

2.1 Platform And Hardware Used:

Device name	DESKTOP-8VU1G4U
Processor	11th Gen Intel(R) Core(TM) i5-1155G7 @ 2.50GHz 2.50 GHz
Installed RAM	8.00 GB (7.75 GB usable)
Device ID	9FDACBEE-4B15-419F-A2AA-BA204EECCE7C
Product ID	00356-24564-00623-AAOEM
System type	64-bit operating system, x64-based processor
Pen and touch	No pen or touch input is available for this display.

2.2 Software Used:

Edition	Windows 11 Home Single Language
Version	23H2
Installed on	02-03-2023
OS build	22631.2715
Experience	Windows Feature Experience Pack 1000.22677.1000.0

2.2.1 MATLAB:

Version:	R2023b Update 4 (23.2.0.2428915)
System type:	64-bit (win64)
Updated on:	October 23, 2023

1.MATLAB:

MATLAB provides Image Processing Toolbox, Computer Vision Toolbox, and Machine Learning Toolbox, among others, which can be used for various stages of number plate detection.

2. OpenCV:

While MATLAB has its own image processing capabilities, OpenCV (usually utilized with Python, C++, or Java) is a powerful library often used for image processing and computer vision tasks, including object detection.

3. Python:

MATLAB supports interoperability with Python through its Python Engine. Python has numerous libraries like OpenCV, NumPy, TensorFlow, and others that can be used for image processing and machine learning tasks.

4. Deep Learning Libraries:

Libraries like TensorFlow or PyTorch can be used within MATLAB through interoperability to implement deep learning models for number plate detection.

5. Machine Learning Libraries:

MATLAB has its own Machine Learning Toolbox, but you can also
use libraries like Scikit-learn in Python or other ML libraries for tasks involving training models for number plate detection.

