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Automated License Plate Recognition System using Computer Vision

K. Akila, B. Sabitha, R. Jayamurugan, M. Teveshvar, N. Vignesh

Abstract*: This paper discusses about License plate recognition using digital processing of images, where the image of a vehicle is taken and the number plate is then recognized by various layers of digital image processing. The number plate is then allowed to undergo optical character recognition (OCR), this extracts the data and then compares it with a database containing the details of the vehicle. This allows the user to identify the type of vehicle and the identity of the person who is driving the vehicle. It will denote the user about the registration of the vehicle by comparing it with the database of the registered vehicle in the area. The device will consist of a camera which will take the real time footage of the vehicles and a snap from the video of the vehicle is used to recognize the number plate. The processor will process the images and will display the number of the vehicle and the owner of the vehicle in the display, this is achieved by comparing the number of the vehicle with the previously fed data from the database. This device will provide an efficient way for automating a parking system where there will be no need for a human to interfere with the checking of the vehicle and providing passes for the vehicle.

***Index Terms*: Optical character recognition, Image Processing, Median filtering.**

I. INTRODUCTION

Monitoring the automobiles has become a difficult task as there is an increase in number of automobiles day by day. So this process requires man power to monitor. Most of the repetitive task are replaced with automation, as like other process the vehicle monitoring can also be automated using digital image processing methods. They can be monitored using various methods. The ANPR systems which are commonly known as MANPR are used by State Police Forces, and the Department of Justice. A fixed ANPR system was first used by the Highway Patrol force in the province of the South Wales. They began with a mobile ANPR system with three infrared cameras fitted to the Highway Patrol force. The system identifies registered, unregistered and stolen vehicles and also the qualified, disqualified or suspended drivers. This made them check one million cars per week automatically. Using this system, data gathering and permanent gantry installations were brought online with ANPR to monitor the speed of vehicles using detection, imaging and statistical capabilities. As all the data points are made portable by connecting to a central system which is linked to a server , every member will be able to utilize its range, such speed, insurance verification, lane driven, vehicle registration through remote and traffic light enforcement. The ANPR in the UK helps to detect, deter and disrupt the criminal activities. Nearly 8000 cameras capture the images of about 25 and 30 million using ANPR. All these records are stored to the required time in a database, they can be accessed, analyzed and used even as an evidence in future. The main objective of the proposed work is to provide a hassle-free process for a vehicle to enter and exit a parking. This provides a way for the automation to break the traditional parking methods using humans. The automation system will work continuously without any breaks or errors. They have more accuracy and repeatability. The general segmentation rate is influenced by the distinctive lighting conditions that occur in the environment. There are a plethora of methodologies on the bases of video processing and image processing to detect and recognize the characters in a number plate. Issues such as darkness, night time photography, and rate of recognition are also addressed. A system with swiftness and precision normally incorporates a perfect technique for the localization of the license plate. The velocity and exactness of the frameworks should be made strides in the ongoing applications. However few parameters makes this a challenging such as,

- Quality of the images
- Lightening conditions for example, day time/night time lighting,
- Point of view
- Damaged character
- Blurring caused due to the movement of the vehicle.

II. LITERATURE REVIEW

Rajagopalan et al. says that intelligent transportation systems (ITS) combines electronics, information, communication, and network technologies. Whereas developing countries use these to address their increasing traffic problems [1]. Presently one of the challenges that appears in the ITS is automatic number plate recognition (ANPR). ANPR is used in different areas such as parking lots, toll gates, road monitoring, security systems and in for traffic law enforcement. This was stated by Kranthi et al. ANPR performs like a surveillance system capturing the images of vehicles to recognizes their license number from the license plate [2]. ANPR can be done through two stages.

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* Correspondence Author
K. Akila*, Department of Mechatronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
B. Sabitha, Department of Mechatronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
R. Jayamurugan, Department of Mechatronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
M. Teveshvar, Department of Mechatronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
N. Vignesh, Department of Mechatronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India.

