

# Automatic Vehicle Recognition System for Enforcing Security in Restricted Places using MATLAB

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**Abstract-** The increase in population has led to increase in the number of vehicles over years. With this, the availability of parking places is shrinking. And in some places such as industries, government offices etc., only certain vehicles are allowed to enter/park in their place. The entry of vehicles in such places can be controlled by using automatic number plate recognition. Our project works in three phases. In first phase we recognize characters from the vehicle number plate. This is done using MATLAB, which involves image processing. In the second phase the recognized characters are compared with the database of authorized vehicle numbers. If the number is found to be unauthorized, it goes to third phase. In third phase, the vehicle number which is identified as unauthorized is sent as text message to the concerned authority of the institution along with current date and time.

**Keywords-** Vehicle number plate recognition, Gray Processing, Number Plate Extraction, Character Segmentation, optical character recognition, Template Matching.

## I. INTRODUCTION

The increase in population has led to increase in the number of vehicles over years. In highly restricted areas like military zones or area around top government offices, apartments, private organizations and industries, only the vehicles belonging to their organization can enter/park inside the campus. The entry of other vehicles in such places is considered unauthorized. Also with the rising number of motor vehicles, the availability of parking places is shrinking. Monitoring unauthorized entry in such places can be enforced using Automatic Number Plate Recognition Systems. For example, this technology is used in many companies to grant access only to vehicles of authorized personnel.

We are using the ANPR technique this technique is also known as Automatic Number Plate Recognition (ANPR). It consists of a camera that has the capability to capture an image, finds the location of the number plate in the image and then extracts the characters using character recognition tool that translates the pixels into alphanumeric, readable character or string. ANPR recognizes a vehicle's license plate number from an image or images taken by either a color, black and white or infrared camera. In our project, we are using an Android camera which is more useful and simpler to handle. To implement this most important technique that we are using is Optimal Character Recognition (OCR).

After the characters in vehicle number plate are recognized, the string of recognized characters is compared with the database which contains the authorized vehicle numbers. We are using Apache as the web server, mariaDB, an open-source as a relational database management system (RDBMS). If the vehicle number is found to be unauthorized, immediately a text message is sent to the concerned personnel. We are using PHP as the object-oriented scripting language to send SMS.

## II. RELATED WORK

There were many projects which we referred before starting our project. "Automatic number plate recognition system for vehicle identification using optical character recognition" was proposed by Muhammad Tahir Qadri and Muhammad Asif [1]. They observed that their system was computationally inexpensive compared to the other ANPR systems. They presented ANPR system which aimed to be light weighted so that it can be run real time and recognized Sindh (three letters followed by three digits) standard number plate under normal conditions.

This system of our project is like that of the Existing System, "Number Plate Recognition Using an Improved Segmentation" which was proposed by Mr. G. T. Sutar, Prof. Mr. A.V. Shah [2]. This system was based on the image processing system. The system can be implemented on the entrance for security control of a highly-restricted area. The developed system extracted Vehicle number plate region using the image segmentation in an image, recognize characters using Optical Character Recognition (OCR).

The work in [4] proposed a novel adaptive approach for character segmentation and feature vector extraction from considerably degraded images. The algorithm is computationally more complex and cannot be extended for real time number plate recognition. The work proposed in [4] is based on single frame approach using Markov Random Fields which simultaneously utilizes spatial and temporal information. The segmentation results were more suitable for automatic character recognition. The brightness

distribution of various positions in a number plate image may vary with condition of the number plate and the effect of lighting environment. The binarization with one global threshold cannot always produce useful results and in such cases, adaptive local binarization methods are used [8, 9]. In our work, a simple projection profile technique [10] is adopted for character segmentation.

Similarly, considerable research works are reported on character recognition for both printed as well as handwritten text. The majority of the character recognitions are developed using any one of the approaches: 7-segment display, Hidden Markov Models, Neural Networks, Hausdorff distance, Support Vector Machine (SVM). Each reported approach has its own advantages and limitations. Since characters in number plates are machine or hand printed not much complex recognition system is required. In this work, we have made use of a basic template matching recognition technique. The design of automatic number plate reading implemented in this work is discussed in the next section.

Text messages sent via the Short Message Service (SMS) have revolutionized interpersonal communication. Recent years have also seen this service become a critical component of the security infrastructure, assisting with tasks including identity verification and second-factor authentication. At the same time, this messaging infrastructure has become dramatically more open and connected to public networks than ever before [6].

