

License Plate Detection and Data Retrieval

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Abstract— With a surge in the need for procuring the identification of vehicles, Automatic License Plate Recognition and Data Retrieval (ALPRD) system has come in handy as it recognizes the license plate of the moving and sedentary vehicles. It is a real time system, which not only recognizes the data, but also retrieves its details notably with much complex characteristics without any human intervention. ALPRD has been at its pinnacle with its usage propagating from an elementary parking lot to a demanding and complex traffic managements and security cameras. Requiring a special strategy to avoid the motion blur caused while capturing and decoding the number plates of fast-moving vehicles, it involves the use of Optical Character Recognition (OCR), cameras and data processors to capture the license plates. The earlier technology applied in Automatic License Plate Recognition (ALPR) was the use of MATLAB as the primary tool and Open Computer Vision library which supports for the development of the vision in computers. This paper provides an insight into the implementation of ALPRD using Open Computer Vision library, Python and Database.

Index Terms— License plate, Database, OpenCV, ALPRD, OCR

I INTRODUCTION

The transportation technology has come a long way over the last few decades. It is undoubtedly at its peak of revolution and the rate at which this happens keeps accelerating with every passing day. It has surpassed the traditional and conventional methods and is replaced with new and transfiguring methods. Automatic License Plate Recognition and Data Retrieval (ALPRD) is an image processing technology that automatically recognizes the number plates of the vehicles from images and retrieves the data of the vehicles from a database. The detection and reading of the number plates makes this system an intelligent system. The entire process can be accomplished in three stages- capturing the image, pre-processing it

and storing the images, thereby to extract the respective license plate and retrieve any information from the database. With the advent of accelerated pace of the data processors and high-resolution image sensors, ALPR's have improved several folds in both detection and accuracy. Also, with the availability of various open source technologies, the domain of Computer Vision has reached greater heights. Multiple solutions have been found by various researchers from across the globe using these open source technologies that are applicable in sectors that are beyond the human vision. One of the most popular and emerging open-source tools is the OpenCV (Open Computer Vision) which plays a vital role in real-time applications with various interfaces like C, C++, Java, and Operating Systems.

II. LITERATURE SURVEY

License plate Recognition has become quite popular and challenging one to be done. In each and every paperwork involves the methods like Character Segmentation and Character Recognition. But each work proposes different method in improving the performance in recognizing the text in the license plate. [1] In this method, they use Backward Propagation Algorithm to form a neural network which is used for character classification. They use edge detection as a major process in pre-process (. Character fragmentation is done using graphical survey. [2] In this method, the entire system relies on MATLAB. They use Sobel Edge detection technique as the major method to segment the letters and numbers easily using surround box method. After segmentation, the follow matching technique to identify the characters. [3] In this method, the entire system is implemented using OpenCV with Image processing techniques. First, they convert input image into threshold using Adaptive thresholding and convert into binary image to suppress the background

and unwanted spaces. They use a special technique called Image scissoring to segment the character and break tesseract to convert ASCII data of the image into required output. [4] They provides a wider knowledge in the area of analysis regarding Pixel count and Aspect ratio analysis.[5] They proposed an idea with the technique of Image live detection using Camera and Obstacle avoidance using Ultrasonic and PIR sensing. They are using OpenCV and TensorFlow OCR engine in RaspberryPi hardware for image detection. They update the Live location so that the blind people can know where they are in. [6] In this proposed concept, they involve the pre-process like adaptive thresholding, conversion into Binary image. They involve Character segmentation technique using KNN algorithm which undergoes the pre-process again on the extracted plates from the image and compares the ASCII values and then converts into License number. This whole system relies on the Open source engines. [7] In this, they had mentioned about python programming and concepts in the future which is incorporated with the database, GUI, etc. [8] This gives an idea which connects the python with the database server online to get and update the data online with the open source engines wider.

