VEHICLE NUMBER PLATE DETECTION

MINI PROJECT REPORT

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BONAFIDE CERTIFICATE

This is to certify that the mini project work entitled **"VEHICLE NUMBER PLATE DETECTION"** is a bonafide work done by **G.AKASH [REGISTER NO: 20TD0306], S.BHALAMOURALE [REGISTER NO: 20TD0317], F.FAYAZ [REGISTER NO: 20TD0326], M.MANIKANDAN [REGISTER NO: 20TD0347]** in partial fulfillment of the requirement for the award of B.Tech Degree in Computer Science and Engineering by Pondicherry University during the academic year 2022 -23.

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ABSTRACT

Automatic license plate recognition (ALPR) is the extraction of vehicle license plate information from an image or a sequence of images. The extracted information can be used with or without a database in many applications, such as electronic payment systems (toll payment, parking fee payment), and freeway and arterial monitoring systems for traffic surveillance. The ALPR uses either a color, black and white, or infrared camera to take images. The quality of the acquired images is a major factor in the success of the ALPR. ALPR as a reallife applicationhas to quickly and successfully process license plates under different environmental conditions, such as indoors, outdoors, day or night time. It should also be generalized to process license plates from different nations, provinces, or states.

These plates usually contain different colors, are written in different languages, anduse different fonts; some plates may have a single-color background and others have background images. The license plates can be partially occluded by dirt, lighting, and towing accessories on the car. In this paper, we present a comprehensive review of the state-of-threat techniques for ALPR. We categorize different ALPR techniques according to the features they used for each stage, and compare them in terms of pros, cons, recognition accuracy, and processing speed. Future forecasts of ALPR are given at the end.

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LIST OF ABBREVIATIONS

ML - **M**achine **L**earning

ALPR - **A**utomatic **L**icense **P**late
Recognition

OPENALPR - **O**pen **A**utomatic **L**icense **P**late

OPENCV - **O**pen **S**ource **C**omputer **V**ision
Library

CHAPTER I

1. INTRODUCTION

1.1 OVERVIEW

Number Plate recognition plays an important role in various applications such as traffic monitoring on road, automatic toll payment, parking lots access control, detection of stolen vehicles. To identify a car number plate is effective because of its uniqueness of the car. Real time number plate recognition plays an important role in automatic monitoring of traffic rules. The recognition of car number plate can be used for automatic car parking because each car has its own identification number. The camera is used to capture the image automatically and can be used for many application such as automatic toll plaza and car parking.

1.2 Objective

This is based on various operation such as image enhancement, morphological transformation, edge detection and extraction of number plate from vehicle image. After this segmentation is applied to recognize the characters present on number plate using template matching. This algorithm can recognize number plate quickly and accurately from the vehicles image.

1.2.1 Fundamental steps in OCR

➢ Image division into small images □

   -detecting probable number plate area □

➢ Recognizing number plate area ☐

➢ Parsing number plate to extract characters ☐

➢ Apply OCR to the parsed character

1.3 Motivation
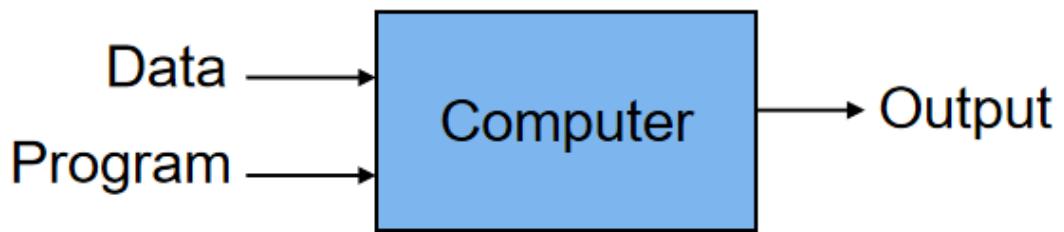
For the standard number plates the automatic number plate recognition becomes very easy to read and recognizes the character. In India the vehicle number plates has no standard size and font so it become very difficult to read and recognize the characters of the number plate. So we are using machine learning algorithm to solve this problem.

1.4 DOMAIN DESCRIPTION
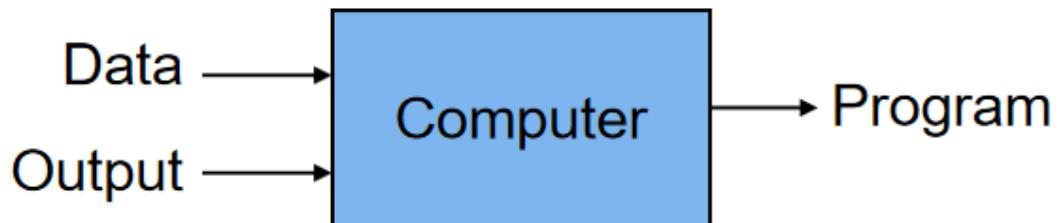
1.4.1 Machine Learning

Machine Learning (ML) is an automated learning with little or no human intervention. It involves programming computers so that they learn from the available inputs. The main purpose of machine learning is to explore and construct algorithms that can learn from the previous data and make predictions on new input data. To solve this problem, algorithms are developed that build knowledge from a specific data and past experience by applying the principles of statistical science, probability, logic, mathematical optimization, reinforcement learning, and control theory.

Traditional Programming

```
Data  ───▶ ┌──────────┐
            │ Computer │ ───▶ Output
Program ──▶ └──────────┘
```

Machine Learning

```
Data   ───▶ ┌──────────┐
            │ Computer │ ───▶ Program
Output ───▶ └──────────┘
```

Applications of Machine Learning

➤ Vision processing

➤ Language processing

➤ Forecasting things like stock market trends, weather

➤ Pattern recognition

➤ Games

➤ Data mining

➤ Expert systems

➤ Robotics

Steps Involved in Machine Learning

✓ Defining a Problem

✓ Preparing Data

✓ Evaluating Algorithms

✓ Improving Results

✓ Presenting Results

Types of Learning

Supervised (inductive) learning

Training data includes desired outputs

Unsupervised learning

Training data does not include desired outputs

Reinforcement learning

Rewards from sequence of actions

Supervised Learning

Supervised learning is commonly used in real world applications, such as face and speech recognition, products or movie recommendations, and sales forecasting. Supervised learning can be further classified into two types - Regression and Classification.

