License Plate Detection System

A PROJECT REPORT

Submitted by

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M.D UNIVERSITY: ROHTAK

BONAFIDE CERTIFICATE

Certified that this project report **"LICENSE PLATE RECOGNITION SYSTEM."**

is the bonafide work of **"SHARAD MOURYA."** who carried out the project work under my supervision.

SIGNATURE	**SIGNATURE**
SHIKHA HANS	**SUMAN AGGARWAL**
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DECLARATION

I hereby declare that the project work entitled **-License Plate Detection System** I submitted to MDU, Rohtak (Haryana), is a record of an original work done by me under the guidance of **Mrs. Suman Aggrawal**,(Supervisor) and **Miss. Shikha Hans**, (H.O.D.) in Computer Science and Engineering, SATYA COLLEGE OF ENGINEERING AND TECHNOLOGY, and this project work is submitted in the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in COMPUTER SCIENCE AND ENGINEERING.

CERTIFICATE

This is to certify that the project report entitled "**License Plate Detection System**" submitted by **Sharad Mourya** to the Satya College of Engineering and technology, Palwal in partial fulfillment for the award of Degree of Bachelor of Technology in Computer Science and Engineering/Information Technology is a bonafide record of the project work carried out by him undermy supervision during the year 2020.

SUMAN AGGARWAL
(Project Guide)
Designation

Abstract

Automatic Number Plate Recognition (ANPR) is a mass surveillance system that captures the image of vehicles and recognizes their license number. ANPR can be assisted in the detection of stolen vehicles. The detection of stolen vehicles can be done in an efficient manner by using the ANPR systems located in the highways. This paper presents a recognition method in which the vehicle plate image is obtained by the digital cameras and the image is processed to get the number plate information. A rear image of a vehicle is captured and processed using various algorithms. In this context, the number plate area is localized using a novel „feature-based number plate localization" method which consists of many algorithms. But our study mainly focusing on the two fast algorithms i.e., Edge Finding Method and Window Filtering Method for the better development of the number plate detection system.

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CHAPTER: 1

1.Introduction

The massive integration of information technologies, under different aspects of the modern world, has led to the treatment of vehicles as conceptual resources in information systems. Since an autonomous information system has no meaning without any data, there is a need to reform vehicle information between reality and the information system. This can be achieved by human agents or by special intelligent equipment that will allow identification of vehicles by their registration plates in real environments. Among intelligent equipment, mention is made of the system of detection and recognition of the number plates of vehicles. The system of vehicle number plate detection and recognition is used to detect the plates then make the recognition of the plate that is to extract the text from an image and all that thanks to the calculation modules that use location algorithms, segmentation plate and character recognition. The detection and reading of license plates is a kind of intelligent system and it is considerable because of the potential applications in several sectors which are quoted:

Command force: This system is used for the detection of stolen and searched vehicles. The detected plates are compared to those of the reported vehicles.

Parking management: The management of car entrances and exits.

Road safety: This system is used to detect license plates exceeding a certain speed, coupling the plate reading system with road radar, crossing wildfires.

CHAPTER 2

2.Project Explanation

2.1 Introduction

Automatic number plate recognition (ANPR) system has been a practical technique in the past decades. One type of intelligent transportation system (ITS) technology is the automatic number plate recognition (ANPR) which can distinguish each vehicle as unique by recognizing the characters of the number plates. Automatic number plate recognition system finds wide varieties of applications to fit itself beyond just controlling access to a toll collection point or parking lot. In ANPR, a camera captures the vehicle images and a computer processes them and recognizes the information on the number plate by applying various image processing and optical character recognition techniques. Prior to the character recognition, the number plates must be separated from the background vehicle images. This task is considered as the most crucial step in the ANPR system, which influences the overall accuracy and processing speed of the whole system significantly. Since there are problems such as poor image quality, image perspective distortion, other disturbance characters or reflection vehicle surface, and the color similarity between the number plate and the background vehicle body, the number plate is often difficult to be located accurately and efficiently. Generally vehicle number plate recognition is divided into several steps including number plate extraction, image region which contains a number plate, character segmentation, and character recognition. Generally, in order to recognize a vehicle number plate, the region of the number plate should be extracted from a vehicle image. Accurate detection of the plate region is essential process to go over to the step of character recognition. There are two major methods to extract number plate region:-

- Edge Detection

- Finding Rectangles in a Vehicle Image.

2.2 Problem with existing system

The first problem is the non-uniformity of the license number plate models for different cities. It may also vary from one state to another and thus from vehicle to vehicle. Length of the number plates may also vary.

Second prime difficulty is the low resolution of the number plates for vehicles in video frames under typical surveillance systems

2.3 Solution

The solution can be to develop the sequential coordination of image and video processing tasks. This processing sequence may include, algorithms Viz. object tracking and segmentation, locating the license plate area, detecting number and its color.

2.4 Objective of ANPR

The overall objective of the project is to develop a system that recognize vehicle number plate from a car at a gate entrance of a parking area. The software could lead to a less expensive and faster way of enhancing and determining the performance of the recognition system. The system will generate report on the vehicle number plate it has captured. Once the vehicle number plate is captured, the characters will be recognized and displayed on the screen. Apart from this, the system can also serve as a security purpose whereby it can spot on any wanted or stolen vehicles. Earlier it was implemented but had less accuracy. Thus, there is need to address a set of constraints and focus on the design of the algorithm to extract the vehicle number plate in order

to improve the accuracy and efficiency.

2.5 Benefits of ANPR

- Provide access control for your car park
- Effectively control unauthorized commuter parking
- Increase gatehouse efficiency
- Realistic means of logging all vehicles entering and / or leaving a specific location (with an image if desired)
- Automatic visual and audible warning to staff of any vehicle previously entered into the database
- Allow easy and fast database searching
- Valuable information source for customer profiling and consumer demographics
- Security tool to retrieve vehicle information
- Output messages to LED signs
- Car park auditing / ticketing / management.

CHAPTER 3

3. Requirements of Project

3.1 Hardware Requirements

- **Client**

  Processor : Intel Core to Duo or advance

  Ram **:** 2 GB

  Hard disk : 10 GB

- **Developer**

  Processor : Intel i3 processor or advance

  Ram **:** 4 GB

  Hard disk : 100 GB

3.2 Software Requirements

- **Client**
  - **Web Browser:** Chrome, Mozilla Firefox etc.
  - **Operating System:** any
- **Developer**
  - **Web Browser:** Chrome, Mozilla Firefox etc.
  - **Programming :** Python, Scikit Learn,Matplotlib,Tkinter
  - **Technology:** Data Science
  - **Operating System:** any

CHAPTER 4

4. Technology Used

ANPR system is developed using Python. The term Python refers to a general-purpose programming language that is class-based, object-oriented, and designed to have as few implementation dependencies as possible.

Python is an **object-oriented programming language** that provides rapid application development. It was released in 1991 by Guido van Rossum. It has huge demand in in the Rapid Application Development field due to its dynamic binding and dynamic typing options.

Python needs a unique syntax that covers readability which makes the language easy and simple to learn. It supports modules and packages that enables code reuse and program modularity.

For better understanding of Python, you must know its features.

4.1 Features of Python:

It can connect with database systems and can read and modify files.

I. It supports rapid prototyping and production completed software development.

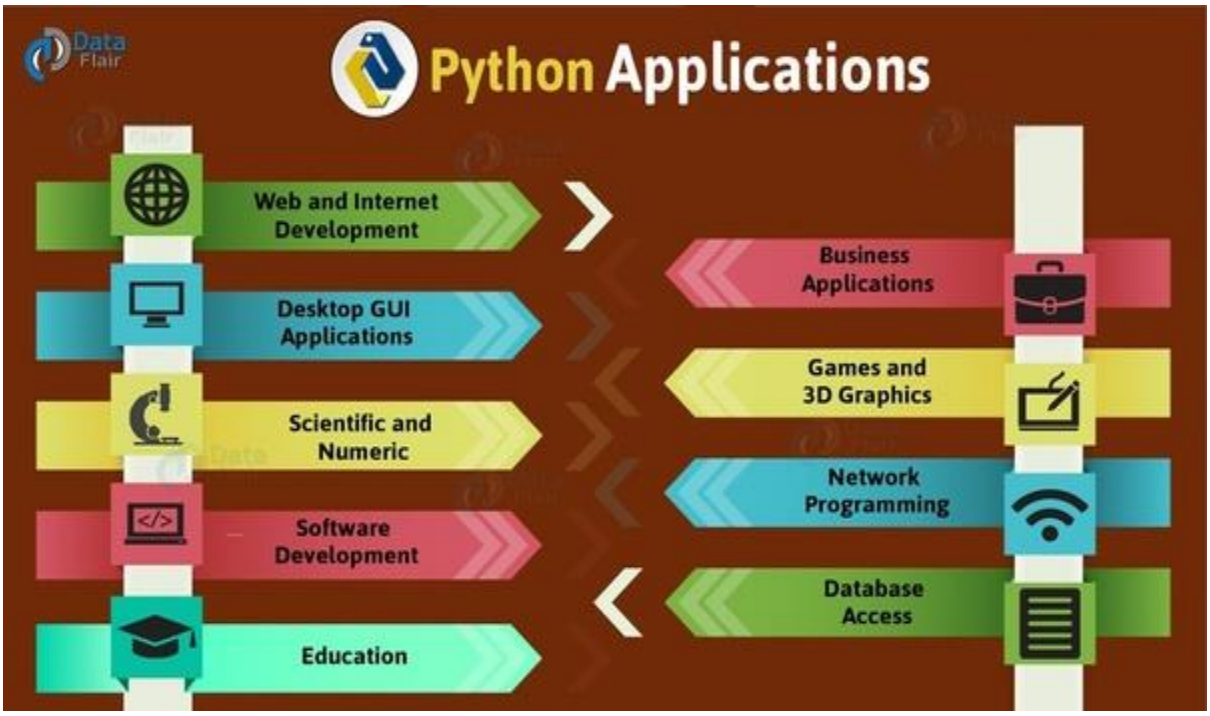
II. It is an interpreted language which means interpreter implements the code line by line at a single time.

III. It can be integrated with the languages like **C, JAVA, C++,** easily.

IV. It is very **easy to learn** language that makes it developer-friendly.

V. It is dynamically-typed language i.e. the type of a value is finalized at runtime.

4.2 Applications of Python:



Python provides constant support to various programming paradigms due to its

I. Python provides constant support to various programming paradigms due to its compatibility with object-oriented and structured programming.
II. It is used for creating various web-frameworks like **Django, Flask, TurboGears** etc.
III. It has huge and powerful standard library for developing the applications.
IV. It can access various types of databases like **Oracle, SQL server, MySQL and PostgreSQL.**
V. It is most suited coding language to customize large scale applications.

4.3 Features of Python

1.Easy to code:

Python is high level programming language. Python is very easy to learn language as compared to other language like c, c#, java script, java etc. It is very easy to code in

python language and anybody can learn python basic in few hours or days. It is also developer-friendly language.

2. Free and Open Source:

Python language is freely available at official website and you can download it from google.

3. Object-Oriented Language:

One of the key features of python is Object-Oriented programming.Python supports object oriented language and concepts of classes, objects encapsulation etc.

4. GUI Programming Support:

Graphical Users interfaces can be made using a module such as PyQt5, PyQt4, wxPython or Tk in python.

PyQt5 is the most popular option for creating graphical apps with Python.

5. High-Level Language:

Python is a high-level language.When we write programs in python, we do not need to remember the system architecture, nor do we need to manage the memory.

6.Extensible feature:

Python is a Extensible language.we can write our some python code into c or c++ language and also we can compile that code in c/c++ language.

7. Python is Portable language:

Python language is also a portable language.for example, if we have python code for windows and if we want to run this code on other platform such as Linux, Unix and Mac then we do not need to change it, we can run this code on any platform.

