AUTOMATIC NUMBER PLATE RECOGNITION AND RFID BASED ACCESS CONTROL SYSTEM

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ABSTRACT

AUTOMATIC NUMBER PLATE RECOGNITION AND RFID BASED ACCESS CONTROL SYSTEM

Access control in general is a mechanism for limiting access to areas and resources based on personnel's identities and their membership in various predefined groups. Access to limited zones can be managed based on vehicle identification alone or together with personnel identity. In this project vehicle access control is provided through Automatic Number Plate Recognition System and personnel access control through the Radio Frequency Identification. Automatic Number Plate Recognition is an image processing technology, which uses number plate to identify the vehicle. Vehicle number plate region is extracted using image segmentation. Optical character recognition technique is used for the character recognition. MATLAB is used for the implementation of License Plate Detection algorithm. This system takes a vehicle image of any size and first of all extracts the number plate area from the image. The image is then given to the Optical Character Recognition module, which recognizes the characters and converts them in text format. Radio Frequency Identification tags are used for the identification of personnel at the entrance of the restricted area. The resulting data obtained through Automatic Number Plate Recognition and Radio Frequency Identification will be used to compare with the record in a database and if the data matches, only then the barrier will be raised and the gate will open at the entrance of the restricted area.

CERTIFICATE

It is certified that the contents and form of this thesis entitled **"Automatic Number Plate Recognition and RFID based Access Control System"** submitted by Capt Umair Fakhar, Capt Muhammad Ali and Capt Mohsin Khan have been found satisfactory for the fulfilment of the requirement of a B.E degree in Telecom Engineering.

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DECLARATION

No portion of the work presented in this dissertation has been submitted in support of another award or qualification either at this institution or elsewhere.

Dedicated to our Parents for their endless love, support and encouragement and to our Teachers, without whose support and cooperation this project would not have been possible.

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LIST OF ABBREVIATIONS

1. **ANPR** - Automatic Number Plate Recognition
2. **LPR** - Liscense Plate Recognition
3. **MATLAB** - Matrix Laboratory
4. **OCR** - Optical Character Recognition
5. **RFID** - Radio-Frequency Identification
6. **RF** - Radio Frequency
7. **RGB** - Red Green Blue

CHAPTER 1

PROJECT DESCRIPTION

1.1 Overview

Access control in general is a mechanism for limiting access to areas and resources based on personnel's identities and their membership in various predefined groups. Access to limited zones, however, may also be managed based on the accessing vehicles alone or together with personal identity. Identification of vehicles and persons is always important for highly restricted areas. There are various methods for auto-identification; some of them are bar-code systems, optical character recognition, biometrics, smart cards and radio frequency identification RFIDs, of which we will be using RFID and Automatic Number Plate Recognition (ANPR) technology in our project for access control. License plate recognition brings automation of vehicle access control management, providing increased security, car pool management for logistics, security guide assistance, event logging, event management, keeping access diary, possibilities for analysis and data mining. To keep unauthorized personnel out of the restricted areas RFID is used. This technique uses electromagnetic fields to exchange data from a tag (like a smartcard) to an object (a reader) for the purpose of authentication, identification or tracking.In this project vehicle access control is provided through Automatic Number Plate Recognition System (ANPR) and personnel access control through the Radio-Frequency Identification (RFID). The resulting data obtained through ANPR and RFID will be used to compare with the record in a database to come up with the specific information like the vehicle’s owner, place of registration, address, etc. The barrier on the entrance of the restricted area will be raised and access will be granted to the vehicle only if the data obtained from the ANPR and RFID matches the data base. This system will be implemented on the entrance for the security control of highly restricted area.

1.2 Problem Statement

The problem statements that have led to this project are:

(1) Unauthorized vehicle/personnel entering any restricted area (any security installation, organization, office area etc) without inspection.
(2) Time consuming when frequently check in for each vehicle that passes by the barrier.
(3) Numbers of vehicle check in and out of any restricted area are unknown.

The first problem is about unauthorized vehicle or personnel entering any restricted area without inspection causes security issue. The problem occur when sometimes vehicle just pass through the entrance of security without stopping by so no authorization process could be done or any unauthorized individual entering a particular restricted area.

Secondly it is time consuming when vehicles have to stop for screening process at the entrance and identification cards of the staff/employees are checked. In case of any unauthorized vehicle, the matter need to be reported manually to the concerned authorities/control room. Therefore this process is time consuming and other vehicles queue up at the line of entrance which can be a security risk.

The third problem is numbers of vehicle check in and out of the restricted area are unknown. It is a problem as we cannot really estimate how many vehicle checks in and are the vehicle checking out the same day or not for unauthorized vehicle. Therefor a record for entering and leaving any restricted area has to be maintained for the vehicles and the individuals driving those vehicles.

1.3 Objective

The objectives of this project are

(1) To design an efficient access control system which includes vehicle and personnel identification.

(2) To develop an efficient automatic vehicle identification system by using the vehicle number plate, granting access to only authorized vehicles, entered in the database.

(3) To develop an efficient RFID system for granting access to only authorized personnel, registered in the data base.

(4) Integrating both vehicle identification system and personnel identification to form an efficient access control system.

1.4 Project Specification

We are providing two specifications in our project which are as follows:

Vehicle Access Control:

Vehicle access control is provided through Automatic Number Plate Recognition System. Access will be granted to the vehicle only if the data obtained from the ANPR matches the data base.

Personnel Access Control:

Personnel access control is provided through the Radio-Frequency Identification. Access will be granted to the personnel only if the data obtained from the RFID matches the data base.

1.5 Scope of the Project

This project has a vast scope and requirement in the present security environment. It will help in providing a quick and effective recognition of vehicle number plate. The ANPR system is tested and practically implemented for standard Islamabad number plates. The project has been completed approximately in a year's time. The final product provides a quick and effective recognition of standard Islamabad number plate.

