

Automatic Number Plate Recognition System (ANPR)

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Abstract: Object detection and Image processing are combinedly vast area of research. Various Notable works have been done in the field of transportation in order to ensure a healthy and lawful traffic environment. A precise and quick vehicle number plate recognition system is a solution to traffic control and resultant in improved regulations. This paper is based on optical character recognition which uses improved techniques and ensures optimized results. A full fledged algorithm of number plate recognition is proposed and the same acquires upgraded accuracy over existing system. The entire system can be mounted as a solution traffics issues related to law and security. Automatic Number Plate Recognition (ANPR) system consists integration of machine learning together with image processing and pattern identification. Optical character recognition (OCR) is an algorithm that plays an important role in automatic number plate recognition and it is one of the main aspect of Research in machine learning and computer vision that has evolved immensely since its inception.

Keywords: Machine learning, ANPR, Software Development Life Cycle - Spiral Model, OCR-Optical character Recognition, KNN classifier, openCV2 image processing; computer vision; intelligent transportation system; smart vehicle technologies; object detection and tracking; Character and digit recognition

I. INTRODUCTION

Every country uses their own way of designing and allocating number plates to their country vehicles. This license number plate is then used by various government offices for their respective regular administrative task like- traffic police tracking the people who are violating the traffic rules, to identify the theft cars, in toll collection and parking allocation management etc. In India all motorized vehicle are assigned unique numbers. These numbers are assigned to the vehicles by district-level Regional Transport Office (RTO). In India the license plates must be kept in both front and back of the vehicle. These plates in general are easily readable by human due to their high level of intelligence on the contrary; it becomes an extremely difficult task for the computers to do the same. Many attributes like illumination, blur, background color, foreground color etc. will pose a problem. Also, the License Plate Recognition (LPR) in India is difficult because the traffic rules are hardly obeyed and the number plate standards are not strictly practiced. Each one is adopting a different style leading to obtaining variation in parameters like, size of number plate and characters, location of number plate, type of font used, background (white background with black letters for non commercial vehicles and white background with yellow letters for commercial vehicles), different unwanted pictures etc. which makes the task of number plate localization very difficult. The main aim of this proposed system is to implement an efficient method to recognize license plates and extract text from them under Indian conditions. This work is carried over for on car number plates as well as on two wheeler number plates.

A typical example of an Indian license plate for car is shown in the figure 1 with the significance of each character (1. State Code, 2. District Code, 3.Type of Vehicle (car, two wheeler, commercial etc.) 4. Actual Registration Number)



Figure 1 Number Plate

A sample two wheeler license plate is given in figure 1. Even many two wheeler license plates are arranged in row wise like in figure 1. Thus in India there is no defined alienation followed for writing the license number plates.

1.1 Motivation

Automatic Number Plate Recognition is a computer vision technology that efficiently identifies vehicle number plates from images without the need for human intervention. In recent years, it has become more and more important due to three main factors: the growing number of cars on the roads, the rapid development of image processing techniques and the great quantity of real-life applications that this technology offers. Some of the most typical applications of ANPR systems are traffic law enforcement, automatic toll collection or parking lot access control. But this technology is also widely used for other, perhaps, more inspiring purposes like crimes resolution, as it helps to identify the cars of the offenders

1.2 Functional Requirements

Operating environment for the automatic number plate recognition system is as follows:

- Client Server System
- Tensor-flow Environment.
- Platform: python 3

1.3 System Features (Functional requirements)

A. Client/Server System

The term client/server refers primarily to an architecture or logical division of Responsibilities, the client is the applications (also known as the front-end), and the server Is a distributed system in which Some sites are client and others are servers Sites.

All the data resides at the server sites.

All applications execute.

B. External Interface Requirements

User Interfaces

The GUI of the proposed system has been made interactive and attractive at the same time. The user goes to the web address of the proposed model and can either use the 'Browse image' function to detect the number plate out of the image. He/She, then clicks on the button to get the availability status of the number Plate. He/She can check if the details are matching with whatever the driver has said. Apart from this, If any of the users documents have not registered to the Database then it will show not registered as it is based on GUI window.

Hardware Interfaces

- A computer or laptop in offices/institutes
- Mobile Phone
- Internet connectivity

Software Interfaces

Following are the software used for the

- Windows 7 or later version
- Linux 14.0 or later version
- OS X 10.5 Leopard or later
- Browser(Google Chrome/firefox/Internet Explorer
- The GUI designed system

Communication Interfaces

The communication interfaces that we will need for our project are as follows

- High speed Internet connections.
- Good mobile network coverage.

Nonfunctional Requirements

Non-functional requirements cover all the remaining requirements which are not covered by the functional requirements. They specify criteria that judge the operation of a system, rather than specific behaviour's. of Some typical non-functional requirements are:

Stability

This allows the business to remain stable. The IT infrastructure is sustainable and guaranteed support the business operations for an estimated period into the future.

Confidentiality

The degree to which the software system protects sensitive data and allows only authorized access to the data. The system restart cycle must execute completely in less than 60 seconds.