8. Python is Integrated language:

Python is also an Integrated language because we can easily integrated python with other language like c, c++ etc.

9. Interpreted Language:

Python is an Interpreted Language. because python code is executed line by line at a time. like other language c, c++, java etc there is no need to compile python code this makes it easier to debug our code.The source code of python is converted into an immediate form called **bytecode**.

10. Large Standard Library

Python has a large standard library which provides rich set of module and functions so you do not have to write your own code for every single thing.There are many libraries present in python for such as regular expressions, unit-testing, web browsers etc.

11. Dynamically Typed Language:

Python is dynamically-typed language. That means the type (for example- int, double, long etc) for a variable is decided at run time not in advance.because of this feature we don't need to specify the type of variable.

4.4. Python Libraries:-

A Python library is a reusable chunk of code that you may want to include in your programs/ projects. Compared to languages like C++ or C, a Python library does not pertain to any specific context in Python. Here, a 'library' loosely describes a collection of core modules. Essentially, then, a library is a collection of modules. A **package** is a library that can be installed using a package manager like rubygems or npm.

The Python Standard Library

The Python standard Library is a collection of exact syntax, token, and semantics of Python. It comes bundled with core Python distribution. We mentioned this when we began with an introduction.

It is written in C, and handles functionality like I/O and other core modules. All this functionality together makes Python the language it is. More than 200 core modules sit at the heart of the standard library. This library ships with Python. But in addition to this library, you can also access a growing collection of several thousand components from the Python Package Index (PyPI).

The various libraries that we used in this project are mentioned as following:-

I. Math
II. Random
III. Computer Vision (CV)
IV. Numpy
V. Pandas
VI. Sklearn
VII. Tkinter
VIII. Pillow

The above mentioned libraries are explained in brief below :-

I. Math:-

This module provides access to the Mathematical functions defined by the C standard.

These functions cannot be used with complex numbers; use the functions of the same name from the cmath module if you require support for complex numbers. The distinction between functions which support complex numbers and those which don't is made since most users do not want to learn quite as much mathematics as required to understand complex numbers. Receiving an exception instead of a complex result allows earlier detection of the unexpected complex number used as a parameter, so that the programmer can determine how and why it was generated in the first place.

II. Random:-

This module implements pseudo-random number generators for various distributions.

For integers, there is uniform selection from a range. For sequences, there is uniform selection of a random element, a function to generate a random permutation of a list in-place, and a function for random sampling without replacement.

Almost all module functions depend on the basic function random(), which generates a random float uniformly in the semi-open range [0.0, 1.0). Python uses the Mersenne Twister as the core generator. It produces 53-bit precision floats and has a period of 2**19937-1. The underlying implementation in C is both fast and threadsafe. The Mersenne Twister is one of the most extensively tested random number generators in existence. However, being completely deterministic, it is not suitable for all purposes, and is completely unsuitable for cryptographic purposes.

The functions supplied by this module are actually bound methods of a hidden instance of the random.Random class. You can instantiate your own instances of Random to get generators that don't share state.

III. Computer Vision :-

OpenCV (Open Source Computer Vision Library: http://opencv.org) is an open-source BSD-licensed library that includes several hundreds of computer vision algorithms. The document describes the so-called OpenCV 2.x API, which is essentially a C++ API, as opposite to the C-based OpenCV 1.x API. The latter is described in opencv1x.pdf.

OpenCV has a modular structure, which means that the package includes several shared or static libraries. The following modules are available:

- **Core functionality** - a compact module defining basic data structures, including the dense multi-dimensional array Mat and basic functions used by all other modules.

- **Image processing** - an image processing module that includes linear and non-linear image filtering, geometrical image transformations (resize, affine and perspective warping, generic table-based remapping), color space conversion, histograms, and so on.
- **video** - a video analysis module that includes motion estimation, background subtraction, and object tracking algorithms.
- **calib3d** - basic multiple-view geometry algorithms, single and stereo camera calibration, object pose estimation, stereo correspondence algorithms, and elements of 3D reconstruction.
- **features2d** - salient feature detectors, descriptors, and descriptor matchers.
- **objdetect** - detection of objects and instances of the predefined classes (for example, faces, eyes, mugs, people, cars, and so on).
- **highgui** - an easy-to-use interface to simple UI capabilities.
- Video I/O - an easy-to-use interface to video capturing and video codecs.
- **gpu** - GPU-accelerated algorithms from different OpenCV modules.

IV. Numpy :-

NumPy is a python library used for working with arrays.

It also has functions for working in domain of linear algebra, fourier transform, and matrices.

NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely.

NumPy stands for Numerical Python.

Why Use NumPy ?

In Python we have lists that serve the purpose of arrays, but they are slow to process.

NumPy aims to provide an array object that is up to 50x faster that traditional Python lists.

The array object in NumPy is called ndarray, it provides a lot of supporting functions that make working with ndarray very easy.

Arrays are very frequently used in data science, where speed and resources are very important.

Why is NumPy Faster Than Lists?

NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently.

This behavior is called locality of reference in computer science.

This is the main reason why NumPy is faster than lists. Also it is optimized to work with latest CPU architectures.

V. Pandas :-

pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series. It is free software released under the three-clause BSD license.[2] The name is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals.

VI. Sklearn:-

Scikit-learn provides a range of supervised and unsupervised learning algorithms via a consistent interface in Python.

It is licensed under a permissive simplified BSD license and is distributed under many Linux distributions, encouraging academic and commercial use.

The library is built upon the SciPy (Scientific Python) that must be installed before you can use scikit-learn. This stack that includes:

- **NumPy**: Base n-dimensional array package
- **SciPy**: Fundamental library for scientific computing
- **Matplotlib**: Comprehensive 2D/3D plotting
- **IPython**: Enhanced interactive console
- **Sympy**: Symbolic mathematics
- **Pandas**: Data structures and analysis

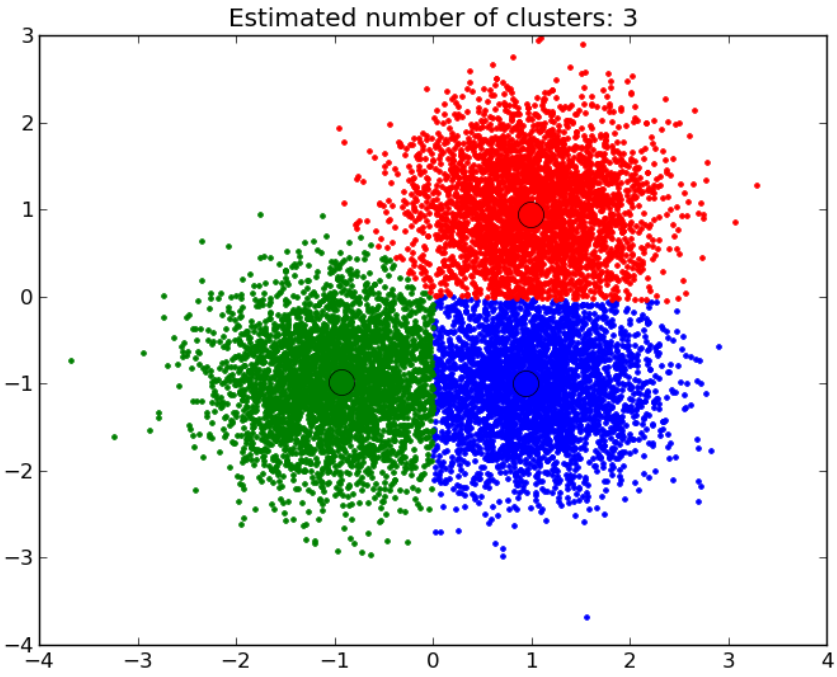
Extensions or modules for SciPy care conventionally named SciKits. As such, the module provides learning algorithms and is named scikit-learn.

The vision for the library is a level of robustness and support required for use in production systems. This means a deep focus on concerns such as easy of use, code quality, collaboration, documentation and performance.

Although the interface is Python, c-libraries are leverage for performance such as numpy for arrays and matrix operations, LAPACK, LibSVM and the careful use of cython.

What are the features?

The library is focused on modeling data. It is not focused on loading, manipulating and summarizing data. For these features, refer to NumPy and Pandas.



Some popular groups of models provided by scikit-learn include:

- **Clustering**: for grouping unlabeled data such as KMeans.
- **Cross Validation**: for estimating the performance of supervised models on unseen data.
- **Datasets**: for test datasets and for generating datasets with specific properties for investigating model behavior.
- **Dimensionality Reduction**: for reducing the number of attributes in data for summarization, visualization and feature selection such as Principal component analysis.
- **Ensemble methods**: for combining the predictions of multiple supervised models.
- **Feature extraction**: for defining attributes in image and text data.
- **Feature selection**: for identifying meaningful attributes from which to create supervised models.
- **Parameter Tuning**: for getting the most out of supervised models.
- **Manifold Learning**: For summarizing and depicting complex multi-dimensional data.
- **Supervised Models**: a vast array not limited to generalized linear models, discriminate analysis, naive bayes, lazy methods, neural networks, support vector machines and decision trees.

VII. Tkinter:-

Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit.

VIII. Pillow:-

Python Imaging Library (abbreviated as **PIL**) (in newer versions known as **Pillow**) is a free and open-source additional library for the Python programming language that adds support for opening, manipulating, and saving many different image file formats. It is available for Windows, Mac OS X and Linux.

Chapter 5

MY SQL

What is a Database?

A database is a separate application that stores a collection of data. Each database has one or more distinct APIs for creating, accessing, managing, searching and replicating the data it holds.

Other kinds of data stores can also be used, such as files on the file system or large hash tables in memory but data fetching and writing would not be so fast and easy with those type of systems.

Nowadays, we use relational database management systems (RDBMS) to store and manage huge volume of data. This is called relational database because all the data is stored into different tables and relations are established using primary keys or other keys known as **Foreign Keys**.

A **Relational Database Management System (RDBMS)** is a software that –

- Enables you to implement a database with tables, columns and indexes.
- Guarantees the Referential Integrity between rows of various tables.

- Updates the indexes automatically.

- Interprets an SQL query and combines information from various tables.

RDBMS Terminology

Before we proceed to explain the MySQL database system, let us revise a few definitions related to the database.

- **Database** − A database is a collection of tables, with related data.

- **Table** − A table is a matrix with data. A table in a database looks like a simple spreadsheet.
- **Column** − One column (data element) contains data of one and the same kind, for example the column postcode.
- **Row** − A row (= tuple, entry or record) is a group of related data, for example the data of one subscription.
- **Redundancy** − Storing data twice, redundantly to make the system faster.

- **Primary Key** − A primary key is unique. A key value cannot occur twice in one table. With a key, you can only find one row.
- **Foreign Key** − A foreign key is the linking pin between two tables.

- **Compound Key** − A compound key (composite key) is a key that consists of multiple columns, because one column is not sufficiently unique.
- **Index** − An index in a database resembles an index at the back of a book.

- **Referential Integrity** − Referential Integrity makes sure that a foreign key value always points to an existing row.

MySQL Database

MySQL is a fast, easy-to-use RDBMS being used for many small and big businesses. MySQL is developed, marketed and supported by MySQL AB, which is a Swedish company. MySQL is becoming so popular because of many good reasons −

- MySQL is released under an open-source license. So you have nothing to pay to use it.
- MySQL is a very powerful program in its own right. It handles a large subset of the functionality of the most expensive and powerful database packages.
- MySQL uses a standard form of the well-known SQL data language.
- MySQL works on many operating systems and with many languages including PHP, PERL, C, C++, JAVA, etc.
- MySQL works very quickly and works well even with large data sets.
- MySQL is very friendly to PHP, the most appreciated language for web development.
- MySQL supports large databases, up to 50 million rows or more in a table. The default file size limit for a table is 4GB, but you can increase this (if your operating system can handle it) to a theoretical limit of 8 million terabytes (TB).
- MySQL is customizable. The open-source GPL license allows programmers to modify the MySQL software to fit their own specific environments

Chapter 6

What is Tkinter?

