OCR-Based Number Plate Identification Using MATLAB

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Abstract Licence plate detection is a fully automated real-time approach that has been broadly used for identification, robbery control, and protection validation of motors. Image processing using Matlab is used for number plate detection by following some methods. This paper uses the optical character recognition (OCR) method to read the image of a number plate. Many automobile industries are urging smart detection on vehicles, such as in parking systems, where parking authorities use this system to allow vehicles to park in their area. Previous works went with detection on type and model of vehicle but not the authorized vehicle. Our research work is giving methodology for finding the authorized vehicle by number plate recognition system. OCR process the captured image and read each character in image for recognition by changing the letters in image to text and that can be converted later. The automatic number plate recognition (ANPR) system employs image processing technology. It is one of the systems required for detecting the vehicle number plate, as well as for template matching and precision (result).

Keywords Optical character recognition (OCR) · Number plate recognition · Thresholding · Template matching

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1 Introduction

Today's digital world is full of digital visual communication. This increased the information in image format and has urged to have the efficient robust object recognition methods. Amongst those number plate identification system is emerging and fundamental security system. Image processing was employed in this paper in order to develop a number plate recognition system that has become increasingly important in today's fast-paced environment [1]. The number of automobiles being stolen, disobeying traffic laws, and entering restricted areas is on the rise, as is the number of cars being given a payslip and then being allowed to drive on the road [2]. They also enable the vehicle to park in their territory through this method. With the increasing number of cars on the road in today's world, it's impossible to keep track of them all manually. A person must be present all over a day to keep track of the quantity. It's a time-consuming process that necessitates manpower. Furthermore, manually stored data becomes unreadable over time. So, in order to overcome some of these limitations, we built a machine that could mechanically locate the variety plate and store it in its database. Later on, when the records are needed, one can obtain and use them [3]. The escalating growth of cutting-edge city and countrywide road networks over the past 3 a long time emerged the want of green tracking and control of street traffic. Conventional strategies for traffic measurements, consisting of inductive loops, sensors or EM microwave detectors, suffer from critical shortcomings, costly to install, they call for site visitors disruption in the course of set up or preservation, they may be cumbersome and they are unable to locate gradual or transient prevent automobiles [4]. On the opposite, structures that are based on video are clean to install, use the prevailing infrastructure of visitors surveillance. Furthermore, they may be effortlessly upgraded and that they provide the power to redesign the device and its functionality with the aid of surely converting the gadget algorithms [5]. There is an extensive sort of structures primarily based on video and image processing using different methodologies to detect cars and items. Traffic surveillance device is an lively studies topic in PC vision that tries to hit upon, apprehend and music automobiles for a different types of some images and it helps in adding and making changes and explain the behaviour, vehicle activity through changing the getting older old traditional method of tracking cameras by using human operators [6]. These structures are proving to be useless for busy large locations as the number of cameras exceeds the capability of human specialists.

As a result, it is always beneficial to automate the process of vehicle licence plate recognition. Autonomous Number Plate Recognition (ANPR) identifies the licence plate information of a vehicle from a picture or sequence of images of vehicles and is the best solution to deal with this concern [7]. The use of ANPR for vehicle inspection has risen significantly in recent years. When using an ANPR system, there are three basic steps to follow: (1) Number plate region detection, (2) Character breakdown, and (3) Optical character recognition (OCR). Only beneficial figures and information are obtained for recognition by separating characters on the number plate. ANPR-centered applications were gleaned from a slew of peer-reviewed articles. Artificial

neural networks (ANNs) and probabilistic neural networks (PNNs) artificial neural networks and probabilistic neural networks optical character recognition (OCR), MATLAB, and a configurable method are some of the methods that can be used to create an ANPR system [8]. This work uses a template matching technique to construct an ANPR system for vehicle number plate identification. For this technique, it's all about matching up the vehicle's licence plate number to a template. The modern era of technology necessitates accurate automatic vehicle plate identification [9]. Toll collecting, parking management, access control, and crime investigation are just a few of the concerns it solves. Many experts throughout the world are excited about the potential of ANPR research [10]. Due to the wide variety of licence plates and non-uniform lighting circumstances when taking images of vehicles, this is a difficult challenge to solve.

The next part of the paper is organized as following. A brief explanation of different existing methods were explained in Sect. 2. Different types of algorithms and various techniques for identifying the location of number plate were discussed in Sect. 3. Simulation results from MATLAB followed by experiments were explained in Sect. 4. Conclusion and future scope were explained in Sect. 5.

2 Literary Review

So, many researches went to find and locate the moving objects. Amongst those some studies focused to find the type to vehicle by using the Sobel filtering approach in helps to precisely identify by detecting the vehicle edges [11]. The Contour Let Transform and Support Vector Machine detect vehicle type and model in addition to vehicle detection. These methods were put to the test in the real world and thoroughly examined before being deemed reliable. According to [12], various statistical methodologies were used to investigate the automobile category. In a cluttered/messy situation, the MACH filter was used to reveal the area of interest. All the previous researches worked on finding the vehicle type and model but not the authorized vehicles and motivated to find the particular vehicle. So, finding licence plate helps to detect the authorized vehicle. For Licence plate detection few steps plays major role like character identification, certified plate recognition. Camera, edge-capture device, PC and ANPR image processing and analysis software can be used to perform these tasks.

