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Intelligent Car Detection and License Plate Recognition System

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***Abstract*: Intelligent car detection and number plate recognition is a well-known manifesto in today's world because of the fleeting growth of cars, bikes, and other vehicles. This system uses image processing techniques for the identification of the vehicles and then their license plate. This set-up can be fully automated and can identify vehicles without authorization, vehicles that violate rules in highly populated areas like malls, universities, hospitals, and other car parking lots by extracting the owner's name, address, and other information via the database stored in the system. We can also use this when we need to find the car-usage in terrorist activities, smuggling, invalid number plates, and other illegal activities. It can also be installed at the tollbooth to automatize highway electronic toll collection.**

Such systems are already available, but efficiency is not achieved thoroughly. This developed system proposes to take a step further, which is automatic car detection along with the acquisition of owner details along with the vehicle registration number.

***Keywords*: Car detection, Image processing, License plate recognition, Localization, Segmentation.**

1. Introduction

We can use car detection and vehicle plate recognition in a plethora of applications, including travel time estimation, car counting on highways, traffic violations detection, and surveillance applications. With the ever-increasing population, vehicle usage has also drastically increased. This made it difficult to find a spot to park a car these days, for many students and faculties at educational institutions, malls, and public places. Most of the car parks are managed manually by security guards who may not keep a record of the vehicles in the parking lot.

The vehicle driver has to keep strolling in the parking lot for finding a slot for car parking. The absence of the security guards may also lead to vehicle stealing and may cause quarrels between drivers to get a parking space. Automatic Number Plate Recognition is a technology that uses pattern recognition to read license number plates. In simple terms, this system's cameras photograph the number plates of the vehicles that pass by violating the rules. It then feeds this image in a computer system to extract details about the driver, owner of the vehicle, and details about the vehicle itself.

This set-up would benefit parking lots a lot. It would be very helpful to develop this recognition system in a university so that everything goes sequentially with less time consumption. Tollbooth is one of the best applications too. It is very difficult in a rush-hour to manually generate a tollgate ticket. Hence this system can be used in coordination with employees. This would be very useful in dreadful weather.

As a vehicle passes, the system reads the number plate from digital images, taken via cameras located either in a mobile unit or pre-installed in a traffic monitoring vehicle. The system for automatic car license plate recognition includes a static camera, a framer, a computer, and custom-designed software for image processing, analysis, and recognition.

2. Literature Review

The literature review has purposed many number plate recognition methods. Car detection and number plate recognition is the hotspot area of research now a day because of the rapid development of transportation systems and from the literature review, we can see various techniques take place for recognizing number plate.

[1] The number plate recognition method here first used Color Edge Detection and fuzzy maps then step taken into account were (1) Pre-processing: - Consists binarization using a variable threshold technique. (2) OCR - Here the character recognition process takes and the task of character categorization is accomplished by the compositional semantics of license numbers. [2] The method mainly consists of the tasks (1) License Plate Segmentation (2) License Plate Processing (3) Character Recognition. [3] The system mainly accomplices with three major steps (1) Plate Region Extraction (2) Segmentation of characters (3) Recognition of Characters. [4] This paper mainly aims to present the various existing techniques to categorize and assess them the number plate recognition consists of three steps (1) Extraction of an ROI (2) Segmentation of the plate characters (3) Character recognition. [5] The algorithm for number plate recognition was composed of several following steps, Pre-processing and Plate Recognition: - To improve the image Quality color image was converted to gray level image using the Standard NTSC model then median filtering was applied for noise reduction. A feature-based number plate localization method was

implemented for further process. [6] The approach mainly based on the Artificial Neural network while the steps proposed were (1) Plate Localization: - Canny Edge Detector used for the image localization purpose. (2) Character segmentation: - Histogram approach was taken into account for Contrast extension while median filtering for noise reduction (3). Feature Extraction: - Artificial Neural Network (ANN) was proposed in this process. [7] The algorithm for number plate verification mainly accomplice four steps (1) License Plate Location (2) License Plate Detection (3) Character Recognition. [8] The automatic Number Plate Recognition system mainly uses the techniques of the Edge finding method and Window filtering method. Where the localization of the Plate consists of the step of converting the Original Colors image to the gray level image. [9] The number plate recognition system was composed of mainly these steps (1) Pre-processing: - Image converted to gray-scale from Original was goes for further process and median filtering was applied for noise removal (2) Plate Localization: - Morphological Operations were performed for Number plate localization (3) Character Segmentation: the process of character segmentation takes place using region props functions. [10] Vehicle license plate recognition System was proposed which contains mainly four steps (1). Pre-processing and Edge Extraction: firstly, the simple pre-processing of the image takes place and then edge extraction without filtering takes place. (2). License Plate Localization: Use the Micron position technology and edge horizontal and vertical direction calculated image. (3) Character Segmentation: they implemented a vertical area projection method for the character segmentation approach. (4). Character Recognition: Character recognition process step implements the Artificial Neural Network approach and then at last Template matching algorithm was taken into account and they returned the best-matched value as a result.