Python provides various options for developing graphical user interfaces (GUIs). The most important features are listed below.

- **Tkinter** − Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this chapter.
- **wxPython** − This is an open-source Python interface for wxWidgets GUI toolkit. You can find a complete tutorial on WxPython
- **PyQt** −This is also a Python interface for a popular cross-platform Qt GUI library. TutorialsPoint has a very good tutorial on PyQt
- **JPython** − JPython is a Python port for Java, which gives Python scripts seamless access to the Java class libraries on the local machine.

Tkinter Programming

Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit.

Creating a GUI application using Tkinter is an easy task. All you need to do is perform the following steps −

- Import the *Tkinter* module.
- Create the GUI application main window.
- Add one or more of the above-mentioned widgets to the GUI application.
- Enter the main event loop to take action against each event triggered by the user.

Tkinter Widgets

Tkinter provides various controls, such as buttons, labels and text boxes used in a GUI application. These controls are commonly called widgets.

There are currently 15 types of widgets in Tkinter. We present these widgets as well as a brief description in the following table −

Sr.No.	Operator & Description
1	**Button** The Button widget is used to display the buttons in your application.
2	**Canvas** The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.
3	**Checkbutton** The Checkbutton widget is used to display a number of options as checkboxes. The user can select multiple options at a time.
4	**Entry** The Entry widget is used to display a single-line text field for accepting values from a user.
5	**Frame** The Frame widget is used as a container widget to organize other widgets.
6	**Label** The Label widget is used to provide a single-line caption for other widgets. It can also contain images.
7	**Listbox**

	The Listbox widget is used to provide a list of options to a user.
8	**Menubutton** The Menubutton widget is used to display menus in your application.
9	**Menu** The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.
10	**Message** The Message widget is used to display multiline text fields for accepting values from a user.
11	**Radiobutton** The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.
12	**Scale** The Scale widget is used to provide a slider widget.
13	**Scrollbar** The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.
14	**Text** The Text widget is used to display text in multiple lines.
15	**Toplevel**

	The Toplevel widget is used to provide a separate window container.
16	**Spinbox** The Spinbox widget is a variant of the standard Tkinter Entry widget, which can be used to select from a fixed number of values.
17	**PanedWindow** A PanedWindow is a container widget that may contain any number of panes, arranged horizontally or vertically.
18	**LabelFrame** A labelframe is a simple container widget. Its primary purpose is to act as a spacer or container for complex window layouts.
19	**tkMessageBox** This module is used to display message boxes in your applications

Standard attributes

Let us look at how some of their common attributes, such as sizes, colors and fonts are specified.

- Dimensions
- Colors
- Fonts
- Anchors
- Relief styles

- Bitmaps
- Cursors

Geometry Management

All Tkinter widgets have access to the specific geometry management methods, which have the purpose of organizing widgets throughout the parent widget area. Tkinter exposes the following geometry manager classes: pack, grid, and place.

- The pack() Method − This geometry manager organizes widgets in blocks before placing them in the parent widget.
- The grid() Method − This geometry manager organizes widgets in a table-like structure in the parent widget.
- The place() Method − This geometry manager organizes widgets by placing them in a specific position in the parent widget.

CHAPTER 7

Data Science

7.1 What is Data Science?

Data science is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from many structural and unstructured data.[1][2] Data science is related to data mining, deep learning and big data.

Data science is a "concept to unify statistics, data analysis, machine learning, domain knowledge and their related methods" in order to "understand and analyze actual phenomena" with data.[3] It uses techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, domain knowledge and information science. Turing award winner Jim Gray imagined data science as a "fourth paradigm" of science (empirical, theoretical, computational and now data-driven) and asserted that "everything about science is changing because of the impact of information technology" and the data deluge

Technologies and techniques

There are a variety of different technologies and techniques that are used for data science which depend on the application.

Techniques

- Clustering is a technique used to group data together.
- Dimensionality reduction is used to reduce the complexity of data computation so that it can be performed more quickly.
- Machine learning is a technique used to perform tasks by inferencing patterns from data.

Technologies

- Python is a programming language with simple syntax that is commonly used for data science.[35] There are a number of python libraries that are used in data science including numpy, pandas, and scipy.
- R is a programming language that was designed for statisticians and data mining[36] and is optimized for computation.
- TensorFlow is a framework for creating machine learning models developed by Google.
- Pytorch is another framework for machine learning developed by Facebook.
- Jupyter Notebook is an interactive web interface for Python that allows faster experimentation.
- Tableau makes a variety of software that is used for data visualization.[37]
- Apache Hadoop is a software framework that is used to process data over large distributed systems.

7.2 Machine Learning:-

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. **Machine learning focuses on the development of computer programs** that can access data and use it learn for themselves.

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. **The primary aim is to allow the computers learn automatically** without human intervention or assistance and adjust actions accordingly.

But, using the classic algorithms of machine learning, text is considered as a sequence of keywords; instead, **an approach based on semantic analysis mimics the human ability to understand the meaning of a text.**

Some machine learning methods

Machine learning algorithms are often categorized as supervised or unsupervised.

- **Supervised machine learning algorithms** can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.
- In contrast, **unsupervised machine learning algorithms** are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.
- **Semi-supervised machine learning algorithms** fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it. Otherwise, acquiring unlabeled data generally doesn't require additional resources.
- **Reinforcement machine learning algorithms** is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is

required for the agent to learn which action is best; this is known as the reinforcement signal.

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in **processing large volumes of information**.

WHAT IS THE DIFFERENCE BETWEEN AI AND MACHINE LEARNING?

Machine learning may have enjoyed enormous success of late, but it is just one method for achieving artificial intelligence.

At the birth of the field of AI in the 1950s, AI was defined as any machine capable of performing a task that would typically require human intelligence.

AI systems will generally demonstrate at least some of the following traits: planning, learning, reasoning, problem solving, knowledge representation, perception, motion, and manipulation and, to a lesser extent, social intelligence and creativity.

Alongside machine learning, there are various other approaches used to build AI systems, including evolutionary computation, where algorithms undergo random mutations and combinations between generations in an attempt to "evolve" optimal solutions, and expert systems, where computers are programmed with rules that allow them to mimic the behavior of a human expert in a specific domain, for example an autopilot system flying a plane.

7.3 WHAT ARE THE MAIN TYPES OF MACHINE LEARNING?

Machine learning is generally split into two main categories: supervised and unsupervised learning.

WHAT IS SUPERVISED LEARNING?

This approach basically teaches machines by example.

During training for supervised learning, systems are exposed to large amounts of labelled data, for example images of handwritten figures annotated to indicate which number they correspond to. Given sufficient examples, a supervised-learning system would learn to recognize the clusters of pixels and shapes associated with each number and eventually be able to recognize handwritten numbers, able to reliably distinguish between the numbers 9 and 4 or 6 and 8.

However, training these systems typically requires huge amounts of labelled data, with some systems needing to be exposed to millions of examples to master a task.

As a result, the datasets used to train these systems can be vast, with Google's Open Images Dataset having about nine million images, its labeled video repository YouTube-8M linking to seven million labeled videos and ImageNet, one of the early databases of this kind, having more than 14 million categorized images. The size of training datasets continues to grow, with Facebook recently announcing it had compiled 3.5 billion images publicly available on Instagram, using hashtags attached to each image as labels. Using one billion of these photos to train an image-recognition system yielded record levels of accuracy -- of 85.4 percent -- on ImageNet's benchmark.
The laborious process of labeling the datasets used in training is often carried out using crowdworking services, such as Amazon Mechanical Turk, which provides access to a large pool of low-cost labor spread across the globe. For instance, ImageNet was put together over two years by nearly 50,000 people, mainly recruited through Amazon Mechanical Turk. However, Facebook's approach of using publicly available data to train systems could provide an alternative way of training systems using billion-strong datasets without the overhead of manual labeling.

WHAT IS UNSUPERVISED LEARNING?

In contrast, unsupervised learning tasks algorithms with identifying patterns in data, trying to spot similarities that split that data into categories.

An example might be Airbnb clustering together houses available to rent by neighborhood, or Google News grouping together stories on similar topics each day.

The algorithm isn't designed to single out specific types of data, it simply looks for data that can be grouped by its similarities, or for anomalies that stand out.

WHAT IS SEMI-SUPERVISED LEARNING?

The importance of huge sets of labelled data for training machine-learning systems may diminish over time, due to the rise of semi-supervised learning.

As the name suggests, the approach mixes supervised and unsupervised learning. The technique relies upon using a small amount of labelled data and a large amount of unlabelled data to train systems. The labelled data is used to partially train a machine-learning model, and then that partially trained model is used to label the unlabelled data, a process called pseudo-labelling. The model is then trained on the resulting mix of the labelled and pseudo-labelled data.

The viability of semi-supervised learning has been boosted recently by Generative Adversarial Networks (GANs), machine-learning systems that can use labelled data to generate completely new data, for example creating new images of Pokemon from existing images, which in turn can be used to help train a machine-learning model.
Were semi-supervised learning to become as effective as supervised learning, then access to huge amounts of computing power may end up being more important for successfully training machine-learning systems than access to large, labelled datasets.

WHAT IS REINFORCEMENT LEARNING?

A way to understand reinforcement learning is to think about how someone might learn to play an old school computer game for the first time, when they aren't familiar with the rules or how to control the game. While they may be a complete novice, eventually, by looking at the relationship between the buttons they press, what happens on screen and their in-game score, their performance will get better and better.

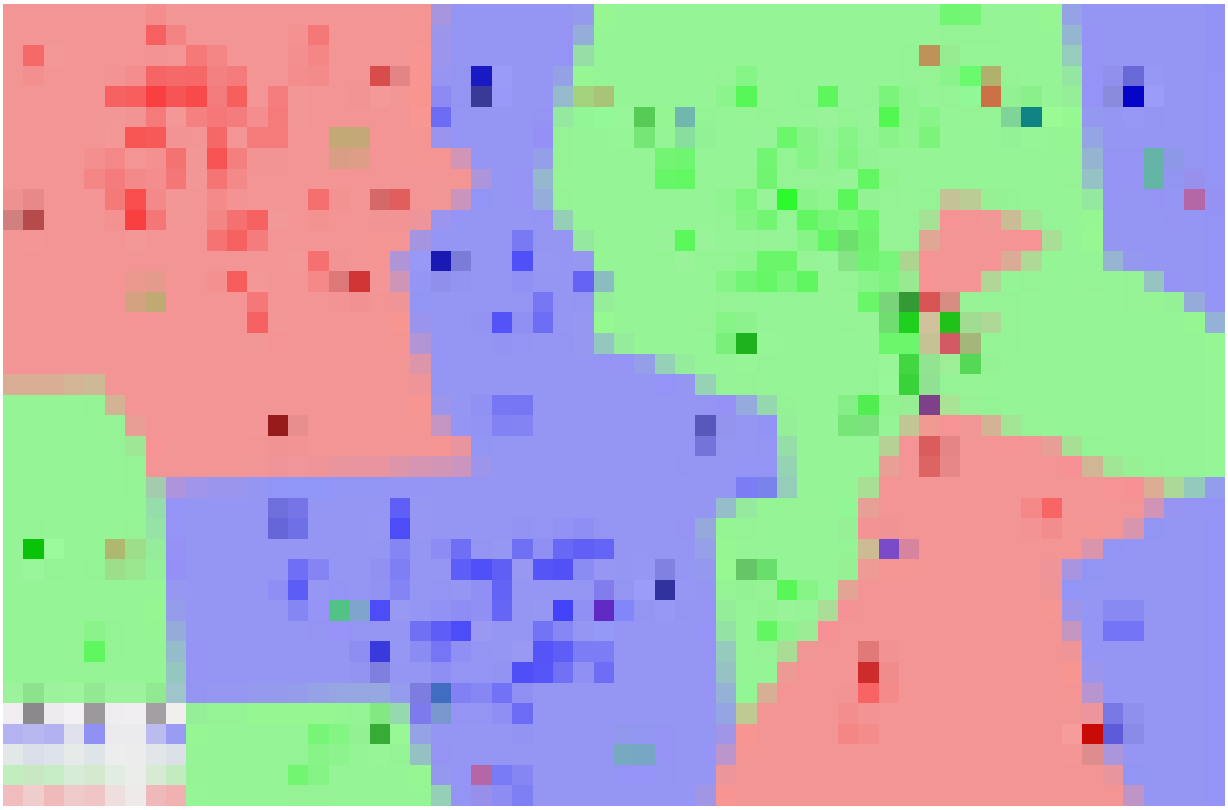
An example of reinforcement learning is Google DeepMind's Deep Q-network, which has beaten humans in a wide range of vintage video games. The system is fed pixels from each game and determines various information about the state of the game, such as the distance between objects on screen. It then considers how the state of the game and the actions it performs in game relate to the score it achieves.