1.6 Project Description

In this project a sensor will sense the presence of a vehicle, camera to capture the image. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique will be used for the character recognition. The resulting data is then used to compare with the record in a database so as to come up with the specific information like the vehicle's owner, rank, name, department etc. The barrier at the entrance of the restricted area will only be raised when information is matched with that stored in the database. For personnel identification RFID module will be used. The RFID module will be interfaced with the micro controller and when the card will come in contact with the reader, it reads the data in the card. If the data in the card is matched with the data stored in the program memory only then the gate at the entrance will open and access will be granted. Access will be denied if any one of the above mentioned conditions are not satisfied. The system is implemented and simulated in Matlab. Block Diagram of Access Control System is given below:

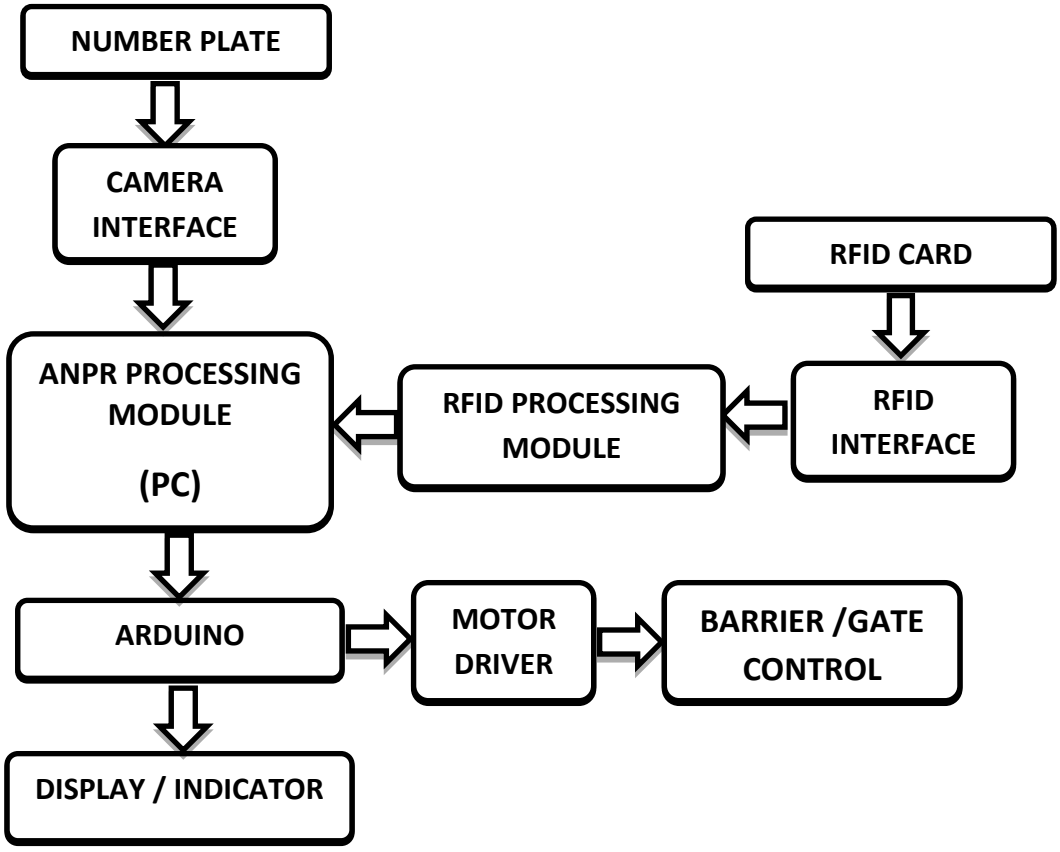

Figure 1.1: Block Diagram of Access Control System

CHAPTER 2

LITERATURE REVIEW/BACKGROUND STUDY

2.1 About Digital Image Processing

In Digital Image Processing, digital computer is used in processing the digital images. There are three levels of processes: low-, mid-, and high level processes. Low-level processes involve primitive operations such as image pre-processing for the reduction of noise, enhancement of image contrast and it's sharpening. In low-level process, both inputs and outputs are images. Segmentation is a task which refers to mid-level processing on images and it involves partitioning an image into regions. Description of those objects is also the part of mid-level processing which reduces the objects to make them suitable for computer processing, and finally the recognition of individual objects is done. In mid-level process, we have the images as the inputs but outputs are attributes taken from those images (e.g., edges, contours, and the identity of individual objects).

2.2 Classification of Images

The actual or captured image can be classified into three categories and that are:

- RGB Image
- Gray Image
- Binary Image

2.2.1 RGB Image

The image in RGB scale is defined as an image having true color. Each pixel separately is defined by three color components; red, green and blue in an array. The pixel color is recognized by the red, green, and blue intensity combinations. In an RGB array, value of each color component is between 0 and 1, such that the black pixels are given as (0,0,0), and the white pixels are given as (1,1,1). All these three RGB color components are saved at the third index of the data array. Considering that

three components of pixel (x, y) is stored in RGB as (x, y, 1), (x, y, 2), and (x, y, 3) respectively for red, green, and blue.

2.2.2 Gray Image

The grayscale image is the image that is made up of white, black and gray shades, having values between 1 and 0. The pixel value in this type of image carries only intensity information i.e. a single value. These are the images having shades of gray in between. Multi bit images is another name given to these gray images.

2.2.3 Binary Image

Binary image (digital image) is just made up of either the pixel value 1 or the pixel value 0. These two values represent the two colors that are black and white for '0' and '1' respectively. Images mostly have black backgrounds with the text or the objects defined in white.

2.3 Edge Detection

Edges are the intensity changes in an image. Edges occur on the boundary between the two different regions in an image.

Edge detection is an important term in digital image processing, particularly in the areas of feature detection and feature extraction. Discontinuities in the image and sharp intensity changes in the image are identified by the edge detection process.

By applying the edge detection technique, a set of connected curves is obtained that indicates the object boundaries. These curves or surface boundaries correspond to discontinuities in surface orientation. This operation also reduces the amount of unnecessary data from the image thus making the processing easy by filtering unnecessary information, while keeping important properties of the image. Edge detection simplifies the extraction of important events from the given image.

2.3.1 Goals of Edge Detection

Goals of edge detection are given as:

- To produce a line drawing sketch of a captured image
- To extract important events from the edge detected image (e.g., corners, lines, curves).
- To use these extracted events by computer algorithms (e.g., recognition).

2.3.2 Steps of Edge Detection

Edge detection is done in four main steps, given as:

- Smoothing: In this step suppression of noise takes place while protecting the true edges.
- Enhancement: In this step a filter is applied to enhance the quality of the edges in the image (sharpening).
- Detection: This step determines that which edge pixel should be discarded as noise and which should remain in the image.
- Localization: This step determines the exact location of the edge and pixel resolution. Thinning and linking of edges are usually required in this step.

Because of small filter size Robert edge detector is fast. But it becomes difficult to detect edges if the edges in the image are not very sharp.

2.3.3 Methods of Edge Detection

Edge detection can be done by convolving the image with different operators; these operators are sensitive to large gradients in the image and return values of zero in uniform regions. Some of them measure the rate of change in the brightness of the image, while others only return information about edge existence at each point. There are many methods to perform edge detection and these different methods are divided into two groups and that are:

- **Gradient:** Gradient method computes the first derivative of the image and then looks for the maxima and minima to detect the edges from the image.
- **Laplacian:** Laplacian method computes the second derivative of the image and search for the critical points (zero crossings) to find the image.

Given below are the names of different operators sensitive to certain types of edges used, out of which we will discuss Sobel Edge Operator as it is used in our project.

