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Automatic Number Plate Recognition System for Stolen Vehicle Detection

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ABSTRACT: In today's world, significant transport systems and expanding vehicle demand causes chaos in the road transport and creates major challenges with respect to safety of vehicles and personal lives. Roads are very congested, with huge amount of traffic and the cases of vehicles theft and accidents at the public places is increasing. Because of such issues, Government and local police administration face challenges in managing the increasing cases of road accidents and stolen vehicles. Hence, it is very important to manage such cases with limited manual intervention and as much as possible automation. We will develop and design an automated system for identification of vehicles, which will read their number plates. This system can be implemented at the various public places such as tollgates, parking lots, traffic signals, residential community. If it is operated manually, it will reflect huge errors, difficulties and challenges for us. As a result, it is necessary to develop automatic recognition and detection of the number plate of vehicles by recognition system. With the help of techniques like Image processing and deep learning a effectual and new Automatic number plate recognition system is possible. Using this system automatic recognition of front plate of vehicle is done. The number plate, which is detected by the system act in accordance with some further steps.

1. Capture images of a number plate.
2. Segmentation and recognition of characters is done.
3. Number plate recognized by the system is displayed on graphical user interface and is saved in the database with date and time for future use.
4. If vehicle detected by the system is stolen, a buzzer will ring and SMS will be sent to the police station for further action to be taken.
5. Such Automatic number plate recognition system are very much useful and convenient for accuracy and security purposes. Number on the number plate is displayed on graphical user interface and is saved in a database with date and time for future use. This system will be very much useful and convenient to reduce the traffic issues such as recognition of high speed vehicles on highway, traffic congestion problems, and automatic collection of tolls on toll plaza and for providing high security in parking areas.

KEYWORDS: Image processing and deep learning, Segmentation and recognition

I. INTRODUCTION

Vehicles are increasing enormously in today's era. It is important to travel from one location to another location in certain amount of time. We see there are numbers of vehicles around us. Everyone needs various vehicles for various different purpose. In the proportion of population, vehicles increase enormously since last two decades. However, it causes troubles, problems and difficulties for human life. It leads to problems of huge traffic, large noise, criminal cases for instance stealing of vehicles etc. As a result, management and administration of vehicle is very important to avoid said problems of society.

As a result, several efforts are taken to improve the difficulties and challenges in transportation of vehicles. Among these, Automatic number Plate Recognition System is the most attractive and appealing research issue to latest researcher. It is based on artificial intelligence, providing a robust and ready to integrate system capturing diverse types of license plates. Thus, this manuscript discusses on some practical aspect of recognizing number written on vehicle number plate.

A Vehicle Plate Recognition System is a tracking system that detects the vehicle, so that, the vehicle is tracked down through the existing database. Normally the recognition system will be installed at the gate of the residential area, factory entrances, parking space, tollgates, university entrances or other high security building such as defence institutes, nuclear factories, or places where security is highly important.

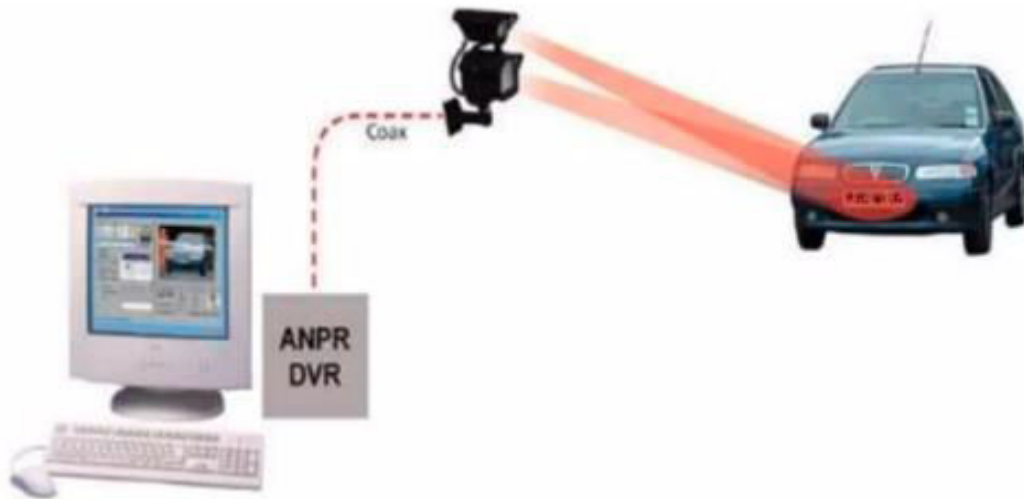


Fig.1 Architecture of Proposed System

Above Fig.1 describes the more details of Vehicle Plate Recognition system thoroughly. Camera reflects the presence of a vehicle. It captures image of vehicle, which will be used for future processing.