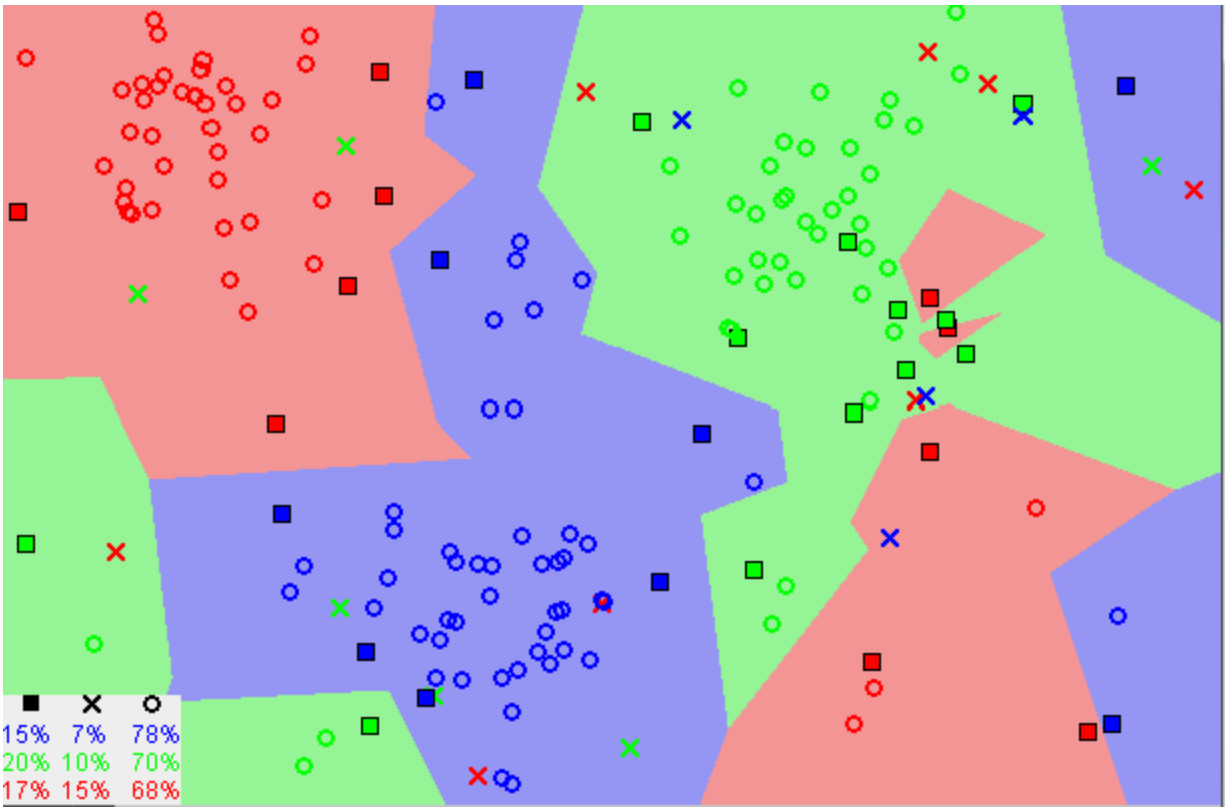
Over the process of many cycles of playing the game, eventually the system builds a model of which actions will maximize the score in which circumstance, for instance, in the case of the video game Breakout, where the paddle should be moved to in order to intercept the ball.

7.4 What is KNN Algorithm?

The KNN algorithm assumes that similar things exist in close proximity. In other words, similar things are near to each other.

"Birds of a feather flock together."





Notice in the image above that most of the time, similar data points are close to each other. The KNN algorithm hinges on this assumption being true enough for the algorithm to be useful. KNN captures the idea of similarity (sometimes called distance, proximity, or closeness) with some mathematics we might have learned in our childhood— calculating the distance between points on a graph.

Note: *An understanding of how we calculate the distance between points on a graph is necessary before moving on. If you are unfamiliar with or need a refresher on how this calculation is done, thoroughly read "Distance Between 2 Points" in its entirety, and come right back.*

There are other ways of calculating distance, and one way might be preferable depending on the problem we are solving. However, the straight-line distance (also called the Euclidean distance) is a popular and familiar choice.

The KNN Algorithm

- Load the data
- Initialize K to your chosen number of neighbors
- For each example in the data
- Calculate the distance between the query example and the current example from the data.
- Add the distance and the index of the example to an ordered collection
- Sort the ordered collection of distances and indices from smallest to largest (in ascending order) by the distances
- Pick the first K entries from the sorted collection
- Get the labels of the selected K entries
- If regression, return the mean of the K labels
- If classification, return the mode of the K labels

Choosing the right value for K

To select the K that's right for your data, we run the KNN algorithm several times with different values of K and choose the K that reduces the number of errors we encounter while maintaining the algorithm's ability to accurately make predictions when it's given data it hasn't seen before.

Here are some things to keep in mind:

1. As we decrease the value of K to 1, our predictions become less stable. Just think for a minute, imagine K=1 and we have a query point surrounded by several reds and one green (I'm thinking about the top left corner of the colored plot above), but the green is the single nearest neighbor. Reasonably, we would think the query point is most likely red, but because K=1, KNN incorrectly predicts that the query point is green.

2. Inversely, as we increase the value of K, our predictions become more stable due to majority voting / averaging, and thus, more likely to make more accurate predictions (up to a certain point). Eventually, we begin to witness an increasing number of errors. It is at this point we know we have pushed the value of K too far.

3. In cases where we are taking a majority vote (e.g. picking the mode in a classification problem) among labels, we usually make K an odd number to have a tiebreaker.

Advantages

1. The algorithm is simple and easy to implement.

2. There's no need to build a model, tune several parameters, or make additional assumptions.

3. The algorithm is versatile. It can be used for classification, regression, and search (as we will see in the next section).

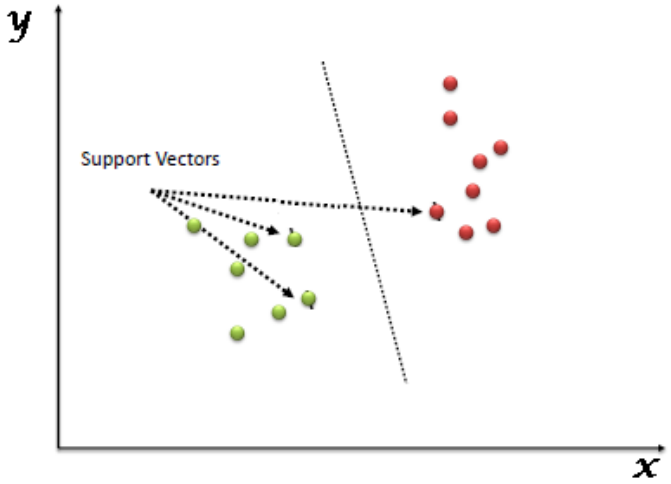
Disadvantages

1. The algorithm gets significantly slower as the number of examples and/or predictors/independent variables increase.

7.5 What is SVM?

What is Support Vector Machine?

"Support Vector Machine" (SVM) is a supervised machine learning algorithm which can be used for both classification or regression challenges. However, it is mostly used in classification problems. In the SVM algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiates the two classes very well (look at the below snapshot).



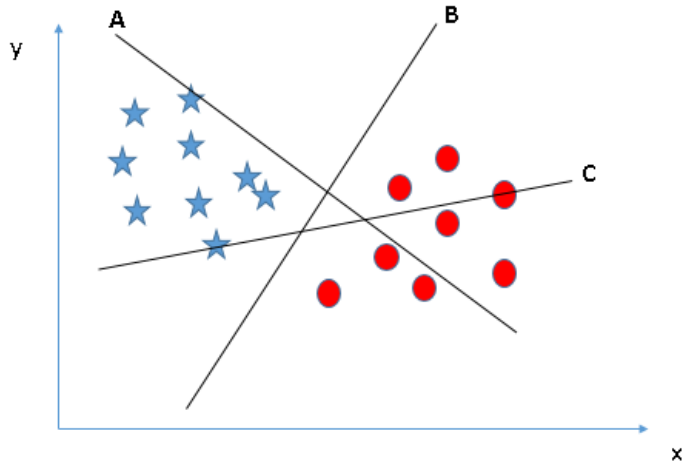
Support Vectors are simply the co-ordinates of individual observation. The SVM classifier is a frontier which best segregates the two classes (hyper-plane/ line).

How does it work?

Above, we got accustomed to the process of segregating the two classes with a hyper-plane. Now the burning question is "How can we identify the right hyper-plane?". Don't worry, it's not as hard as you think!

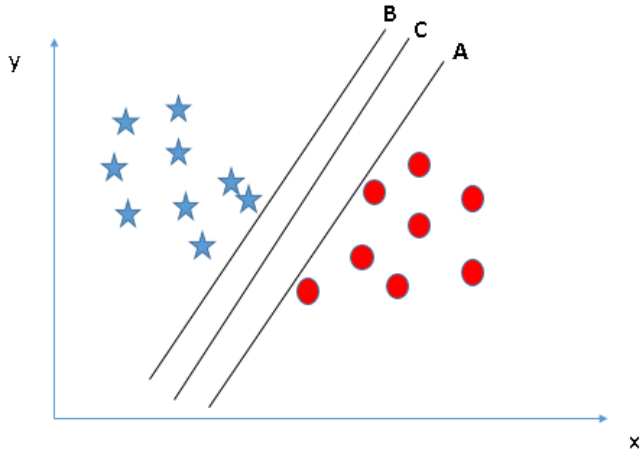
Let's understand:

- **Identify the right hyper-plane (Scenario-1):** Here, we have three hyper-planes (A, B and C). Now, identify the right hyper-plane to classify star and circle.

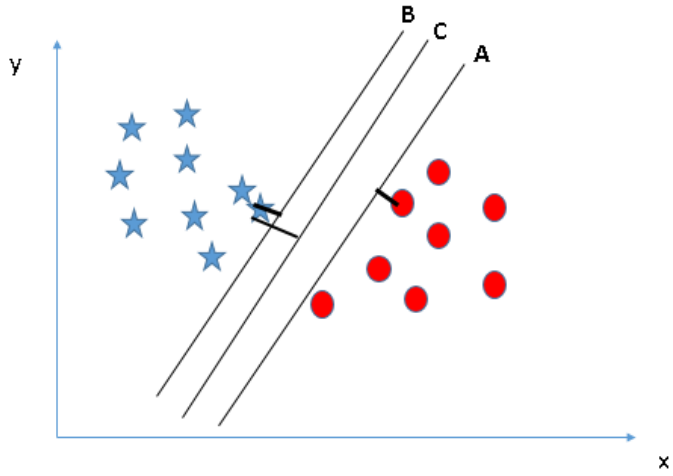


You need to remember a thumb rule to identify the right hyper-plane: "Select the hyper-plane which segregates the two classes better". In this scenario, hyper-plane "B" has excellently performed this job.

