isrjournals

International Journal of Advanced Research in Electronics, Communication & Instrumentation Engineering and Development

Volume: 2 Issue: 1 Apr,2016,ISSN_NO: 2347 -7210

# A Survey of character recognition using image processing algorithm

GOWTHAMI P [1], JEGATHEES KUMAR B[2]
PG Student [1],Assistant Professor[2]
Department of Electronics and communication engineering, RVS Educational Trust's Group of Institutions, Dindigul, India[1,2].

***ABSTRACT*** -Automatic Number Plate Recognition (ANPR) is the process of identifying the unique number of the vehicle from a still image or chain of image (video). ANPR includes the following processes Number Plate Location (NPL), Character Segmentation and Number Plate Recognition. The extracted output is used in various applications like security purposes, lane departure, toll gate, arterial monitoring system for traffic surveillance and parking lots. The characters are recognized with a standard data base using template matching algorithm. The proposed method is tested on 50 vehicle images which are captured from different illumination condition and complex back ground condition.

## 1. INTRODUCTION

An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.

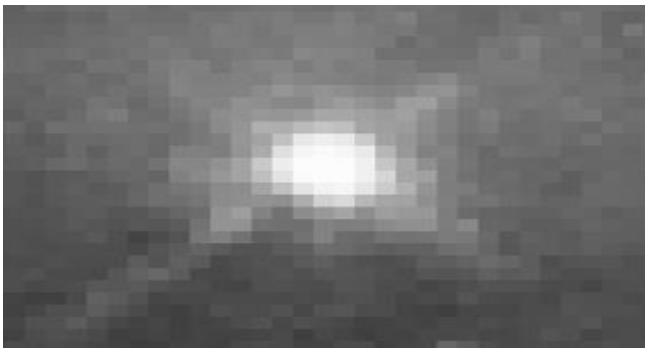


Figure 1. Image

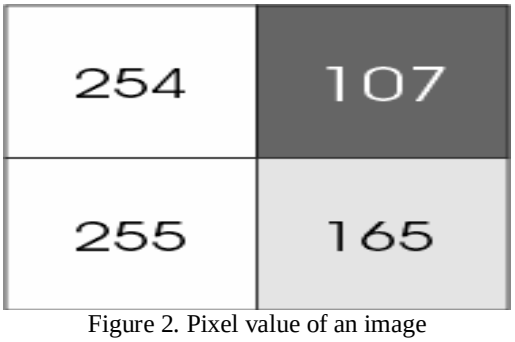



Figure 2. Pixel value of an image

### 1.1 Fundamentals of image processing

Image Processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-to-day life for various applications. Various techniques have been developed in Image Processing during the last four to five decades.

Most of the techniques are developed for enhancing images obtained from unmanned spacecrafts, space probes and military reconnaissance flights. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics software etc

There are two methods available in Image Processing.

- Analog Image Processing
- Digital Image Processing

### 1.2 Analog Image Processing

Analog Image Processing refers to the alteration of image through electrical means. The most common example is the television image. The television signal is a voltage level which varies in amplitude to represent brightness through the image. By electrically varying the signal, the displayed image appearance is altered. The brightness and contrast controls on a TV set serve to adjust the amplitude and reference of the video signal, resulting in the brightening, darkening and alteration of the brightness range of the displayed image.

### 1.3 Digital Image Processing

In this case, digital computers are used to process the image. The image will be converted to digital form using a scanner – digitizer and then process it. It is defined as the subjecting numerical representations of objects to a series of operations in order to obtain a desired result. It starts with one image and produces a modified version of the same. It is therefore a process that takes an image into another. The term digital image processing generally refers to processing of a two-dimensional picture by a digital computer [7, 11]. In a broader context, it implies digital processing of any two-dimensional data. A digital image is an array of real numbers represented by a finite number of bits. The principle advantage of Digital Image Processing methods is its versatility, repeatability and the preservation of original data precision.