3. Architecture

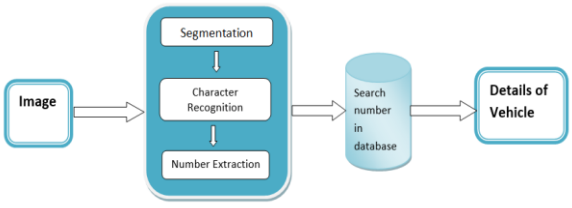

Fig. 1. The architecture of the proposed methodology

The architecture comprises the fundamental building blocks of my proposed system. It comprises the Input image block, Processing unit, Database block, and output block. We give the image as an input to the fundamental processing unit where all the image processing operations takes place such as pre-processing, which is a conversion of RGB image to Grayscale image, Segmentation, which is the localization of number plate, Optical character recognition, which is used to extract the number from the license plate. Once we withdraw the number of the vehicle, we hunt for it into the database to find the information about the owner of the vehicles, which is ultimately the output of the system. The output will comprise the details of the vehicle like the driver and owner name, model name, vehicle number, etc.

4. Methodology

License plate recognition is one technique used for vehicle identification purposes. The sole intention of this project is to find the most efficient way to recognize the registration information from the digital image which is obtained from the camera.

The process usually comprises three steps. The first step is the license plate localization, regardless of the license-plate size and orientation. The second step is the segmentation of the characters, and the third step is the recognition of the characters from the license plate. Hence, this project uncovers the fundamental idea of various algorithms required to accomplish character recognition from the license plate during template matching.

All the below-proposed flowchart helped in achieving faster character recognition of the license plate. Various processes of character recognition comprise of steps like Image processing, Defragmentation, Resizing and Character localization are required to be performed on the image for Template Matching to be done.

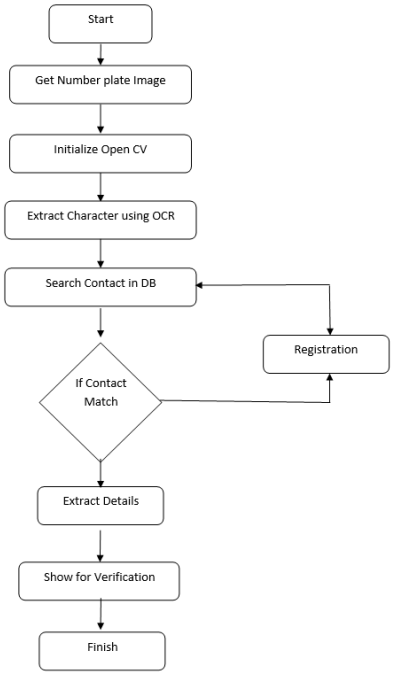

Fig. 2. Flowchart of the proposed methodology

Beginning with the initial phase, first, we will capture the image of the number plate of the vehicle. Then we will initialize OpenCV by feeding the program or software with the captured

image. OpenCV is a highly optimized library in python programming language for numerical operations, also OpenCV makes it easier to integrate with other required libraries. The next step is to extract the characters from the captured image using OCR for further manipulations. Optical Character Recognition (OCR) is a technology that recognizes text within digital images and enables you to convert original documents, files, or images into editable and searchable data. The basic algorithm used in OCR to read individual letters is the OTSU algorithm that converts the image to grayscale and binarizes it. After the extraction of characters, we search for the contact or information about the owner in the Database. If present in the Database, then verification of the vehicle will be done by displaying the information. If not, registration of the vehicle will be done by collecting and feeding the information of the vehicle and the owner in the Database.

5. Techniques Used

A. *Segmentation*

Image segmentation is partitioning an image into multiple segments. Image segmentation is typically used to locate objects and boundaries in images.

Image segmentation is a commonly used technique in digital image processing and analysis to partition an image into multiple parts or regions, often based on the characteristics of the pixels in the image. Image segmentation could involve separating the foreground from the background, or clustering regions of pixels based on similarities in color or shape. For example, a common application of image segmentation in medical imaging is to detect and label pixels in an image of a 3D volume that represents a tumor in a patient's brain or other organs.