- Roberts Operator
- Sobel Operator
- Prewitt Operator
- Canny Operator

2.3.4 Sobel Edge Detection

The Sobel edge detector uses the 3x3 convolution mask which when applied to the image creates the series of gradient magnitudes. The two convolution masks used by the sobel edge operator are hx and hy and are shown below:

$$h_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, \quad h_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

The working of the sobel operator can be understood by considering an example. Considering an image shown in Figure-2.1:

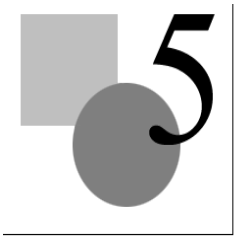

Figure 2.1: Image before applying Sobel operator

The first image on the left shows the effect of horizontal convolution mask hx as it computes the gradient along x-axis or columns. And the second figure shows the effect of vertical convolution mask on the actual image, which computes the vertical gradient along y-axis or along rows

(a) (b)

Figure 2.2: Image after convolution with hx and hy masks where (a) shows is the gradient along x-axis and (b) shows the gradient along y-axis.

"These resulted images are stored as vectors (gradient vector)" [4]. The two resulted vectors can be regarded as the x and y components of the gradient. Therefore the gradient magnitude and direction can be found as:

$$\mathbf{g} = \begin{bmatrix} g_x \\ g_y \end{bmatrix}$$

$$g = \sqrt{g_x^2 + g_y^2}$$

$$\theta = \tan^{-1}\left(\frac{g_y}{g_x}\right)$$

Where

"g" is the gradient vector

"g" is the magnitude of gradient

"θ" is the gradient direction

The final gradient magnitude will look like as shown in Figure-2.3

Figure 2.3: Image resulted after computing the gradient magnitude.

2.4 RFID Systems

RFID stands for Radio Frequency Identification it is a term used to explain a system used for the identification of an object using Radio Frequency. RFID technologies are more commonly used in the Automatic Identification technologies. RFID, a mean to automatically identify objects, has many applications.

RFID technology is somehow similar to bar code technology. This technology detects the objects from some distance and does not require line of sight communication, whereas bar codes detect the object when it comes in line of sight of the reader.

The major elements of the RFID are:

- Tags
- Readers
- Antennas and radio
- Network infrastructure

2.4.1 Tags

There are three basic types of RFID tags. These types differ due to their electrical properties and are given as follows:

- Passive tags
- Active tags
- Semi passive tags

Passive tags: Passive tag is the type of RFID tag that does not consists of a battery to power it or to activate its communication. These tags are activated by the radio frequency signals transmitted by the reader when the tags come in certain range of the reader. Passive tags are smaller in size as compared to other types of tags

Active tags: Active tags are the RFID tag that consists of a inbuilt battery in their architecture. These types of tags does not require reader's RF signal for its activation and its communication with the RFID reader. These tags are reliable because are always active even in the absence of RF signals. They are larger in size then the passive tags.

Semi passive tags: Semi passive tags are the RFID tags that have characteristics that lie between the passive and active tags. They consist of battery but they also need a RF signal of the reader to communicate with the RFID reader by reflecting the received RF signal. Semi passive tags have longer life and have short range like passive tags, whereas they are more reliable like the active tags

2.4.2 Reader

RFID reader is the device that sends the electrical signal in the form of radio frequency signal and in response RFID tags after listening to these signals transmits their information to the reader. The information transmitted from the tag consists of the tag identification number and other information if stored in the tag. The readers set the mode of the tags to write mode or read mode and both, as instructed by the computer program.

2.4.3 Antennas and Radio

Every communication device needs an antenna and needs radios on the physical layer to transmit the modulated and encoded signal in the air towards the reader. So that the RFID system also needs an antenna which develops an association or link between the tag and the reader for radio signal or energy transmission.

2.4.4 Network Infrastructure

Network structure is the computer system which receives the digital data from the reader. The reader first decodes the tag's information and then digitally transfers it to the computer in the PC to which it is attached to. This information is further used by the computer software and the required operation is performed or programmed.

CHAPTER 3

DETAILED DESIGN

3.1 Implementation of ANPR

In this section we will explain the working of all the three sub-systems in detail. First of all we will explain that how we are extracting the number plate area from the image then we will explain the process of character segmentation and finally the character recognition part.

3.2 How this system works?

This system takes a vehicle image of any size and first of all extracts the License Plate Area from the image and then segments the number plate into the individual characters. These characters are then given to the OCR module; OCR module then recognizes these characters and converts them in text format.

3.3 Steps for ANPR

An efficient automatic number plate recognition process is the most important part of access control systems, computerized traffic monitoring systems, parking systems etc. It includes the following three steps:-

- Number Plate Region Extraction
- Character Segmentation
- Optical Character Recognition

3.4 System Architecture

- Image Acquisition
- Convert RGB to Gray
- Extract number plate region

- Character Segmentation
- Optical Character Recognition

3.4.1 Image Acquisition

Acquire the image through a camera. The distance between a camera and an acquired vehicle should be between 5-8 feet.

3.4.2 RGB to Gray-Scale Conversion

Image acquired by a common cameras are in RGB color model by default. RGB stands for Red Green Blue. In this model each of the primary color i.e. Red Green Blue valued form 0 to 255 this means combination of intensities of these three colors identifies different unique colors e.g. if intensities of these three colors in RGB model is 255, 255 and 255 respectively, the visual effect will be white. Also if the intensities are 255, 0, 0 the result will be Red etc…

We can process our image using RGB model but this would result in high processing time and heavy load on processor as it not only processing a single matrix but three different matrices. So to simplify and improve the efficiency of our processing we convert the acquired image from RGB to Gray scale. Gray scale image commonly called black and white image. In this we have only one matrix to cater. Each value of the pixel of the image varies from 0 to 255. These values are the intensity value of the pixel. Zero is the darkest value and 255 is the brightest value.

3.4.3 Number Plate Area Extraction

Now we will give the detail description of each step involved in extraction of number plate.

