An Efficient Method for Vehicle theft and Parking rule Violators Detection using Automatic Number Plate Recognition

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***Abstract*— A modern-day security technology is the Automatic Number Plate Recognition (ANPR) system. The fundamental component of an ANPR system is image processing. This uses an optical character recognition (OCR) approach to read and extract characters from a vehicle registration plate image. Automatic Number Plate Recognition (ANPR) has been popular in a variety of settings. It can be used by highway tollgate authorities to allow vehicles to enter toll roads by automatically recognising their license plates, providing them with a toll-slip, and then opening the road. Parking authorities in areas like malls and hotels use this technique to assign distinct parking spaces to individual cars and allow them to park in their designated area. We snap images of the license plate with this ANPR device, then process and extract every character of the license plate for exact detection. The crucial phase of ANPR is OCR, which extracts and converts the characters on the acquired image of the vehicle registration plate into text that can be decoded further. In this study, we propose a method for parking rule offenders that involves storing the extracted number plates in a database and cross-verifying them against existing registered number plates that have paid the parking fee. Our proposed method can also detect stolen autos.**

Keywords— ANPR; OCR; OpenCV

I. INTRODUCTION

In the twenty-first century, traffic congestion, delays, and overcrowding have become important challenges in developing countries. The number of cars on the road is rapidly increasing, as is the number of different offences. Over speeding, auto theft, and other traffic violations have become all too typical in our daily lives. The necessity for parking, where you will lose a large amount of time seeking for a free spot, is the most compelling reason for driving no-permit cars in private areas and shopping malls. Adoption of an ANPR (automated number plate recognition) system could be a key component in addressing all of the above concerns. To build such a system, however, an algorithm that can recognize the placement of a number plate within a video frame, extract the characters from it, and then identify them must be developed. The demand for handling vehicles as theoretical techniques in information systems grew as a result of significant improvements in today's information technology in all fields/areas of work. The study of essential data offered by automobiles for accuracy and information is successful in recognizing vehicles in the real world by their number or license plates and diverting it into a theoretical technique. As the number of cars on the road keeps rising, available parking spot for a large community of researchers and instructors at Scholastic Institutes or in multi-storey buildings is becoming increasingly challenging. Security personnel manually monitor a huge number of parking lots and are usually unable to keep track of how many cars enter and exit the lot. This makes it harder for vehicle parkers to locate a free parking space, resulting in increased time consumption as well as driver discomfort and delay. Car robberies can sometimes occur when the safe keeper is absent. It is not cost effective to increase the number of parking places; thus, the best answer to this problem is to implement a working ANPR. The ANPR has shown to be a viable way of vehicle inspection in recent years. There are three key steps in an ANPR system: Detection of number plate areas, character breakdown, and optical character recognition are the three steps (OCR).

Each character is segregated from the Number Plate in the final stage, leaving only meaningful figures/facts for recognition [2]. In order to gather essential information on ANPR-based applications, a huge number of research publications were reviewed. The technologies employed in ANPR systems include Artificial Neural Networks, Probabilistic Neural Networks, Optical Character Recognition, Configurable Methods, Sliding Concentrating Window, Back-Propagation Neural Networks, and Support Vector Machines. This research employs a new matching algorithm to identify vehicle license plates using ANPR technology. The framework's final outcome is to match the pattern scheme to detect the vehicle's number plate.

VNPR (Vehicle Number Plate Recognition) [2] is a key component of an autonomous vehicle identification system. The identification of automotive license plates has been the subject of numerous researches. Some of the shortcomings of the VNPR technique were overcome in this study. On the market, there are many different number plate font styles and designs to pick from, and people choose designs based on their personal preferences. To tackle this problem, researchers must find the best algorithm for the above-mentioned complicated operation [1]. Based on fundamental aspects of the vehicle number plate, the detection method was divided into color-dependent and shape-dependent algorithms. Color-based algorithms can only detect a few fixed colors of license plates [4]. The form-dependent number plate detects the rectangular shape in the vehicle image.

Similar problems can be solved in a variety of ways. The difficulty in recognizing license plates has been exacerbated by changes in weather conditions, unanticipated interference

from ambient variables, and the concentration of license plates. Colors [3] and license plate shapes [1] are two strategies for recognizing license plates. Pattern matching compatible with the license plate recognition technique is specially intended for parking lots to detect unauthorized vehicles in the parking lot. Another well-known number is [4] Others, on the other hand, prefer to use a smooth and forward projection of the acquired image to center the image of the printing plate [7]. The novel approach [9] and the Hough transform [5] are used to determine the location of the automobile. To achieve good results, they used block-based algorithms and coupled edge statistics and mathematical morphology [12]and [11]. Another method, based on online spacing [14], counts the existing edges and, if the number is also a threshold, identifies the license plate. The wavelet transform algorithm is used to extract the key characters used to calculate the position of the license plate. The advantage of this method is that it can find a sufficient number of license plates in the picture. Some of the techniques listed above may be complex, and many of them can be called at runtime, making real-time implementation challenging. On the other hand, different countries may take different techniques with sophisticated traits, similar backdrop colors, and so on.