CHAPTER 3

PROJE
CT ANALYSIS

3.1 Architecture Diagram :

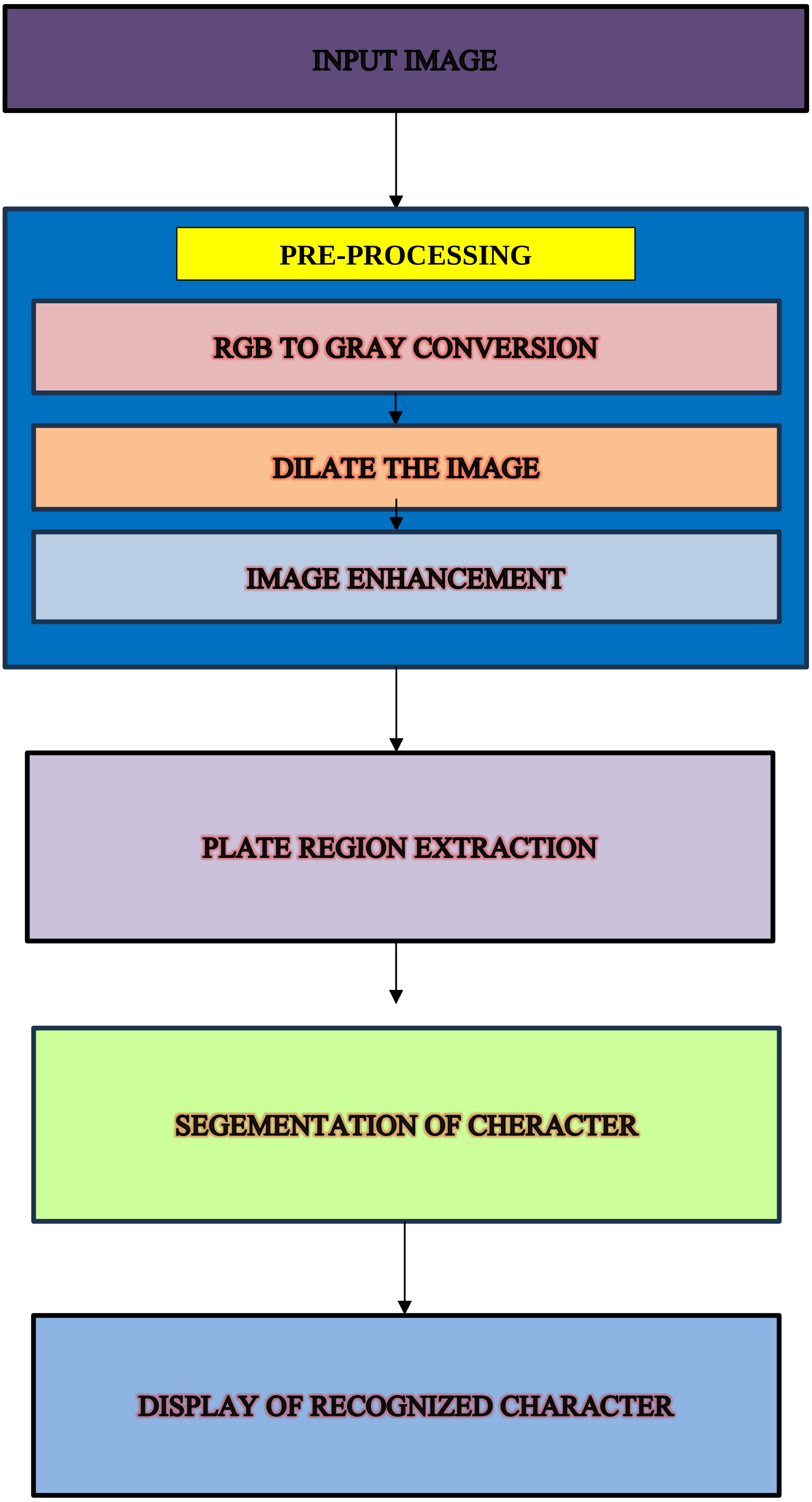


Fig 4: Flow chart of Implementation

3.2 Implementation:

Template Creation:

- First create a folder for the project (my folder name is Number Plate Detection) to save and store the files. We have stored the binary images of all the alphabets and numbers in the sub-folder named as 'alpha'.

- Now, open the Editor window in the MATLAB.

  Template_creation.m file, and save the file in the project folder (Number Plate Detection):

- Here, we are saving the images into a variable by using the command **'imread()'**. This function is used to call the images from the folder or from any location of the PC into the MATLAB.

- **A=imread('alpha/A.bmp').**

- Where A is the variable, and in 'alpha/A.bmp', 'alpha' is the folder name and '*A*.bmp' is the file name.
- Then create a matrix of 'letter' and 'number' and save it in variable 'NewTemplate*s*' by using command 'save(filename, variables)'.
- Now start coding Letter_detection.m, in a new editor window.

Letter Detection:

- Here we are creating the second code file named Letter_detection.m.
- Here, we have created a function named letter which gives us the alphanumeric output of the input image from class 'alpha' by using command 'readLetter()*'*. And then load the saved templates by using command load *'*NewTemplates.

- After that, we **have** resized the input image so it can be compared with the template's image**s** by using the command *'*imresize(filename,size)*'*. Then ***for*** loop is used to correlates the input image with every image in the template to get the best match.

- A matrix 'rec*'* is created to record the value of correlation for each alphanumeric template with the characters template from the input image.