Regression

Regression trains on and predicts a continuous-valued response, for example predicting real estate prices.

Classification

It attempts to find the appropriate class label, such as analyzing positive/negative sentiment, male and female persons, benign and malignant tumors, secure and unsecure loans etc.

Unsupervised Learning

Unsupervised learning is used to detect anomalies, outliers, such as fraud or defective equipment, or to group customers with similar behaviors for a sales campaign. It is the opposite of supervised learning. There is no labeled data here. Unsupervised learning algorithms are extremely powerful tools for analyzing data and for identifying patterns and trends. They are most commonly used for clustering similar input into logical groups. Unsupervised learning algorithms include Kmeans, Random Forests, Hierarchical clustering and so on.

Reinforcement Learning

Here learning data gives feedback so that the system adjusts to dynamic conditions in order to achieve a certain objective. The system evaluates its performance based on the feedback responses and reacts accordingly. The best known instances include self-driving cars and chess master algorithm AlphaGo. Decision making (robot, chess machine)

2 LITERATURE SURVEY

1.A New Approach for Vehicle Number Plate Detection

Authors: Sarthak Babbar ; Saommya Kesarwani ; Navroz Dewan ; Kartik Shangle ; Sanjeev Patel, 2018

Identification of cars and their owners is a tedious and error prone job. The advent of automatic number plate detection can help tackle problems of parking and traffic control. The system is designed using image processing and machine learning. A new system is proposed to improve detection in low light and over exposure conditions. The image of vehicle is captured, which is preprocessed using techniques like grayscale, binarization. The resultant image is passed on for plate localization, for extracting the number plate using CCA (Connected Component Analysis) and ratio analysis. The characters of the number plate are segmented by CCA and ratio analysis as well. Finally, the recognized characters are compared using techniques such as SVC KNN, Extra Tree Classifier. The proposed techniques help the system to detect well under dim light, over-exposed images and those in which the vehicle is angled.

2.A hierarchical license plate recognition system using supervised K-means and Support Vector Machine

Authors: Wei-Chen Liu ; Cheng-Hung Lin, 2017

License plate recognition technology has been widely used in parking lot management systems which has fixed shooting angle and lighting environments. The license plate recognition used in traffic monitor will encounter difficulties in character recognition due to factors such as shooting angle, vehicle speed and environment light and shadow. The supervised K-means is used to classify characters into subgroups. The advantage of the proposed approach is to reduce the classes of characters in each subgroup to further reduce the number of SVMs and their complexity, and thus improve the accuracy of character recognition. Experimental results show that our proposed hierarchical architecture achieves an accuracy of 98.89% in character recognition. Compared with the license plate recognition technology using SVM alone, we get a 3.6% improvement in recognition rate.

3.Deep Learning System for Automatic License Plate Detection and Recognition

Authors: Zied Selmi ; Mohamed Ben Halima ; Adel M. Alimi, 2017

The detection and recognition of a vehicle License Plate (LP) is a key technique in most of the applications related to vehicle movement. Moreover, it is a quite popular and active research topic in the field of image processing. Different methods, techniques and algorithms have been developed to detect and recognize LPs. Nevertheless, due to the LP

characteristics that vary from one country to another in terms of numbering system, colors, language of characters, fonts and size. Further investigations are still needed in this field in order to make the detection and recognition process very efficient. Although this domain has been covered by a lot of researchers, various existing systems operate under well-defined and controlled conditions.

4.Automatic number plate recognition for motorcyclists riding without helmet

Authors: Yogiraj Kulkarni ; Amit Kamthe ; Shubhangi Bodkhe ; Archana Patil, 2018

Motorcycles have always been the primary mode of transport in developing countries. In recent years, there has been a rise in motorcycle accidents. One of the major reasons for fatalities in accidents is the motorcyclist not wearing a protective helmet. The most prevalent method for ensuring that motorcyclists wear helmet is traffic police manually monitoring motorcyclists at road junctions or through CCTV footage and penalizing those without helmet. But, it requires human intervention and efforts. This paper proposes an automated system for detecting motorcyclists not wearing helmet and retrieving their motorcycle number plates from CCTV footage video. The proposed system first does background subtraction from video to get moving objects. Then, moving objects are classified as motorcyclist or non-motorcyclist.

5.Automatic car number plate recognition

Authors: Anumol Sasi ; Swapnil Sharma ; Alice N. Cheeran, 2017

A traffic surveillance system includes detection of vehicles which involves the detection and identification of license plate numbers. This paper proposes an intelligent approach of detecting vehicular number plates automatically using three efficient algorithms namely Ant colony optimization (ACO) used in plate localization for identifying the edges, a character segmentation and extraction algorithm and a hierarchical combined classification method based on inductive learning and SVM for individual character recognition. Initially the performance of the Ant Colony Optimization algorithm is compared with the existing algorithms for edge detection namely Canny, Prewitt, Roberts, Mexican Hat and Sobel operators. The Ant Colony Optimization used in communication systems has certain limitations when used in edge detection like random initial ant position in the image and the heuristic information being highly dictated by transition probabilities. In this paper, modifications like assigning a well-defined initial ant position and making use of weights to calculate heuristic value which will provide additional information about transition probabilities are used to overcome the limitations.

6.License Plate Detection with Machine Learning Without Using Number Recognition

Authors: Kazuo Ohzeki ; Max Geigis ; Stefan Alexander Schneider, 2019

In autonomous driving, detecting vehicles together with their parts, such as a license plate is important. Many methods with using deep learning detect the license plate based on number recognition. However, there is an idea that the method using deep learning is difficult to use for autonomous driving because of the complexity in realizing deterministic verification.