Availability

The degree to which users can depend on the system to be up (able to function) during "normal operating times". Unless the system is non-operational, the system shall present a user with notification informing them that the system is unavailable.

Reliability

The extent to which the software system consistently performs the specified functions without failure. The data transmission process shall confirm the receiving terminal is in a ready state prior to the start of transmission.

Reusability

The extent to which a portion of the software system can be converted for use in another system. Application shall be developed to adhere to Graphics User Interface guidelines and standards.

Maintainability

The ease with which faults in a software system can be found and fixed. The system shall not be shut down for maintenance more than once in a 24-hour period.

Scalability

The degree to which the system is able to expand its processing capabilities upward and outward to support business growth. The business rules repository shall be scalable to manage an unrestricted number of additional rules.

Security

The extent to which the system is safeguarded against deliberate and intrusive faults from internal and external sources. Users must change the initially assigned login authentication information (password) immediately after the first successful login. The initial password may never be reused

Scope of this Paper

The scope of our project is to recognize the vehicle number and display the details regarding insurance and license registration. The main objective is to develop an efficient, fast and reliable ANPR application that is able to compete with other recently developed ANPR systems of similar characteristics and to create a full vehicle images dataset in order to be able to both train and test the Machine Learning algorithms and to evaluate the performance of the developed system.

Number Plate Detection

As we have developed a system that is based on spiral model the working of system is divided into 4 quadrant and the work flow is depends on quadrant but the important thing to is to discuss over the number plate . As we know that this project is based on optimizing characters and numbers from number plate with the help of an image for the accuracy. Therefore, what should be the quality of the image ? This is one of the priority question that should be solved first. Hence,

1. Plate size: a plate can be of rectangular in size in a vehicle image.
2. Plate area: a plate can be located anywhere in the vehicle.
3. Plate BG-color: A plate can have different background colors based on vehicle authorization. We can see that a government vehicle number plate may be in different background than other vehicles.
4. Screw: Problem is that a plate may have screw and that could be considered as a character.

Edge Detection

Edge detection is fundamental method for feature detection or feature extraction. In general case the result of applying edge detection of algorithm is an object boundary with connected curves. It becomes very difficult to apply this method to complex images as it might result with object boundary with not connected curves. Different edge detection algorithm / operators such as Canny, Canny-algorithm, is used for edge detection.

Proposed Methodology

The user of the system will have either of the two options :

Capture/Upload to detect the license number plate. Post successful detection of number plate, the user will be able to check if the following vehicle exists in the database or not and if it is available, then it will convey the availability status. This will be followed by an alert box containing the thorough details of the Registered Vehicle.

Assumptions: The application is used on a computer with enough performance ability, and the use of an up to-date internet browser. If the computer does not have enough performance to support the back-end (the input of mental commands from the hardware), then there may be scenarios Assumptions: The application is used on a computer with enough performance ability, and the use of an up to-date internet where the application does not work as intended. This could cause performance and usability issues for the user.

Main Dependency:

Internet is required.

II. ANALYSIS MODELS- SDLC MODEL TO BE APPLIED

Software Development Life Cycle (SDLC) is a process used by the software industry to design, develop and test high quality software. The SDLC aims to produce a high- quality software that meets or exceeds customer expectations, reaches completion within times and cost estimates. It is also called as Software Development Process. SDLC is a framework defining tasks performed at each step in the software development process. consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process. SDLC Models There are various software development life cycle models defined and designed which are followed during the software development process. These models are also referred as Software Development Process Models". Each process model follows a Series of steps unique to its type to ensure success in the process of software development. For our project we are using Spiral model.

Spiral model is one of the most important Software Development Life Cycle models, which provides support for Risk Handling. In its diagrammatic representation, it looks like a spiral with many loops. The exact number of loops of the spiral is unknown and can vary from project to project. Each loop of the spiral is called a Phase of the software development process. The exact number of phases needed to develop the product can be varied by the project manager depending upon the project risks. As the project manager dynamically determines the number of phases, so the project manager has an important role to develop a product using spiral model. The Radius of the spiral at any point represents the expenses(cost) of the project so far, and the angular dimension represents the progress made so far in the current phase.

Below diagram shows the different phases of the Spiral Model:

Each phase of Spiral Model is divided into four quadrants as shown in the above figure. The functions of these four quadrants are discussed below-

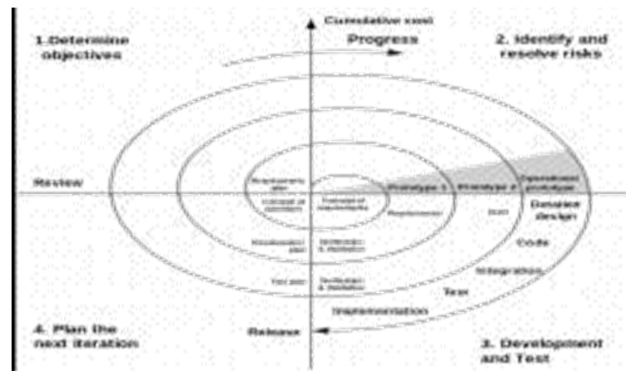


Figure 2: SDLC Spiral Model

I. Objectives determination and identify alternative solutions:

Requirements are gathered from the customers and the objectives are identified, elaborated and analyzed at the start of every phase. Then alternative solutions possible for the phase are proposed in this quadrant.