- cor=corr2(NewTemplates{1,n},snap);

- Then 'find()' command is used to find the index which corresponds to the highest matched character. Then according to that index, corresponding character is printed using'if-else' statement.

- Now, after completing with this open a new editor window to start code for the main program.

Number Plate Detection:

- Here is the third and final code file named Plate_detection.m copy and paste the below code in this file and save into the project folder.

- After that crop the number plate and remove the small objects from the binary image by using command 'imcrop()' and 'bwareaopen()' respectively.
- process that cropped license plate image and to display the detected number in the image and text format (in the command window).

Plate Number Detection

- In the template_creation.m file we have design the code to save all the binary images of alphanumerics into a directory or file named as 'NewTemplates'. Then that directory is called in the Letter_detection.m
- Then in the Plate_detection.m code file the Letter_detection.m code file is called when we process the image .
- Now, click on the 'RUN' button to run the .m file.
- MATLAB may take few seconds to respond, wait until it shows busy message in the lower left corner.
- **Complete working of Vehicle License Number Plate Detection System.**

3.3 Algorithm:

1. Image Acquisition:

• MATLAB provides functions to read images or capture frames from a video source using its Image Acquisition Toolbox.

2. Preprocessing:

• Grayscale Conversion: Convert the image to grayscale using `rgb2gray()` function.*

Noise Reduction: Apply filters like Gaussian blur (`imgaussfilt()`) or median filter (`medfilt2()`) to reduce noise.

