Automatic Number Plate Recognition(ANPR) System for Vehicle Identification

Mr.Jigar Patel[1], Pandal Shailu[2], G.Soumya[3],Md.Shaibaz Adil[4]

[1]*Electronics and Communication&B.V.Raju Institute of Technology*
[2]*Electronics and Communication &B.V.Raju Institute of Technology*
[3]*Electronics and Communication &B.V.Raju Institute of Technology*
[4]*Electronics and Communication & B.V.Raju Institute of Technology*

Abstract -The Number Plate Recognition System (ANPR) plays an important role in addressing these issues as its application ranges from parking admission to monitoring urban traffic and to tracking automobile thefts. ANPR system is created using Raspberry pi 3 as base hardware component interfacing with Open CV to improve the accuracy of the system.Automatic vehicle license plate recognition is an important component of modern intelligent transportation systems (ITS). Generally vehicle license plate recognition is divided into several steps including license plate extraction, image region which contains a license plate, character segmentation, and character recognition. Automatic license plate recognition system using Camera mounted over the exposure system image of the license plate is captured and the image is processed to extract the license number. The extracted information can be used with or without a database in many applications, such as electronic payment systems toll payment, parking fee payment, and freeway and arterial monitoring systems for traffic surveillance. If a vehicle tries to cross traffic rules, its license number is extracted and information regarding the offense along with the license plate no is sent to the Traffic Control Section for further legal actions to be taken. An alarm is raised to inform the on field policeman about the offense. It should also be generalized to process license plates from different nations, provinces, or states.

Key Words:Character recognition, Open CV-Python, Raspberry Pi 3, Python-tesseract, Vehicle Number Plate, Image Segmentation,Edge detection, Plate Localization Character Segmentation.

1.INTRODUCTION

The growing affluence of urban India has made the ownership of vehicles a necessity. This has resulted in an unexpected civic problem that of traffic control and vehicle identification. Parking areas have become overstressed due to the growing numbers of vehicles on the roads today. The Number Plate Recognition System (ANPR) plays an important role in addressing these issues as its application ranges from parking admission to monitoring urban traffic and to tracking automobile thefts. There are numerous ANPR systems available today which are based on different methodologies. The massive integration of information technologies, under different aspects of the modern world, has led to the treatment of vehicles as conceptual resources in information systems. Since an autonomous information system has no meaning without any data, there is a need to reform vehicle information between reality and the information system. This can be achieved by human agents or by special intelligent equipment that will allow identification of vehicles by their registration plates in real environments. Among intelligent equipment, mention is made of the system of detection and recognition of the number plates of vehicles. The system of vehicle number plate detection and recognition is used to detect the plates then make the recognition of the plate that is to extract the text from an image and all that thanks to the calculation modules that use location algorithms, segmentation plate and character recognition. The detection and reading of license plates is a kind of intelligent system and it is considerable because of the potential applications in several sectors which are quoted.

COMPONENTS DESCRITION:

The raspberry pi comes in two models, they are model A and model B. The main difference between model A and model B is USB port. Model A board will consume less power and that does not include an Ethernet port. But,

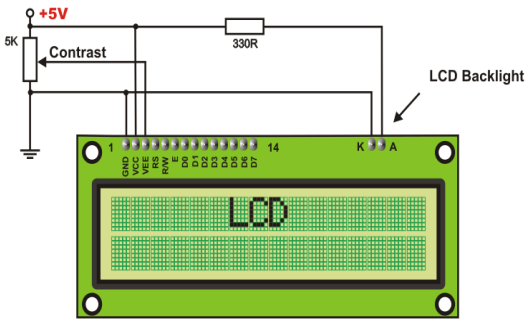
the model B board includes an Ethernet port and designed in china. The raspberry pi comes with a set of open source technologies, i.e. communication and multimedia web technologies.In the year 2014, the foundation of the raspberry pi board launched the computer module, that packages a model B raspberry pi board into module for use as a part of embedded systems, to encourage their use. The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, Xbee socket, UART, power source connector. And various interfaces for other external devices. It also requires mass storage, for that we use an SD flash memory card. So that raspberry pi board will boot from this SD card similarly as a PC boots up into windows from its hard disk. Essential hardware specifications of raspberry pi board mainly include SD card containing Linux OS, US keyboard, monitor, power supply and video cable. Optional hardware specifications include USB mouse, powered USB hub, case, internet connection, the Model A or B: USB WiFi adaptor is used and internet connection to Model B is LAN cable.

