RES MILITARIS
Social Science Journal

AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM FOR VEHICLE IDENTIFICATION USING OPTICAL CHARACTER RECOGNITION

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ABSTRACT
In recent years the number of vehicles has increased drastically. With this increase, it is becoming difficult to keep track of each vehicle for purpose of law enforcement and traffic management. License Plate Recognition is used increasingly nowadays for automatic toll collection, maintaining traffic activities and law enforcement. Many techniques have been proposed for plate detection, each having its own advantages and disadvantages. The basic step in License Plate Detection is localization of number plate. Automatic License Plate Recognition system is a real time embedded system which automatically recognizes the license plate of vehicles. There are many applications ranging from complex security systems to common areas and from parking admission to urban traffic control. Automatic license plate recognition (ALPR) has complex characteristics due to diverse effects such as of light and speed. Most of the ALPR systems are built using proprietary tools like Matlab. This system presents an alternative method of implementing ALPR systems using Free Software including Python and the Open Computer Vision L.
Keywords: Optical, Recognition, ANN, Computer Vision

1.INTRODUCTION

The Automatic Number Plate Recognition (ANPR) was invented in 1976 at the Police Scientific Development Branch in the UK. However, it gained much interest during the last decade along with the improvement of digital camera and the increase in computational capacity. It is simply the ability to automatically extract and recognition a vehicle number plate's characters from an image [1]. In essence it consists of a camera or frame grabber that has the capability to grab an image, find the location of the number in the image and then extract the characters for character recognition tool to translate the pixels into numerically readable character [2].

ANPR can be used in many areas from speed enforcement and tool collection to management of parking lots, etc. It can also be used to detect and prevent a wide range of criminal activities and for security control of a highly restricted areas like military zones or area around top government offices [3]. The system is computationally inexpensive compare to the other ANPR systems. Besides the robustness, the earlier methods use either feature based approached using edge detection or Hough transform which are computationally expensive or use artificial neural network which requires large training data [4].

Figure 1: An Automatic License Plate Recognition.

Automatic Number Plate Recognition (ANPR) is a sophisticated image processing technology designed to identify vehicles through their unique license plates. This technology plays a crucial role in maintaining law enforcement and traffic regulations, with wide-ranging applications in toll collection, parking management, high-security areas, and traffic monitoring [5].

As the number of vehicles continues to rise, ANPR systems offer a practical solution to traffic congestion and related challenges. The process involves three key stages: number plate extraction, character segmentation, and Optical Character Recognition (OCR).

Initially, the system identifies and isolates the number plate from an image, followed by segmenting individual characters for recognition [6]. Using OCR algorithms, the characters are converted into digital text, facilitating efficient vehicle identification. This innovative approach serves as an impetus to develop cost effective smart cameras equipped with dedicated hardware for accurate and real- time vehicle recognition [7].

Number plate extraction is that phase where vehicle number plate is recognized. The recognized number plate is pre-prepared to evacuate the clamor and after that the outcome is passed to the division part to portion the exclusively characters from the removed number plate. The divided characters are standardized and gone to an OCR calculation.

At last the optical character data will be changed over into encoded content. The characters are perceived utilizing Template coordinating. In this framework, another thought is appeared for Automatic number plate acknowledgment framework for vehicle recognizable proof and control reason.

2.LITERATURE REVIEW

The projected system is to observe every character from range plate one by one. This could be done by morphological operation. It includes a way to section all the characters employed in the quantity plate. Range plate extraction is that stage wherever vehicle range plate is detected. The detected range plate is pre-processed to get rid of the noise then the results passed to the section half to segment the one by one character from the extracted range plate [8].

The divided characters normalized associate degreed passed to an OCR formula. Ultimately the optical character info is going to be regenerate into encoded text [9]. The characters recognized exploitation template matching. The ultimate a. output should be within the type of string of characters.

Automatic Number Plate Recognition is a process where vehicles are identified or recognized using their number plate or license plate. ANPR uses image processing techniques so as to extract the vehicle number plate from digital images.ANPR systems normally comprises of two components: A camera that used in capturing of vehicle

number plate images, and software that extracts the number plates from the captured images by using a character recognition tool that allows for pixels to be translated into numerical readable characters [10]. A license plate recognition system generally works in four main parts namely image acquisition, license plate detection, characters

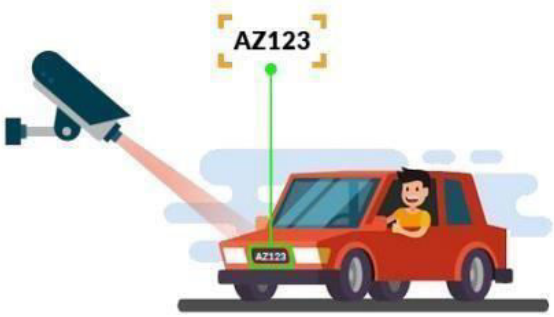


Figure 2: segmentation,and lastly character recognition.