Therefore, development of a method that does not use deep learning(DL) has become important again. Although the authors have made the world's best performance in 2018 for Caltech data with using DL, this concept has now turned to another research without using DL. The CT5L method is the latest type, that includes techniques of the continuity of vertical and horizontal black-and-white pixel values inside the plate, unique Hough transform, only vertical and horizontal lines are detected, the top five in the order of the number of votes to ensure good performance. In this paper, a method to determine the threshold value for binarizing input by machine learning is proposed, and good results are obtained. The detection rate is improved by about 20 points in percent as compared to the fixed case. It achieves the best performance among the conventional fixed threshold method, Otsu's method, and the conventional method of JavaANPR.

7.A New Convolutional Architecture for Vietnamese Car Plate Recognition

Authors: Thanh-Nga Nguyen ; Duc-Dung Nguyen, 2018

License plate recognition is a form of an intelligent transportation system. Although, there have been many studies on plate detection, character segmentation, and character recognition, many challenges have still remained. Convolutional Neural Network (CNN) has proven to be a powerful classification tool to achieve state-of-the-art results on various recognition tasks. In the problem of number plate recognition, CNN based methods are being used to solve problems such as plate detection, character segmentation, and character recognition. Quality of identification depends on the quality of each task. Viet Nam does not have a recognition system that combines the three tasks together. So, our key idea is to combine

detection, segmentation, and recognition of multi-character number plates using CNN. Our purpose is to recognize the full sequence of the number plate without pre-segmentation. This paper presents a CNN-based method for high accuracy car license plate recognition. The presented methods are evaluated 1,000 plate images of US car plates and 1,000 plate images for Vietnamese car plate recognition. The experimental results show that our network achieves better performance than many standard plate detection and recognition algorithms. This dataset and the investigation results could be used as a baseline for future research in the field.

8.Bangladeshi License Plate Recognition Using Adaboost Classifier

Authors: Prashengit Dhar ; Md. Zainal Abedin ; Razuan Karim ; Fatema-Tuj-Johora ; Mohammad Shahadat Hossain, 2019

License plate recognition (LPR) is a technology for the authentication of a vehicle by locating and recognizing the license plate number in an image through computer vision techniques and machine learning models. To develop intelligent traffic management such as vehicle monitoring, LPR is a key component. However, due to the diversity of layouts and characters of plates, universal solution is not possible. So, this research focuses on development of an algorithm for the recognition of license plate of Bangladesh by using image processing's and machine learning model. This algorithm executes in three steps: detection of the plate with shape verification, tilt correction and recognition of the number. For detection, RGB color space, median filtering, binarization, morphological analysis, region properties for filtering are applied. To discard noisy object, shape verification is done through robust distances to borders vectors. Before character segmentation, horizontal tilt correction is applied.

9.Long distance Automatic Number Plate Recognition under perspective distortion using zonal density and Support Vector Machine

Authors: Noprianto ; Sunu Wibirama ; Hanung Adi Nugroho, 2017 3rd International Conference on Science and Technology - Computer (ICST)

Automatic Number Plate Recognition (ANPR) is one of computer vision applications to extract information in vehicles plate number. Nevertheless, perspective distortion is unavoidable when taking pictures of the plate number. Another factor that causes inaccuracy is the distance of the camera from the plate number. To solve these problems, we propose a new method to automatically detect and recognize vehicle plate number with regards to perspective distortion and distance of capturing plate number. We used zonal density with Support Vector Machine (SVM) as a classifier. We tested our algorithm on 21 vehicles plate number with 1, 3, and 5 meter of capturing distance. Our method yields an accuracy of 89.77%, 82.86%, and 65.22% for 1, 3, and 5 meters capturing distance, respectively. Compared with previous work, our method is able to preserve high accuracy when segmenting characters of plate number taken from 5 meter distance.

10.Extraction of number plate images based on image category classification using deep learning

Author: Yoshihiro Shima, 2016

Automated Number Plate Recognition is a technique involving image processing which is used to identify a vehicle by reading its number plate. A proposed method is capable of extracting the number plate region in the image captured from its rear end at various car distances. The system

analyzes the input image and identifies the location of the number plate. The plate candidate region is extracted by using dilation morphology and scoring based on the height-width ratio and the number of connected components in the region. The candidate region images are classified in two classes, namely number plate and outlier images. As image feature extractor, pre-trained CNN (convolutional neural network) is used and as classifier, SVM (support vector machine) is used. The algorithm was implemented by programming language C++ in morphological image processing and MATLAB in pre-trained CNN and SVM parts. The paper shows experimental verification of the algorithm and test results for 126 car images.

CHAPTER III

3 SYSTEM ANALYSIS

3.1Existing System

In previous we used that project in matlab with hardware connection.but now we use no hardware only software.we use only python code & some libraries. The drowsiness detection system is built using MATLAB and Viola Jones Algorithm.

Limitations

1. It is cost of License. Its very costly user has to buy each and every module and pay for it.

2. Disadvantage is during cross compiling or converting Matlab to other language code is very difficult.

3. Its very difficult or requires deep devel Matlab knowledge to deal with all errors

4. It only Detect Licence Plate in recorded footages.
5. It takes time to detect the details of the License Plate.
6. Detects all moving objects.

3.2Proposed System

Minimum image angle: 90 degree (looking straight at the license plate). Image should be captured in daylight. The efficiency of the proposed system can be measured only in terms of number plates successfully and correctly recognized which can only be measured upon implementation. In proposed system it can able to find owner details from captured image. Efficiency and Performance of new system may decline due to discard of

OCR library but the memory requirements will decrease and also the effort for installing, configuring and running the system would decrease.

Advantages of OCR

1.Higher Productivity

OCR software helps businesses to achieve higher productivity by facilitating quicker data retrieval when required.