III. METHODOLOGY

Number Plates

Generally, various types of license plates are being followed in different countries. In India, there are three types of number plates, White background with Black text, Yellow background with Black text, and Black background with yellow text which is shown in below, fig 1. The first one, for Private vehicles. The second one, for Commercial vehicles and the third one, for hired vehicles who drives himself. This approach involves these three kinds of plates.



Fig 1 Various Types of License Plates

Camera

High resolution camera is used to capture image of the license plate of the vehicle like fig 2. The major factor that affects the quality of image is Speed and lighting while capturing. For better resolution and accuracy,

Dual Sensor camera is used, which includes Night sensor and LPF (Low-Pass filter) sensor.



Fig 2 Sample Picture for Input image Resolution

MATLAB and OpenCV

MATLAB is a high-performance language and interactive environment for developing algorithm, analyzing and visualizing data and performing numerical computations. MATLAB is widely used by the image processing and computer vision community because it provides strong mathematical and numerical support for the implementation of advanced algorithms.

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning library. OpenCV provide a lot of features for computer vision application.

OpenCV has more functions for computer vision system than Matlab. The latter is more convenient for developing and data presentation, however, OpenCV is much faster in execution. OpenCV is harder to learn due to a lack of documentation and error handling codes. This is the only disadvantage of OpenCV. But once you gain expertise, OpenCV is very easy to use. It is an open source library, we can freely use it. But Matlab is not open source. We need a license which is expensive. Both OpenCV and Matlab can be used for image processing. But MATLAB is suitable for industry personnels, who are doing some research based on computer vision and patenting based on a proprietary software and OpenCV is used by students at universities/colleges because it is open source and needs no licensing. The scientific world have merged to its peak by using the open source engines. With the scope of Python and OpenCV open source engines, researchers have achieved greater heights in the field of computer vision by discovering new solutions to many unanswered problems which are beyond human sight

Features of OpenCV

OpenCV is a open-source engine. OpenCV was originally developed in C++. In addition to it, Python and Java bindings were provided. OpenCV runs on various Operating Systems such as windows, Linux, OSx, FreeBSD, Net BSD, Open BSD, etc. OpenCV is much faster in execution. The library has more than 2500 optimized algorithms. OpenCV is used in Robotics, Medicine, Industrial Automation, Security and Transportation applications. Other main features are, it takes images as input and perform read, write operation of the image. It process the images like filter, transform operations. It performs feature detection. Most used application as detecting face, eyes, cars, and other video or image objects.

Optical Character Recognition (OCR)

Optical Character Recognition (OCR), otherwise known as Optical Character Reader is an image processing concept in which printed, handwritten texts, and alphanumeric are converted into electronic versions at a faster speed. OCR boosts up the recognition even more accurately by pre-processing the images. Most probably, things get worse with handwriting and keystrokes. But here OCR eliminates the keystrokes and maintains the accuracy at a higher level.

Recently, ICR (Intelligent Character Recognition) becomes more popular as it converts the data received from the OCR concept into ASCII data which means it is one of the key factors in the OCR technique. There are two methods to extract the character that needs to be converted into electronic version:

- An algorithm that recognizes character by examining its lines and strokes in fig 3.
- An algorithm that uses pattern matching to find the whole character in fig 4.



Fig 3 Recognition based on Keystrokes



Fig 4 Pattern Recognition as a character

Pre-processing

Preprocessing is making use of computer algorithms to perform image processing techniques on digital images. It allows a wider range of algorithms to be applied to the input data. Pre-Processing aims to improve the image data (features) by suppressing unwanted distortions and enhancement of some important image features. It is an important phase to be carried out in any visual concept. It involves two stages in the proposed system, Gray scaling - converts the whole image from RGB channels into grayscale like fig 5. Convert into Threshold image like fig 6. Captured image is converted by using the adaptive gaussian threshold technique and converted into binary image. Normally, these two processes have been carried out in two stages of the proposed system. After performing pre-process, the next step is finding possible plates in the image and possible characters in that each plate.