Edge Detection: Use edge detection techniques like Canny edge detection (`edge()` function) to highlight potential edges in the image.

3. License Plate Localization:

- Thresholding: Apply thresholding techniques (such as Otsu's method using `graythresh()` and `imbinarize()`) to create a binary image.

* Region of Interest (ROI) Selection: Identify potential regions where license plates might be located based on size, aspect ratio, or other characteristics. Techniques like connected component analysis (`bwconncomp()`) or morphological operations (`bwareaopen()`, `strel()`, `imdilate()`, `imerode ()`) can help isolate candidate regions.

4. Character Segmentation:

- Once the potential plate region is identified, individual characters need to be segmented for recognition
- Techniques like blob analysis, contour detection (`bwboundaries()`), or geometric properties can be used to separate individual characters.

5. Character Recognition:

- After segmentation, character recognition algorithms (like OCR - Optical Character Recognition) can be used to identify and recognize characters within each segmented region.

3.4 Result:

The result of implementing license plate detection using MATLAB and image processing involves several facets. Initially, the system aims to accurately identify and localize license plates within images, potentially marking these regions with bounding boxes or outlines. Through preprocessing steps like noise reduction, edge detection, and thresholding techniques, it attempts to isolate plate regions while filtering out unwanted information. The successful execution of these steps leads to the segmentation of individual characters within the plate area, allowing for character recognition. The accuracy of character segmentation and subsequent recognition using OCR techniques determines the final outcome-where recognized characters should ideally match the plate's actual content. The system's robustness becomes crucial, as its performance varies based on environmental factors, image quality, and the chosen algorithms' adaptability to different scenarios. Ultimately, the result should ideally showcase an accurately located plate, segmented characters, and correctly recognized characters, demonstrating the system's effectiveness and reliability.

CONCLUSION

The implementation of license plate detection and recognition using MATLAB and image processing techniques is a multi-step process involving image preprocessing, localization, segmentation, and character recognition. The success of this approach depends on the effectiveness of algorithms applied at each stage, the quality of input images, and the system's robustness across varying conditions. While the system aims to accurately identify and localize license plates within images and extract individual characters for recognition, its performance can vary based on factors like image quality, lighting, and plate variations. Achieving high accuracy necessitates continual refinement, parameter tuning, and potentially integrating machine learning or deep learning methods for improved recognition in diverse scenarios. Overall, the implementation provides a foundational framework for license plate detection, with further enhancements and optimizations crucial for achieving higher accuracy and reliability in real-world applications.

Appendices

Source Code:

```
%Alphabets
A=imread('alpha/A.bmp');B=imread('alpha/B.bmp');C=imread('alpha/C.bmp');
D=imread('alpha/D.bmp');E=imread('alpha/E.bmp');F=imread('alpha/F.bmp');
G=imread('alpha/G.bmp');H=imread('alpha/H.bmp');I=imread('alpha/I.bmp');
J=imread('alpha/J.bmp');K=imread('alpha/K.bmp');L=imread('alpha/L.bmp');
M=imread('alpha/M.bmp');N=imread('alpha/N.bmp');O=imread('alpha/O.bmp');
P=imread('alpha/P.bmp');Q=imread('alpha/Q.bmp');R=imread('alpha/R.bmp');
S=imread('alpha/S.bmp');T=imread('alpha/T.bmp');U=imread('alpha/U.bmp');
V=imread('alpha/V.bmp');W=imread('alpha/W.bmp');X=imread('alpha/X.bmp');
Y=imread('alpha/Y.bmp');Z=imread('alpha/Z.bmp');

%Natural Numbers
one=imread('alpha/1.bmp');two=imread('alpha/2.bmp');
three=imread('alpha/3.bmp');four=imread('alpha/4.bmp');
five=imread('alpha/5.bmp'); six=imread('alpha/6.bmp');
seven=imread('alpha/7.bmp');eight=imread('alpha/8.bmp');
nine=imread('alpha/9.bmp'); zero=imread('alpha/0.bmp');

%Creating Array for Alphabets
letter=[A B C D E F G H I J K L M N O P Q R S T U V W X Y Z];

%Creating Array for Numbers
number=[one two three four five six seven eight nine zero];

NewTemplates=[letter number];
save ('NewTemplates','NewTemplates')
clear all




%Creating Array for Alphabets
```

```
letter=[A B C D E F G H I J K L M N O P Q R S T U V W X Y Z];

%Creating Array for Numbers
number=[one two three four five six seven eight nine zero];

NewTemplates=[letter number];
save ('NewTemplates','NewTemplates')
clear all
unction letter=readLetter(snap)

load NewTemplates
snap=imresize(snap,[42 24]);
rec=[ ];

for n=1:length(NewTemplates)
    cor=corr2(NewTemplates{1,n},snap);
    rec=[rec cor];
end

ind=find(rec==max(rec));
display(find(rec==max(rec)));

% Alphabets listings.
if ind==1 || ind==2
    letter='A';
elseif ind==3 || ind==4
    letter='B';
elseif ind==5
    letter='C'
elseif ind==6 || ind==7
    letter='D';
elseif ind==8
    letter='E';
elseif ind==9
```

```
    letter='F';
elseif ind==10
    letter='G';
elseif ind==11
    letter='H';
elseif ind==12
    letter='I';
elseif ind==13
    letter='J';
elseif ind==14
    letter='K';
elseif ind==15
    letter='L';
elseif ind==16
    letter='M';
elseif ind==17
    letter='N';
elseif ind==18 || ind==19
    letter='O';
elseif ind==20 || ind==21
    letter='P';
elseif ind==22 || ind==23
    letter='Q';
elseif ind==24 || ind==25
    letter='R';
elseif ind==26
    letter='S';
elseif ind==27
    letter='T';
elseif ind==28
    letter='U';
elseif ind==29
    letter='V';
elseif ind==30
```