2.Cost Reduction

Opting for OCR will help businesses on cutting down on hiring professionals to carry out data extraction, which is one of the most important benefits of OCR data entry methods.

3.High Accuracy

One of the major challenges of data entry is inaccuracy. Automated data entry tools such as OCR data entry result in reduced errors and inaccuracies, resulting in efficient data entry.

4.Increased Storage Space

OCR can scan, document, and catalogue information from enterprise-wide paper documents.

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates.

During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential. Three key considerations involved in the feasibility analysis are

     1. Economic feasibility

     2. Technical feasibility

     3. Social feasibility

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands being placed on the client. A feasibility study evaluates the project's potential for success.

SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends

on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

3.3. LANGUAGES USED IN THE SYSTEM

A language is a formal constructed symbol designed to communicate instructions to a machine, particularly a computer. Languages can be used to create programs and control the behavior of the machines or for expressing the algorithms. This work uses python language.

3.3.1 About Python Language

Python is an object-oriented programming language created by Guido Rossum in 1989. It is ideally designed for rapid prototyping of complex applications. It has interfaces to many OS system calls and libraries and is extensible to C or C++. Many large companies use the Python programming language include NASA, Google, YouTube, BitTorrent, etc. Python programming is widely used in Artificial Intelligence, Natural Language Generation, Neural Networks and other advanced fields of

Computer Science. Python had deep focus on code readability & this class will teach you python from basics.

Python Programming Characteristics

➢ It provides rich data types and easier to read syntax than any other programming languages

➢ It is a platform independent scripted language with full access to operating system API's

➢ Compared to other programming languages, it allows more run-time flexibility

➢ It includes the basic text manipulation facilities of Perl and Awk

➢ A module in Python may have one or more classes and free functions

➢ Libraries in Pythons are cross-platform compatible with Linux, Macintosh, and Windows

➢ For building large applications, Python can be compiled to byte-code

➢ Python supports functional and structured programming as well as OOP

➢ It supports interactive mode that allows interacting Testing and debugging of snippets of code

➢ In Python, since there is no compilation step, editing, debugging and testing is fast.

Applications of Python Programming

Web Applications

You can create scalable Web Apps using frameworks and CMS (Content Management System) that are built on Python. Some of the popular platforms for creating Web Apps are: Django, Flask, Pyramid, Plone, Django CMS. Sites like Mozilla, Reddit, Instagram and PBS are written in Python.

Scientific and Numeric Computing

There are numerous libraries available in Python for scientific and numeric computing. There are libraries like: SciPy and NumPy that are used in general purpose computing. And, there are specific libraries like: EarthPy for earth science, AstroPy for Astronomy and so on. Also, the language is heavily used in machine learning, data mining and deep learning.

Creating software Prototypes

Python is slow compared to compiled languages like C++ and Java. It might not be a good choice if resources are limited and efficiency is a must. However, Python is a great language for creating prototypes. For example: You can use Pygame (library for creating games) to create your game's prototype first. If you like the prototype, you can use language like C++ to create the actual game.

Good Language to Teach Programming

Python is used by many companies to teach programming to kids and newbies. It is a good language with a lot of features and capabilities. Yet, it's one of the easiest language to learn because of its simple easy-to-use syntax.

Python GUI Tkinter

Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is the most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter is the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task.

To create a tkinter app:

➢ Importing the module – tkinter

➢ Create the main window (container)

➢ Add any number of widgets to the main window

➢ Apply the event Trigger on the widgets.

Importing tkinter is same as importing any other module in the Python code. Note that the name of the module in Python 2.x is 'Tkinter' and in Python 3.x it is 'tkinter'.

tkinter also offers access to the geometric configuration of the widgets which can organize the widgets in the parent windows. There are mainly three geometry manager classes class.

✓ pack() method:It organizes the widgets in blocks before placing in the parent widget.

✓ grid() method:It organizes the widgets in grid (table-like structure) before placing in the parent widget.

✓ place() method:It organizes the widgets by placing them on specific positions directed by the programmer.

About Opencv Package

Python is a general purpose programming language started by Guido van Rossum, which became very popular in short time mainly because of its simplicity and code readability. It enables the programmer to express his ideas in fewer lines of code without reducing any readability.

Compared to other languages like C/C++, Python is slower. But another important feature of Python is that it can be easily extended with C/C++. This feature helps us to write computationally intensive codes in C/C++ and create a Python wrapper for it so that we can use these wrappers as Python modules. This gives us two advantages: first, our code is as fast as original C/C++ code (since it is the actual C++ code working in background) and second, it is very easy to code in Python. This is how OpenCV-Python works, it is a Python wrapper around original C++ implementation.

And the support of Numpy makes the task more easier. Numpy is a highly optimized library for numerical operations. It gives a MATLAB-style syntax. All the OpenCV array structures are converted to-and-from Numpy arrays. So whatever operations you can do in Numpy, you can combine it with OpenCV, which increases number of weapons in your arsenal.

Besides that, several other libraries like SciPy, Matplotlib which supports Numpy can be used with this.

So OpenCV-Python is an appropriate tool for fast prototyping of computer vision problems.

CHAPTER IV

4.SYSTEM REQUIREMENTS

4.1 HARDWARE REQUIREMENTS

Hardware requirement are the principles used for the implementation of the system which shows what the system does and not how it should be implemented. Software requirements deal with defining software resource requirement and prerequisites that need to be installed on a computer to provide optimal functioning of an application. Such as,

☐

System   : Pentium IV 2.4 GHz

Hard Disk   : 1TB

Floppy Drive   : 1.44 Mb

Monitor   : 15 VGA Colour

Mouse   : Logitech

Ram   : 8Gb

4.2 SOFTWARE REQUIREMENTS

Software is the term for the various kinds of programs used to operate computers and related devices

- ➢ PYTHON 3.7.2
- ➢ PYCHARM
- ➢ OPENCV
- ➢ OPENALPR
- ➢ WINDOWS 10 / 11 OPERATING SYSTEM

4.2.1 CODING LANGUAGES
a) Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

Python is Interpreted − Python is processed at runtime by the interpreter.