It is possible to edit and search information from several types of documents thanks to OCR technology, such as scanned paper documents, PDF files, and photos taken with a digital camera. Computers can read handwritten, typed, or printed text by converting scanned images into a form that can be read by OCR systems. Using this method, we are able to save storage space, change the content, and index it. Optical character recognition (OCR) systems play a critical role in document image processing because they help convert electronic photos into electronic text documents that can be altered, searched, indexed, and stored effectively and efficiently. It is possible to extract text from an image using generic OCR systems, although there

are several restrictions to this capability. In most cases, OCR systems are unable to read text from document photos due to technical restrictions, and as a result, the images must be properly prepared before they can be read by OCR systems. In this study, the goal is to establish a few preprocessing processes for document images so that OCR systems can more easily read and understand them [13].

Optimizing the images for recognition helps the OCR software do its job better. Using two non-intersecting pictures data sets, the neural network was able to mimic real-world conditions. In the field of pattern recognition, artificial neural networks (ANNs) are widely employed. To categorize inputs into a collection of target groups, the multilayer feed-forward neural network (ANN) is the most commonly utilized type of algorithm. When it comes to neural network implementation, the most fundamental way is information mining, which is employed in both and to handle the contributions of neural network contributions independently. A two-stage hybrid OCR technique can boost recognition rates. Using four statistical sub-classifiers, each of which recognizes input characters on its own, the Bayes' method is used to integrate the results. An operational stage can be used for further differentiation if a character documented in the first step matches a group of similar characters (e.g., A/4, B/8, and S/5). Jaya Lakshmi et al. [14] used a computer with a Dual Core 2 GHz processor and 8 GB of RAM to test the method. Neural networks can also be created using this method. Six thousand and forty-five distinct binary images of varying tenacity were employed. Initial step is to resize the binarized images of the characters such that they are all of the same size [15]. In order to determine the correct size, a variety of input photos were employed. By employing larger character images, by the complexity of neural network increasing there is possibility to increase the rates of recognition. For the best results, the final neural network is scaled to the appropriate size [16]. All of the methods for identifying automobiles and recognizing number plates covered in the study have their own advantages and disadvantages.

3 Working Method and Design

The goal of this study is how to notice a licence plate in the snapshot you took. It is not uncommon for ANPR systems to make use of cameras with both a monochrome and a colour sensor. Become familiar with the area around the number plate before applying for a number plate ID. The methods we use to locate the position of the number plate in images can be classified into three processing groups. Some programmes use a pattern image, grayscale, and colour to aid in character recognition. We can identify characters by separating them from each other, but we can also achieve this by matching a template or by learning about them. Figure 1 illustrates the various methods in which plate numbers can be recognized.

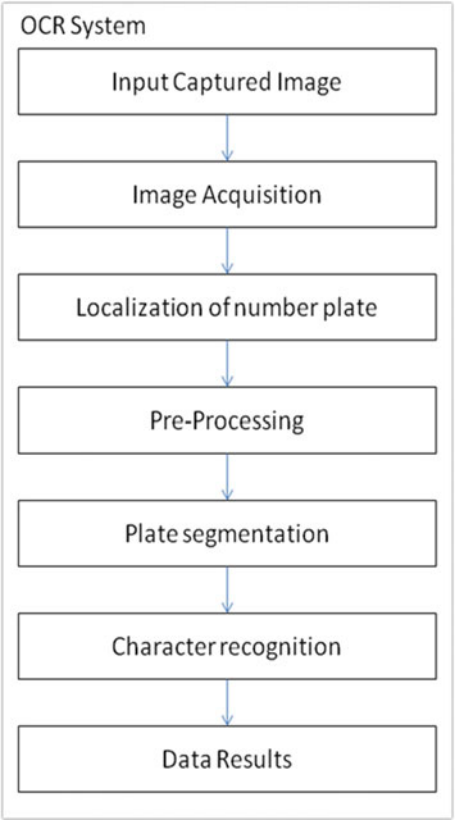

Fig. 1 Block diagram of a car numbering system

3.1 Binary Image Processing

Using edge statistics and morphological approaches, our strategy extracts licence plate regions from backdrop pictures. From a total of 9745 photos, our method has been able to correctly identify 98% of them, assuming that the borders of the number plate frame are perfectly straight. To find the no plate region, this approach of extracting characters from a binary image requires a lengthy analysis of all binary objects. The result will be incorrect if there is any other text in the image.

3.2 Grey-Level Processing

A grayscale image contains only one value for each pixel and is used to record only intensity data. To differentiate between black and white or monochrome, these

images are typically greyscale because the intensity of the colours is separated, with black presenting a low level of intensity and white an extremely high one. To begin, a colour image is converted to a greyscale image. This can be stated as follows: $R =$ rgb2grey (p), where R is the greyscaled image and p is the colour image.