3.SYSTEM MODEL

- Software Model:

The main and the most important portion of this system is the software model. The software model use series of image processing techniques which are implemented in MATLAB 7.0.1. The ANPR algorithm is broadly divided into three parts:

• Capture image
• Extract the plate from the image
• Recognize the numbers from the extracted plate

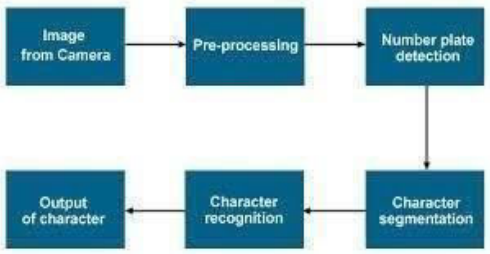
The first step is the capturing of an image using the USB camera connected to the PC. The images are captured in RGB format so it can be further process for the number plate extraction.

The second step of the ANPR algorithm is the extraction of the number plate in an image. A yellow search algorithm is used to extract the likelihood ROI in an image. As the official number plate of Sindh has yellow background with alphanumeric character written in black, it is easy to detect the plate area by searching for yellow pixels. The image is search for the yellow color pixels or some which are closer to yellow in value. If pixel value is of yellow color the pixel is set to 1, otherwise the pixel value is set to 0. The image obtained after the search algorithm is in black and white format. After identify the ROI, image is then filtered using two different filtering techniques. The first technique involves removing of all white patches that are connected to any border and set their pixel value to 0. The second filtering technique use pixel count method to remove the small regions in an image other than the plate region. The number of consecutive white pixels is inspected and regions that contain number of white pixels less than the predefined threshold are set to 0. At this stage the image contains only the vehicle number plate. Smearing algorithm [x] is used next to extract the number plate in an image. The smearing algorithm is search for the first and last white pixels starting from top left corner of an image. The image is then cropped that only contain the vehicle number plate.

The third step of the developed ANRP algorithm uses Optical Character Recognition (OCR) algorithm to recognize the vehicle number. The resultant cropped image obtained after the second step is inverted i.e. all white pixels are converted to black and black pixels to white. Now the text is in white and the plate background is black. Before applying the OCR the individual lines in the text are separated using line separation process. The line separation adds the each pixels value in a row. If the resultant sum of row is zero that means no text pixel is present in a row and if the resultant sum of row is greater than zero that means the text is present in row. The first resultant sum greater than zero represents the start of the line and after this the first resultant sum equal to zero represents the end of the line. The start and end values of the line is used to crop

the first line in the text. The same process continues to separate the second line in the text.

Once the lines in an extracted vehicle number plate are separated, the line separation process is now applied column wise so that individual character can be separated. The separated individual characters are then stored in separate variables. The OCR is now used to compare the each individual character against the complete alphanumeric database. The OCR actually uses correlation method to match individual character and finally the number is identified and stored in string format in a variable. The string is



then compared with the stored database for the vehicle authorization. The resultant signals are given according to the result of comparison. The complete detail of the software model is shown in figure 3.