II. EXISTING METHODS

Knowledge of PC and character identification, as well as strategies for certified plate recognition, is required when studying a licensed number plate. As a result, the foundation is being laid for any ANPR system. The Number Plate Recognition method consists of a camera, an edge capturing device, a PC, and custom-designed software for image management, inspection, and recognition. For several years, vehicle identification has been the topic of study. Some studies have looked into the many types of vehicles, such as cars, vans, buses, scooters, and motorcycles. The Sobel filter approach is demonstrated to be useful in accurately recognising a variety of automobiles in [11]. This method can be used to find the borders of a vehicle. The Contour Let Transform and the Support Vector Machine are two ways for determining the automobile model. These tactics were put to the test and examined so that they could be trusted completely. In [12], the Maximum Average Correlation Height filter and Log r-theta Mapping techniques were used to explore the car category. The MACH filter was intended to reveal the region of interest in a confusing environment. OCR (Optical Character Recognition) is a tool that converts images of typed, handwritten, or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene photo, or subtitle text placed on an image. The photos are pre-processed with OCR software to improve the odds of successful recognition. To mimic real-world circumstances, the neural network was trained using two non-intersecting photo data sets. Artificial Neural Networks (ANNs) are a pattern recognition and intelligent computation architecture that is widely used. The most often used ANN is the multilayer feed-forward neural network, which has a modular structure and can categorise inputs into a number of target categories. In general, the works [15] and [16] employ information mining to control individual neural network contributions, whereas the first method is the most fundamental. Even in the face of adversity, good enactment is possible.

III. PROPOSED FRAMEWORK

The purpose of this chapter is to give detailed instructions on how to locate a number plate in a photograph. In most ANPR systems, both a monochrome and a colour camera are used. Locating the registered plate region is the first step in obtaining verified plate identification. There are three sorts of processing methods for tracking the position or portion of a number plate in photographs. Some systems use pattern graphics, grayscale, and colour to distinguish split characters. Separating characters is a crucial stage in character recognition, and the same approach may be used to separate template matching and learning-based classification. Figure 2 demonstrates the various methods for recognizing plate numbers in a flow chart.

A. Binary Image Processing

As demonstrated in Figure 1, to extract license plate regions from backdrop pictures, the following unique method is employed. Edge statistics and morphological approaches are combined in this strategy. This approach has a Ninety Eight percent recognition rate from 10,000 photos if the number plate frame's edges are perfect and plane. This method of extracting characters from a binary image to determine the no plate zone is similarly time consuming because it analyses all of the binary items. In addition, if the image incorporates additional text, the result is wrong.

Fig. 1. Binarizing the number plate image

B. Processing the greyscale images

The images that include only intensity information and have a single value are greyscale images. Because they are predominantly grey in colour, they are referred to as black and white or monochrome images. The intensity is separated into two categories: black and white, with black being the least intense and white being the most intense. A colour image must first be converted to a greyscale image.

C. Colour Processing

In most nations, strict regulations for plate colour and numbers are in place, such as in India, where cars must have black lettering on a white backdrop. Image processing and plate recognition rely heavily on colour processing. However, the output is inefficient due to low illumination and plate alignment, necessitating the adoption of a colour solution to recover characters more precisely and effectively.

D. Thresholding adaptively

It is indeed a method in which every pixel is compared to a constant (threshold) value, with a black pixel being replaced if the value is much less than the fixed value and a white pixel getting replaced if the value is larger. Averaging the local values of each pixel

yields the threshold value. The adaptive threshold is formulated using the local mean of pixel intensity:

$$M(x,y)= 255, \text{ if } N(x,y) < m+n$$

$$M(x,y)= 0, \text{ if } N(x,y) > m-n$$

M and N indicate the input image and output image, respectively. The size of the characters in the region determines the m and n window size parameters.

E. *Extension of contrast*

To increase the image's contrast, the histogram equalization method must be utilized. The contrast extension method improves the sharpness of the image. The brightness of a pixel is indicated by the grey level histogram of a picture. The goal of histogram equalization is to improve the quality of a photograph with low contrast. The entire procedure is broken down into four steps: After aggregating all of the histogram values, normalized the data by dividing it by the total number of pixels. Use the highest grey level setting to boost these numbers. Plot the new grey level value on a graph.