Features of Raspberry PI Model B

- 512 MB SDRAM memory
- Broadcom BCM2835 full high definition multimedia processor
- Dual Core Video Core IV Multimedia coprocessor
- Single 2.0 USB connector
- HDMI (rev 1.3 and 1.4) Composite RCA (PAL & NTSC) Video Out
- 3.5 MM Jack, HDMI Audio Out
- MMC, SD, SDIO Card slot on board storage
- Linux Operating system
- Dimensions are 8.6cm*5.4cm*1.7cm
- On board 10/100 Ethernet RJ45 jack

LCD screen:

LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).



USB Camera

Fig: USB Camera

In our undertaking camera is utilizing to consistently gushing the video of found place. The details are demonstrated as follows.

Particulars:

- Built-in mic with commotion decrease
- Interpolated to 25 Mega Pixels
- 10 Level Zoom on live Motion Picture
- Special Visual Effects
- True Motion Picture

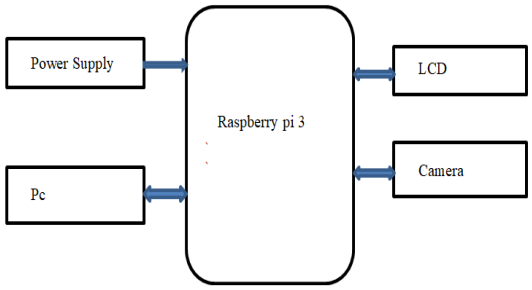
Fundamental Requirements:

- 1 GHz
- 512 MB RAM or more
- 200 MB hard drive space
- Internet association
- USB 1.1 port (2.0 prescribed)

DESIGN DESCRIPTION:

Automatic number plate recognition system for vehicle identification consists of two modules. Hardware interfacing and software module.

HARDWARE INTERFACING:



Hardware interfacing module consists of hardware components such as Raspberry Pi 3 ,personal computer to process open CV code to Raspberry Pi3, Power supply, HDMA2 vga cabel,

Arduino based camera upto 8MP, arduino based LCD display.

Raspberry pi3 is connected to desktop using HDMA2 cabel and power supply is given to raspberry pi 3 upto 2amp and is connected to LCD display to display the number plate.

Camera captures the image of number plate and using open cv code interfaced to raspberry Pi3 chescks the number plate from dataset given in code and displays on LCD screen.

The below figure is block diagram of hardware interfacing.

In addition to the Python programming language used in Raspberry Pi,this system will also use OpenCV, a computer vision simulation to help with image pre-processing that is designed with criteria of speed.

SOFTWARE MODULE:

Software module consists of how the particular number plate will recognized from a single image.

Firstly the captured image is taken from camera connected to raspberry pi then edge detection, plate localization, character detection, character recognition is done using a simple python code through open CV.

Using Machine Learning algorithm such as pytesseract. Python-tesseract is an optical character recognition (OCR) tool for python. That is, it will recognize and “read” the text embedded in images. Additionally, if used as a script, Python-tesseract will print the recognized text instead of writing it to a file.

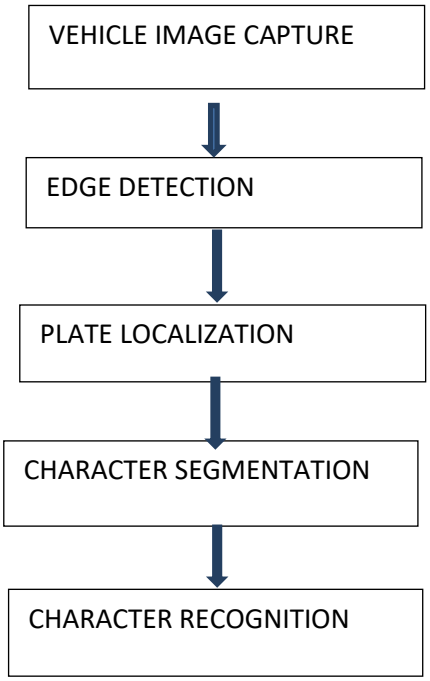
Edge Detection:Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data

extraction in areas such as image processing, computer vision, and machine vision.

Plate Localization: Number plate localization plays a key role in various applications. Number of techniques has been proposed for number plate localization. Number plate recognition is the process of extraction of any vehicle number plate information from an image which is taken from a video.

Character segmentation : Character segmentation is an operation that seeks to decompose an image of a sequence of charac- ters into subimages of individual symbols. It is one of the decision processes in a system for optical character recognition (OCR).

Character recognition: Character recognition usually abbreviated to optical character recognition or shortened OCR, is the mechanical or electronic translation of images of handwritten, typewritten or printed text (usually captured by a scanner) into machine-editable text.