II. Identify and resolve Risks:

During the second quadrant all the possible solutions are evaluated to select the best possible solution. Then the risks associated with that solution is identified and the risks are resolved using the best possible strategy. At the end of this quadrant, Prototype is built for the best possible solution.

III. Develop next version of the Product:

During the third quadrant, the identified features are developed and verified through testing. At the end of the third quadrant, the next version of the software is available.

IV. Review and plan for the next Phase:

In the fourth quadrant, the Customers evaluate the so far developed version of the software. In the end, planning for the next phase is started.

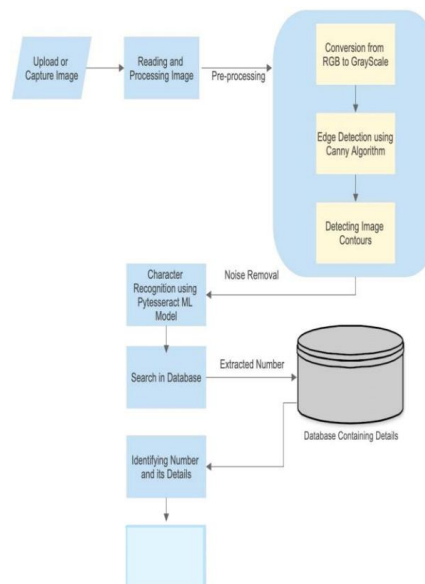


Figure 3: Flow of the System

Operating environment for the automatic number plate recognition system is as follows:

- Client Server System
- Tensorflow Environment
- Platform: python 3

Related work in number plate detection

There are different terminologies used for ANPR systems:

- Number plate Recognition (NPR)
- Automatic License Plate Recognition (ALPR)
- License Plate Recognition (LPR)
- License Plate Recognition (LPR)
- Automatic Vehicle Identification (AVI)
- Car Plate Recognition (CPR)

This paper provides a systematic review of the existing ANPR techniques. It covers the main features of ANPR systems by analyzing their performance summary, pros and cons accordingly. This research aims to advance the state of knowledge in smart vehicle technologies for future researchers.

- Providing a detailed knowledge on past and current algorithms for Automatic number plate recognition systems.
- Analyzing and presenting a survey of ANPR image processing based techniques for each stage systematically, (Number plate: Extraction, Segmentation followed by Recognition), with relevant brief of the techniques used at each stage along with the performance summary, where applicable.
- Summarizing the performance of different algorithms used and tested by various researchers for vehicle recognition.
- Summarizing previous reviews and surveys related to ANPR.
- Providing the performance summary with analysis and limitations.
- Providing list of useful ANPR datasets which the researchers may utilize to test their algorithms,
- Discussing current and future trends in the area of ANPR.
- Discussing and citing relevant prior work for all ANPR techniques listed.

Some ANPR systems may use simple image processing techniques, performed under controlled conditions for predictable license plate styles. However, dedicated object detectors-such as HOG, CNN, SVM and YOLO to name a few-are used by advanced ANPR systems. Further advanced and intelligent ANPR systems utilize state-of-the-art ANPR software based on Neural Network techniques with AI capabilities. Just like many other fields, computer vision and machine learning have applications in ANPR too. The sheer diversity of license plate types across territories, states and countries makes ANPR challenging. The fact that any ANPR algorithm will need to work in real time further complicates Number Plate identification. Hence, utilizing ML, CV, AI techniques can relevantly empower ANPR.

III. CONCLUSION

In this paper, the Automatic Number Plate Recognition system using vehicle license plate is presented. This system use image processing techniques for recognition of the vehicle from the database stored in the computer. The system works satisfactorily for wide variation of conditions and different types of number plates. The system is implemented and executed in Matlab and performance is tested on genuine images. This ANPR system works quite well however, there is still room for improvement. This ANPR system speed can be increase with high resolution camera. Which can be able to capture clear images of the vehicle. The OCR method is sensitive to misalignment and to different sizes, so we have to create different kind of templates for different RTO specifications. The statistical analysis can also be used to define the probability of detection and recognition of the vehicle number plate. At present there are certain limits on parameters like speed of the vehicle, script on the vehicle number plate, skew in the image which can be removed by enhancing the algorithms further.

IV. FUTURE WORK AND SCOPE

There no need to give pre- defined direction, angles, speed and size in which the plate would be passing the camera field of view. Also Smaller cameras which can read license plates at high speed, along with smaller, more durable processors that can fit in police vehicles, allowed law enforcement officers to patrol daily with the benefit of license plate recognition in real time Today advances technology took Automatic Number Plate Recognition (ANPR) systems from hard to set up, limited expensive, fixed based applications to simple mobile ones in which “point to shoot” method can be used. This is possible because of the creation of software which ran on cheaper PC based and also non specialist hardware in which.

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