F. *Median Filtering*

An image's median filter is used to reduce unwanted noise. In this technique, the image is submitted as a 3x3 matrix. These proportions can be modified depending on the noise levels. This method involves sorting all of the pixel values correctly, then replacing the problematic pixel with the median pixel value.

G. *Segmentation of characters*

The Regionprops function in MATLAB is used to partition the characters in the produced number plate region, resulting in defined boxes for each character. The Regionprops function returns the smallest character-containing defined box. This method is used to enter all of the characters from the license plate into the appropriate fields.

H. *Extracting the features of interest*

During the feature extraction operation, we locate, mark, and keep all of the features from the split number plate. The zonal density characteristic is used to recognize characters in number plate images. Using the spatial density function, the image is divided into many segments, and each object's pixel in each area is counted.

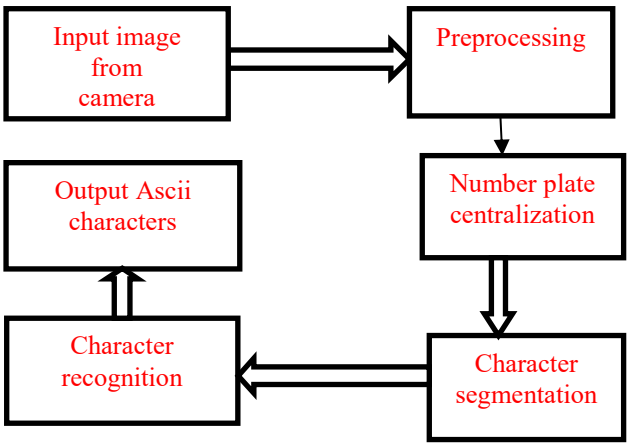

Fig2: Flow chart of proposed method

IV. Implementation

The project is divided into several stages. The first stage, which we created expressly for our university, is to acquire a data set of Indian car number plates. We gathered data from parking lots and photographed bikes and cars for a total of about 500 images, as well as 600 images downloaded from the internet. The second phase is preprocessing, which includes things like clarifying, lightening, and classifying photographs by resolution. The number plate is centered in the image after preprocessing. Character segmentation is the following step, which comes after centralization. OCR character recognition is employed when the segmentation has been done successfully. In the last stage, the recognized characters are presented.

The programming language used was Python3, and the code was ran using Google Colab. OPENCV cv2, pyteserect, numpy, and Easyocr were the python libraries we utilized. We were able to properly execute the code and acquire image results using this library. We generated a table that displays character recognition accuracy, image segmentation accuracy, and a final comparison of the actual number plate and the presented number plate. The outputs of the photographs are considered, and the outcomes are properly evaluated. Our recommended method and code produced satisfactory results. There are a few project limits that can be solved in the future, such as vehicle speed and a few temperature conditions.

V. RESULTS AND DISCUSSION

The images below show the outcomes of the program after it was implemented.

Fig3: Extraction license number from image of car

Fig4 Extraction license number from image car

Fig5: Extraction license number from image of bikes

Actual plate	Recognized Plate	Accuracy by recognition of char	Accuracy of character by segmentation
ANR 486	ANR 48	92%	100%
DZ17 YXR	DZ17 YXR	100%	100%
AP 16 CW 2408	AP 16 CW 2408	100%	100%
TS 07 EL 5034	TS 07 EL 5034	100%	100%

Table1: Results of matching license plate

The findings of character recognition accuracy in car pictures, as well as character segmentation accuracy, are shown in the table above. We employed multiple prototypes of cars in completely different settings and dimensions under shifting conditions to test the precision and accuracy of our proposed system.

VI. Conclusion and Future Work

The license plate recognition system has been successfully implemented. When the distance between the camera and the vehicle is uncontrolled and the weather conditions are bad, the solutions we supply are acceptable for a wide range of situations. For some applications, however, the performance of our system will improve if the distance between the camera and the vehicle remains constant. We need to update a number of segments and acquire more training data for future work. Artificial neural networks and Markov chains are two other well-known techniques that can help improve OCR. In the coming years, we intend to establish an automatic license plate recognition system with its own database and user interface, which will use license plate recognition to authorize people's vehicles. To automatically recognize licenses in a real-time system, our proposal might be used in conjunction with road traffic cameras and minimal software updates, as well as the development of an app. This automatic license plate recognition can also be used to create software that creates challans for drivers who breach the law.

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