**III. SYSYEM DESIGN AND IMPLEMENTATION**

A system that demonstrates the use of automatic vehicle number plate recognition system for detecting the vehicle number plate, extracting and recognizing the characters, comparing the extracted vehicle number with database to check if the vehicle is authorized or not, and notify the concerned people by sending message.

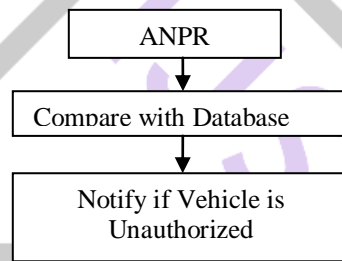


Fig. 1 Proposed System

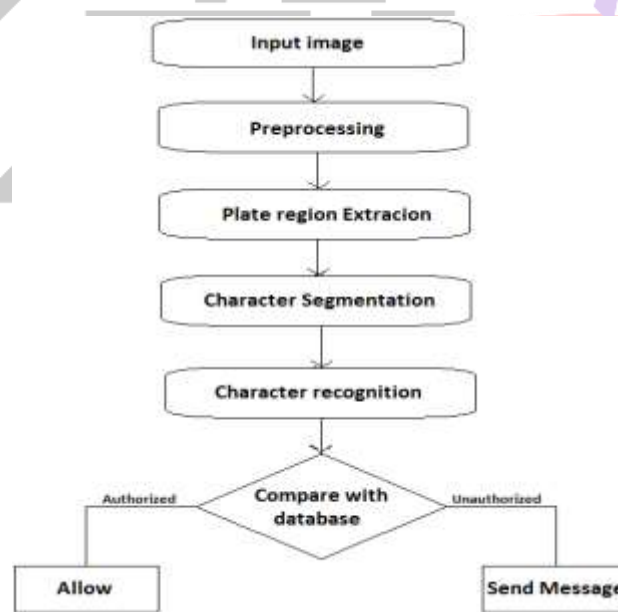


Fig.2 Flowchart of ANPR System

**A. Automatic Number plate Recognition**

ANPR algorithm is implemented in MATLAB which uses series of image processing techniques.

**Input Image:** the vehicle number plate is captured. Since we are using android camera to capture the image, it must be preinstalled with IP Webcam application. The image containing the number plate of vehicle is captured using an android camera (10MP or more resolution of size 4208x3120 approximately) from the distance of less than 1m. The image will be stored in

colored JPEG format. Next, we proceed using the MATLAB functions to convert the vehicle JPEG image into gray-scale image for further processing.

### **B. Preprocessing**

Image is processed to remove noises that affect the recognition rate. It includes the following steps

**Resize the image:** The image resized for some fixed aspect ratio.

**Gray processing:** The RGB image is converted to gray image. The method is based on different color transform. According to the R, G, B value in the image, it calculates the gray value and obtains the gray image at the same time.

**Median Filtering:** When images are acquired there is lot of noises present in image. The noise cannot be eliminated in gray processing. To remove noise from the image median filters are used. Noise removal is necessary step in License plate recognition system because it greatly affects the recognition rate of the system.

**Morphological operations:** Morphological operations are used for edge enhancement of number plate. It applies a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. The number of pixels added or removed from the objects in an image depends upon the size and shape of the structuring element used to process the image. Structural element is a rectangular array of pixels which contains values either 0 or 1 and with a designated central pixel. The most basic morphological operations are dilation and erosion.

**Sobel filter:** is a derivative mask used for edge detection. It detects two kinds of edges. Sobel filter is used for illuminating the very small objects based on the size of each one.

1. Vertical direction
2. Horizontal direction

### **C. Plate region extraction**

The regions of the image are filled to define border. It fills holes in the input binary image. In this syntax, a hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image. Morphological operations are used for thinning the binary image to ensure character isolation. It removes pixels so that an object without holes shrinks to a minimally connected stroke. The objects (connected components) having the pixel value less than 100 are eliminated.

### **D. Segmentation of characters in the extracted number plate**

Character segmentation uses bounding box technique. Regions properties are used to calculate bounding boxes for connected components in the image. Concatenate structure array containing bounding boxes into a single matrix. Bounding box technique is used to detect the centroid of a particular image. In bounding box technique, we find the coordinates of the rectangular border that fully encloses a digital image when it is placed over a page, a canvas, a screen or other similar bi-dimensional background. Only those bounding boxes having specific y-width are obtained. Then these bounding-boxes are concatenated to form a single array. 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. The bounding box is used to measure the properties of the image region. The minimum bounding box of a point set is the same as the minimum bounding box of its convex hull, a fact which may be used to speed up computation. The term "box" comes from its usage in the Cartesian coordinate system, where it is indeed visualized as a rectangle.