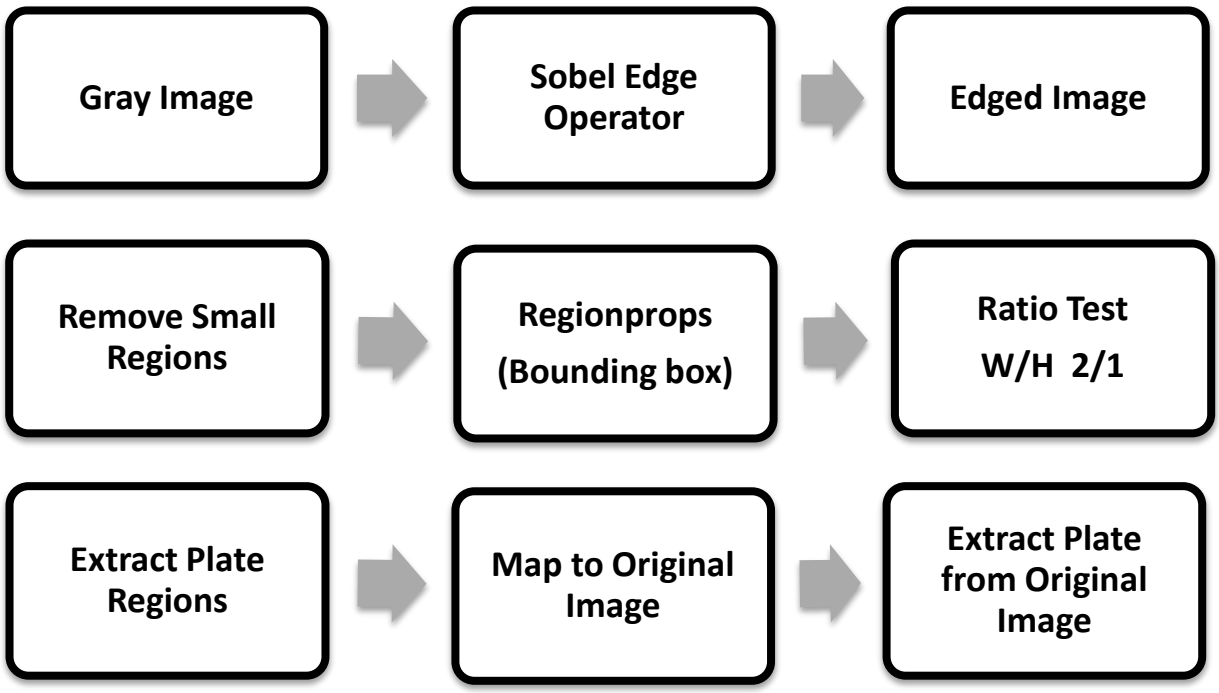

Figure 3.1: Steps in Extraction of Number Plate Area

For the number plate extraction, we will apply the sobel edge detectors on a grey scaled image. These edge detectors will give us an edged image in which all the edges of an image will become prominent. Now our next task is to remove all the small regions in order to clarify an image. After that, we will apply a region props command which will determine a set of properties for each connected object in the edged, grey scaled image.

Now we will use the ratio test to extract the number plate region from the grey scaled edged image. The region having width/height ratio as 2:1 will be considered as number plate region and will be extracted. Before the extraction of a number plate, we will map this image to the original image.

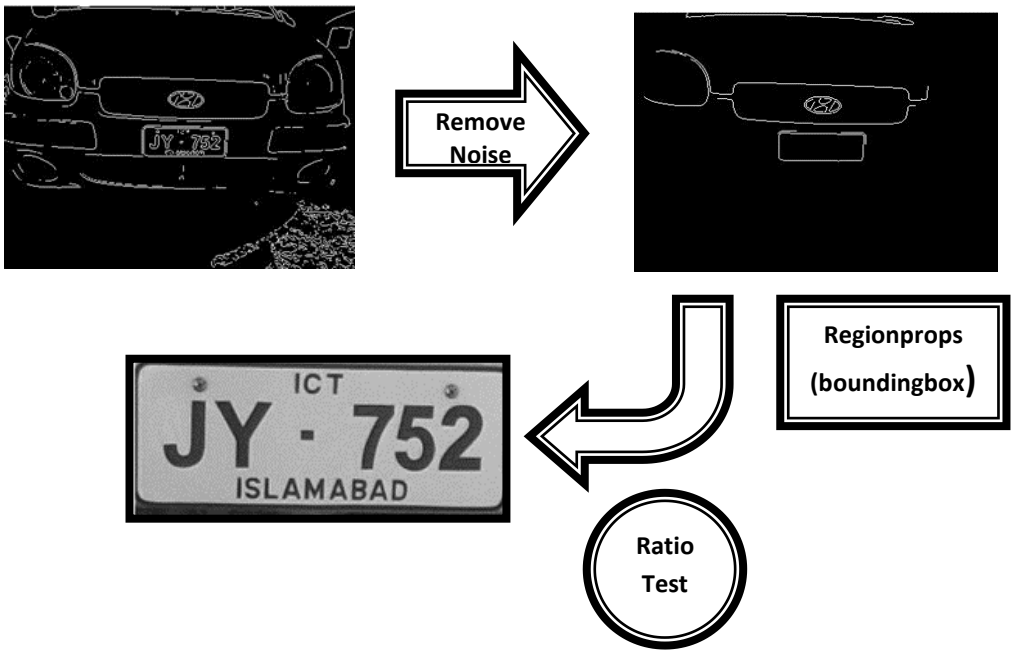

Figure 3.2: Process of ANPR

3.4.4 Character Segmentation:

The steps which are involved in the process of Character Segmentation are:

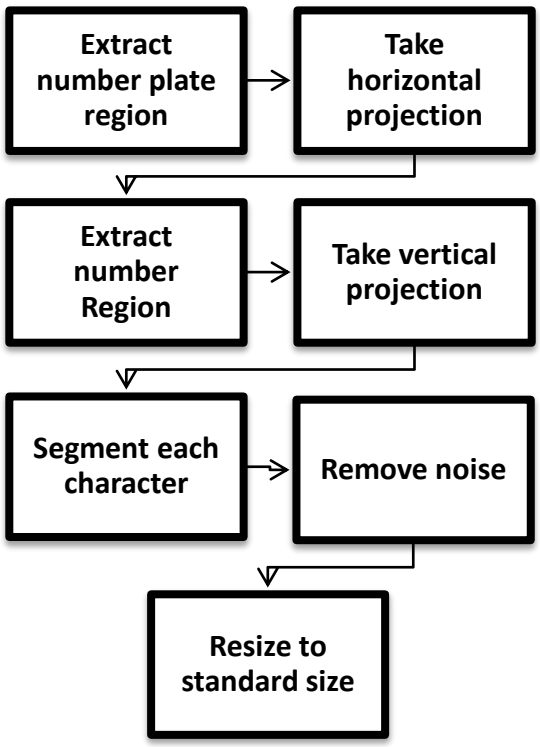

Figure 3.3: Character Segmentation

In this particular problem for character segmentation we are using a different technique. For example if we have a look on the Number Plate Area of the Islamabad standard number plates as given in the following Figure 3.5, we note that there are three rows of characters in the Number Plate Area but we are interested just in the middle row as this is our area of interest which contains the actual number of the Number Plate. It consists of two characters and three digits. So first of all we discarded the First and Third rows.