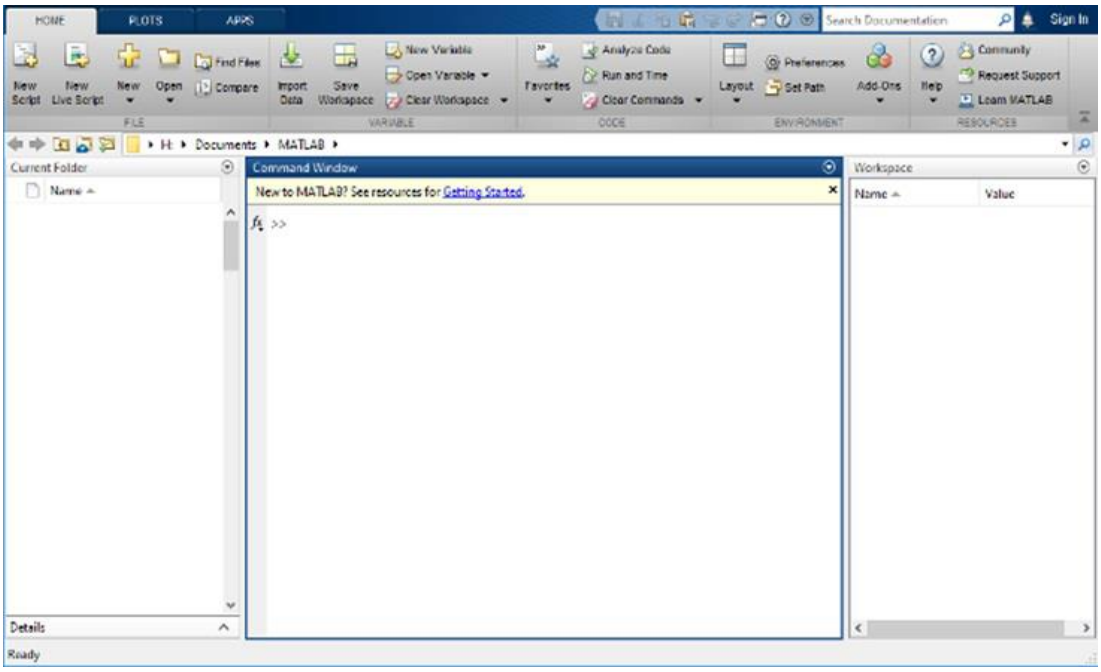
```
    letter='W';
elseif ind==31
    letter='X';
elseif ind==32
    letter='Y';
elseif ind==33
    letter='Z';
 %*-*-*-*-*

% Numerals listings.
elseif ind==34
    letter='1';
elseif ind==35
    letter='2';
elseif ind==36
    letter='3';
elseif ind==37 || ind==38
    letter='4';
elseif ind==39
    letter='5';
elseif ind==40 || ind==41 || ind==42
    letter='6';
elseif ind==43
    letter='7';
elseif ind==44 || ind==45
    letter='8';
elseif ind==46 || ind==47 || ind==48
    letter='9';
else
    letter='0';
end
end
close all;
clear all;
```

```
im = imread(' Number Plate Images/ image1.png');
imgray = rgb2gray(im);
imbin = imbinarize(imgray);
im = edge(imgray, 'prewitt');

%Below steps are to find location of number plate
Iprops=regionprops(im,'BoundingBox','Area', 'Image');
area = Iprops.Area;
count = numel(Iprops);
maxa= area;
boundingBox = Iprops.BoundingBox;
for i=1:count
   if maxa<Iprops(i).Area
       maxa=Iprops(i).Area;
       boundingBox=Iprops(i).BoundingBox;
   end
end

im = imcrop(imbin, boundingBox);
im = bwareaopen(~im, 500);
 [h, w] = size(im);

imshow(im);

Iprops=regionprops(im,'BoundingBox','Area', 'Image');
count = numel(Iprops);
noPlate=[];
for i=1:count
   ow = length(Iprops(i).Image(1,:));
   oh = length(Iprops(i).Image(:,1));
   if ow<(h/2) & oh>(h/3)
       letter=Letter_detection(Iprops(i).Image);
       noPlate=[noPlate letter]
   end
```

```
end



Iprops=regionprops(im,'BoundingBox','Area', 'Image');
area = Iprops.Area;
count = numel(Iprops);
maxa= area;
boundingBox = Iprops.BoundingBox;
for i=1:count
  if maxa<Iprops(i).Area
     maxa=Iprops(i).Area;
     boundingBox=Iprops(i).BoundingBox;
  end
end
Iprops=regionprops(im,'BoundingBox','Area', 'Image');
count = numel(Iprops);
noPlate=[];

for i=1:count
  ow = length(Iprops(i).Image(1,:));
  oh = length(Iprops(i).Image(:,1));
  if ow<(h/2) & oh>(h/3)
     letter=Letter_detection(Iprops(i).Image);
     noPlate=[noPlate letter]
  end
end
```