Do not need to compile program before executing it. This is similar to PERL and PHP.

Python is Interactive − Can actually sit at a Python prompt and interact with the interpreter directly to write programs.

Python is Object-Oriented − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

Python is a Beginner's Language − Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.
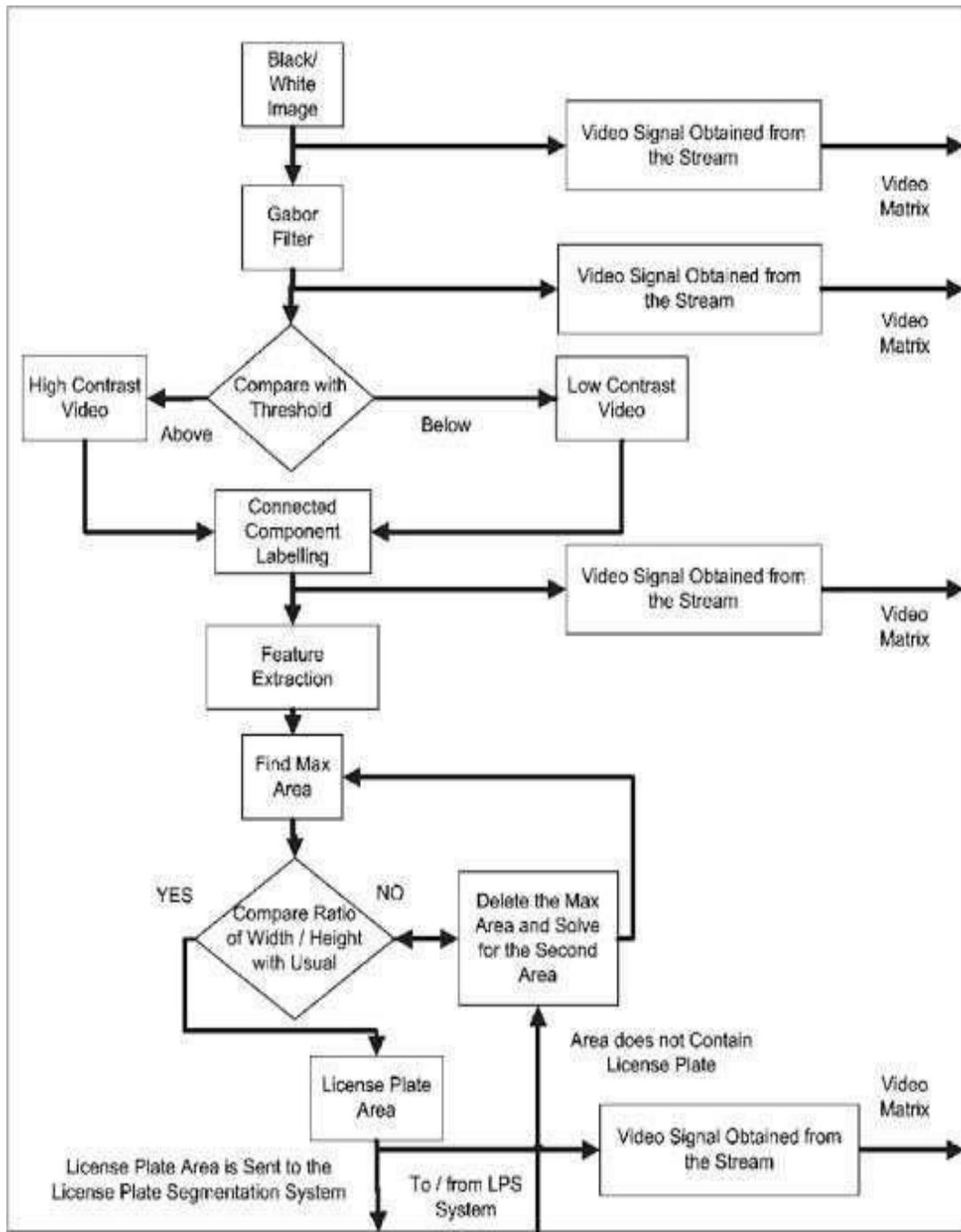
Features

➤ **Easy-to-learn** − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.

➤ **Easy-to-read** − Python code is more clearly defined and visible to the eyes.

➤ **Easy-to-maintain** − Python's source code is fairly easy-to-maintain.

➤ **A broad standard library** − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.

➤ **Interactive Mode** − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

➤ **Portable** − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
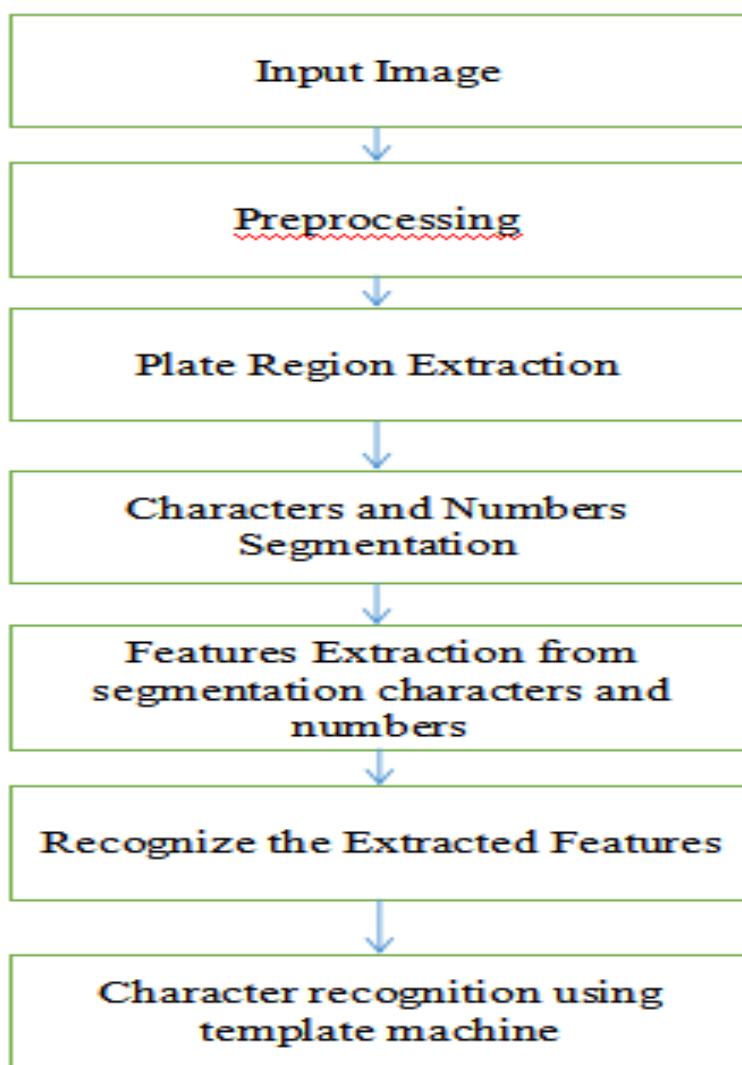
- ➤ **Extendable** − Add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.