First of all we are finding all the rows with complete white pixels (i.e. with no black pixel) and storing them in an array. Then we are computing the difference of each consecutive pair of that array and if the difference is greater than 25 (Threshold value) then we save that pair of rows which is basically the boundary of the Middle Row, which is our area of interest. We are using 25 as a threshold value because 1st and 3rd both rows have the height of characters always less than 20 pixels and middle row have height always greater than 25 pixels. After that we are copying the Middle Row of characters from the above image to a new separate image. This is our area of interest, as shown in the Figure-3.6 below:

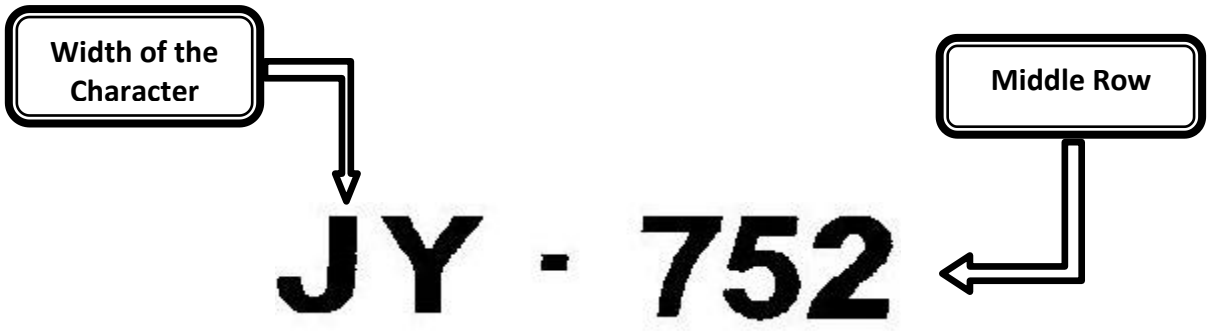

Figure 3.4: The Segmented Middle Row of Characters.

Now we are separating all the characters in the same manner but this time we are finding the columns instead of rows with complete white pixels. Storing all those columns in an array and then compute the difference of each consecutive pair and if the difference is greater than 3 then we store all those pairs, these pairs are basically the boundaries of the width of the characters. This threshold value 3 also removes noise if any, introduced in our area of interest.

There is still a chance of noise that can be introduced because of any mud sign in our area of interest and we also tried to remove that noise. To remove noise we are counting the number of black pixels in image segments of each pair of columns stored and if the numbers of black pixels are less than 30 then we will discard that pair because the numbers of black pixels in a character segment are always greater than 30. All the remaining 5 pairs are the boundaries of the 5 character segments. After that we will copy all 5 character segments to 5 new separate images. The resultant separate images are shown in the following image.

Figure 3.5: All 5 Separate Character Segments

For recognition of Alphabets we first read all the 26 templates and resize all of them equal to the size of the character segment taken from the number plate after the process of segmentation. Now we subtract the character segment from all the 26 templates using pixel-by-pixel processing and store the result into new images hence this process results in 26 new images. We count the numbers of white pixels in all the resultant 26 images and store them in an array. Then we take the minimum value from that array, which corresponds to that character which has been matched. Same process is done for the recognition of 2nd alphabet character segment.

For recognition of Digits we are using the same technique but this time we are using 10 templates obviously for 10 digits.

3.4.5 Data base Connectivity:

We have created our database using Microsoft Excel file, which is attached with our program. The database contains number of registered numbers of vehicles. The segmented characters are now compared with database one by one. If the segmented characters are matched with any vehicle number in database the system will authorize the car. If the segmented characters are not matched with database the will restrict the

entry of vehicle. This type of authorization can be used in many organizations where only registered vehicles are allowed to enter. Vehicles from outside the organization would be restricted to enter.

3.5 RFID System

RFID, or Radio Frequency Identification, is a system for transferring data over short distances (typically less than 6 inches). Often only one of the two devices needs to be powered, while the other is a passive device. This allows for easy use in such things as credit cards, key fobs, and pet collars as there is no need to worry about battery life. The downside is that the reader and the information holder (ie credit card) must be very close, and can only hold small amounts of data. As shown in the figure below, the process begins when RFID tag comes in the range of the RFID reader then the reader transmits the signals to the tag. Then tag will modulate that carrier signal with the data present in it. Then this modulated signal will be received by the RFID reader.