Screenshots:

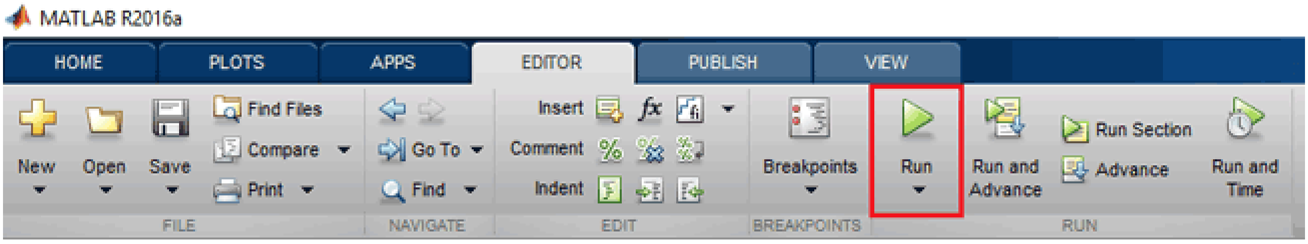
Home Page of the MATLAB:



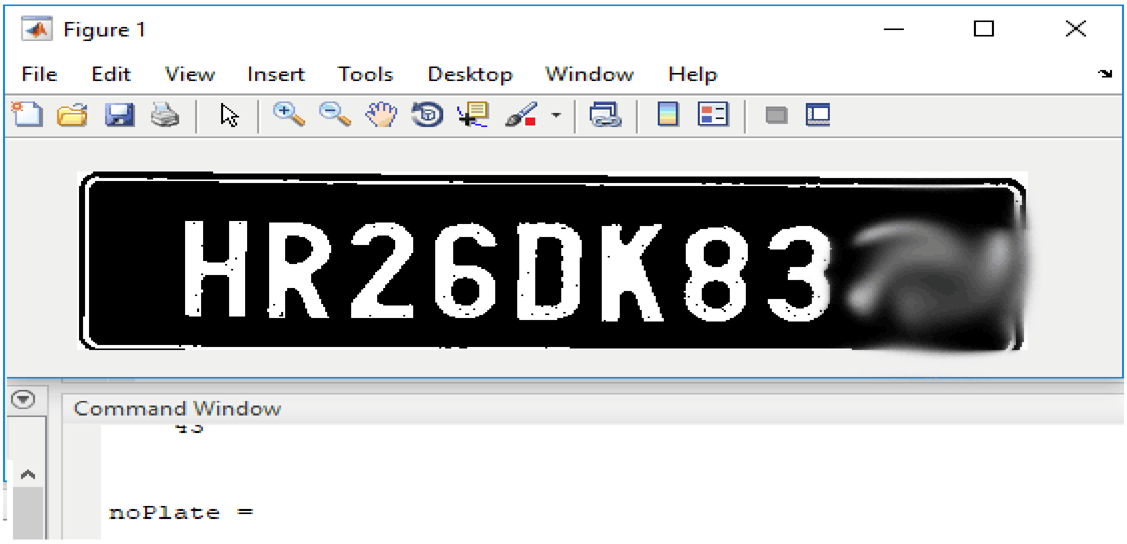
New to MATLAB? See resources for Getting Started.

```
fx >>
```

Execution of the File:

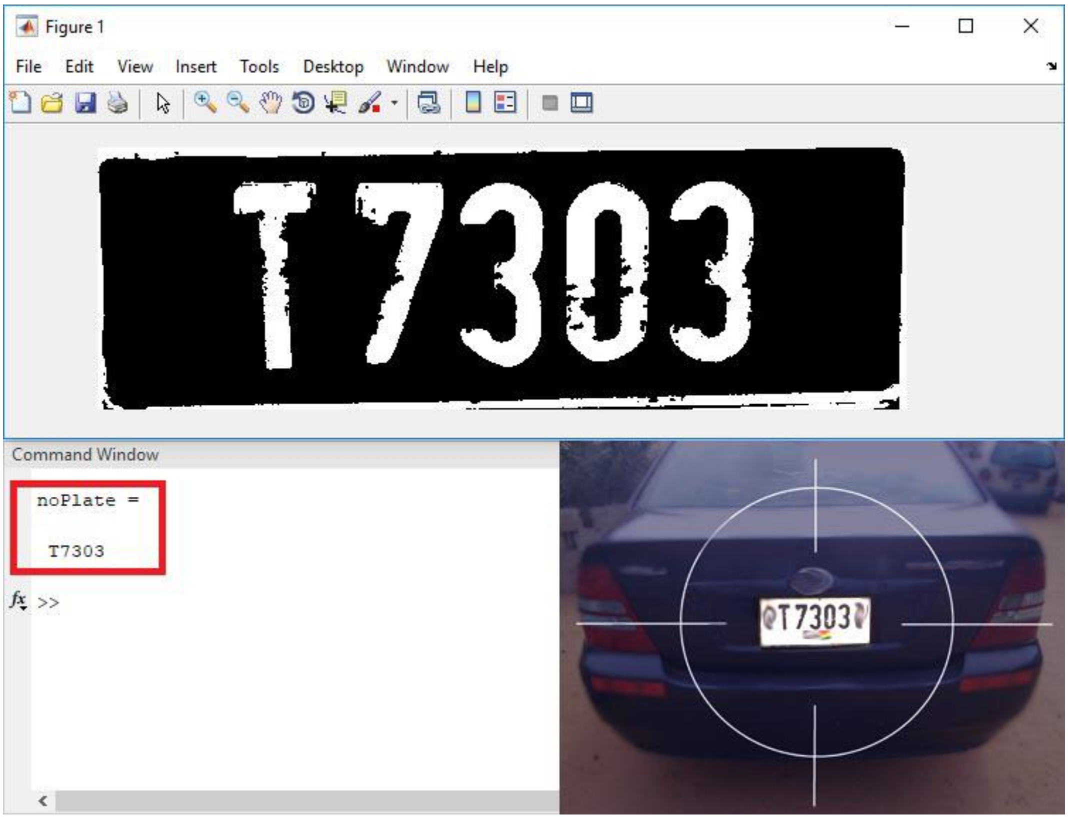


Output of the project in MATLAB(Sample output 1):



```
       43


  noPlate =
```

Output of the project in MATLAB(Sample output 2):



```
noPlate =

  T7303

fx >>
```

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