- ➤ **Databases** − Python provides interfaces to all major commercial databases.

- ➤ **GUI Programming** − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.

- ➤ **Scalable** − Python provides a better structure and support for large programs than shell scripting.

5.METHODOLOGY

5.1 SYSTEM ARCHITECTURE

Fig.3: System Architecture

```
┌─────────────────────────────────────┐
│            Input Image              │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│           Preprocessing             │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│       Plate Region Extraction       │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│      Characters and Numbers         │
│           Segmentation              │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│     Features Extraction from        │
│   segmentation characters and       │
│             numbers                 │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│   Recognize the Extracted Features  │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│    Character recognition using      │
│          template machine           │
└─────────────────────────────────────┘
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The projected system is to observe every character from range plate one by one. This could be done by morphological operation. It includes a way to section all the characters employed in the quantity plate. Range plate extraction is that stage wherever vehicle range plate is detected. The detected range plate is pre-processed to get rid of the noise then the results passed to the section half to segment the one by one character from the extracted range plate. The divided characters normalized associate degreed passed to an OCR formula. Ultimately the optical character info is going to be regenerate into encoded text. The characters recognized exploitation template matching. The ultimate output should be within the type of string of characters.

5.2MODULES

5.2.1Data Pre-Processing

The entries are present in the dataset. The null values are removed using df = df.dropna() where df is the data frame. The categorical attributes (Date,High,Low,Close,Adj value) are converted into numeric using Label Encoder. The date attribute is splitted into new attributes like total which can be used as feature for the model.

1.DataCleaning:

The data can have many irrelevant and missing parts. To handle this part, data

cleaning is done. It involves handling of missing data, noisy data etc.

2.DataTransformation:

This step is taken in order to transform the data in appropriate forms suitable for mining process.

3.DataReduction:

Since data mining is a technique that is used to handle huge amount of data.While working with huge volume of data, analysis became harder in such cases.In order to get rid of this, we uses data reduction technique. It aims to increase the storage efficiency and reduce data storage and analysis costs.

Convert color to grayscale

Three algorithms for converting color to grayscale

The lightness method averages the most prominent and least prominent colors: (max(R, G, B) + min(R, G, B)) / 2. The average method simply averages the values: (R + G + B) / 3. The luminosity method is a more sophisticated version of the average method

Gaussian filter

A Gaussian filter is a linear filter. It's usually used to blur the image or to reduce noise.The Gaussian filter alone will blur edges and reduce contrast. The Median filter is a non-linear filter that is most commonly used as a simple way to reduce noise in an image.

Edge Detection

Each image (video frame) has three significant features to achieve detection goals. These features include: edges, contours and points. Among mentioned features, an appropriate option is to use edge pixels. Processing of image pixels enables us to find edge pixels, which are the main features of passing vehicles in a roadway video frame.

Edge detection process is demonstrated in a binary image (threshold) with the detected edge pixels.

The next step is to extract moving edges from sequential video frames and process the resulting edge information to obtain quantitative geometric measurements of passing vehicles.

Contour

Contour map uses contours or color-coded regions helps us to visualize 3D data in two dimensions. Contour maps are also used to visualize the error surfaces in deep learning/machine learning optimization techniques

Masking

The idea behind masking is to have two additional arrays that record whether an input or output is actually present for a given time step and example, or whether the input/output is just padding.

Model Creation ;

CNN Algorithm

A convolutional neural network (CNN) is a specific type of artificial neural network that uses perceptrons, a machine learning unit algorithm, for

supervised learning, to analyze data. CNNs apply to image processing, natural language processing and other kinds of cognitive tasks.

CNN image classifications takes an input image, process it and classify it under certain categories.

We have 4 steps for convolution:

➢ Line up the feature and the image

➢ Multiply each image pixel by corresponding feature pixel

➢ Add the values and find the sum

➢ Divide the sum by the total number of pixels in the feature

Training

The training data set in Machine Learning is the actual dataset used to train the model for performing various actions. This is the actual data the ongoing development process models learn with various API and algorithm to train the machine to work automatically.