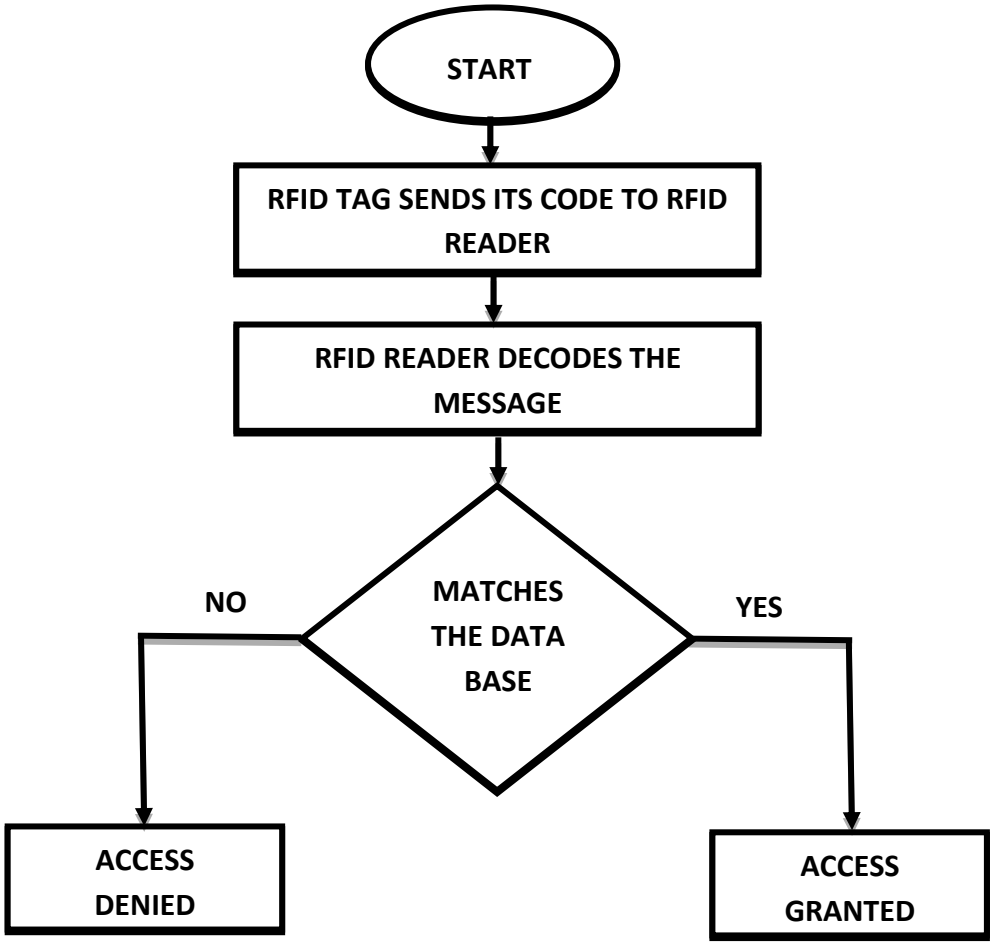

Figure 3.6: Flow chart of design of the RFID system

The following table shows the connections between the RFID and the Arduino Uno

RFID-RC522 Module	Arduino Uno
1 - SDA	Digital 10
2 - SCK	Digital 13
3 - MOSI	Digital 11
4 - MISO	Digital 12
5 - IRQ	--unconnected--
6 - GND	Gnd
7 - RST	Digital 5
8 - 3.3V	3.3v

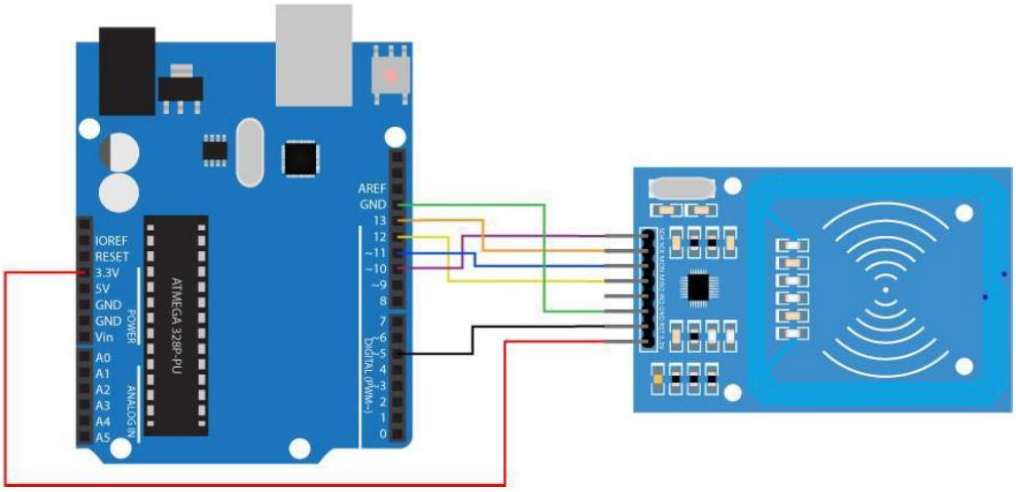

Figure 3.7: Connections between the RFID and the Arduino Uno

CHAPTER 4

PROJECT ANALYSIS

4.1 Results

The results obtained are as follows:

4.2 Reading Still Image

This is the first step in the LPR system, input to the system is RGB image. The image is stored in the form data array of size 3 in MATLAB. Each pixel separately is defined by three color components; red, green and blue in an array.

Figure 4.1: Original Image

4.3 Gray Scale Conversion

For further processing of the image, it was converted in to gray scale in order to obtain an image having less intensity which is required when the threshold value for the binary image is being calculated. For the conversion, “rgb2gray” command was used.

Figure 4.2: Gray Image

4.4 Edge Detection

In this step all the edges of the gray scale image are detected. The edges are detected by finding sharp contrasts in intensities in an image. The command use for edge detection is “edge” which takes either a binary image or an intensity image as input and returns an image of same size which contain all the edges in that image. Sobel method is used here for detection of edges.

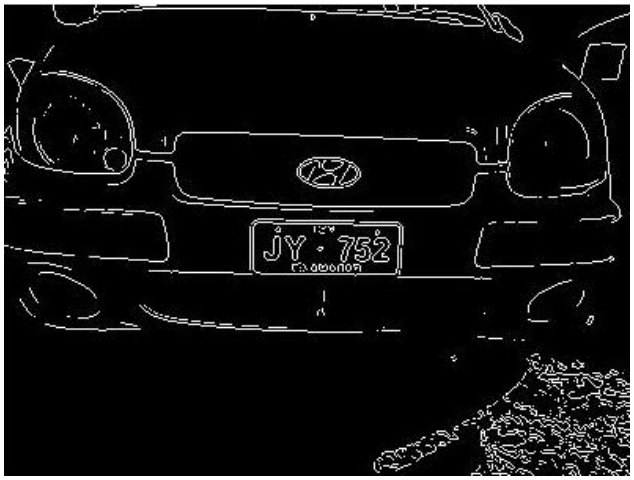

Figure 4.3: Edge Detected Image

4.5 Removing fewer pixels

As we can see that we have obtained too many edges and most of them are useless, so to remove them we have used “bwareaopen(img,P)” command in which argument P is the number of pixels. The connected pixels which are less than P are removed and others will be shown in the next resultant image.

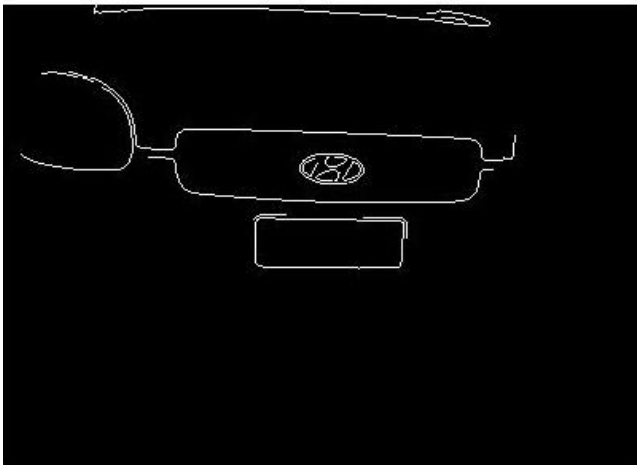

Figure 4.4: Filtered Image

4.6 Number Plate Extraction

Now the number plate region is extracted. This is done by using “regionprops” command which measures a set of properties for each connected component or object in the binary image. This command returns properties of the bounding boxes, which includes coordinates, length and width. As there are more than one bounding box in most of the images so we have applied a ratio test to determine the number plate region. The region having width/height ratio as 2:1 will be considered as number plate region and will be extracted.