- **Identify the right hyper-plane (Scenario-2):** Here, we have three hyper-planes (A, B and C) and all are segregating the classes well. Now, How can we identify the right hyper-plane?



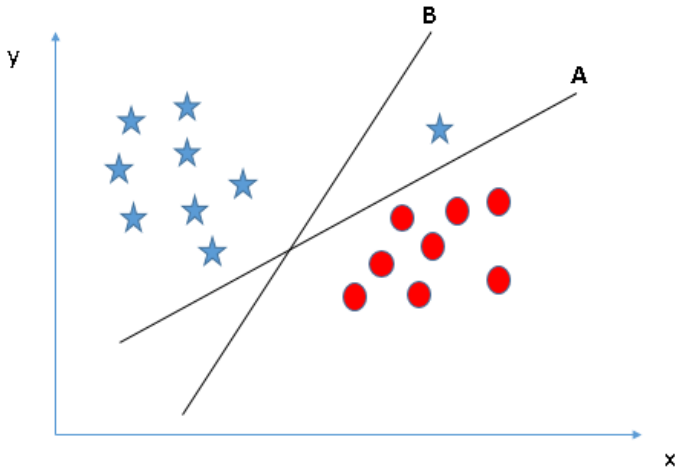
Here, maximizing the distances between nearest data point (either class) and hyper-plane will help us to decide the right hyper-plane. This distance is called as **Margin**. Let's look at



the below snapshot:

Above, you can see that the margin for hyper-plane C is high as compared to both A and B. Hence, we name the right hyper-plane as C. Another lightning reason for selecting the hyper-plane with higher margin is robustness. If we select a hyper-plane having low margin then there is high chance of miss-classification.

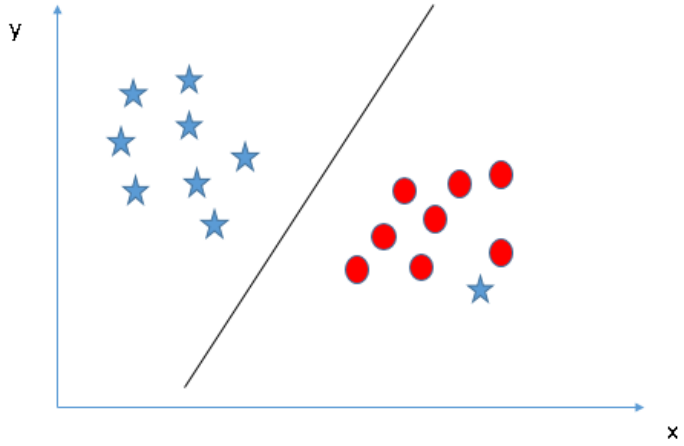
- **Identify the right hyper-plane (Scenario-3):**Hint: Use the rules as discussed in previous section to identify the right hyper-plane



Some of you may have selected the hyper-plane **B** as it has higher margin compared to **A.** But, here is the catch, SVM selects the hyper-plane which classifies the classes accurately prior to maximizing margin. Here, hyper-plane B has a classification error and A has classified all correctly. Therefore, the right hyper-plane is **A.**

- **Can we classify two classes (Scenario-4)?:** Below, I am unable to segregate the two classes using a straight line, as one of the stars lies in the territory of other(circle) class as an outlier.

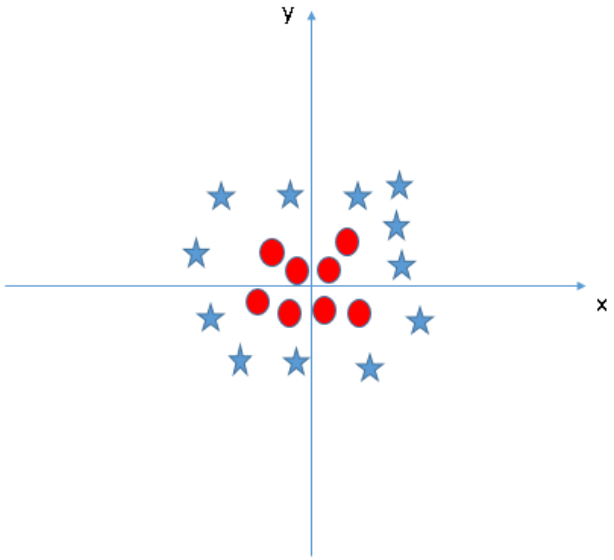
- As I have already mentioned, one star at other end is like an outlier for star class. The SVM algorithm has a feature to ignore outliers and find the hyper-plane that has the maximum margin. Hence, we can say, SVM classification is robust to outliers.



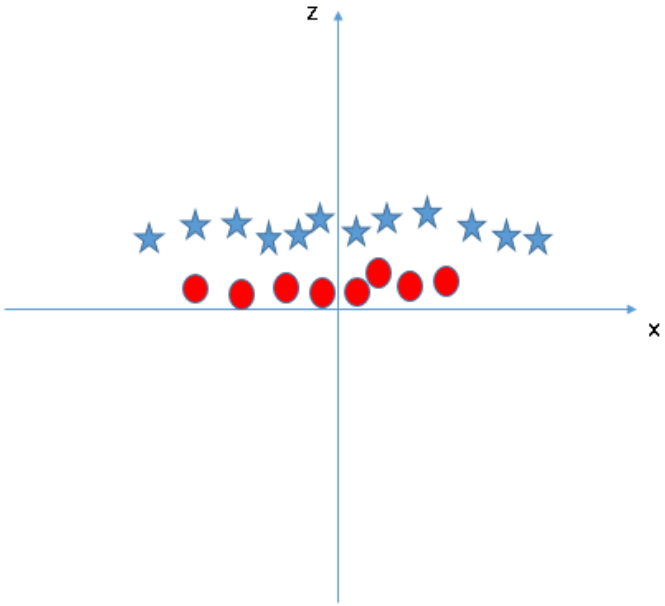
- **Find the hyper-plane to segregate to classes (Scenario-5):**

In the scenario below, we can't have linear hyper-plane between the two classes, so how does SVM classify these two classes? Till now, we have only looked at the linear hyper-

plane.



SVM can solve this problem. Easily! It solves this problem by introducing additional feature. Here, we will add a new feature z=x^2+y^2. Now, let's plot the data points on axis x and z:

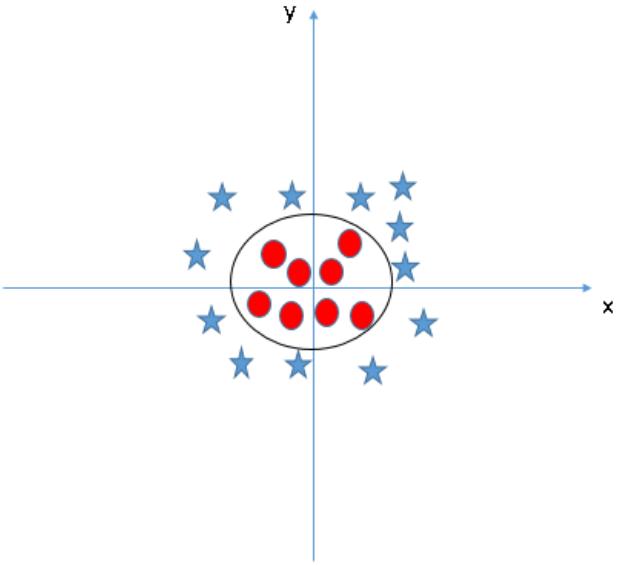


In above plot, points to consider are:

- All values for z would be positive always because z is the squared sum of both x and y
- In the original plot, red circles appear close to the origin of x and y axes, leading to lower value of z and star relatively away from the origin result to higher value of z.

In the SVM classifier, it is easy to have a linear hyper-plane between these two classes. But, another burning question which arises is, should we need to add this feature manually to have a hyper-plane. No, the SVM algorithm has a technique called the **kernel trick**. The SVM kernel is a function that takes low dimensional input space and transforms it to a higher dimensional space i.e. it converts not separable problem to separable problem. It is mostly useful in non-linear separation problem. Simply put, it does some extremely complex data transformations, then finds out the process to separate the data based on the labels or outputs you've defined.

When we look at the hyper-plane in original input space it looks like a circle:



How to implement SVM in Python ?

In Python, scikit-learn is a widely used library for implementing machine learning algorithms. SVM is also available in the scikit-learn library and we follow the same structure for using it(Import library, object creation, fitting model and prediction).

Now, let us have a look at a real-life problem statement and dataset to understand how to apply SVM for classification.

7.6 What is Deep Learning?

Deep learning is an artificial intelligence function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence (AI) that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also known as deep neural learning or deep neural network.

How it Works?

Deep learning has evolved hand-in-hand with the digital era, which has brought about an explosion of data in all forms and from every region of the world. This data, known simply as big data, is drawn from sources like social media, internet search engines, e-commerce platforms, and online cinemas, among others. This enormous amount of data is readily accessible and can be shared through fintech applications like cloud computing.

However, the data, which normally is unstructured, is so vast that it could take decades for humans to comprehend it and extract relevant information. Companies realize the incredible potential that can result from unraveling this wealth of information and are increasingly adapting to AI systems for automated support.

Deep learning learns from vast amounts of unstructured data that would normally take humans decades to understand and process.

Deep Learning vs. Machine Learning

One of the most common AI techniques used for processing big data is machine learning, a self-adaptive algorithm that gets increasingly better analysis and patterns with experience or with newly added data.

If a digital payments company wanted to detect the occurrence or potential for fraud in its system, it could employ machine learning tools for this purpose. The computational algorithm built into a computer model will process all transactions happening on the digital platform, find patterns in the data set and point out any anomaly detected by the pattern.

Deep learning, a subset of machine learning, utilizes a hierarchical level of artificial neural networks to carry out the process of machine learning. The artificial neural networks are built like the human brain, with neuron nodes connected together like a web. While traditional programs build analysis with data in a linear way, the hierarchical function of deep learning systems enables machines to process data with a nonlinear approach.

KEY TAKEAWAYS

- Deep learning is an AI function that mimics the workings of the human brain in processing data for use in decision making.
- Deep learning AI is able to learn from data that is both unstructured and unlabeled.
- Deep learning, a machine learning subset, can be used to help detect fraud or money laundering.

CHAPTER 8

What is OCR?

OCR (optical character recognition) is the use of technology to distinguish printed or handwritten text characters inside digital images of physical documents, such as a scanned paper document. The basic process of OCR involves examining the text of a document and translating the characters into code that can be used for data processing. OCR is sometimes also referred to as text recognition.

OCR systems are made up of a combination of hardware and software that is used to convert physical documents into machine-readable text. Hardware, such as an optical scanner or specialized circuit board is used to copy or read text while software typically handles the advanced processing. Software can also take advantage of artificial intelligence (AI) to implement more advanced methods of intelligent character recognition (ICR), like identifying languages or styles of handwriting.

The process of OCR is most commonly used to turn hard copy legal or historic documents into PDFs. Once placed in this soft copy, users can edit, format and search the document as if it was created with a word processor.

How optical character recognition works

The first step of OCR is using a scanner to process the physical form of a document. Once all pages are copied, OCR software converts the document into a two-color, or black and white, version. The scanned-in image or bitmap is analyzed for light and dark areas, where the dark areas are identified as characters that need to be recognized and light areas are identified as background.