### 1.4 Morphological operations

Morphological operations are affecting the form, structure or shape of an object. They are used in pre or post processing (filtering, thinning, and pruning) or for getting a representation or description of the shape of objects/regions (boundaries, skeletons convex hulls). The two principal morphological operations are dilation and erosion [1]. Dilation allows objects to expand, thus potentially filling in small holes and connecting disjoint objects. Erosion shrinks objects by etching away (eroding) their boundaries. These operations can be customized for an application by the proper selection of the structuring element, which determines exactly how the objects will be dilated or erode.

**Notations:**

1. Black pixel: in gray scale values for 8 bits/pixel indexed image its value will be 0.
2. White pixel: in gray scale values for 8 bits/pixel indexed image its value will be 255.

The dilation process is performed by laying the structuring element **B** on the image **A** and sliding it across the image in a manner similar to convolution (will be presented in a next laboratory). The difference is in the operation performed. It is best described in a sequence of steps:

1. If the origin of the structuring element coincides with a 'white' pixel in the image, there is no change; move to the next pixel.

2. If the origin of the structuring element coincides with a 'black' in the image, make black all pixels from the image covered by the structuring element.

**Notation:** $A \oplus B$

The structuring element can have any shape. Typical shapes are presented.

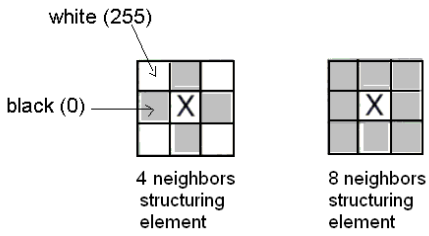



Figure 3. Typical shapes of the structuring elements

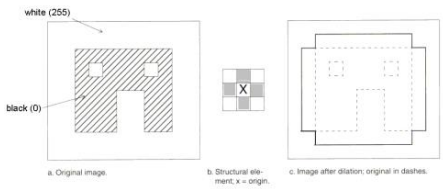



Figure 4. Illustration of the Dilation process

The erosion process is similar to dilation, but we turn pixels to 'white', not 'black'. As before, slide the structuring element across the image and then follow these steps:

1. If the origin of the structuring element coincides with a 'white' pixel in the image, there is no change; move to the next pixel.

2. If the origin of the structuring element coincides with a 'black' pixel in the image, and at least one of the 'black' pixels in the structuring element falls over a white pixel in the image, then change the 'black' pixel in the image (corresponding to the position on which the centre of the structuring element falls) from 'black' to a 'white'.

These two basic operations, dilation and erosion, can be combined into more complex sequences. The most useful of these for morphological filtering are called opening and closing [1]. Opening consists of an erosion followed by a dilation and can be used to eliminate all pixels in regions that are too small to contain the structuring element. In this case the structuring element is often called a probe, because it is probing the image looking for small objects to filter out of the image.

**Notation:**

$$A \circ B = (A \Theta B) \oplus B$$

Closing consists of a dilation followed by erosion and can be used to fill in holes and small gaps the closing operation has the effect of filling in holes and closing gaps. These two basic operations, dilation and erosion, can be combined into more complex sequences. The most useful of these for morphological filtering are called opening and closing .Closing and opening will generate different results even though both consist of erosion and dilation.

**Notation:**

$$A \bullet B = (A \oplus B) \Theta B$$

### 1.5 Edge detection

- Edges are significant local changes of intensity in an image
- Edges typically occur on the boundary between two different regions in an image
- Goals of edge detection are as follows
- These features are used by higher-level computer vision algorithms (e.g., recognition).

Stages of canny edge detection contains,

- Smoothing suppresses as much noise as possible, without destroying the true edges.
- Enhancement applies a filter to enhance the quality of the edges in the image (sharpening).
- Detection determines which edge pixels should be discarded as noise and which should be retained (usually, thresholding provides the criterion used for detection).
- Localization determines the exact location of an edge (sub-pixel resolution might be required for some applications, that is, estimate the location of an edge to better than the spacing between pixels). Edge thinning and linking are usually required in this step.