Fig 5 Gray scaling Image

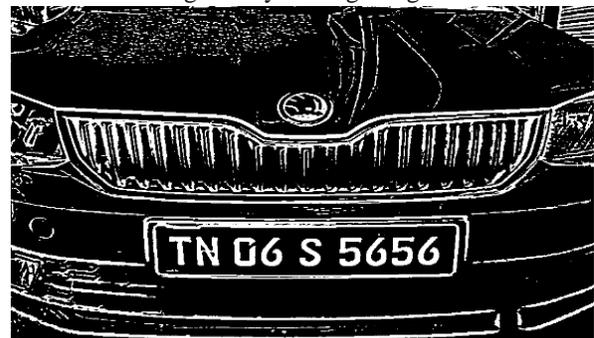


Fig 6 Threshold Image

IV. EXTRACTION OF LICENSE PLATE

Here, our aim is to locate the possible license plates in the image, performing character segmentation to find the exact plate and cross referencing with the database to find the information of that particular vehicle. Below fig 7 shows a flow of process.

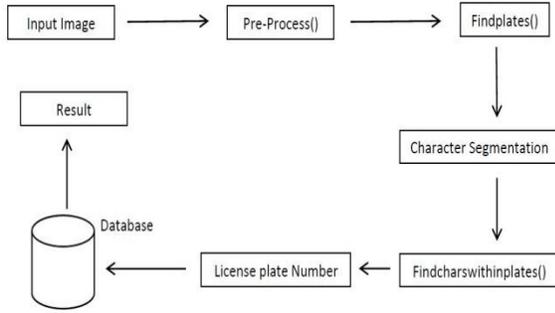


Fig 7 Flow chart of the Proposed system

a. Possible Plates

First, the image undergoes edge detection technique in the previous step to convert the image into binary image. After the following steps are used to extract the plate,

- Possible plates in the image is found by finding all the possible contours in image using findContours() function in fig 9.
- The list of possible contours is found when the Contour's pixel area, width and height are greater than the minimum value set. (Here only possible contours are found not compared with other contours)
- Next, Possible contours and list of possible contours are compared to find the ones that match to look for a group in fig 10.
- Then, the plates have been extracted from the image in three steps. First, find the center of the plate based on the contours adjacent to each other. The second one, find the plate's height, width and Correction angle. The third one, find the actual rotation matrix for correction angle (entire image of chars within box) and cropping the image which includes applicable member of the possible plate in fig 11.
- Finally, all the possible plates in the image have been extracted.



Fig 8 Binary image



Fig 9 Possible Contours in Image

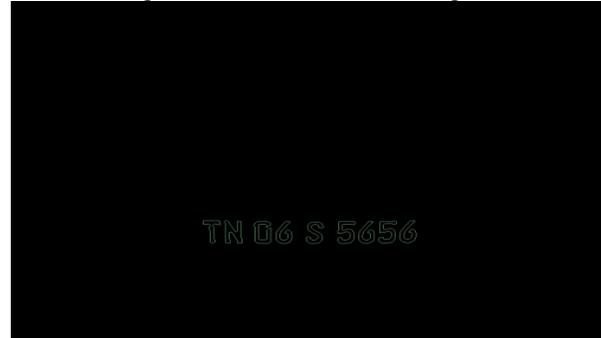


Fig 10 Comparison with possible characters

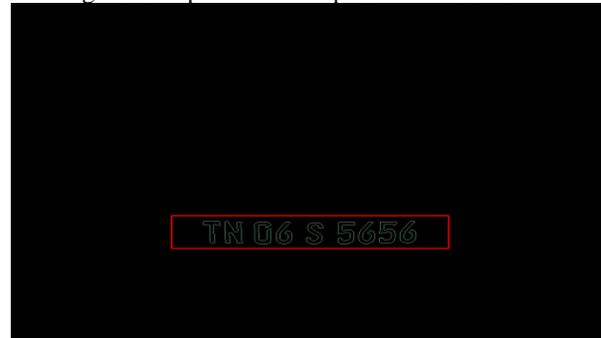


Fig 11 Extracted License plates in image

• Character Segmentation

Character segmentation is a process to breakdown the sequence of characters into individual symbols. It is one of the decision-making processes in Optical Character Recognition. In this part, further the image processing are concepts applied to the extracted plate to remove unwanted data. After applying Character segmentation, the extracted plate has only the characters of the license plate. The process of Character Segmentation on extracted plate is as follows,

- The possible plates found in the image again undergoes some sort of Pre-process techniques to separate and compare the characters.
- We use findcontours() function find the possible contours in the possible plates extracted.