Testing

It uses patterns identified by your machine learning algorithms to predict. the machine recognizes patterns in the data, the cross-validation data is used to ensure better accuracy and efficiency of the algorithm used to train the machine, and the test data is used to see how well the machine can predict based on its training.

5.2.2 Feature selection:

Features selection is done which can be used to build the model. The attributes used for feature selection are Date,Price,Adj close,Forecast X coordinate , Y coordinate, Latitude , Longitude, Hour and month.

5.2.3 Building and Traning Model:

After feature selection location and month attribute are used for training. The dataset is divided into pair of xtrain ,ytrain and xtest, y test. The algorithms model is imported form skleran. Building model is done using model. Fit (xtrain, ytrain). This phase would involve supervised classification methods like linear regression, Ensemble classifiers (like Adaboost, Random Forest Classifiers), etc.

5.2.4 Number Plate Extraction

The captured image is in capital RGB format. It is converted into grayscale image and into binary image.

5.2.5 Character Segmentation

The character segmentation part further segments the character individually from the extracted number plate. From input image the first process will be to crop out the number plate characters from starting to the ending point leaving all the extra wide spaces from top to below and from right to left as it is. Characters are equally fit in the plate region. For easy comparison of the input character with the character in the data base the result is normalized into the character set as the size of the images in the database.

5.2.6 Optical Character Recognition

The optical character recognition is a recognition method in which the input is an image and the output is string of character. OCR is a process which separates the different characters from each other taken from an image. Template matching is one of the approaches of OCR. The cropped image is compared with the template data stored in database. OCR automatically identifies and recognizes the characters without any indirect input. The characters on the number plate have uniform fonts then the OCR for number plate recognition is less complex as compared to other methods.

5.2.7 Template Matching

Template matching affects the accuracy of Automatic number plate recognition

5.3 UML DIAGRAMS

UML is simply another graphical representation of a common semantic model.UML provides a comprehensive notation for the full life cycle of object oriented development. Unified Modeling Language is a general purpose developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of the system.

UML is a standard language for specifying, visualizing, and documenting of software systems and created by Object Management Group (OMG) in 1997.There are three important type of UML modeling are Structural model, Behavioral model, and Architecture model. To model a system the most important aspect is to capture the dynamic behavior which has some internal or external factors for making the interaction. These internal or external agents are known as actors. It consists of actors, use cases and their relationships. In this fig we represent the Use Case diagram for our project.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems.

The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

GOALS:
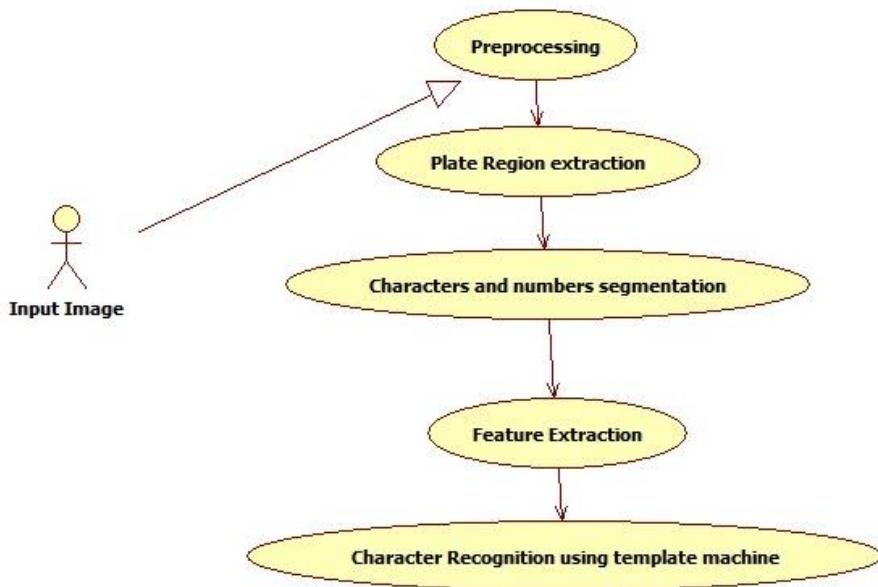
The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.

2. Provide extendibility and specialization mechanisms to extend the core concepts.

3. Be independent of particular programming languages and development process.

4. Provide a formal basis for understanding the modeling language.

5. Encourage the growth of OO tools market.

6. Support higher level development concepts such as collaborations, frameworks, patterns and components.

5.3.1 USECASE DIAGRAM

A use case is a set of scenarios that describing an interaction between a user and a system. A use case diagram displays the relationship among actors and use cases. The two main components a user or another system
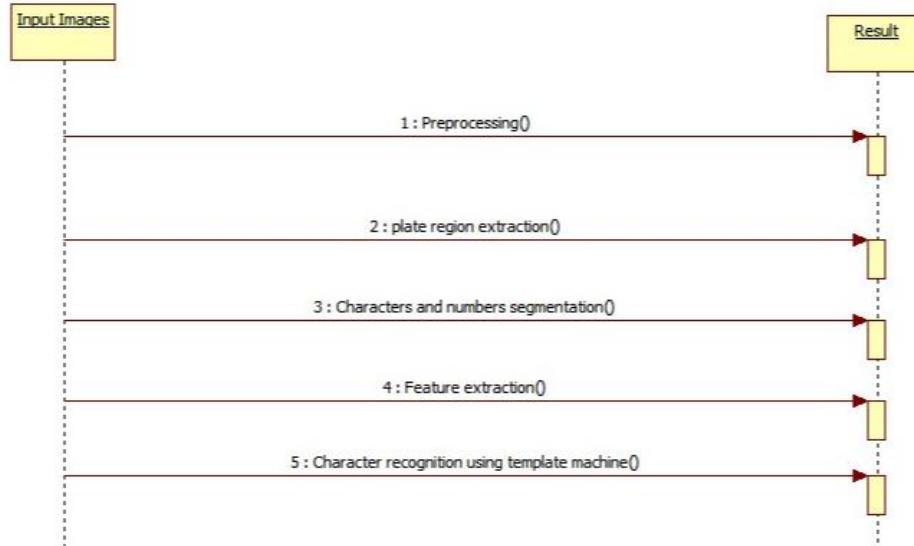
that will interact with the system modeled. A use case is an external view of the system that represents some action the user might perform in order to complete a task.

5.3.2 SEQUENCE DIAGRAM
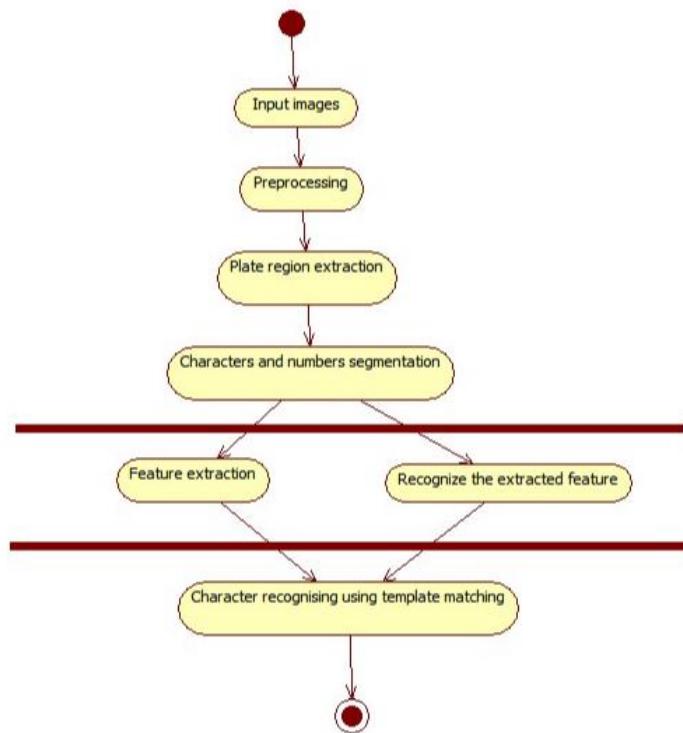
A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence

diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

5.3.3 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

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              ┌──────────────┐
              │ Input images │
              └──────────────┘

              ┌──────────────┐
              │ Preprocessing│
              └──────────────┘

           ┌────────────────────┐
           │ Plate region extraction │
           └────────────────────┘

      ┌──────────────────────────────┐
      │ Characters and numbers segmentation │
      └──────────────────────────────┘

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      ┌──────────────────┐      ┌──────────────────────────┐
      │ Feature extraction │      │ Recognize the extracted feature │
      └──────────────────┘      └──────────────────────────┘

   ════════════════════════════════════════════

      ┌────────────────────────────────────────┐
      │ Character recognising using template matching │