Figure 3: Steps of automatic number plate recognition software model

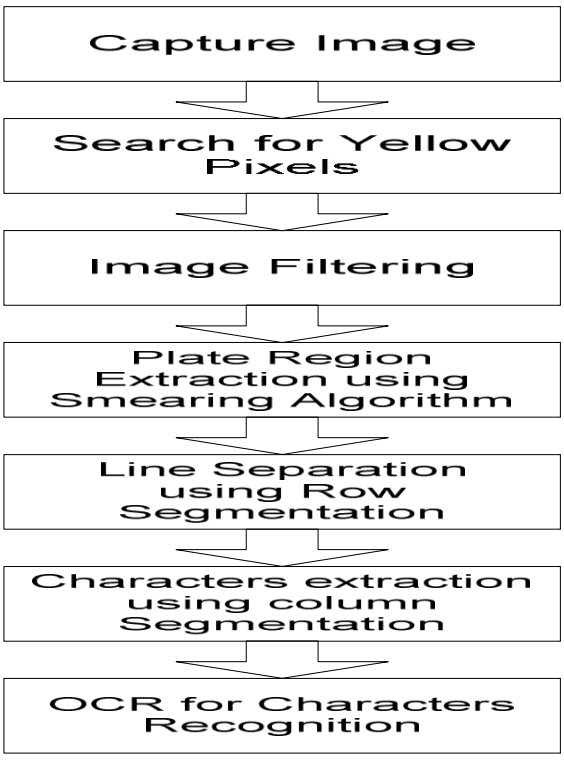


Figure 4: Flow chart of the Proposed Model

This research adopted an Object-oriented System Development methodology. An Object-oriented softwaredesign is a design strategy where system designers think in terms of 'things' instead of operations or functions. Object -oriented development methodology ensures that the system being developed is refined and transformed through analysis, design, code and test phases. Details and modifications are added in successive iterations (changes and improvements are introduced as needed) and incremental releases of software modules are delivered.

4.WORKING:

Requirements analysis: - This phase is critical to the success of the project. Expectations need to be fleshed out in great detail and documented. This is an iterative process with much communication taking place between stakeholders, end users and the project team. The key stakeholders and users included the University's Head of Security as well as theSecurity Personnel manning the entry points of the University, the Researcher interacted with them so as to fully understand their daytoday processes as well as to collect/gather the desired system features.

Design: - During this phase, the technical design requirements are prepared. The User requirements are used to define how the application will be written; the technical requirements are specified to detail for instance; database to be used, features and functionalities, security processes andhardware and system requirements.

Code: - At this stage, the design is translated into a machine-readable form. Programming tools like compilers, interpreters, debuggers areused to generate the code. Different high level programming languages like, C, C++, Java, PHP, HTML are used for coding.

Test: - This stage occurs after the application has been developed; different types of testing will be performed including performance and integration testing. User acceptance testing is the last part of testing and is performed by the end users to ensure the system meets their expectations. At this point, defects may be found and more work may be required in the analysis, design or coding.

Maintenance: - This phase confirms the software passed the user acceptance stage and now is operational. If required, the users are trained on, or aided with the documentation on how to operate the software and how to keep the software operational. The software is maintained timely by updating the code according to the changes taking place in user end environment or technology. This phase may face challenges from hidden bugs and real- world unidentified problems.

5.RESULTS:

This section presents the simulation results of the developed ANPR system.

Firstly, the camera is interfaced using Matlab with the PC. The camera is attached using USB port. Different images of cars having different colors and structure types are taken and stored in PC. The different effects of the day lightsare also considered during the processing. The images are in RGB format and the resolution is 800 x 600 pixels.

Figure 5: Capture Mode for Recognition

After capturing the image the next step was the yellow search algorithm. The images after the executing the yellow search algorithm. The white region represents the yellow or color closer to the yellow. It can be observed that the yellow search algorithm successfully detectthe ROI that only contain vehicle number plate. The smearing algorithm used next to extract the vehicle number plate. Once the vehiclenumber plate is extracted, it is converted into the binary format.

Figure 6: Recognition Phase

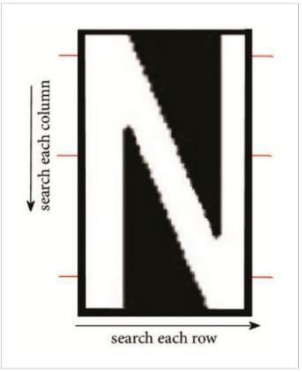


Figure 7: Search Mode for Each Character

The row and column segmentations methods are used next to extract the individual character in the vehicle number plate. The results of the row and column segmentation are shown in figures respectively. Finally OCR is used for character recognition and each and every alphanumeric character.

6.CONCLUSION:

In this paper, the automatic vehicle identification systemusing vehicle license plate is presented. The system useseries of image processing techniques for identifying the vehicle from the database stored in the PC. The system is implemented in Matlab and it performance is tested on real images. The simulation results shows that the system

robustly detect and recognize the vehicle using license plate against different lightening conditions and can be implemented on the entrance of a highly restricted areas.

The implementation works quite well however, there is still room for improvement. The camera used in this project is sensitive to vibration and fast changing targets due to the long shutter time. The system robustness and speed can be increase if high resolution camera is used. The OCR methods used in this project for the recognition is sensitive to misalignment and to different sizes, the affine transformation can be used to improve the OCR recognition from different size and angles. The statistical analysis can also be used to define the probability of detection and recognition of the vehicle number plate.

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