The performance of the canny algorithm depends heavily on the adjustable parameters, which is the standard deviation for the Gaussian filter, and the threshold values, 'T1' and 'T2' also controls the size of the Gaussian filter. The bigger the value for the larger the size of the Gaussian filter becomes. This implies more blurring, necessary for noisy images, as well as detecting larger edges. As expected, however, the larger the scale of the Gaussian, the less accurate is the localization of the edge. Canny's edge detection algorithm is computationally more expensive compared to Sobel, Prewitt and Robert's operator. However, the Canny's edge detection algorithm performs better than all these operators under almost all scenarios.

Image used for edge detection analysis. Edge detection of all four types was performed.

Canny yielded the best results. This was expected as canny edge detection accounts for regions in an image. As expected, however, the larger the scale of the Gaussian, the less accurate is the localization of the edge. Canny yields thin lines for its edges by using non-maximal suppression. Canny also utilizes hysteresis with thresholding. The Canny's edge detection algorithm performs better than all these operators under almost all scenarios.

### 1.6 THRESHOLDING

Thresholding is the simplest method of image segmentation. From a gray scale image, thresholding can be used to create images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T (that is, ), or a white pixel if the image intensity is greater than that constant. This results in the dark tree becoming completely black, and the white snow becoming complete white. $T\_M[x, y, p(x, y), f(x, y)]$ 1 In this equation, T stands for the threshold; $f(x, y)$ is the gray value of point $(x, y)$ and $p(x, y)$ denotes some local property of the point—such as the average gray value of the neighbourhood centred on point $(x, y)$ . Connected component approach steps are as follows

- Once region boundaries have been detected, it is often useful to extract regions which are not separated by a boundary.
- Any set of pixels which is not separated by a boundary is call connected.
- Each maximal region of connected pixels is called a connected component.

- The set of connected components partitions an image into segments.
- Image segmentation is a useful operation in many image processing applications.

### 1.7 Number plate in India

All motorized road vehicles are tagged with a license number in India. The license plate (commonly known as number plates) number is issued by the district-level Regional Transport Office (RTO) of respective states - the main authority dealing matters. The license plates are placed in the front and back of the vehicle.

By law, all plates are based on modern Hindu-Arabic numerals with Roman alphabet, though many states violate this by writing the numerals in the local script. Other guidelines include having the plate lit up at night and the restriction of the fonts that could be used. In some states such as Sikkim, cars bearing outside plates are barred from entering restricted areas. Plates for private car and two-wheeler owners have a white background with black lettering (e.g., **TN 05 M 5399**). Commercial vehicles such as taxis and trucks have a yellow background and black text (e.g., **PY 01 AP 6011**). Vehicles belonging to foreign consulates have white lettering on a light blue background. The President of India and state governors travel in official cars without license plates. Instead they have the Emblem of India in gold embossed on a red plate. Since June 1, 2005, the Government of India has introduced High Security Registration (HSR) number plates which are tamper proof. All new motorized road vehicles that come into the market have to adhere to the new plates, while existing vehicles have been given two years to comply with. Features incorporated include the number plate having a patented chromium hologram; a laser numbering containing the alpha-numeric identification of both the testing 3 agency and manufacturers and a retro-reflective film bearing a verification inscription "India" at a 45- degree inclination. The numbers would be embossed on the plate, rather than being painted for better visibility. The term "India" is to be in a light shade of blue.

In India, people follow various types of format for numbering their license plate but there is a proper format proposed by the regional transport office. Format of the registration is as shown below:

**AA 11 BB 1111**

Where AA is the two letter state code; 11 is the two digit district code; 1111 is the unique license plate number and BB is the optional alphabets if the 9999 numbers are used up. An example would be:

**TN 01 CA 1003**

The first two alphabets TN indicate that the vehicle is from the Tamil Nadu state. The next two are representing the district (In this case the capital Chennai). CA 1003 is the unique license plate number. In some states (such as the union territory of Delhi) the initial 0 of the district code is omitted; thus Delhi district 2numbers appears as DL 2 not DL 02. The National Capital Territory of Delhi has an additional code in the registration code:

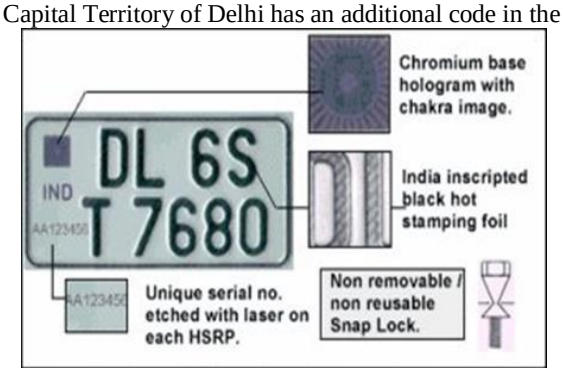



Figure 5. Standard formats for Indian license plate

## 2.PROPOSED METHOD

License plate recognition is playing an important role in variety of applications related to automated transport system such as road traffic monitoring, detection of stolen vehicles, automatic payments of tolls on highways or bridges, parking lots access control etc. License plate recognition system is composed of three parts, which are license plate detection, character segmentation and recognition.

### 2.1 Flow of Proposed method

The ALPR system that extracts a license plate number from a given image can be composed of four stages.

The first stage is to acquire the car image using a camera. The parameters of the camera, such as the type of camera, camera resolution,

Shutter speed, orientation, and light, have to be considered. The quality of the acquired images is a major factor in the success manner. ALPR as a real life application has to quickly and successfully process license plates under different environmental conditions, such as indoors, outdoors, day or night time. It should also be generalized to process license plates from different nations, provinces, or states. These plates usually contain different colors, are written in different languages, and use different fonts; some plates may Have a single colour background and others have background images.

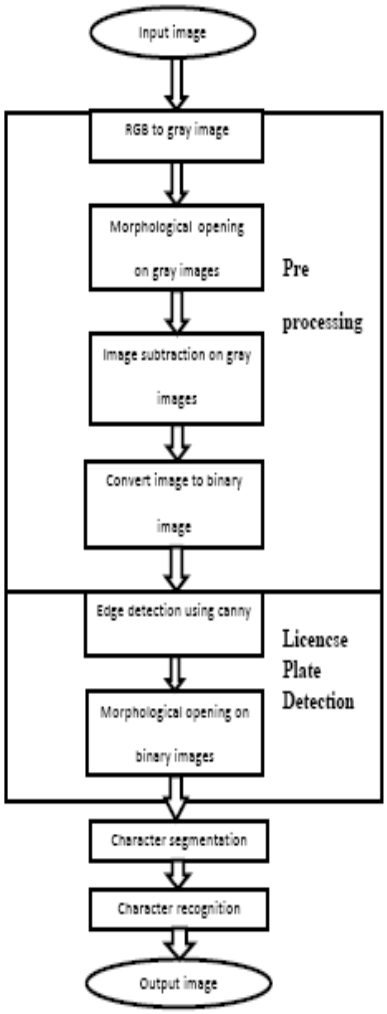
The second stage is to extract the license plate from the image based on some features, such as the boundary, the colour, or the existence of the characters. The extracted information can be used with or without a database in many applications, such as electronic payment systems (toll payment, parking fee payment), and freeway and arterial monitoring systems for traffic surveillance.

The third stage is to segment the license plate and extract the characters by projecting their colour information, labelling them, or matching their positions with templates.

The final stage is to recognize the extracted characters by template matching or using classifiers, such as neural networks and fuzzy classifiers.

Figure 6.Flow chart for the proposed method

Figure 4.2 Flow chart for the proposed method




## 2.2 Pre processing

Pre-processing images commonly involves removing low frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image pre-processing is the technique of enhancing data images prior to computational processing.

RGB image is formed by weighted sum of the R, G, B components, with 8 bit per pixel, 256 different intensities. The effective luminance of a pixel is calculated with the formula

$$Y=0.2989*R+0.5870*G+0.1140*B$$

Figure 7. Input image

Morphological opening on gray image is used to remove small objects from the foreground of an image. The opening of A by B is obtained by the erosion followed by dilation A.B= (AΘB) ⊕ B (Θ denotes erosion and ⊕ denotes dilation)

Image subtraction on gray images is used to detect different between Gray images and morphological operated gray image

G(x,y)=f1(x,y)-f2(x,y)

G(x,y)=|f1(x,y)-f2(x,y)|

F1(x,y)& f2(x,y) are input images and G(x,y) is output image.