Figure 4.5: Extracted Number Plate

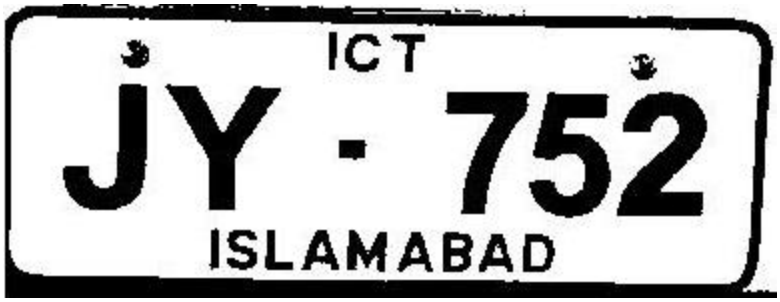

Figure 4.6: Binary Image of Extracted Number Plate

4.7 Extraction of Middle Row

Now we have to determine the rows which contain the alphabets and digits. This will be done by summing the rows to detect numbers area from plate horizontally

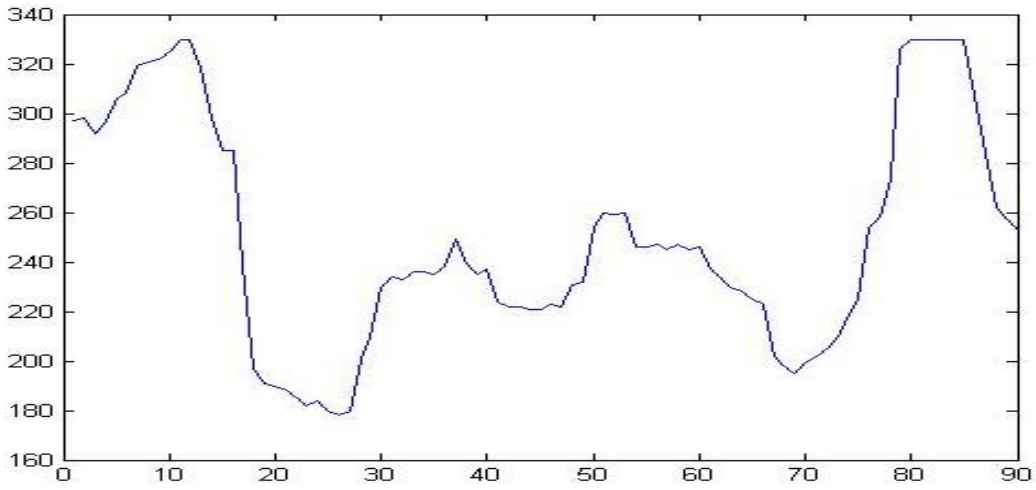

Figure 4.7: Graph of sum of rows

In the above image there are three rows. We want to discard first and third row which contains ICT and ISLAMABAD letters. In the graph we can see that while summing the rows there are two peaks, these peaks appear because of the rows having all white pixels. The sum decreases at any of the character row due to the black pixels. We have to extract only the middle row which is lying in between the two peaks of the graph.

4.8 Segmentation :

The extracted middle row image is shown in fig. From here segmentation of the characters will start. We will take the vertical sum of the image below.

Figure 4.8: Extracted Middle Row

This graph shows the sum of the columns of the above image, if we take a closer look on this graph it can be seen that the peaks arise at the columns where only white pixels exist. These peaks are the seperation between two characters. Now we can estimate the beginning and ending column of every character, this will help us segmenting the characters.