Vehicle registration plate is a plate that is normally attached by either metal or plastic and is usually placed at the front or back of a vehicle. Vehicle plate number contains of numbers and alphabetical letters, which can be used to represent an identity of respective vehicle.

The initial two letters of the vehicle serves as the state location prefix, followed by two numerical digits that represents district from where vehicle belongs. Number plate format of Indian vehicle is LLNN LLNNNN where “L” is letter and “N” is the number.

If vehicles are recognized manually then it will cause more mistakes with less efficiency and slow operation. If the described system will be implemented artificially by using machines, it will be more efficient and less costly. Each License plate has a unique number assigned to it for vehicle identification. The main challenge while working with ALPR is Accuracy and Detection speed viz. ALPR produces correct output within certain amount of time, which is the prime necessity of ALPR system.

This can be obtained with quality of Algorithms used in a License Plate Detection. The distance between the camera and the vehicle should be approximately constant. For Automatic number plate detection purpose the concept of edge detection, contour determination and bounding box formation and elimination is used. Selection of license plate areas (LPA) and their elimination to obtain the actual license plate was based on various searches and algorithms. This stage is important since improper detection of LPA can lead to misrecognized characters.

Manipulating traffic signals to help recover the wanted automobiles can be done with few future enhancements. The proposed system of automatic number plate detection can be implemented using the method, which involves image-processing steps.

II. RELATED WORK

Phases of AVNPR

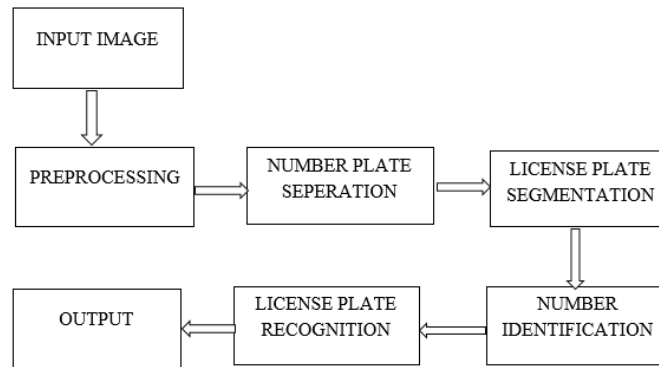


Fig. 2. Phases of ANPR

ANPR system work according to the given phases

1. Capture images of license through a camera.
2. License Plate Separation
3. License Plate Segmentation
4. Number Identification
5. License Plate Recognition
6. Character Extraction from Plate
7. Showing Document of the extracted

As shown in (Fig 2), Image need to be captured first and the image should not be blurred so that system should be able to do necessary processing on image for number identification. Then the license plate needs to be extracted from the whole image. Segmentation is performed on extracted image. Through Segmentation the extracted image is divided into many segments for further processing. Noise needs to be removed from the image for proper number identification. The final phase of Automatic Number Plate Recognition (ANPR) is Number identification.

Working of AVNPR

- i. **Input a raw image:**
It captures the image from a digital Camera for extracting crystal-clear images. The resolution of camera needs to be good so that the captured image can be further utilizes for processing; Captured image is given to the ANPR as input.
- ii. **Converting image into Grey Scale:** Grey scale conversion is nothing but converting an image into black and white view with grey shades. Coloured images don't help us to identify the important edges and other features of the image. So, the image needs to be converted in Grey scale format.
- iii. **Binarization:** Thresholding method is applied to convert the grey scale image to monochrome image .This method is used to reduce the complexity of captured image (input).
- iv. **Morphological operation:** It performs operation on grey scale image .This operation starts with the dilation of an image. Then, erosion needs to be performed after that by applying median filtering noise can be used.
- v. **License Plate Recognition:** The important step is to detect the size of the license plate. In general the shape of the License Plate is rectangular. The edges of rectangular area need to be found first. Depending upon the Threshold value of an input image, edges can be detected. Hence, the whole license plate can be recognized.
- vi. **Character Extraction from License Plate:** OCR (optical character recognition) Algorithm is used for Character Extraction.
- vii. **Showing document of the extracted:** Search and display the details of extracted number of License plate on micro computer unit

4.Implementation

The implementation can be carried out in four stages as follows:

- A. Blob Detection
- B. Localization and Extraction of Number Plate



- C. Segmentation
- D. Character Recognition using Genetic Algorithm A.

A. Blob Detection/ Image Processing

In this, a blob is anything that is considered as a large object, detecting regions in a digital image that vary in attributes such as brightness or colour, are compared to areas covering those regions. A blob is a part of a digital image in which some attributes are fixed or change within a predefined range of values; all the points in a blob can be used in some sense to be alike each other.