- Grayscale and Adaptive Gaussian Thresholding is carried out again to precisely locate the contours and converted into binary image.
- Then, finding the possible characters in it by calculating the distance and angle between the characters.
- The characters whose distance is lesser than the pre-set value will be considered as a group or cluster.
- After finding out the matching characters, here we go for the actual char recognition. Cropping out the individual characters from the threshold image after the contours are drawn in it.
- Here, we use KNN algorithm which converts into ASCII data and compares with the classifications which are already pre-set. The default K value is set to 1 and the characters which are found is evaluated across the steps followed in the KNN algorithms.
- Then, resize each individual image of characters and flatten the image into 1D array. Convert 1D array of ints into 1D array of floats and call findNearest() function (K-Nearest Neighbours) to get the exact result. Then convert that result into char to get the exact individual character for that resized image. Now, we get a string of characters.
- Finally, the obtained string is written in the input image and it is displayed below the number plate in fig 16.



Fig 12 Extracted plate



Fig 13 Grayscale Image of the plate



Fig 14 Threshold Image of plate



Fig 15 Individual Character Segmentation



Fig 16 Result of the Character Recognition

V. DATABASE – CONNECTION AND DATA RETRIEVAL

Here, we use a strong database to check out the vehicle's details which is already fed with the list of vehicles. For example: All the vehicles of a small town are collected from RTO.

PostgreSQL

PostgreSQL is a powerful, open source object-relational database system that uses and extends the SQL language combined with many features that safely store and scale the most complicated data workloads. It is possible to define our own data type, build out custom functions, even write code from different programming languages without recompiling your database. It is an open source software (free software). PostgreSQL is highly extensible

Features

PostgreSQL comes with many features aimed to help developers build applications, administrators to protect data integrity and build fault-tolerant environments, and help you manage your data no matter how big or small the dataset. PostgreSQL has been proven to be highly scalable both in the sheer quantity of data it can manage and in the number of concurrent users it can accommodate. There are active PostgreSQL clusters in production environments that manage many terabytes of data, and specialized systems that manage petabytes.

Memory Management

Memory management in PostgreSQL is more important factor for improving the performance of the database server. The parameters use default values, but it is possible to change these values to better reflect workload and operating environment. Memory in

PostgreSQL can be classified into two categories: 1. Local Memory area: It is allocated by each backend process for its own use. 2. Shared memory area: It is used by all processes of a PostgreSQL server. It allocates memory within a section known as memory contexts, which provide a convenient method of managing allocations made in many different places that need to live for differing amounts of time. Destroying a context releases all the allocated memory that was allocated as a data storage. Thus, it is not necessary to keep track of individual objects to avoid memory leaks, instead only a relatively small number of contexts have to be managed.

Database Server

PostgreSQL provides two interactive ways of connectivity with the database server. The one with SQL Shell Command looks to act as a command prompt. The other one is with the PgAdmin application fig 17 which interacts with you with the database server with an intuitive user interface. Most of the users prefer the second one as the easiest and interactive way to connect with the database server. After opening that GUI application, you can do further progress on naming the host, password, server. It has the easier way to add, update, delete the data using the Query tool.