They are 1. Plate localization stage and 2. Character recognition stage. The first stage localizes the number plate from the input data of image or video, this process is known as Number Plate Localization (NPL) where the extraction of the plate takes place. This does not require any external devices such as transmitter, tags, cards, ID's etc. Yu and Kim et al, explains about the Character features such as the aspect ratio of the characters and the sign of the gradient magnitudes to be used [3]. Poon [5] and Soh et al, [4] says about the distribution of intervals between characters in the license plate and also about the alignment of characters. The ANPR system should be efficient, reliable and must have robust object features for real time usage. The characters and symbols are segmented in the second stage from the localized system by segmentation process.

Image processing and segmentation is an essential and critical component for image analysis of pattern recognition system. It is an arduous process a digital image using image processing methods. As the success and failure is determined by the precision and the accuracy of the system. While acquiescing the number plate, the image may suffer from various effects such as luminance, rain, fog, presence of darkness in the environment. If the background illumination is uneven the global thresholding may not function properly. Adaptive binarisation methods are used in these scenario for the process of segmentation. This has been explained in detail by Bir Mohan Singh [6].

III. PROPOSED LICENSE PLATE RECOGNITION SYSTEM

The proposed system involves the usage of sensors and actuators which is controlled by a microcontroller. The processing is done by a mathematical software which performs the image processing and receives the video from the sensor. The signal to the microcontroller is sent by the software. The microcontroller controls the actuator.

A. Process Flow

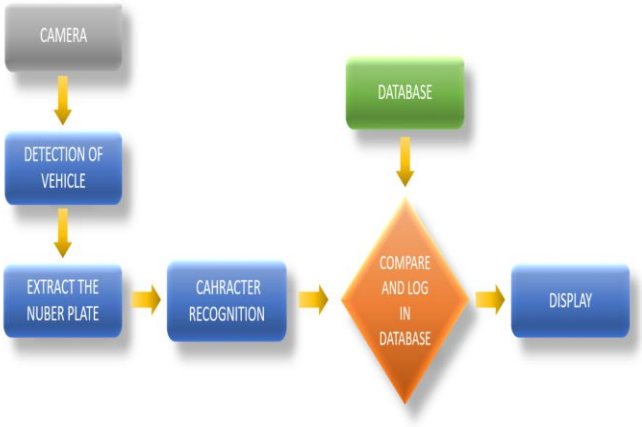


Figure 1 Block diagram of the Proposed System

The Camera which is fitted in the vehicle crossing area monitors the vehicle intrusion into the area and records the action as video and it is known as the detection of vehicle. The video is separated into various frames and then the license plate of the vehicle is segmented, this step is known to Extraction of the number plate. The extracted number plate images are subjected to a process named (OCR) Optical Character Recognition and then the Characters from the license plate are separated through a various pre-processing techniques and they are sent to the compare. It compares the obtained data to the data stored in the database. And, finally the compared data display in the monitor. It not only displays the extracted characters but also the information collected from the database. The process flow of the system is shown in figure 1.

B. Detection of Vehicles

The vehicle entering the parking lot is detected using a camera. Image processing methods are implemented where a Gaussian Filter is used to subtract the original image from the live video to detect the vehicle entering the parking lot.

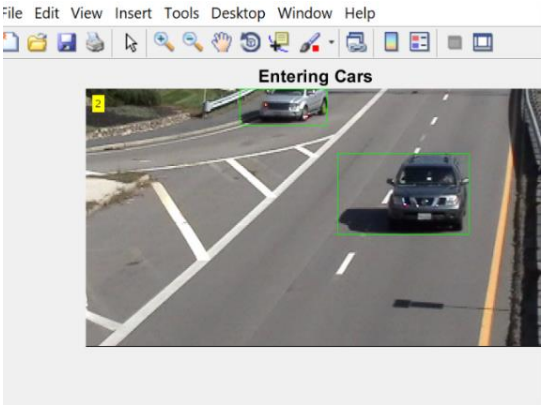
The image is extracted from video and taken as frames or captured by digital camera are sequenced need to be pre-processed. The recording will produce noise due to the variation in the luminance, color and other parameters. This causes a downgrade in the image quality acquired from the recording, which could be overcome by making it apparent and distinguishable. This is done in the stage of preprocessing where the unwanted information (noise) are pared and the required data is manifested, such as the contrast, sharpness and smoothness. A GUI based system is used to incorporate the enhancing process of the number plate. Whereas the integration of low-pass Gaussian filter is used to reduce the noise. There are two types of processing techniques. They are,