B. Localization and Extraction of Number Plate

The extraction of plate region is the first step of the algorithm. Image captured from the camera is first converted to the binary image which exists of only 1s and 0s (only black and white) by using the method of thresh holding. In this method, the pixel values of 0 (black) are given for all pixels in the input image with light factor less than threshold value. In addition, the pixel value of 1 (white) is given for all other pixels. The processing of the binarized image is carried out with the help of some methods. To obtain the plate area, smearing algorithm is used initially. The method for the extraction of text regions on a mixed image is called as smearing. The image is refined along vertical and horizontal runs (scanlines) using the smearing algorithm. If the number of white pixels is less than the predefined threshold or greater than any other predefined threshold, white pixels are made black. Threshold values are selected as 10 and 100 for both horizontal and vertical smearing in this system. This is done using Morphological operations
If number of white pixels $i=10$; pixels become black Else; no change
If number of white pixels $i=100$; pixels become black Else; no change [2] Once smearing is completed, dilation which is a morphological operation, is employed on the image for distinguishing the plate region. However, there can be more than one candidate region for plate location [2]. Some criteria tests are applied to the image by smearing and filtering operation to find the exact location and reject the other locations.

C. Segmentation

Number plate is segmented into its components obtaining the characters one by one in the segmentation procedure. In the first step, image is filtered for improving the attributes of the image and eliminating the noises and unwanted spots. Then dilation operation is applied to the image for distinguishing the characters from each other which is required if the characters are close to each other. Horizontal and vertical smearing are applied for finding the character regions after segmentation and dilation operations are carried out. The next step is to separate the plate characters. It is carried out by detecting the starting and end points of characters in horizontal direction. The individual characters separated from the plate are as follows in Fig3.



Fig. 3. Segmented Character

D. Character Recognition using OCR Algorithm

Character recognition is an art of detecting, segmenting and identifying characters from image. More precisely, character recognition is a process of detecting and recognizing characters from input image and converts it into American Standard Code for Information Interchange (ASCII) or other equivalent machine editable form [1], [2], [3]. Character recognition is one of the most interesting and fascinating areas of pattern recognition and artificial intelligence .Character recognition is getting more and more attention since last decade due to its wide range of applications

OCR (Optical character Recognition) algorithm is employed for recognition of character at the second level. OCR stands for Optical Character Recognition and refers to a software technology that electronically identifies text (written or printed) inside an image file or physical document, such as a scanned document, and converts it into a machine-readable text form to be used for data processing. It is also known as text recognition. In short, optical character recognition software helps convert images or physical documents into a searchable form.



Fig. 4 Templates

Templates will exist for all the characters i.e. A-Z and 0-9 as shown above in figure number 4.

Automatic number plate recognition (ANPR) is used as a mass surveillance technique making use of optical character recognition on images to identify vehicle registration plates. ANPR has also been made to store the images captured by the cameras including the numbers captured from license plate. ANPR technology own to plate variation from place to place as it is a region specific technology. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and cataloguing the movements of traffic or individuals.

The major steps in the OCR process are - first the image is converted into a black and white image i.e. binary image. The next step would be to crop and separate the lines from the image rows. The same process is repeated on the columns of each row to separate each character. The templates files are then loaded. The templates file is a file in which the images of all the letters and numbers have been stored and against which all the characters will be compared to identify the character.

5. Proposed System

The system includes a hardware module and a software module. Hardware module includes image acquisition system Arduino Nano board, power supply, sensor, buzzer and servo sg 90, GSM. Image acquisition is done using a digital camera. Software module includes image processing. Image processing involves Number detection and Number recognition. Block diagram of entire system is shown in figure no 5 below.

When, a car appears in the toll plaza, the gate will stop the car and the camera will capture the image of that car. The camera sends the image of appeared car to microcomputer unit. It extracts number plate and segmented characters. It also recognizes the getting information with help of Python software. It is software that used for image processing. After that, Python program recognizes the number plate and it will be compared with the database of missing car that is provided by police station for the stolen cars. The number plate of captured car is compared with information of stolen car that is provided by police station. When, a car moves toward the gate. The car becomes obstacle for IR sensor. If appeared car is found stolen according to database, the gate will not open for stolen car. At the same time, the alarm rings and sends a message to police station as well as it also displays on LCD of toll plaza. All above said functions are done by ATMEGA328P. In the contrast, if the captured image of car will not match and exist in the database, the door will open and buzzer does not make sound or ringing. In this way, vehicle after vehicle successfully detection is going 24 hours on toll plaza.