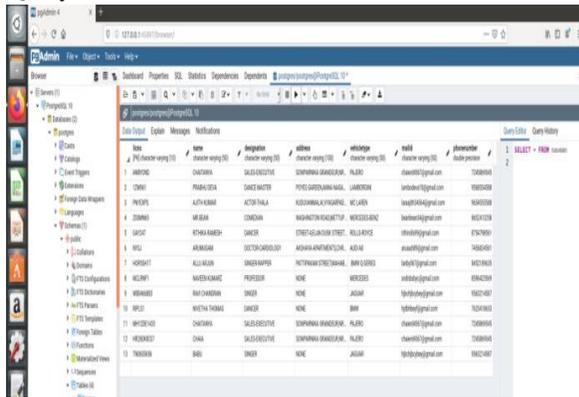


Fig 17 PgAdmin Application

Establishing Connection with Python

Python is a high-level programming language with object-oriented structures and dynamic aspects. It is a simple language to learn and program it but has a high-level built-in data structures which enable for Rapid Application Development. However, we need a medium to be connected with the database and python. So, we develop python database applications with PostgreSQL database server using several modules

like Psycopg2, pg8000, py-postgresql, pyGresql, ocpgdb, etc. We use “Psycopg2” because it is thread-safe, designed for multi-threaded applications, and actively maintains and supports the latest python versions.

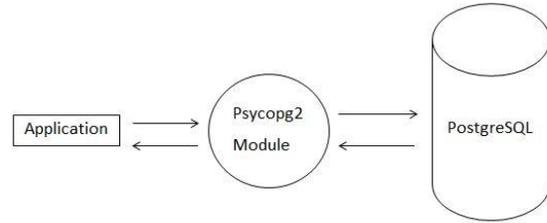


Fig 18 Database connectivity

Data Retrieval

In this part, the details of the vehicle are found from the database using the license plate number which is extracted from the image. In the database, the license plate number is made as a primary key so that there won't be any repetition in the vehicle's details. After we got the license plate number, we pass it to the database server using the Psycopg2 module which bridges the connection between the server and the application. Once the module receives the data, it starts establishing the connection with the database using the hostname, password, and port number. After establishment, the license number is searched in the list of data. When it is found, the data of that particular data is moved to the application and therefore the data is displayed in the terminal.

```

naaveenkarz@naaveenkarz-Lenovo-IdeaPad-S145-15JWL:~/Desktop/OpenCV_3_license_plate_recognition_5$ python Main.py
step 2 · len(contours) = 1914
step 2 · intCountOfPossibleChars = 106
step 2 · len(listOfPossibleCharsInScene) = 106
step 3 · listoflistsOfMatchingCharsInScene.Count = 1

possible plate 0, click on any image and press a key to continue . . .

plate detection complete, click on any image and press a key to begin char recognition . . .

chars found in plate number 0 = TN0655656, click on any image and press a key to continue . . .

char detection complete, click on any image and press a key to continue . . .

license plate read from image = TN0655656

.....
('Owner Name', 'BABU')
('Designation', 'SINGER')
('Vehicle name', 'JAGUAR')
('Mail-ID', 'hjbchjbcybey@gmail.com')
('Owner-Address', 'NONE')
('Phone number', '9563214587.0)
  
```

Fig 19 Data is displayed in the terminal

VI. PROPOSED SYSTEM

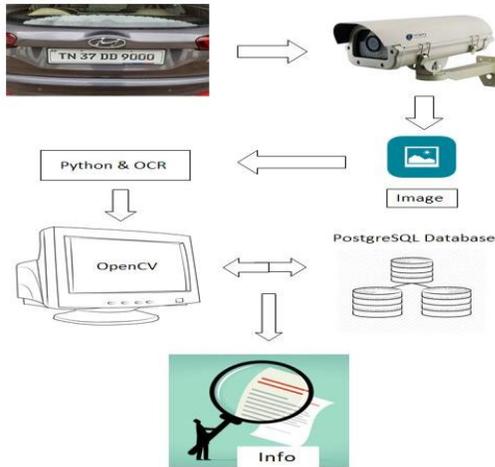


Fig 20 Flow chart of proposed method

Requirements

The main motive of our method is to recognize the license plate from the image and retrieve the details of it. There are some basic requirements to be taken care in our proposed method as follows:

- The license plate should be captured with a High-Resolution camera with good exposure. (Minimum Pixel: 5MP)
- The camera and the license plate should be parallel and straight to each other at the right angle. (angle = 90 degree)
- The font type and style of the plate should be according to the government norms. As people change font types according to their wish, fancy fonts may not work efficiently as the characters and numbers seem pretty the same in different fonts. So, the same font type and style are highly recommended.