- Gray Processing: This step converts the image in to gray levels where, the color images are converted in to gray image. The of gray value of an image is calculated and the gray image at the same time using the values of R, G, B colours in the image.
- Median Filtering: Media filtering is a step, in which the noises of the image are removed. Gray Processing cannot remove the noises.

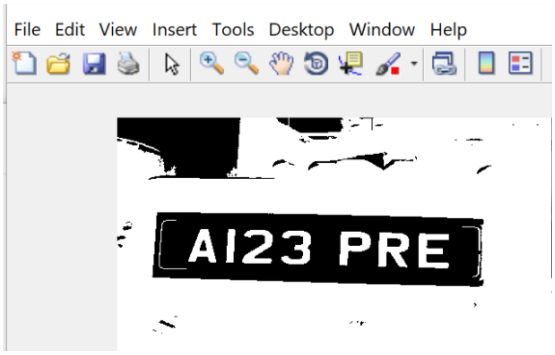
The detected license plate is made to undergo the process of segmentation which has an impact on the swiftness and the precision of the algorithm. As it proceeds further, only after the verifying the efficacy of the segmented character. To use the threshold effectively, the image of the license plate is made larger by the method known as "Super Resolution". After the completion of adaptive thresholding the obtained result is used for further processing. The void region which does not contain the character is liquidated using morphological operations. It is then followed by Connected Component Analysis (CCA) which is used to analyze the number plate to find a particular component. The three regions namely character, numbers and some non-character region are the foundation of license plate recognition. The Aspect Ratio (AR) Pixel Count (PC) and the height are used to control the identification of the non-character region. They are set based on the different types of observation results obtained from different images and they are made into soft threshold so that the segmentation will be robust.

C. Character Recognition

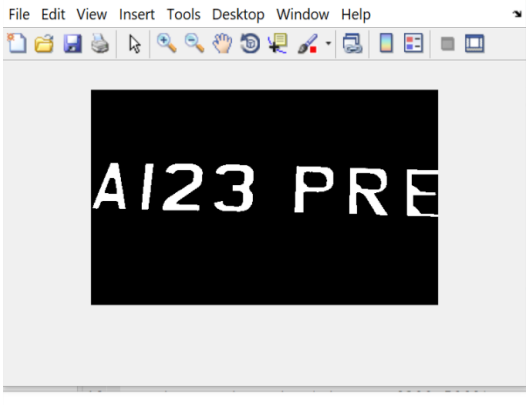
The extracted character from license plate image is segmented correctly. The obtained characters are given to the licensed software MATLAB® as algorithm. Different luminous conditions are considered while simulating. For some of the blurred images, segmentation is an arduous task, better thresholding is needed for highly blurred images. CCA provides the average value of the AR and the least value for PC area. Mostly, the character region from License Plate satisfies all the criteria. The result of the soft threshold will be much more precise. The result are also taken from the variant conditions like darkness, night time, glaring, dustiness, greens, occlusion, blurriness and damaged plate.



(a)



(b)



(c)

Figure 2. (a) Detected Vehicle (b) Segmented Number plate (c) Binary image with discarded background

IV. RESULTS AND DISCUSSION

The camera is placed above the check post to monitor the vehicle and also to allow the easy capture of the image of the vehicle. It monitors the entry of the vehicle continuously the data from the plate is extracted and it is logged in the database. It can be used to compare with the previous database and detect if the vehicle is registered or unregistered. The information of the vehicle owners can be derived from the extracted number plate and can be used to identify the owner for further processing. The results obtained for the sample vehicle is shown in figure2 and 3.