      └────────────────────────────────────────┘

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CHAPTER VI

6.TESTING

6.1 Software Testing

General

In a generalized way, we can say that the system testing is a type of testing in which the main aim is to make sure that system performs efficiently and seamlessly. The process of testing is applied to a program with the main aim to discover an unprecedented error, an error which otherwise could have damaged the future of the software. Test cases which brings up a high possibility of discovering and error is considered successful. This successful test helps to answer the still unknown errors.

6.2 TEST CASE

Testing, as already explained earlier, is the process of discovering all possible weak-points in the finalized software product. Testing helps to counter the working of sub-assemblies, components, assembly and the complete result. The software is taken through different exercises with the main aim of making sure that software meets the business requirement and user-expectations and doesn't fails abruptly. Several types of tests are used today. Each test type addresses a specific testing requirement.

6.3 Testing Techniques

A test plan is a document which describes approach, its scope, its resources and the schedule of aimed testing exercises. It helps to identify almost other test item, the features which are to be tested, its tasks, how will everyone do each task, how much the tester is independent, the environment in which the test is taking place, its technique of design plus the both the end criteria which is used, also rational of choice of theirs, and whatever kind of risk which requires emergency planning. It can be also referred to as the record of the process of test planning. Test plans are usually prepared with signification input from test

engineers.

(I) UNIT TESTING

In unit testing, the design of the test cases is involved that helps in the validation of the internal program logic. The validation of all the decision branches and internal code takes place. After the individual unit is completed it takes place. Plus it is taken into account after the individual united is completed before integration. The unit test thus performs the basic level test at its component stage and test the particular business process, system configurations etc. The unit test ensures that the particular unique path of the process gets performed precisely to the documented specifications and contains clearly defined inputs with the results which are expected.

(II) INTEGRATION TESTING

These tests are designed to test the integrated software items to

determine whether if they really execute as a single program or application. The testing is event driven and thus is concerned with the basic outcome of field. The Integration tests demonstrate that the components were individually satisfaction, as already represented by successful unit testing, the components are apt and fine. This type of testing is specially aimed to expose the issues that come-up by the components combination.

(III) FUNCTIONAL TESTING

The functional tests help in providing the systematic representation that functions tested are available and specified by technical requirement, documentation of the system and the user manual.

(IV) SYSTEM TESTING

System testing, as the name suggests, is the type of testing in which ensure that the software system meet the business requirements and aim. Testing of the configuration is taken place here to ensure predictable result and thus analysis of it.System testing is relied on the description of process and its flow, stressing on pre driven process and the points of integration.

(V) WHITE BOX TESTING

The white box testing is the type of testing in which the internal components of the system software is open and can be processed by the

tester. It is therefore a complex type of testing process. All the data structure, components etc. are tested by the tester himself to find out a possible bug or error. It is used in situation in which the black box is incapable of finding out a bug. It is a complex type of testing which takes more time to get applied.

(VI) BLACK BOX TESTING

The black box testing is the type of testing in which the internal components of the software is hidden and only the input and output of the system is the key for the tester to find out a bug. It is therefore a simple type of testing. A programmer with basic knowledge can also process this type of testing. It is less time consuming as compared to the white box testing. It is very successful for software which are less complex are straight-forward in nature. It is also less costly than white box testing.

(V) ACCEPTANCE TESTING

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

CHAPTER VII

7.RESULT

7.1 CONCLUSION

In this work, we have presented technique to recognize number plate of vehicles. For this, we introduced Image capture, preprocessing, edge detection, segmentation, character resizing, feature extraction and finally recognized character of number plate using machine learning algorithms. Dataset creation consisted number of images which are collected real times, parking and etc.

7.2 FUTURE WORK

Future work lies in producing more accurate results with lesser response time according to the prescribed specifications of vehicle number plates and automated system software is to be developed in future work.

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