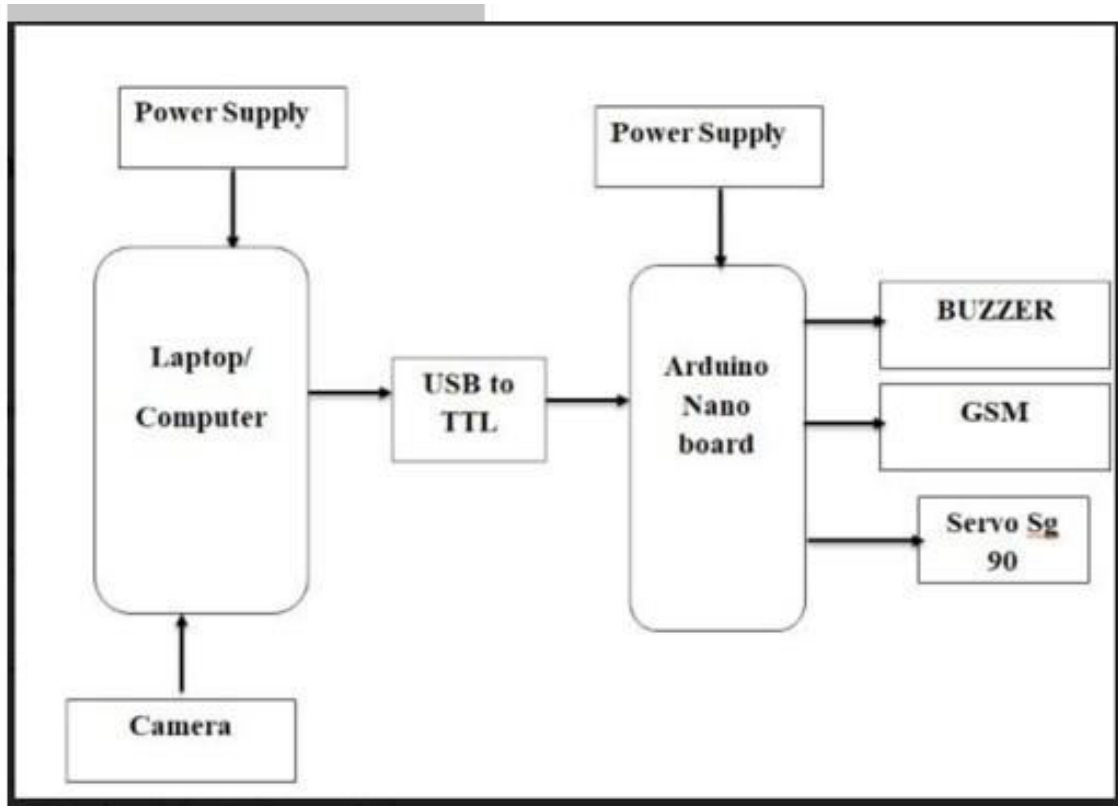


Fig. 5 Block Diagram

Software Requirements:

- 1) Arduino IDE (Arduino Programming C)
- 2) Express PCB (Circuit & Layout Design)
- 3) Python IDE (Software Programming)

Hardware Requirements:

- 1) Laptop / PC
- 2) Arduino Nano
- 3) Servo Motor
- 4) LCD Display
- 5) Power Supply

E. EXPERIMENTAL RESULTS

We have taken number of photos of cars by a digital camera .We have done a survey to know what would be the exact position of number plate in total image.

If detected number plate is stolen vehicle, then the door will not be opened and SMS will be sent to nearby Police Station.

If detected number plate is not a stolen vehicle, then door will open and after some time door will close. In some cases, characters are not properly recognized due to some issues like improper size of segmented character and templates.

III. CONCLUSION

The proposed system of the Automatic Number Plate recognition system for stolen vehicle detection can be implemented using above discussed method which involves fundamental Image processing steps using Python. We can detect and recognize license number of captured front view image of any vehicle by camera. It contains main three processes:

1. Plate extraction
2. Character detection
3. Character recognition



Further, we can detect a stolen vehicle by comparing it with database of a stolen vehicle provided by the police station. Afterwards, it rings an alarm and sends a SMS to police station. It increases the security of the vehicles. It can be used in many security purposes like speed detection, detection of traffic violation, toll collection, parking system. It can also be beneficial to secure areas like the gate of residential area, factory gates, parking space, toll plazas, university entrance or other high-secured building such as defence institutes and nuclear factories. Further, we can detect a stolen vehicle. Such kind of system is necessary in every country, as problems of traffic and stealing cars are increasing day by day. In addition, this system is economical if applied effectively. This change will surely help.

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