2.1 Plate Detection

In this step, we have to detect all the plates in the current camera frame. Two broad categories in which they can be defined are,

Segmentation

Classification

2.1.1 **Segmentation**

Segmentation is the process of dividing an image into multiple segments. This process is to simplify the image for analysis and make feature extraction easier. One important feature that can be exploited from Number plates is the high number of vertical edges. But before that, we need to do some handy pre-processing of the current image namely:

1. Conversion to Gray Scale: The Red, Green, and Blue components are separated from the 24-bit color value of each pixel. To convert the image captured into Gray Scale code can be written in Python IDLE:

img = cv2.imread('2.jpg',0)

An example of image converted to grayscale is shown in Fig. (a).

2. **Blur the Image**: The result of blurring an image by a Gaussian functions. Using this technique image looks sharper or more detailed if we are able to perceive all the objects and their shapes correctly in it. Using Code: Blur =cv2.GaussianBlur(img,(5,5),0)

An example of image blurring is shown in Fig. (b).
Figure (a)

Fig (a): Grayscale Image

Fig (b): Blurred Image

2.1.2 Classification

This technique is utilized to distinguish the potential number plate region from the given picture. The principle target of such sort of systems is to confine the number plate region from images of the Shovel Dumper that are captured from the camera mounted on the Raspberry Pi2. The quality of the image forms an important part of this technique so preprocessing the image helps in improving the quality.

Number plates usually appear to have high contrast areas in the image (black-and-yellow or black-and-white). The numbers and letters are placed in the same row (i.e. at an identical vertical level), which results in frequent changes in intensity horizontally .This provides the basis for detecting the changes in the horizontal intensity horizontally. This provides the basis for detecting the changes in the horizontal intensity, as the rows that will contain the number plate are expected to show sharp variations. The reason for this sharp variation is the contrast between the letters and its background.

2.3.1 Edge Detection

Edge helps to characterize the boundaries and therefore are a problem of fundamental importance while processing the image. Edges in images are the areas where strong intensity contrasts are present ,a sudden variation in the intensity from one pixel to the next Detecting the edges of an image significantly reduces the amount of data and it helps in filtering out the useless information, while preserving the important structural properties of an image. There are many ways to perform the edge detection.

However, the majority of various methods can be grouped in to two different categories, gradient and laplacian. The gradient methods detect the edges by finding out the maximum and minimum in the first derivative of the image. The Laplacian method searches for the zero crossings in the second

derivative of the image to find the edges. An edge has the one dimensional shape of the ramp and calculation the derivative of the image can highlight its location. Suppose we have the signal shown below in Figure (a). If we take the gradient of this given signal we get the following shown in Figure (b).

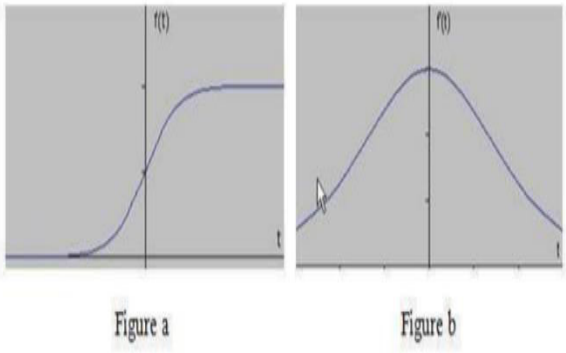


Fig: trend of signal and its derivative

As shown, the derivative shows maximum located at the centre of the edge in the original signal. Such a method of finding an edge is characteristic of the gradient filter family of the edge detection filters and it includes the Sobel method .A pixel location is declared as an edge location if the value of the gradient is exceeding some threshold. The edges will have higher pixel intensity values than their surrounding pixels. So once a threshold has been set, we can compare the gradient value of the threshold value and an edge can be detected whenever the threshold is exceeded. Also, when the first derivative is at a maximum, the second derivative is turns out to be zero.

2.3.2 Sobel Filter

The theory of the one-dimensional analysis can be carried over to two –dimensions as long as there an accurate approximation for calculating the derivative of a two-dimensional image. The Sobel operator helps to perform a 2 dimensional spatial gradient measurement on an image. Generally, it is used to find the approximate absolute gradient magnitude at each point on an input grayscale image .The Sobel edge detector make use of a pair of 3X3 convolution masks, one estimates the gradient in the x-direction(columns) and the other estimates the gradient in the y-direction(rows).

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Using Python code As one of the consequences, the inherent errors introduced by the edge detection mechanism are typically below 5% (1-2 pixels for a character size of 40x100 pixels) and therefore not significant for the subsequent processing.

sobelx=cv2.Sobel(blur, cv2.CV_8U, 1, 0, ksize=3).