The dark areas are then processed further to find alphabetic letters or numeric digits. OCR programs can vary in their techniques, but typically involve targeting one character, word or block of text at a time. Characters are then identified using one of two algorithms:

1. **Pattern recognition-** OCR programs are fed examples of text in various fonts and formats which are then used to compare, and recognize, characters in the scanned document.
2. **Feature detection-** OCR programs apply rules regarding the features of a specific letter or number to recognize characters in the scanned document. Features could include the number of angled lines, crossed lines or curves in a character for comparison. For example, the capital letter "A" may be stored as two diagonal lines that meet with a horizontal line across the middle.

   When a character is identified, it is converted into an ASCII code that can be used by computer systems to handle further manipulations. Users should correct basic errors, proofread and make sure complex layouts were handled properly before saving the document for future use.

Optical character recognition use cases

OCR can be used for a variety of applications, including:

- Scanning printed documents into versions that can be edited with word processors, like Microsoft Word or Google Docs.
- Indexing print material for search engines.
- Automating data entry, extraction and processing.
- Deciphering documents into text that can be read aloud to visually-impaired or blind users.
- Archiving historic information, such as newspapers, magazines or phonebooks, into searchable formats.
- Electronically depositing checks without the need for a bank teller.
- Placing important, signed legal documents into an electronic database.
- Recognizing text, such as license plates, with a camera or software.
- Sorting letters for mail delivery.
- Translating words within an image into a specified language.

Benefits of optical character recognition

The main advantages of OCR technology are saved time, decreased errors and minimized effort. It also enables actions that are not capable with physical copies such as compressing into ZIP files, highlighting keywords, incorporating into a website and attaching to an email.

While taking images of documents enables them to be digitally archived, OCR provides the added functionality of being able to edit and search those documents.

CHAPTER 9

9 Literature Survey

9.1 Existing System

- Current System has lot of problems and constrains.
- Current System require a lot of manual efforts.
- Require a lot of time and money to gather resource.
- May require a special person having core knowledge about art, exhibitions and planning.
- Require a lot of planning.
- Current System is not capable to judge the true potential of artist.
- With current System it takes a lot of time to generate results.
- Managing test and providing suitable environment is a great headache.

9.2 Proposed System

- A system is required which can handle the following things.
- Can generate ideas and take test of those ideas automatically.
- Provide a readymade and suitable environment to take test for the generated ideas.
- A system which is cheap and easy to maintain.
- No special training or efforts are required to generate, manage and take test for ideas.
- A system which is time efficient and secure.

9.3 Feasibility Study

Preliminary investigation examines project feasibility; the likelihood the system will be useful to the individual or organization. The main objective of the feasibility study is to test the Technical, Operational and Economical feasibility for adding

new modules, ideas and debugging old running system. All systems are feasible if they are given unlimited resources and infinite time. There are aspects in the feasibility study portion of the preliminary investigation:

- Technical Feasibility
- Operation Feasibility
- Economical Feasibiliy

9.3.1 Technical Feasibility

The technical issue usually raised during the feasibility stage of the investigation includes the following:

I. Does the necessary technology exist to do what is suggested?

II. Do the proposed equipments have the technical capacity to hold the data required to use the new system?

III. Will the proposed system provide adequate response to inquiries, regardless of the number or location of users?

IV. Can the system be upgraded if developed?

Are there technical guarantees of accuracy, reliability, ease of access and data security?

9.3.2 Operational Feasibility

9.3.2.1 **User-friendly:** Both the artist and user feel comfortable and confident while using the software. He should be able to find all the related data and details and not be able to see unrelated data.

9.3.2.2 **Reliability:** Project should be able to handle all the errors and exceptions like network failure.

9.3.2.3 **Security:** The web server and database server should be protected from hacking, virus etc.

9.3.2.4 **Portability:** Web potable should be able to work in all browsers and operating systems. And should too able to shift to other server if anything goes wrong.

9.3.2.5 **Maintenance**: Finish project should be easy to maintain and cost of maintenance should be less.

9.3.3 Economical Feasibility

The computerized system takes care of the present existing system's data flow and procedures completely and should generate all the reports of the

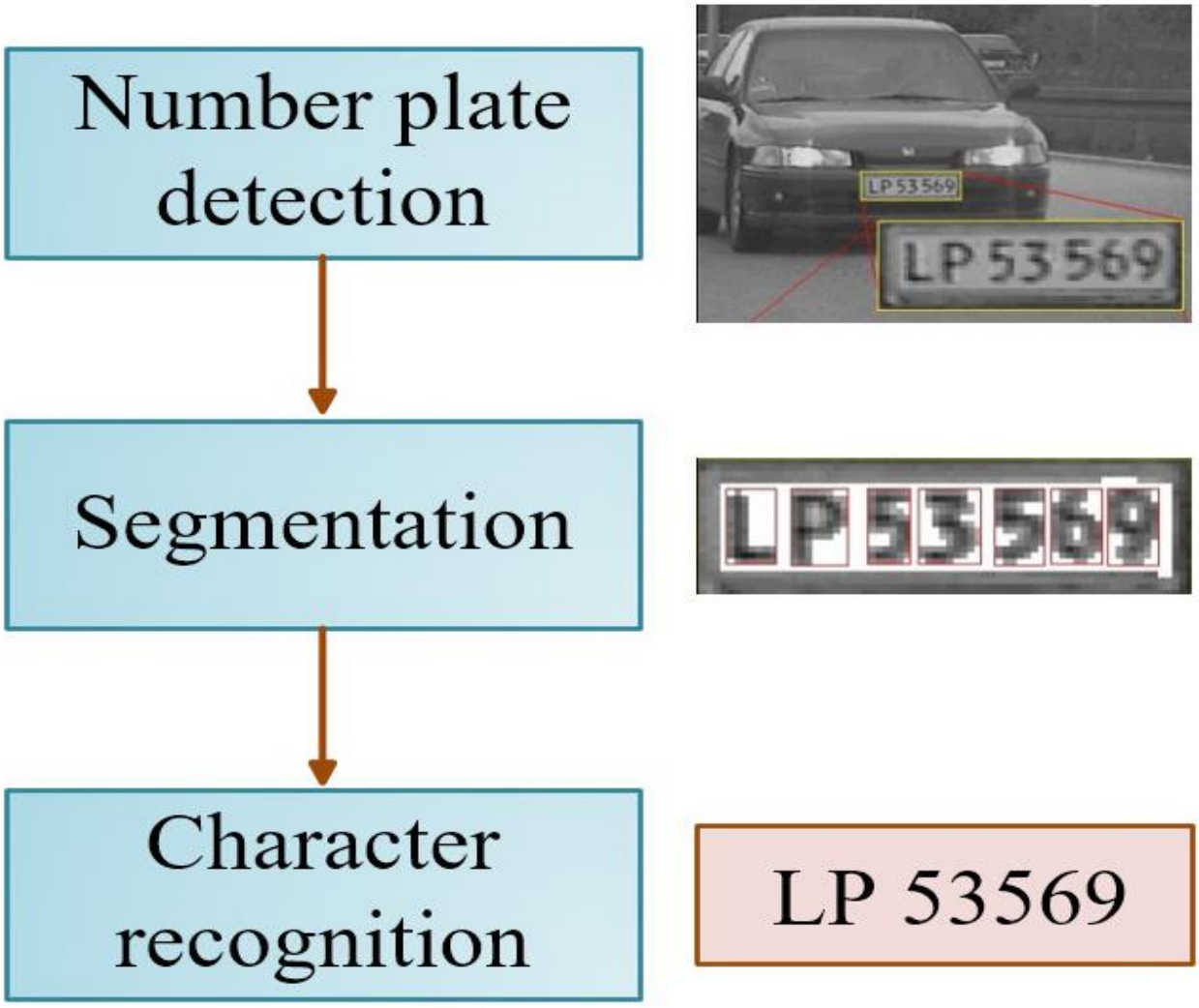
manual system besides a host of other management reports. It should be built as a web based application with separate web server and database server. This is required as the activities are spread throughout the organization customer wants a centralized database. Further, some of the linked transactions take place in different locations.

CHAPTER 10

10 System Analysis and Design

10.1Analysis of proposed System

ANPR is distributed project. A distributed system is a network that consists of autonomous computers that are connected using a distribution middleware. They help in sharing different resources and capabilities to provide users with a single and integrated coherent network.



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10.2 Functional Specification

Working of this Project is divided into three steps:-

1. Detection Vehicle
2. Capture of Image
3. Process of Recognition

Detection Of Vehicle

1. The vehicle approaches the secured area and the process starts when the vehicle steps over a magnetic loop detector
2. The loop Detector senses the car and its presence.

Capture Of Image

1. This Unit Activates the illumination and take picture of the front and rear plates using camera.

2.The Image of the vehicle is read by the unit's image processing hardware or the frame grabber

Process of Recognition

1.Unit analyze the image with different image processing software.

2. Unit checks if the vehicle appears on predefined list of authorized cars and if found it signals to open the gate by activating it's relay.

10.3Performance Requirement

Performance is measured in terms of the output provided by the application.
Requirement specification plays an important part in the analysis of a system.

Only when the requirement specifications are properly given, it is possible to design

a system, which will fit into required environment. It rests largely with the users of the existing system to give the requirement specifications because they are the people who finally use the system. This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements. It is very difficult to change the system once it has been designed and on the other hand designing a system, which does not cater to the requirements of the user, is of no use.

The requirement specification for any system can be broadly stated as given below:

- The system should be able to interface with the existing system
- The system should be accurate
- The system should be better than the existing system

CHAPTER 11

11 Structure of Project

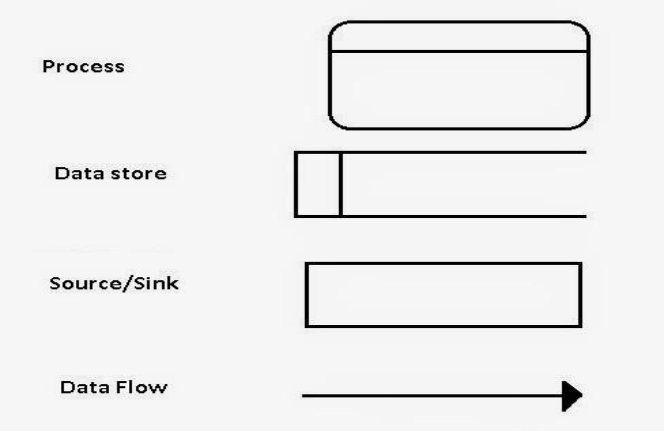
11.3System Design:

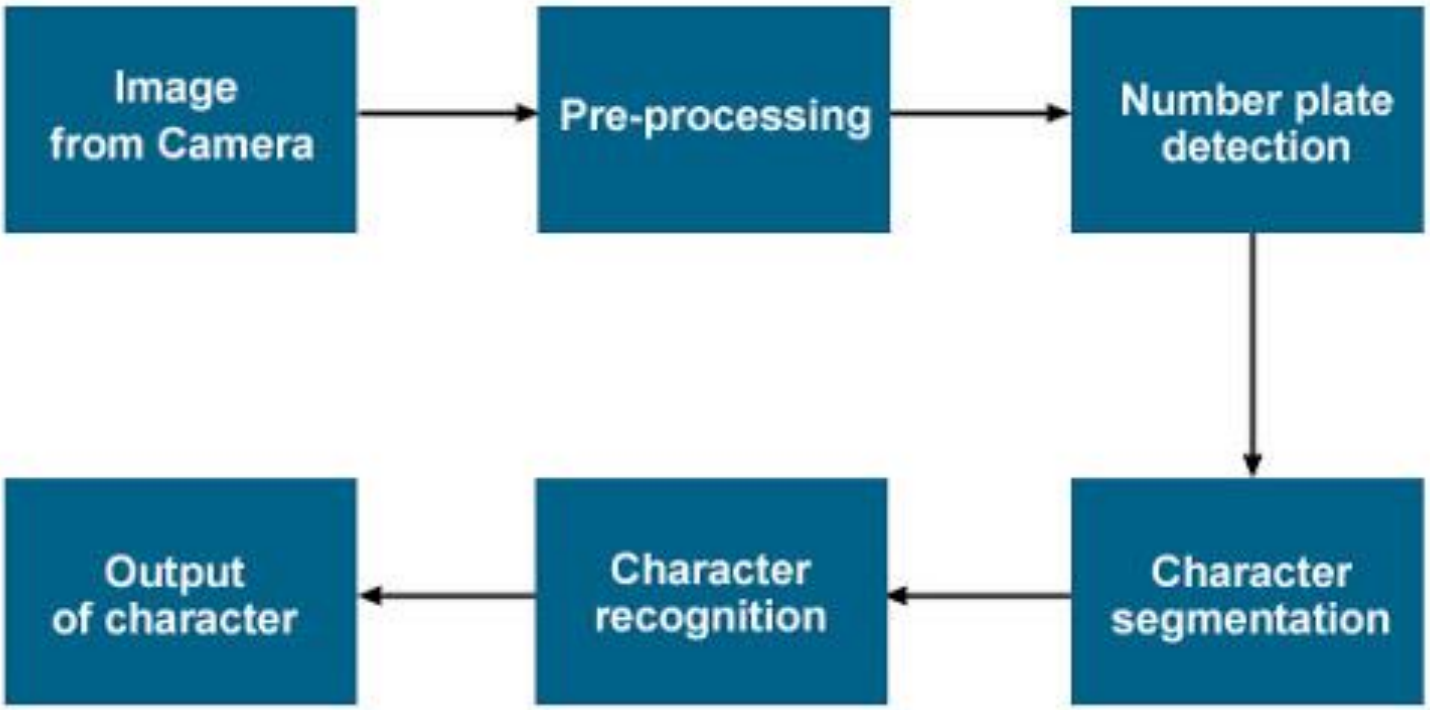
Systems design is the process or art of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. One could see it as the application of systems theory to product development. There is some overlap and synergy with the disciplines of systems analysis, systems architecture and systems engineering

11.4 Data Flow Diagram (DFDs):

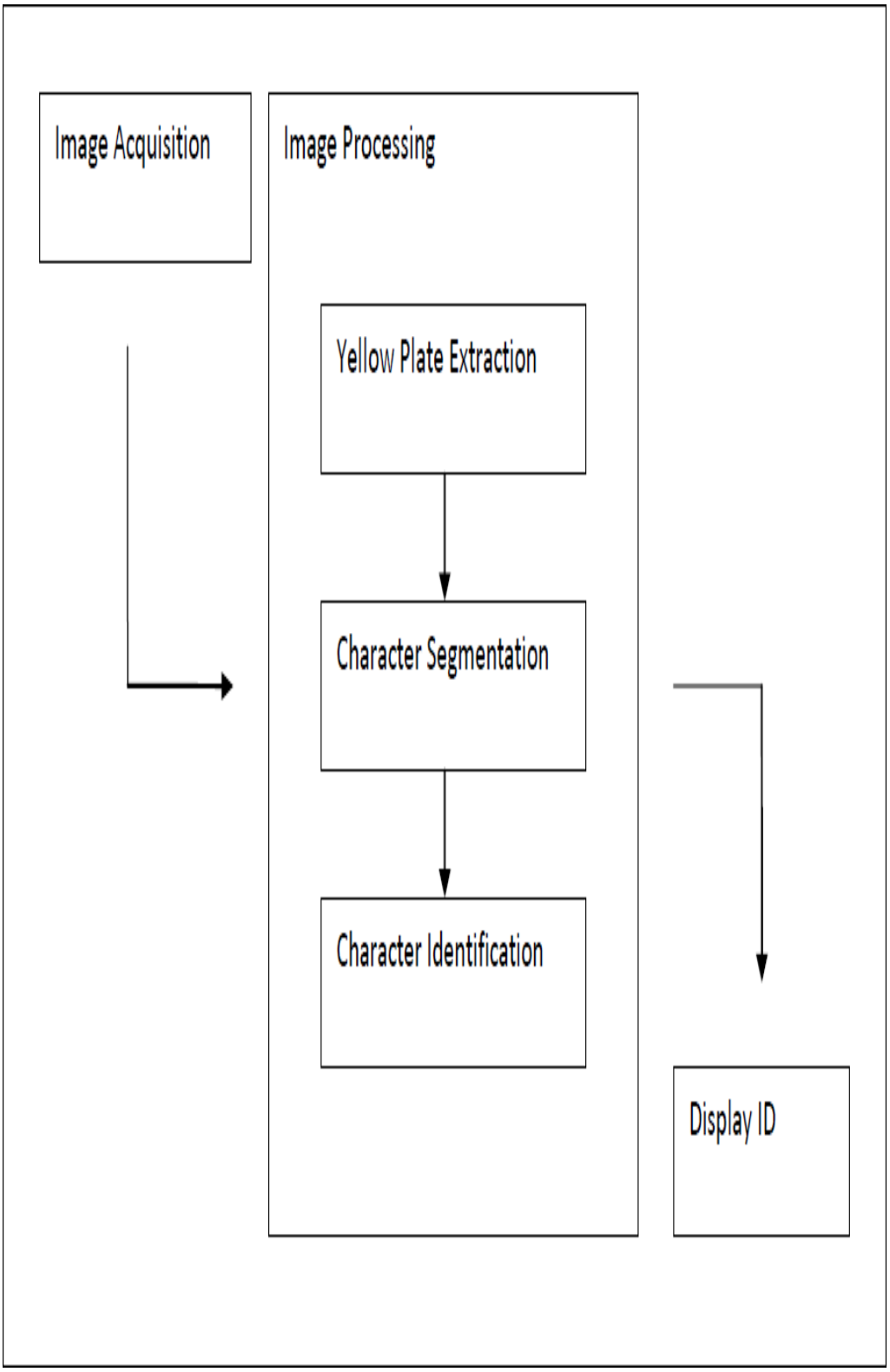
A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled.

11.5DFD Notations:





The proposed method for the localization of license plate consists of the steps explained in the figure

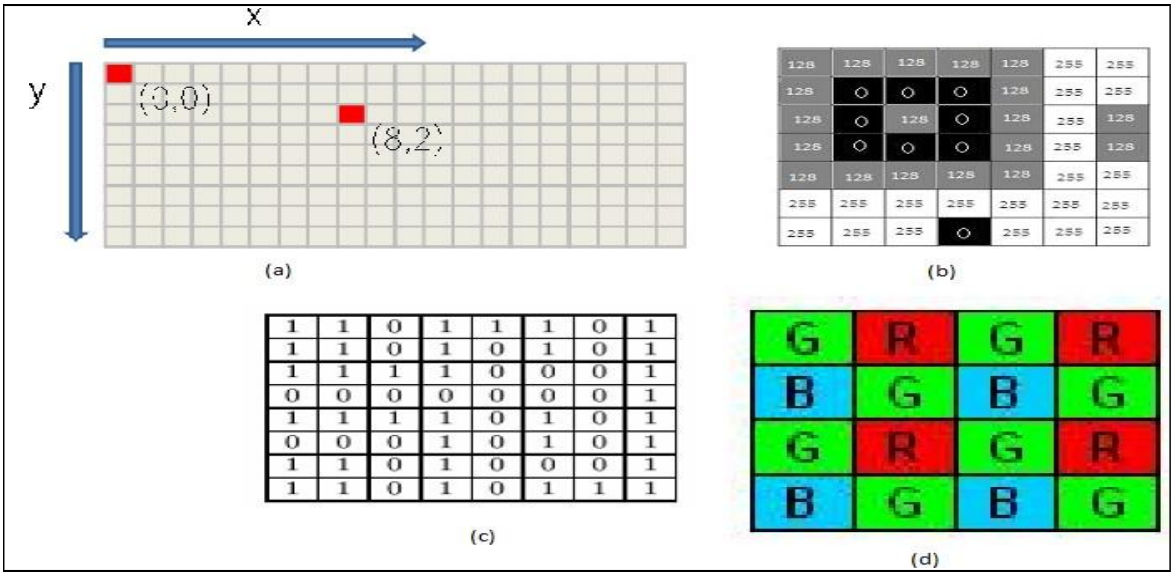


Chapter12

Working

Introduction to images

An image is a matrix with X rows and Y columns. It is represented as function say f(x, y) of intensity values for each color over a 2D plane. 2D points, pixel coordinates in an image, can be denoted using a pair of values. The image is stored as a small squared regions or number of picture elements called **pixels** as shown in the following figure:



In digital image, pixels contain color value and each pixel uses 8 bits (0 to 7 bits). Most commonly, image has three types of representation gray scale image, Binary image and colored image as shown in figure. Gray scale image, figure calculates the intensity of light and it contains 8 bits (or one Byte or 256 values i.e. $2^8 = 256$). Each pixel in the gray scale image represents one of the 256 values, in particular the value 0 represents black, 255 represents the white and the remaining values represents intermediate shades between black and white. The images with only two colors (black and white) are different to these gray scale images. Those two colored images are called binary images . So binary representation of the images does not contains shades between black and

white. Color images, are often built of several stacked color channels, each of them representing value levels of the given channel. For example, RGB images are composed of three independent channels for red, green and blue as primary color components. The color image contains 24 bits or 3 bytes and each byte has 256 values from 0 to 255.

Process of acquisition

Image acquisition is the process of obtaining an image from the camera. This is the first step of any vision based systems. In our current research we acquire the images using a digital camera placed by the road side facing towards the incoming vehicles .Here our aim is to get the frontal image of vehicles which contains license plate. The remaining stages of the system works in offline mode. Grayscale image: After acquiring the image, the very next step is to derive the gray scale image. Pseudo code to convert an image to a grayscale:

STEP1 : Load the image

STEP2 : Retrieve the properties of image like width, height and n channels

STEP3: Get the pointer to access image data

STEP4: For each height and for each width of the image, convert image to grayscale by calculating average of r,g,b channels of the image convert to grayscale manually

STEP5 : Display the image after converting to grayscale

The flowchart shown in the following figure describes the algorithm to convert an image to gray scale image.

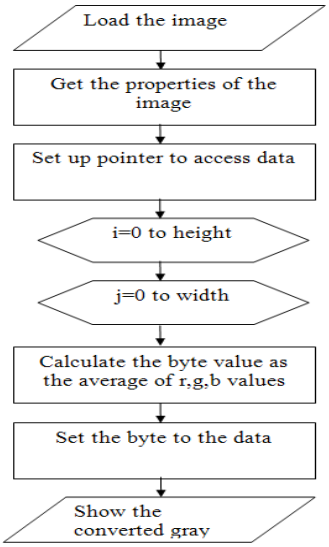


Image Processing

- ***Pre- Processing:*** The pre-processing is the first step in number plate recognition. It consists the following major stages: 1.Binarization, 2.Noise Removal
- ***Binarization****:* The input image is initially processed to improve its quality and prepare it to next stages of the system. First, the system will convert RGB images to gray-level images.
- ***Noise Removal:*** In this noise removal stage we are going to remove the noise of the image i.e., while preserving the sharpness of the image. After the successful Localization of the Number Plate, we go on with Optical Character Recognition which involves the Segmentation, Feature extraction and Number plate Recognition.