Additional Features

In this 21st Century, with the growing technology maintaining handwritten papers and records of the vehicles are more difficult and even there is a chance of data misplacement. To avoid this situation, our paper forms a basis for it with the OCR image processing algorithm and the database server. As a whole, the traditional methods of recognizing characters from the license plate are the same as those with the OCR concept. Here, the additional feature is that connecting with the database directly with the application to be known about the details of the vehicle at the instance the image is captured and loaded. Database Connectivity is our main objective in this

method in which millions of data can be stored and maintained. Older systems of entering data and maintaining records will vanish with this system.

Results

This proposed method is precise in recognizing the license plates on implementation and retrieve data from the database. Performance and efficiency in recognition might go down only because of the mismatched font type and styles. Other than that, this system is exact to about 95% in recognizing the character and data retrieval. The performance of the system was evaluated by recognizing some license plates and the results of the same are shown below. This system thus relieves the need for a faster and accurate license plate recognition system, which can be used in various departments like transportation, law and order, private surveillance systems, etc., The recognition is complete and useful by accessing the database. This system can also be used in organizations and various institutions were the owner of a particular vehicle has to be found on various occasions. Moreover, the system can be used as a subsidiary in parking management system, where once the car enters the main gate, the parking lot of the respective car can be automatically freed from other occupancies.

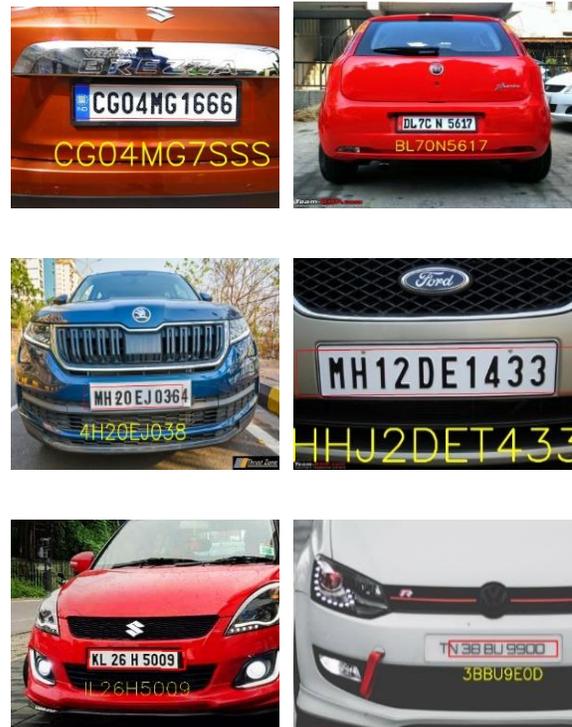


Fig 11.3.1 Recognised license plates

VII. CONCLUSION AND FUTURE SCOPE

Efficiency and performance are measured with the number of plates as dataset and verified if it gets correctly recognized. The motive of this paper is to show how the license plate recognition is applied with the database server which enables you to implement in the real-world application, to get the vehicle's information at an instance. This technology can be applied in the fields where the vehicles have to be monitored 24/7 especially parking lots of Malls, Colleges, Security areas like Bank Parking, Jewelry shop, and even in Highways and traffic signals. This system works satisfactorily in every area under all illumination conditions.

In the future, we will come out with updated algorithms and a wider range of connectivity using the Internet of Things so that the responsible person will receive the information of the vehicle at his/her workstation and makeover an action at an instant. We would do some analysis so that the accuracy of the system is improved to 100%. As the world is moving towards Smart Automation, we would try to bring the OCR and the Recognition algorithm to be best suited in our hands with an easy access and compact system.

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