After a Sobel Filter, we apply a threshold filter to obtain a binary image with a threshold value

obtained through Otsu's Method.Otsu's algorithm needs an 8-bit input image and Otsu's meth od

automatically determines the optimal threshold value. An image with output as Threshold image from otsu's algorithm is shown in Fig.

2.3.3 Contours

The minimum or the smallest bounding or the enclosing box for any point set in N dimensions is the box with the smallest measure within which all points lie. When the other kinds of measure are used, the minimum box is usually called accordingly depending on the measure used.eg. "Minimum-perimeter bounding box".

The minimum bounding box of any point set is same as the minimum bounding box of its convex hull, this is a fact which can be used heuristically to speed up computation. The term "box"/"hyper rectangle" has come from its usage in Cartesian coordinate system, where it can be indeed visualized as a rectangle, rectangular parallelepiped etc. In the case of two-dimensional it is called the minimum bounding rectangle. In other words it is a rectangle which has the minimum height and which that covers all the pixels present in a particular connected component or region. An image with contouring of captured image is shown in Fig.

2.4 Principles of Character

The character segmentation process acts as bridge between plate detection and optical character recognition modules. Its main function is to segment the characters in the selected candidate region (extracted number plate) such that each character can be sent to the optical character recognition module individually for recognition.

Normalized or standardized are of a fancy format the conditions of the number plates are important criteria for efficient segmentation because if numbers are of a fancy format the conditions of the number plate as described .Once the number plate is localized we proceed to obtain the individual characters.

Anumberplate as described above has high intensity variation regions. This forms the basis for character segmentation. Sometimes it is observed that along with numbers, various texts may be present, which have to be removed. By various observation we observed that for the number plate regions the amount of white on black is specific for the number regions and falls within a certain range. Morphological technique are used to remove small white areas which escape range corrections. Finally individual characters are extracted to pass on through the optical character recognition system. Segmentation is one of the most important processes in the automatic number plate recognition, because all further steps rely on it. If the segmentation fails, a character can be improperly divided in two pieces, or two characters can be wronged merged together which would lead to the failure of following stages of recognition. The second phase of the segmentation is an enhancement of segments. The segment of a plate contains besides the character also undesirable elements such as noise due to shadows or defects in camera equipment as well as redundant space on the sides of characters.

PYTHON-TESSERACT

Python-tesseract is an optical character recognition (OCR) tool for python. That is, it will recognize and "read" the text embedded in images.

we will try to explain the technology behind the most used Tesseract Engine, which was upgraded with the latest knowledge researched in optical character recognition. This article will also serve as a how-to guide/ tutorial on how to implement OCR in python using the Tesseract engine. We will be walking through the following modules:

- Tesseract OCR Features
- Preprocessing for OCR using OpenCV
- Running Tesseract with CLI and Python
- Limitations of Tesseract engine

RESULTS

5.1.IMPLEMENTATION PERFORMANCES

The automatic vehicle number plate detection is very important in areas like toll collection, parking management and traffic policing and crime investigation. For the efficient identification and detection of vehicles, a Raspberry Pi based Vehicle Number Plate Recognition project is proposed. Generally, an automatic number plate recognition (ANPR) system is made up of five modules; number Detection, Segmentation, Classification, number Recognition, OCR Segmentation modules.

5.2.SIMULATION RESULTS

Figure 5.1 Captured Image

STEP-1:

After all the hardware implementation we detect the number plate using a camera the above image shows that we selected a printed format paper due to low efficient camera the camera will recognize the number plate.

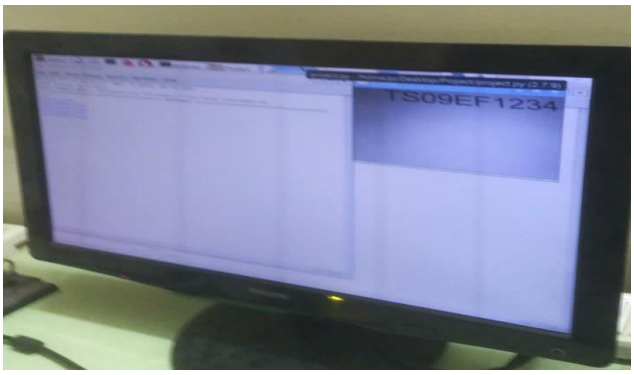


Figure 5.2 Working Image

STEP-2:

When the camera detects the number from the image due to character recognition algorithm python-tesseract is used in the software code shows on the widow as above figure and send the information to Raspberry Pi-3.