The result of image segmentation is a set of segments that collectively cover the entire image or a set of contours extracted from the image. Each of the pixels in a region is similar regarding some characteristics or, computed property, such as color, intensity or texture. Adjacent regions are different regarding the same characteristics.

B. *Optical character recognition*

OCR is a technology to convert handwritten, typed, scanned text, or text inside images to machine-readable text. You can use OCR on any image files containing text or a PDF document or any scanned document, printed document, or handwritten document legible to extract text.

Matrix matching involves comparing an image to a stored glyph on a pixel-by-pixel basis, we also know it as pattern matching, pattern recognition, or image correlation. This relies on the input glyph being correctly isolated from the rest of the image, and on the stored glyph being in a similar font and at the same scale. This technique works best with typewritten text and does not work well when new fonts are encountered. This is the technique the early physical photocell-based OCR implemented, rather directly.

Feature extraction decomposes glyphs into features like lines, closed loops, line direction, and line intersections. The extraction features reduce the dimensionality of the representation and makes the recognition process computationally efficient. We compare these features with an abstract vector-like representation of a character, which might reduce to one or more glyph prototypes. General techniques of feature detection in computer vision applied to this OCR, which is commonly seen in intelligent handwriting recognition and most modern OCR software.

6. Implementation

A. *Home Page*

This is the first screen that you see when you run the script and after you log in by using user-id and password. On the home page, there are six buttons through which a user can add a vehicle, view all, search one, live track one, and car detection as well.

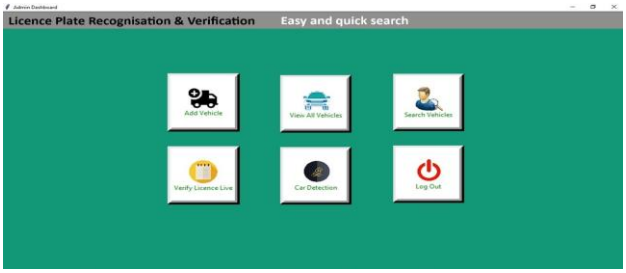

Fig. 3. Home page

B. *Add vehicle*

If a new vehicle wants to register then first fill the details as shown below, after that need to submit the response, then they will be registered and their data will be stored in the database. The responses to be filled are,

- Vehicle owner name
- Owner contact
- Owner email id
- Vehicle number

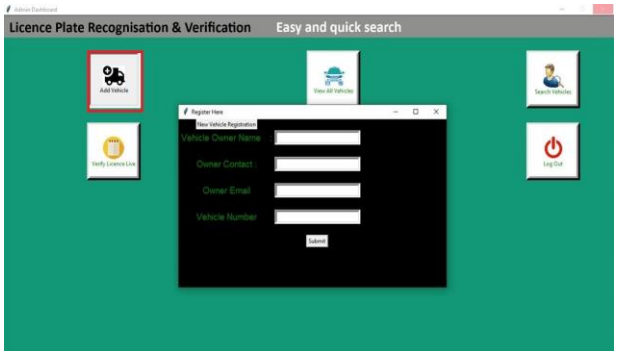

Fig. 4. Add vehicle

C. *View all vehicle*

Once the users have been registered successfully, we can

view all the user databases by clicking on the view vehicle option. The entire registration details can be seen here. By right-clicking any of the data below, you will be able to edit, rename, delete the database as per your preference. This makes work easy. So basically, view all vehicle button is just the access button for accessing the user database.

Fig. 5. View all vehicles

D. Verify license live and Car detection

By clicking this button, we can start live streaming and then we try to detect cars and simultaneously their license plate as well. It also has access to manually input the video and then detect the car as well as the license plate. Both of the options can be used as per user preference.

Car detection button is one of the added functionalities that we included with this model. If a user only wants to determine the car and not the license plate with it, you can use this button for the same. It can detect multiple cars without any hesitation.