The output image will replace all the pixels in the input image with luminance greater than level with the value 1(white) and replaces all other pixels with the value 0 (black) i.e.to binary images

Level= (fmax1-(fmax1-fmin1)/2)/225

fmax1=double (max (max (I4)))

fmin1=double (min (min (I4)))

### 2.2 Number plate detection

The number plate detection can be done by the following operations

Edge Detection using canny involves

Step1: convolve with gradient filter

Step2: compute response magnitude

Step3: compute local edge orientation

Step4: Identifying peak detection

Step5: non maximum suppression through scale and hysteresis thresholding along edges

Closing removes small holes in the foreground, changing small islands of background into foreground. These techniques can also be used to find specific shapes in an image

Opening removes small objects from the foreground of an image, placing them in the background. Opening can be used to find things into which a specific structuring element can fit (edges, corners,)

Dilation is one of the basic operations in mathematical morphology originally developed for binary images, it has been expanded first to gray scale images, and then to complete lattices. The dilation operation usually uses a structural element for probing and expanding the shapes contained in the input image.

### *2.4* Character segmentation

After locating the LP and skew correction, next step is the segmentation of characters. Character segmentation is the procedure of extracting the characters from the LP image. Almost all the papers that had been surveyed [1], [3] and [10] used horizontal and vertical projection to segment the characters. In vertical and horizontal scanning is used to dig out the characters. Vertical scanning will scan the image vertically from [0, 0] to [height, width] which is executed on column by column basis. Width between the first and last column is computed and each character is separated from the plate background and stored in separate array so that it is used for horizontal scanning. Horizontal scanning is performed to eradicate the extra upper and lower region from the image.

Currently image segmentation approach, based on two properties of an image, is divided into two categories:

**Discontinuities based-** subdivisions of images are carried out on the basis of abrupt changes in the intensity of grey levels of an image. Our focus is primarily based on identification of isolated points, lines and edges. This includes image segmentation algorithms like edge detection.

**Similarities based-** In this category, subdivisions of images are carried out on the basis of similarities in intensity or grey levels of an image. Our focus here is on identification of similar points, lines and edges. This includes image segmentation algorithms like thresholding, region growing, region splitting and merging.

As compared to segmentation based on edge detection, segmentation methods based on regions are relatively simple and are more immune to noise. Contrary to edge based segmentation techniques who segmenting image based on the abrupt changes in the intensities of neighbouring pixel, region based segmentation algorithms segment an image into regions that are similar according to a set of predefined criteria [10]. Region based segmentation include.

Region Growing groups pixel in an entire image into sub regions or large regions based on predefined criterion. In other words, the basic idea is to group a collection of pixels with similar properties to form a region [10]. Region growing can be processed into four steps:

- Select a group of seed particles in original image
- Select a set of criteria for determining similar seeds based on properties such as grey level intensity or colour and then set up a stopping rule
- Grow the region by adding to each seed those neighbouring pixels that have predefined properties similar to the seed pixel
- Stop the region growth when there are no more pixels that match the criterion for inclusion in that region.

### *2.5* Character recognition

By comparing the pre-processed input image with the reference binary images in the database, paintings in the input image can be recognized. Template Matching is a high-level machine vision technique that identifies the parts on an image that match a predefined template. Advanced template matching algorithms allow finding occurrences of the template regardless of their orientation and local brightness.