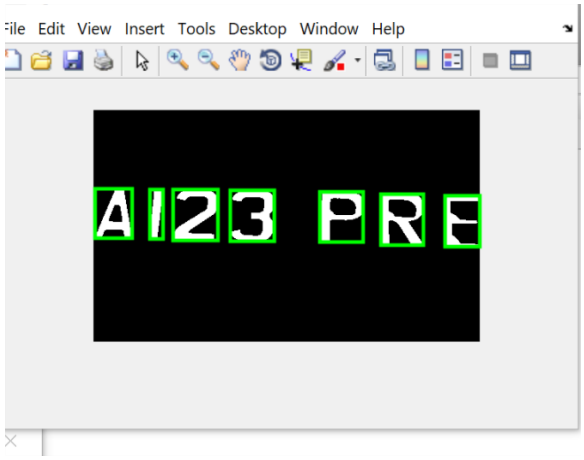


Figure 3 Character Segmentation

V. VALIDATION OF THE SYSTEM

A database containing a plethora of various car images under different luminous conditions is used to check the robustness and reliability of the system. The results of the particular License Plate are detected, segmented and they are also stored in the database. This feature extracts the object by measuring the values which are unique to other objects under the same category, but the values vary for objects in the other category. The main key of recognizing the character for the algorithm has become successful in classification through choosing discriminating and independent features. The ANPR system recognizes the character in the number plate using the optical character recognition (OCR) method using the recursive subdivisions of character image in English language. The binary image is divided repeatedly and the fixed length vector coordinates is used to represent the features in the binary image. The coordinates serves its purpose in computation of various procedures. The image is divided into two sub-images based on the center of mass acquired form the x-coordinate as the image possess a fixed size, thus allowing an easier separation. The output vector is of 2d size making it dependent on the parameter d. The subdivisions along the axis with respect to other is twice, hence the features in the transported image is also calculated to balance the output vector. The resultant vector is obtained by combining the original and the transported vector images. The features of 26 uppercase and lowercase English alphabets of different writing styles used to create the number plate with the 10 numeral styles included are extracted in a recursive depth of 6.

The data obtained is stored in the database and then compared. The system implements the data and simulates on MATLAB. All these testing process is carried out on real images. The performance is testis carried out based on the data that are previously stored in the database. The ANPR algorithm on the system receives the image and continues the process, where the output is obtained as the vehicle number. And then the obtained vehicle number is compared to standard data. Thus it gives final signal to microcontroller, the control the system. The input is recognized and then the data is compared to get the result. The authorized number and unauthorized number are separated and indicated tithe user. The comparing of data helps the user to identify the vehicles previous history.

VI. CONCLUSION

The proposed automatic number plate detection system methodology is efficient and can be used in real time environment. This algorithm performs by capturing the input image file captured throughout the various timings and with variety of lighting conditions. The Optical Character Recognition (OCR) is used to extract the number from the number plate. The system has been tested for various data's with various styles of number plates like dark, inverted color, bold or stylish pattern. To extract the features of character image, recursive sub-divisions has been used. License plate detection, extraction and segmentation was achieved successfully. The test results of License Plate detection and segmentation shows a higher rate which is good and satisfactory. This system allows the user to use various formats number plate which is the unique feature of our system.

VII. SCOPE FOR FURTHER STUDIES

The extracted data that has been stored in database can be stored in cloud, which enables the user to check the information of the vehicle from any part of the world. This helps to collect information about the past usage of the vehicle. This system does not classify between the user and guest, in future scope system a separate scanner can be added to identify the visitor. This type of system helps to identify unknown vehicles. In many parts of the world, people use their own language for license plate. When the system is stored and trained continuously with the language, the system will be able to collect the information of any language license plate.

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