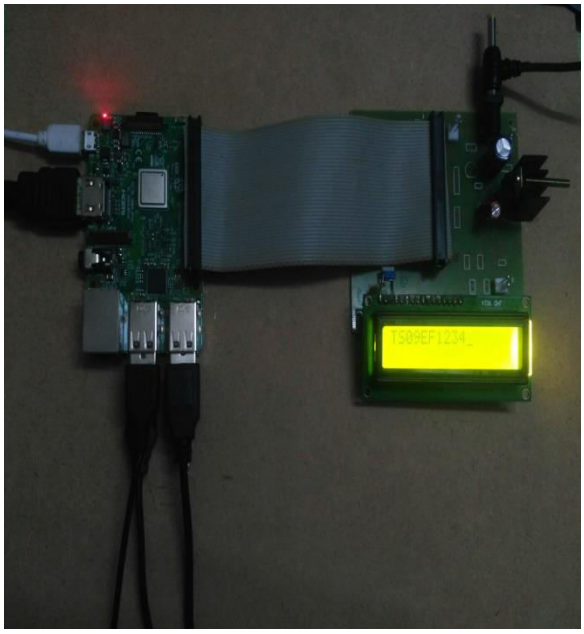


Figure 5.3 Output on LCD

STEP 3- RESULT:

The extracted number plate is detected and displays on LCD screen.

This is the final output of the system extracting a number plate from image detected**.**

Working

The Pi can efficiently communicate with the output and input modules which are being used. Recognizing vehicle number plates is a difficult but much needed system. Here we propose a Raspberry Pi based vehicle number plate recognition system that automatically recognizes vehicle number plates using image processing. The system uses a camera along with LCD display circuit interfaced to a Raspberry pi. The system constantly processes incoming camera footage to detect any trace of number plates. On sensing a number plate in front of the camera, it processes the camera input, extracts the number plate part from the image. Processes the extracted image using OCR and extracts the number plate number from it. The system then displays the extracted number on an LCD display.

6.1.CONCLUSION

The implementation of **"Automatic Number Plate Recognition System for Vehicle Identification"** is done successfully. And the system is ready to differentiate the vehicles whether they safe or not. The issues faced by many organizations can be solved by using Automatic number recognition system. It gives very accurate and efficient record of all the motor vehicles. Also it can reduce the error rate of manual checking but automating the system. This automated system is easy to use and very transparent.

6.2.FUTURE WORK

ANPR system using Raspberry Pi 3 is demonstrated in this article, implementing OpenCV as the core image processing software. The system performs effectively, this process can be used in identification number plate in particular areas can also be used in toll gate applications. To improve the speed and accuracy of ANPR system for vehicle number identification better version of Raspberry Pi 3 and higher definition camera should be used.

In future we can create system which can handle the drawbacks of the proposed system and can improve

recognition of number plate even in poor lighting, during snow issues and can improve the system using advance algorithm.

ACKNOWLEDGEMENT

The heading should be treated as a 3rd level heading and should not be assigned a number.

REFERENCES

[1] Juhi Ranglani and Vijay Lachwani "Automatic Number Plate Recognition" SSRG International Journal of Computer Science and Engineering (SSRG-IJCSE) – volume 3 Issue 8–August 2016

[2] Jasper RR Uijlings, Koen EA van de Sande, Theo Gevers, and Arnold WM Smeulders. Selective search for object recognition. International journal of computer vision, 104(2):154{171, 2013.

[3] "S. Ma, X. Wu, and D. Bi, "Implementation of character recognition system for bank cashbox," Computer Engineering, vol. 29, no. 20, pp.173-174, November 2013.

[4] Cui Chen gyi, Zhao Guannan, Jin Minglu "A ZigBee Based Embedded Remote Control System". Electronic Information and Electrical Engineering Dalian University of Technology Dalian, China e-mail: cuichengyi@dl.cn.2010 2010

[5] Vishnu K.B, Vishnu S.Nair, Rahul C.M, Akhil J, Gibi Sunny "automatic number plate recognition for vehicle identification".Vo.l8 No.22, July 2012

[6] Krishna, Shashi Yadav and Nidhi, "Automatic Railway Gate Control Using Microcontroller" Oriental Journal Of Computer Science & Technology, Vol.6, No.4, December 2013

[7] Leonard G. C. Hamey, Colin Priest, "Automatic Number Plate Recognition for Australian Conditions", Proceedings of the Digital Imaging Computing: Techniques and Applications (DICTA), pp. 14- 21, December 2005.

[8] Sourav Roy, Amitava Choudhury, Joydeep Mukherjee, "An Approach towards Detection of Indian Number Plate from Vehicle", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-4, March 2013.