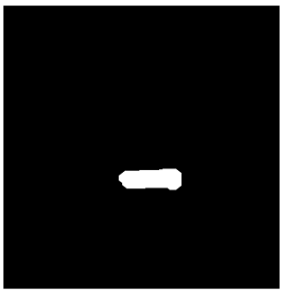
Template Matching techniques are flexible and relatively straightforward to use, which makes them one of the most popular methods of object localization. Their applicability is limited mostly by the available computational power, as identification of big and complex templates can be time-consuming Template Matching: It is a Technique used to categorize objects. A template is a small image (sub-image) .The goal is to find occurrences of this template in a larger image that is, you want to find matches of this template in the image. Template matching techniques compare portions of images against one another. Sample image may be used to recognize similar objects in source image. Template matching has been a classical approach to the problems of locating and recognizing of an object in an image. Template matching technique, especially in two dimensional cases, has many applications in object tracking, image compression, stereo correspondence, and other computer vision applications.

Usually we identify as matches the positions that (simultaneously) represent the template correlation:

- stronger that some predefined threshold value (i.e. stronger that 0.5) locally maximal (stronger that the template correlation in the neighboring pixels)
- Finally the characters are recognized using template matching for the input image of the number plate.

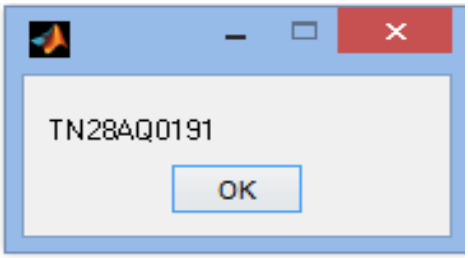
## 3. RESULTS

**Result of pre processing**



**Result of Licence Plate Detection**

**Result of Character segmentation**




**Final Result**

## 4.CONCLUSION

The process of vehicle number plate recognition requires a very high degree of accuracy when we are working on a very busy road or parking which may not be possible manually as a human being tends to get fatigued due to monotonous nature of the job and they cannot keep track of the vehicles when there are multiple vehicles are passing in a very short time .To overcome this problem, many efforts have been made by the researchers across the globe for last many years. A similar effort has been made in this work to develop an accurate and automatic number plate recognition system. The setup has been tested for 50 vehicles containing different number plates out of which 47 number plates are recognized successfully. It may be concluded that the project has been by and far successful.

## REFERENCES

[1] Chirag N. Paunwala, SupravaPatnaik, "A Novel Multiple License Plate Extraction Technique for Complex Background in Indian Traffic Conditions", In Proceedings of International Journal of Image Processing, vol.4, issue2, 2007

[2]Cheok Man, Kengchung "A High Accurate Macau License Plate Recognition System", 2008

[3]Chirag Patel Smt. Chandaben Mohanbhai Dipti Shah, G. H. Patel Atul Patel, "Automatic Number Plate Recognition System (ANPR): A Survey" International Journal of Computer Applications (0975 – 8887) Volume 69– No.9, May 2013

[4]Chong Yu, Yonghong Song , Quan Meng, Yuanlin Zhang, Yang Liu," Text detection and recognition in natural scene with edge analysis", February 2015

[5] Divya Gilly, Kumudha Raimond "A Survey on License Plate Recognition Systems" International Journal of Computer Applications (0975 – 8887) Volume 61– No.6, January 2013

[6] Feng Yang, Zheng Ma "Vehicle License Plate location Based on Histogramming and Mathematical Morphology ", 2005

[7] Gurjinder Pal Singh1, Chhailadeep Kaur "Automatic Vehicle's Number Plate Identification using Image Segmentation and Comparison Techniques" International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064 Volume 1 Issue 3, December 2012

[8] Kuo-Ming Hung, Hsiang-Lin Chuang, Ching-Tang Hsieh, "License Plate Detection Based on Expanded Haar Wavelet transform", IEEE Fourth International Conference on Fuzzy Systems and Knowledge Discovery, pp. 415-419

[9] Mahmoud Ibrahim, Mohamed Shehata, "Automatic License Plate Recognition (ALPR): A State-of-the-Art Review IEEE Transactions on circuits and systems for idea technology, VOL. 23, NO. 2, FEBRUARY 2013 311

[10]Priyanka Prabhakar, P. Anupama," A Novel Design For Vehicle License Plate Detection and Recognition", July 8, 2014