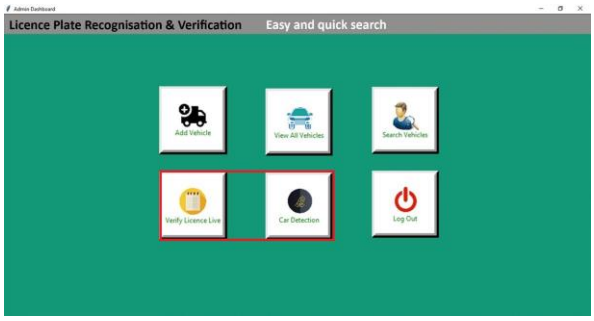

Fig. 6. Verify license live and Car detection button

E. Logout

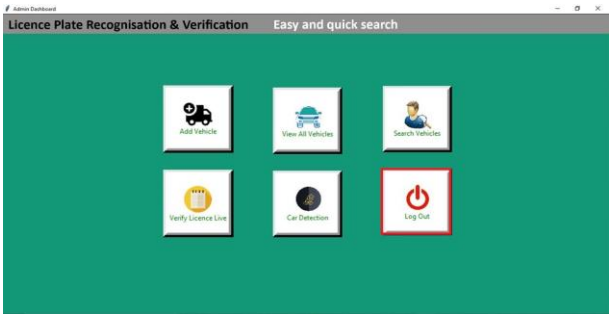

Fig. 7. Logout button

As soon as we are done using the model. We can log out of the system to keep your own database safe. For every login, we have designated a separate database to keep every user's database confidential. Logout will just make you exit the model. You can log in anytime when wanted.

7. Result

A. License Plate detection

This is how after all the pre-processing and finally running the verify button we can confirm that our system can detect the number plate exactly as it was.

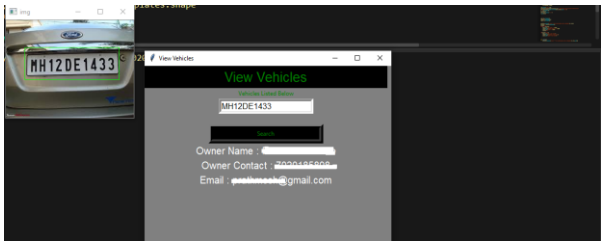

Fig. 8. License plate detection 1

Here is another example where the camera angle is changed but still the model can determine the exact number shown on the license plate. Camera angles play a very important role when it comes to detecting a license plate.

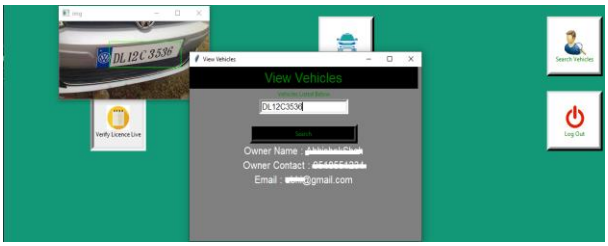

Fig. 9. License plate detection 2

My model can detect those license plates as well, which are only alphabetical. Here is an analysis showing how my model successfully identified PRIVATE and even when it has a different camera angle that the previous two analyses that we did.

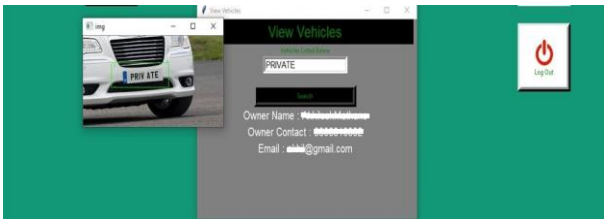

Fig. 10. License plate detection 3

B. Car detection

This is how we can detect one car as well as multiple cars based on the organization's needs.

Fig. 11. Car detection 1

Fig. 12. Car detection 2

8. Conclusion

This Project has different recognition methodologies, their advantages, and drawbacks and gives the best of all those to opt for a user friendly, efficient system that works in any climatic conditions unaffected. Factors like speed, light, font size, and styles should not affect this system.

In this project, I introduce the intelligent car detection and number plate recognition system using a vehicle license plate. The system uses image processing techniques for recognizing the vehicle from the database stored in the computer by the user. The system works agreeably for a wide variety of conditions and distinctive sorts of number plates. The system is actualized and executed in Python and it tries performance on genuine images. In the existing work, I have done work on contorted number plates. This method has an issue of commotion and it takes the image from separation. I have proposed a novel system for denoising and better character detection using standard classifiers of neural networks and gives better detection. Thus, this project uncovers the fundamental idea of various algorithms required to accomplish car detection and character recognition from the license plate during Template Matching.

9. Future Scope

In this project, I reviewed existing methodologies and algorithms proposed in the literature for Vehicle and Number Plate recognition. Because of the unavailability of such system off the shelf in tune with our requirements, we endeavour to customize such system for an educational institution. I implemented template matching on number plates got from static images, and an average accuracy of 80.8% was obtained. This accuracy can be improved by,

- Positioning the camera suitably to capture the best frame and using two layers of neural networks.
- Using convolutional neural layer or by any of the pre-trained neural network model that has been previously trained on and for license plate detection.

Implementing the proposed system can be extended for the recognition of number plates of multiple vehicles in a single image frame by using multi-level genetic algorithms. Also, a more sophisticated version of this system can be implemented by taking inputs from the live video feed and selecting the best vehicle frame for the classification of vehicle types and recognizing the number plates using neural networks.

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