3.3 Colour Processing

Plate identification relies heavily on colour processing, as most nations mandate that the letters on licence plates be black on a white backdrop. This is particularly true in India, where vehicles are required to adhere to certain colour standards. We need colour processing to get a more accurate character retrieval with more efficiency, but, because of the bad lighting circumstances and plate placement.

3.4 Adaptive Thresholding

The images must first be turned to grayscale before thresholding can begin. A binary image is created through the process of thresholding. As an illustration, the values of each pixel are compared to a predetermined constant (threshold). Pixels of black or white are used to replace values that fall below or exceed the constant value. Threshold values are computed by averaging pixels' local values In order to formulate the adaptive threshold, the local mean intensity of pixels is taken into account: $O(X, Y) = 255\, I(X, Y) < + O(X, Y) = 0\, I(X.Y) >$ Images that are used as input and output, respectively, are referred to as I and O. The window size parameters are chosen based on the character size in the region, m and n.

3.5 Contrast Extension

Histogram equalization is necessary to increase the contrast in an image. The sharpness of the image is enhanced by the contrast extension technique. Here, we are using pixel to find and represent the brightness of that we can use image's grey level histogram. To increase the quality of an image with weak contrast, histogram equalization is used. In total, there are four stages: (i) totalling the data in the histogram in order to normalize the data, (ii) multiply these figures by the image's pixel count, and (iii) to enhance and improve the values we can use or we 9 can increase the grey level value.

3.6 Median Filtering

The noise in an image can be reduced using a median filter. A 3×3 matrix is passed into the image using this way. It is possible to alter these parameters in response to changes in noise levels. Sorting the pixel values and then replacing the pixel that's under consideration with the median value accomplishes this task.

3.7 Character Segmentation

MATLAB's region props function separates the alphanumeric characters from the output image in the resulting output plate region into their own described boxes. The Region props method gives the output as the smallest described box with an individual character. This is the only method can be used here to create and generate a list of all the individual characters from the plate.

3.8 Feature Extraction

In order to extract and find all the image features of a number plate segmented, the Feature Extraction technique is used. The zonal density feature is used to identify characters on licence plate images. Each pixel of an image is counted using the Zonal density function, which divides the image into sections. Each area's pixel density is equal to the object's total pixel density. The image's total area is equal to the number of features it contains. We divide a 32×32 image into 16 zones of different densities, resulting in 16 distinct features per image. In order to have 16, 64, 128 or 256 zones, the pixel must be 32×32.

3.9 Template Matching for OCR

One character recognition employs a technique known as template matching. Locating a subphotograph known as a template, which is embedded in an image, is the goal of this method. Matching a template to other windows of the same size in a picture requires identifying similarities and differences between the two. As the template is moved about, this approach looks at each individual image pixel for any differences between that pixel and the template's location. Using a database of characters or templates, this technique works. For each and every one of the input characters, a template exists. For all alphanumeric characters, the "normal" font type is utilized (from A–Z and 0–9). Table 1 shows a selection of alphabetic characters with their corresponding template. A possible match or a layout that comes closest

Table 1 Template matching results

Actual plate	Predicted plate	Mismatched character	Accuracy (%)
HR26DK8337	HR26DK8337	0	100
MH12DE14##	MH12DE14##	0	100
HR26DK83##	HR26DK83##	0	100

to portraying the current information character must be found in order for recognition to take place. Moving the standard layout allows it to capture the character's ideal position and perform the correct match. Target characters are coordinated using conventional character format from eight directions: up, down, left and right, as well as upper and lower right. Layout coordination for character identification is shown in Table 1 using still pictures of Indian licence plates. The photos of licence plates shown in Fig. 2 are those that were utilized for format coordination.

Fig. 2 Number plates used for template matching and output images

4 Results

We typically conduct our experiments on a variety of vehicle prototypes of varying shapes and sizes in a variety of environments to measure our methods and precision. The algorithm's accuracy was limited because the segmentation method did not work for plates at a certain angle and plates at the edges of the picture.

A software application is created in this system to detect the licence plate numbers of vehicles by reading their licence plates. In the beginning, the location of the plate is determined through morphological operations, followed by segmentation to separate the plate characters. Plate characters are finally recognized using correlation in the final step of template matching.

5 Conclusion and Future Scope

There has been a thorough analysis of the new technologies and algorithms proposed in this paper for determining the number and type of vehicles with no licence plates. Because an off-the-shelf ANPR device that meets our needs isn't readily available, we've taken it upon ourselves to create one specifically for educational institutions. An average Accuracy has been reached by using template matching on static plates. Table 1 shows the degree of precision with which each character was generated (number 1–9, alphabet A–Z, and a–z). Using two layers of neural networks and positioning the camera such that it captures the exact image of the body, this degree of accuracy may be substantially increased. Multi-level evolutionary algorithms can be used to advance the execution of the stated technique in order to boost the popularity of multiple vehicles with quantity number plates in a single photo body. By using a stationary clip to record images, selecting the best vehicle border for the vehicle category, and applying neural networks to recognize number plates, the device's complexity can be reduced.

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