### **E. Character recognition**

Character recognition is done by using OCR (Optical Character Recognition) which uses template matching. It is a classical pattern recognition method. OCR by using template matching is a system prototype that is useful to recognize the alphanumeric characters by comparing two binary images. The outcome of the NPR module in terms of foreground segments is to be recognized using template matching. In this method, pixel values of template characters (A-Z, 0-9) are stored in vector such that vector location 1 stores value for character A, location 2 for B and so on. Firstly, the sample is classified and then the recognized characters are normalized by the template size in the character database. It will match with all templates and calculate their similarity. Template matching techniques compare portions of images against one another. Each data segment corresponding to each character is matched with all the 36 data templates in the library. Finally, the best match will be chosen as the result. The characters in the number plate are obtained.

### **F. Compare with Database**

Once the characters are obtained, it should be compared with database which contains all the vehicles numbers which are authorized. The connection is established between MATLAB and MariaDB. All the numbers in the database are imported to

MATLAB. The imported numbers will be of 'cell array' type. They should be converted to string type. Then the string of characters extracted from the number plate is compared with each and every number in the database. If it matches with any of the numbers in the database, it is considered authorized and no action will be taken. If it does not match, the vehicle is considered unauthorized and goes to next step.

**G. Verification of Vehicle**

After comparing the vehicle number with the stored database of authorized numbers. If the vehicle is found to be authorized, no actions will be taken. If the vehicle is found to be unauthorized, a text message is sent to the mobile of the person responsible for security whose mobile number is already stored. The message contains the details such as unauthorized vehicle's number, date and time of entry. XAMPP server is used to send the SMS. The sample of the received SMS is as shown in Fig. 8.

**IV. EXPERIMENT AND ANALYSIS**

The first step is capturing the image. The image containing the number plate of vehicle is captured using an android camera, from the distance of less than 1m. Then the image is pre-processed and the plate region is extracted after which each character in the number plate is segmented and is recognized. In the next step, the recognized string of character is compared with the stored database. If the string matches, it is termed as Authorized and that vehicle is allowed. If not, the vehicles are termed as Unauthorized and warning SMS is sent to the concerned authority which is done in the last step.



Fig 3: Captured image

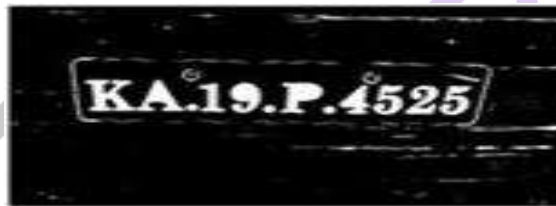


Fig.4 Preprocessed image

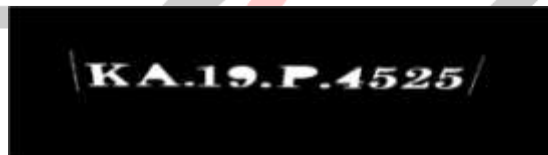


Fig.5 Extracted plate region



Fig.6 Segmented Image

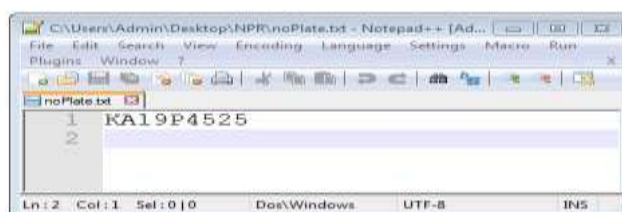


Fig.7 Recognized Characters



Fig.8 Received message

## V. CONCLUSION

We have implemented the automatic vehicle recognition system for enforcing security in restricted places using MATLAB. The system uses series of image processing techniques for recognizing the vehicle numbers. The recognized vehicles are then compared with the already vehicle is authorized or unauthorized. If the vehicle is authorized, then no action is taken. Or if the vehicle is unauthorized, its vehicle number is sent as an SMS to the concerned authority working in that institution. In the entrance of the highly restricted areas, we can easily identify the vehicles which are not allowed.

## VI. FUTURE WORK

We have used Android camera with the resolution greater than 10MP. Since it can only capture the still images, a high definition camera should be used for capturing moving vehicle number plate. The success of this system is limited for very small distance. Its real time implementation requires a camera sensor for capturing moving vehicle when it comes nearer to the camera automatically.

The characters in the vehicle number plate can recognized only with the proper set of lighting conditions. So a method should be adopted for recognizing the characters from a varying set of lighting conditions.

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