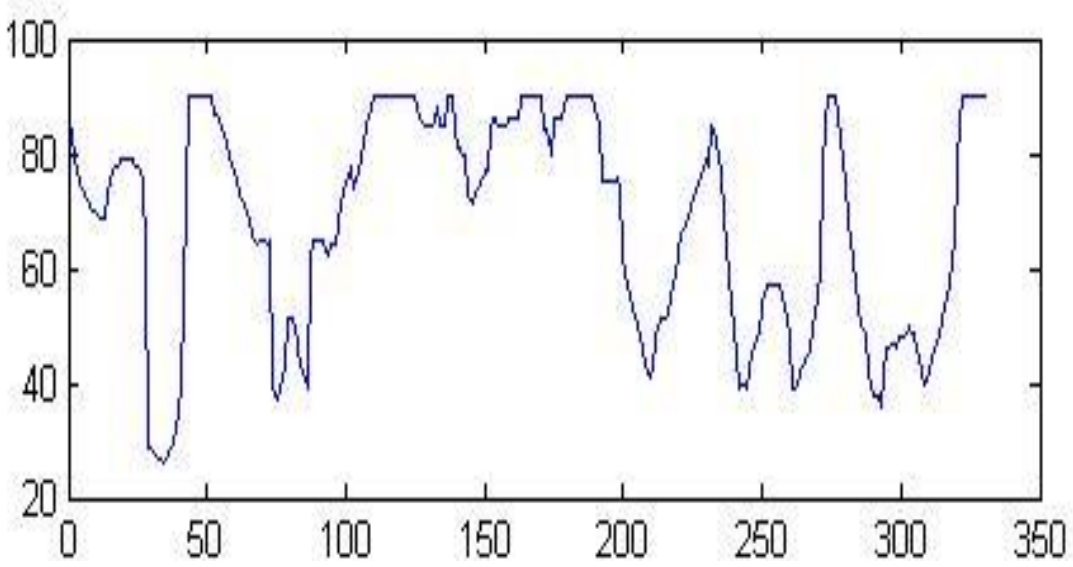

Figure 4.9: Graph of sum of the columns

Figure 4.10: Segmented Characters

4.9 Optical Character Recognition

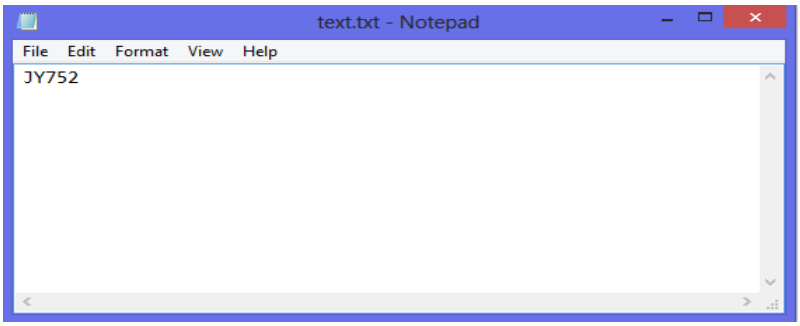

Figure 4.11: Output Image for OCR

4.10 RFID LCD Display

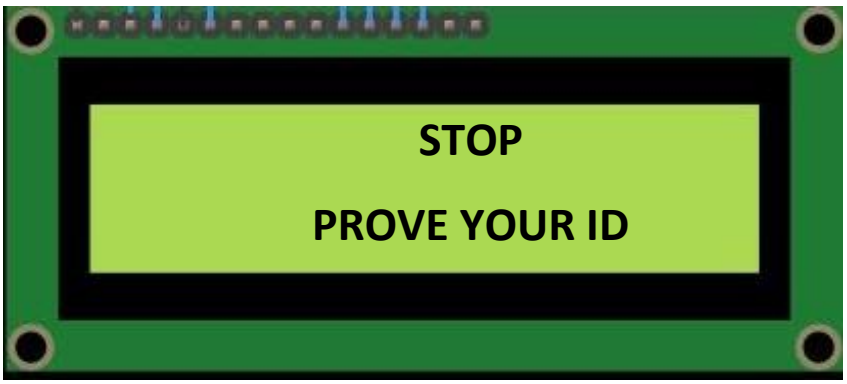

Figure 4.12: RFID LCD Display at the entrance

Figure 4.13: LCD Display when RFID Card data matches the database

CHAPTER 5

RECOMMENDATIONS FOR FUTURE WORK

In this project the ANPR system developed is valid only for standard Islamabad number plates having standard dimensions (width: 12 inches and height: 6 inches). Improvements that can be done to this system would be incorporation of recognition of standard number plates of either Punjab, Sindh, Khyber Pakhtunkhwa or Baluchistan in the next phase. The ANPR system developed is for the access control of the vehicles i.e the identification of the vehicles at the entrance of any restricted place. Since in this system the images were captured from the front of the vehicle with the main application area being deployment at entrance points of any restricted area, in future, it would be more beneficial if the system could process images captured from different angles and from different distances. In future ANPR system can be developed and implemented using different algorithms or using any programming language e.g C, C++ or OpenCV etc.

Some organizations do not even register their vehicles with the excise and taxation department and operate with their own generated number plate system. One simple solution will be to standardize all number plates for all vehicles — identical size, identical material, identical font, identical color, identical pattern of installation. This will not only enable the police and the ANPR system to easily detect an unlawful vehicle but also make it easier for the police to stop and check any vehicle.

CHAPTER 6

CONCLUSION

An automatic number plate recognition (ANPR) system has been effectively used by many countries to manage number plates. The system involves a network of CCTV cameras that can read and communicate the number plate, time and location to a central database. This information helps in identifying and tracking suspicious vehicles, nabbing criminals, gathering intelligence, investigating crime and automatically generating tickets for traffic violations or non-payment of motor vehicle taxes. With ANPR cameras fitted on roads, highways, intersections and police cars, a typical national ANPR data centre could receive up to 50 million number plate "reads" per day. There is an urgent need to establish a modern ANPR and a national vehicle database in Pakistan.

Access control in general is a mechanism for limiting access to areas and resources based on personnel's identities and their membership in various predefined groups or through identification of vehicles entering a restricted/prohibited area. In this project vehicle access control is provided through ANPR and personnel access control through the RFID. The automatic vehicle identification system using vehicle license plate is presented. The system use series of image processing techniques for identifying the vehicle from the database stored in the PC. The system is implemented in MATLAB and it performance is tested on real image. The MATLAB results shows that the system robustly detect and recognize the vehicle using license plate against different lightening conditions and can be implemented on the entrance of a highly restricted areas. The system successfully detects and recognize standard Islamabad number plate. The implementation works quite well and thus there is still room for improvement. The camera used in this project is sensitive to vibration and fast changing targets due to the shutter long time. The system speed and robustness can be

increase if high resolution camera is used. The OCR methods used in this project for the recognition is sensitive to misalignment and to the sizes.

RFID information can be accurately collected. Users will have cards or tags registered to access the system. When approaching the card/tag to the RFID sensor (approximately 6 cm), the serial number of this card/tag is detected and so compared with a serial number that are recorded in the software or in a database on a memory card; if it is a registered serial number, the system will release the entry of this user. The gate at the entrance of the restricted area will open and some messages will be appearing in the LCD display (user recognition and access granted). Accurate, high-performance and security are the features of this system, applicable to Military Intelligence, and can be used in high standard of residential and company, etc. Radio frequency identification security and privacy are stimulating research areas that involve rich interplay among many disciplines, like signal processing, and hardware design, supply-chain, logistics and privacy rights.

Applications of ANPR

Automatic Number Plate Recognition has a very wide range of applications since the license number is the primary, most widely accepted, human readable, important identifier of motor vehicles.

ANPR provides automated access of the content of the number plate for computer systems managing databases and processing information of vehicle movements.

There are thousands of different ANPR applications, from simple monitoring hardware to full offence prosecution systems. It is important to understand all options available and to get proper consultation when specifying a professional ANPR system.

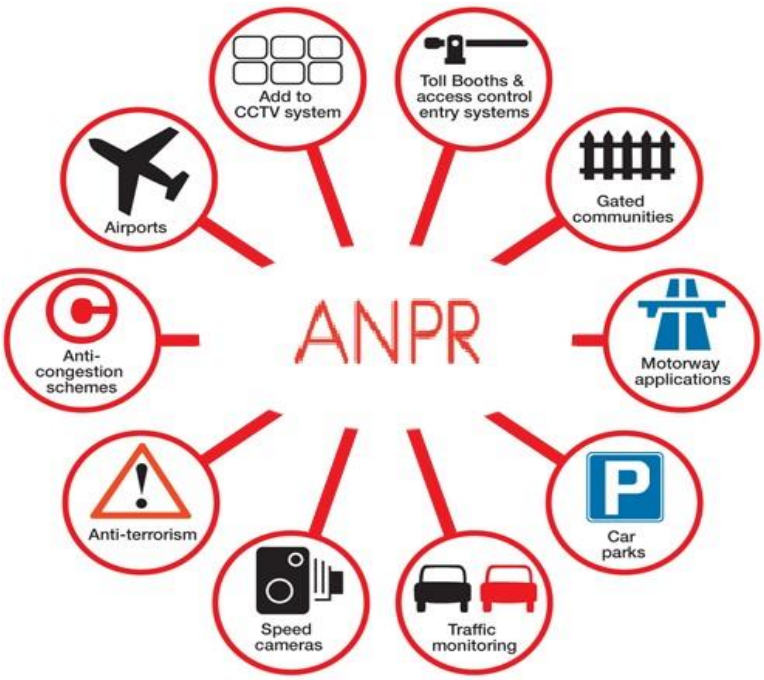

Fig 6.1: Applications of ANPR

There are many places where we can install the ANPR system for example in:

- Airports
- Apartment blocks
- Banks
- Car dealerships
- Car hire and rental
- Car manufacturing
- Car parks
- Caravan parks
- Colleges
- Courts
- Factory gates and industrial parks
- Fleet vehicle compounds
- Golf clubs
- Hospital access
- Hotels
- Petrol stations
- Police stations
- Prisons
- Railways
- Traffic monitoring
- Transport logistics
- Residents parking
- Supermarkets
- Town centre CCTV (vehicle checks against police database)
- Weighbridge auditing

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