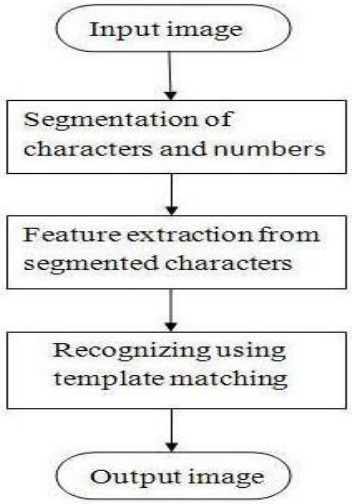
Character Segmentation

Segmentation is one of the most important processes in the automatic number plate recognition, because all further steps rely on it. If the segmentation fails, a character can be improperly divided into two pieces, or two characters can be improperly merged together. We can use a horizontal projection of a number plate for the segmentation, or one of the more sophisticated methods, such as segmentation using the neural networks. In this segmentation we use two types of segmentation: 1. Horizontal segmentation 2. Vertical segmentation. First we have performed vertical segmentation on the number plate then the characters are vertically segmented. After performing vertical segmentation we have to perform horizontal segmentation by doing this we get character from the plate.

Character Recognition

We have to recognize the characters we should perform feature extraction which is the basic concept to recognize the character. The feature extraction is a process of transformation of data from a bitmap representation into a form of descriptors, which are more suitable for computers. The recognition of character should be invariant towards the user font type, or deformations caused by a skew. In addition, all instances of the same character should have a similar description. A description of the character is a vector of numeral values, so called descriptors or patterns.

Flow chart of the OCR process:



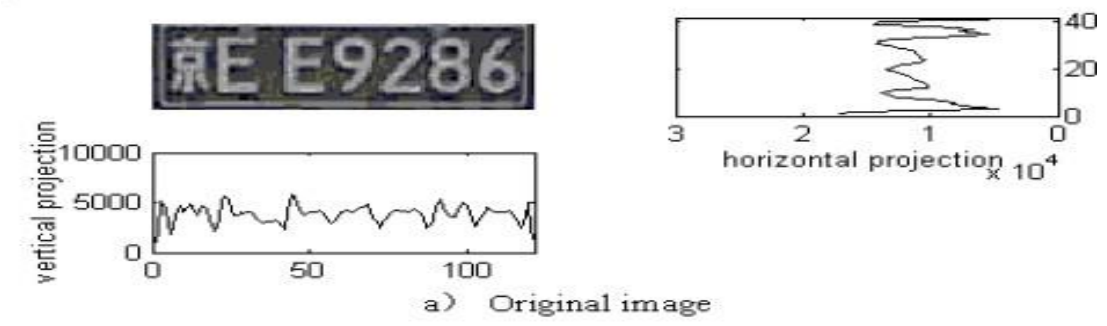
Proposed Algorithm And Implementation:-

Character segmentation:

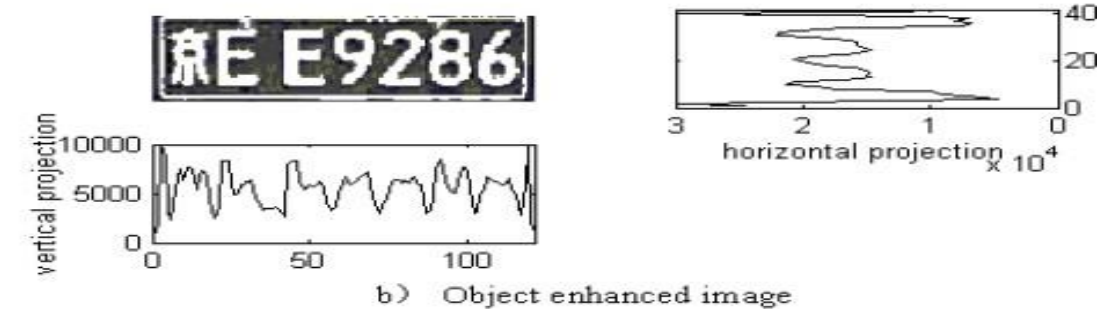
This is the second major part of the License Plate detection algorithm. There are many factors that cause the character segmentation task difficult, such as image noise, plate frame, rivet, space mark, and plate rotation and illumination variance. We here propose the algorithm that is quite robust and gives significantly good results on images having the above mentioned problems. The Steps involved in character Segmentation are:

- ***Preprocessing****:* Preprocessing is very important for the good performance of character segmentation. Our preprocessing consists of conversion to grayscale and binarization using a object enhancement technique. The steps involved are: Conversion to Grayscale, Binarization**.** Compared with the usual methods of image binarization, this algorithm uses the information of intensity and avoids the abruption and conglutination of characters that are the drawbacks of usual image binarization techniques.
- ***Object enhancement algorithm:*** The quality of plate images varies much in different capture conditions. Illumination variance and noise make it difficult for character segmentation. Then some image enhancement should be adopted to improve the quality

of images. As we all know, the image enhancement methods of histogram equalization and gray level scaling have some side effects. They may have the noise enhanced as well. For character segmentation, only the character pixels need to be enhanced and the background pixels should be weakened at the same time. In fact, a license plate image contains about 20% character pixels. So these 20% character pixels need to be enhanced and the rest pixels need to be weakened. It is called object enhancement. The object enhancement algorithm consists of two steps: Firstly, gray level of all pixels is scaled into the range of 0 to 100 and compared with the original range 0 to 255, the character pixels and the background pixels are both weakened. Secondly, sorting all pixels by gray level in descending order and multiply the gray level of the top 20% pixels by 2.55. Then most characters pixels are enhanced while background pixels keep weakened. The following figure shows the result of object enhancement. It can be seen from the figure that after object enhancement the contrast of peaks and valleys of the projection is more significant than the original.



a) Original image



b) Object enhanced image

***Horizontal Segmentation*:**

For this we calculate the horizontal and vertical projections of intensity. Then we find the local minima for horizontal projection. Based on the threshold calculated from the above local minima"s, we find x locations of the segmented regions. In order to locate the right and left edges of license plate from candidate region, the vertical projection after mathematical morphology deal is changed into binary image. The arithmetic for doing this is: F = Image between i &l

.

Where, fT (1, i) is the vertical projection after mathematical morphology, T is the threshold. Then scan the function of fT (1, i) and register the potions where values change from 0 to 1 and from 1 to 0 in stack1 and stack2 respectively. So the candidate position of the left and right edge of the license plate are in stack1 (1,i) and stack2(1,i) respectively, and the candidate"s width of the license plate is calculated by:

stack1 (1, i)

These give the coordinates of the potentially candidates regions. Merging and removing the Horizontal segments: Based on thresholds found by experiments we merge two segments if they happen to be very close and the segments having width less than a specified threshold are dropped**.**

$$\text{Width}(1,i) = \square\text{stack2}(1,i)^{-}$$

Finding Vertical bounds:

For each of the horizontal segments we follow the same procedure as discussed above to get the vertical bounds.

Optical Character Recognition

OCR is the mechanical or electronic translation of images of handwritten or typewritten text (usually captured by a scanner) into machine-editable text. The procedure consists of two important steps, training and recognition. Training**:** The program is first trained with a set of sample images for each of the characters to extract the important features based on which the recognition operation would be performed. Our program is trained on a set of 10 characters with 10 samples of each.

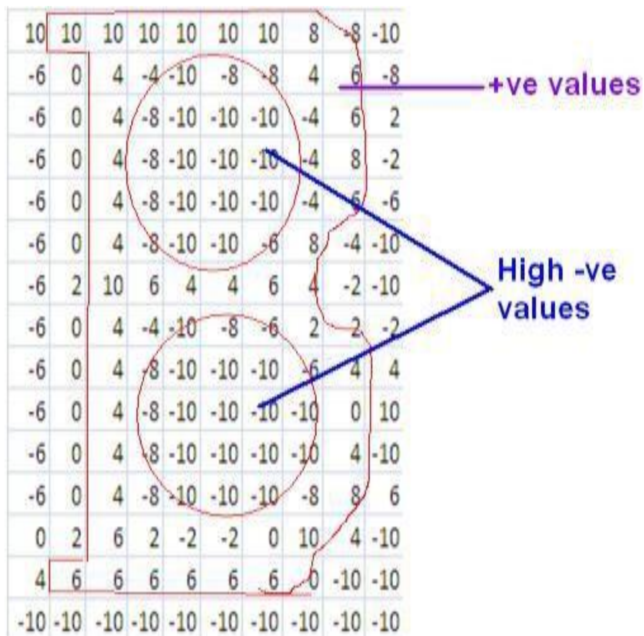
- Preprocessing:

Before preparing the template for each of the characters for further use, we need to do some processing on the images. The following are the operations that are performed: Binarization, Inversion of intensity of the characters. Finding the connected component that represents the character. Finding the smallest rectangle enclosing this connected component. Normalization of the image to size 15 X 15. - Storing the intensity values using the below mentioned algorithm for each of the characters.

- **Creating the template:**

  In order to create the template for each character we do the following operation. For every white pixel we insert the value 1 and for every black pixel 0. We do this for all the 10 training samples for each character and calculate the weights to get the template.

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0



10	10	10	10	10	10	10	8	-8	-10
-6	0	4	-4	-10	-8	-8	4	6	-8
-6	0	4	-8	-10	-10	-10	-4	6	2
-6	0	4	-8	-10	-10	-10	-4	8	-2
-6	0	4	-8	-10	-10	-10	-4	6	-6
-6	0	4	-8	-10	-10	-6	8	-4	-10
-6	2	10	6	4	4	6	4	-2	-10
-6	0	4	-4	-10	-8	-6	2	2	-2
-6	0	4	-8	-10	-10	-10	-6	4	4
-6	0	4	-8	-10	-10	-10	-10	0	10
-6	0	4	-8	-10	-10	-10	-10	4	-10
-6	0	4	-8	-10	-10	-10	-8	8	6
0	2	6	2	-2	-2	0	10	4	-10
4	6	6	6	6	6	6	0	-10	-10
-10	-10	-10	-10	-10	-10	-10	-10	-10	-10

Character Recognition:

- ***Preprocessing:*** The image obtained after segmentation is Grayscale. Follow the preprocessing steps used for the training of the characters. Calculate the score for each of the characters**:** We calculate the matching score of the segmented character from the templates of the character stored by the following algorithm. We compare the pixel values of the matrix of segmented character and the template matrix, and for every match we add 1 to the matching score and for every mis-match we decrement 1. This is done for all 225 pixels. The match score is generated for every template and the one which gives the highest score is taken to be the recognized character. Character sets used for training the OCR**:** This is contained in a directory named "OCR_Training_Data"

In order to locate the right and left edges of license plate from candidate region, the vertical projection after mathematical morphology deal should be changed into binary image. The arithmetic is:

$$f_T(1,i) = \begin{cases} 1 & f_1(1,i) \geq T \\ 0 & f_T(1,i) < T \end{cases}$$

Where fT (1, i) is the vertical projection after mathematical morphology, T is the threshold. Obviously, the key problem of getting binary image is how to choose the threshold. In the algorithm proposed in this paper, the threshold is calculated by where *aver* is the average value of fT (1, i) and t is weight parameter. We use t =1.23**.** Then scan the function of fT (1,i) and register the potions where values change from 0 to 1 and from 1 to 0 in stack1 and stack2 respectively. So the candidate position of the left and right edge of the license plate are in stack1 (1,i) and stack2(1,i) respectively, and the candidate"s width of the license plate is calculated by : Width

(1, i) = stack2(1, i) - stack1(1, i).

Extract License Plate:

From the above steps, we can get the row and column position of the license plate. Implemented algorithm at times gives more than 1 license plate on detection.

End output

Recognized Number plate of the vehicle

CHAPTER 13

Future Scope

- Parking
- Access Control
- Tolling
- Border Control
- Stolen Car
- Traffic Control

CHAPTER 14

Conclusion

- There is an immediate need of such kind of Automatic Number Plate Recognition System in India as there are problems of traffic,stealing cars etc.
- Government should take some interest in developing this system as this system is very economical and Eco-friendly,if applied effectively.
- This change will help in the progress of the nation.

CHAPTER 15

References: -

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