# PREVENTION OF UNAUTHORIZED TRANSPORT OF ORE IN OPENCAST MINES USING AUTOMATIC NUMBER PLATE RECOGNITION

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# PREVENTION OF UNAUTHORIZED TRANSPORT OF ORE IN OPENCAST MINES USING AUTOMATIC NUMBER PLATE RECOGNITION

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## *SUPERVISOR'S CERTIFICATE*

This is to certify that the thesis entitled, **"PREVENTION OF UNAUTHORIZED TRANSPORT OF ORE IN OPENCAST MINES USING AUTOMATIC NUMBER PLATE RECOGNITION"** is being submitted by **Y.N. HARISH, 214MN1368**, in partial fulfillment of the requirements for the award of degree of **Master of Technology in Mining Engineering** at National Institute of Technology, Rourkela and is an authentic study analysis work carried out by him under my supervision. To the best of my knowledge, the matter exemplified in the thesis has not been submitted to any other university/institute for the award of any degree/diploma.

**Dr. Debi Prasad Tripathy**
Professor

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# ABSTRACT

Security in mining is a primary concern, which mainly affects the production cost. An efficiently detecting and deterring theft will maximize the profitability of any mining organization. Many illegal transportation cases were registered in spite of rules imposed by central and state governments under Section 23 (c) of MMDR Act 1957. Use of an automated checkpoint gate based on license plate recognition and biometric fingerprint system for vehicle tracking enhances the security in mines. The method was tested on the number plates with various considerations like clean number plates, clean fingerprints, dusty and faded number plates, dusty fingerprints, and number plates captured by varying distance. By considering all the above conditions the pictures were processed by ANPR and bio-metric fingerprint modules. Vehicle license number plate was captured using a digital camera and the captured RGB image was converted to grayscale image. Thresholding was done to remove unwanted areas from the grayscale image. The characters of the number plate were segmented using Gabor filter. A track-sector matrix was generated by considering the number of pixels in each region and was matched with existing template to identify the character. The fingerprint scans the finger and matches with the template created at the time of fingerprint registration at the machine. The micro-controller accepted the processed output in binary form from ANPR and bio-metric fingerprint system. The micro-controller processed the binary output and the checkpoint gate was closed/open based on the output provided by the microcontroller to motor driver.

***Keywords: ANPR; Fingerprint Recognition, Character Segmentation; Track-Sector Matrix; Template Matching; Minutia Matching***

# ACRONYMS

| | |
|---|---|
| AC | Alternate Current |
| ANPR | Automatic Number Plate Recognition |
| CCA | Connected Component Analysis |
| DC | Direct Current |
| DoG | Difference of Gaussian |
| DoH | Determinant of Hessian |
| GDP | Gross Domestic Product |
| GBM | Global Business Ministries |
| GUI | Graphical User Interface |
| IC | Integrated Circuit |
| LCD | Liquid Crystal Display |
| LPD | License Plate Detection |
| LoG | Laplacian of Gaussian |
| OCR | Optical Character Recognition |
| PT | Potential Transformer |
| PCB | Printed Circuit Board |
| RGB | Red Green Blue |
| USART | Universal Synchronous Asynchronous Receiver and Transmitter |

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# Chapter 1

# INTRODUCTION

## 1.1 INTRODUCTION

The mining industry is the one of the major contributors to the growth of Indian economy. It has an average GDP contribution of 686.08 billion rupees to Indian economy from 2011 to 2015 [1]. The mining industry, however, faces a significant number of challenges regarding productions cost and crime. The theft of precious minerals from the mines results in huge loss to the company. Madhya Pradesh state registered 982 illegal transportation cases during the year 2013 and recovered fine worth 7.11 crore Indian rupees [2]. Measures are being taken by the central and state governments by framing rules under section 23 (c) of MMDR Act 1957. It was stated that every vehicle carrying minerals should have a transit pass issued by the authorities and action has against vehicle without a valid and countersigned transit pass [3].

Productivity of coal India is estimated to be only one-eighth when compared to its technologically developed rivals in the United States of America, and as much as a fifth of Coal India's annual output is stolen, that costs up to $1 billion loss each year to the company [4].

Mahanadi Coalfields Ltd. implemented a GPS-based tracking system for the truck and in the year 2015, 36 third-party contractor's trucks were blacklisted, each carrying up to 17 tons of coal. The organization introduced CCTV cameras at shipment destinations, hooked up trucks with satellites and fitted them with radio frequency identification tags to automatically transfer data to a control room at the organization's central command [4].

Image and video processing play a significant role in the development of technologies for dealing with security issues: surveillance cameras for crime reduction and image analysis tools in the forensics field. Automatic Number Plate Recognition (ANPR) system is an impressive strategy, utilized as a part of Intelligent Transportation System. ANPR is an advanced machine vision innovation used to recognize vehicles by their number plates without direct human intervention. Biometrics is generally connected with the utilization of unique physiological attributes to recognize a person. The application which most people associate with biometrics is security.

This project provides an innovative approach to reducing the illegal mineral transportation based on ANPR and Biometric fingerprint system.

## 1.2 MOTIVATION FOR THE PRESENT WORK

The substantial scale robbery of mineral like coal, gold, diamonds from mining organizations is primary concern nowadays. Surface mining, underground mining, minerals processing and development industries are all having extraordinary difficulties and dangers in the regions of wellbeing and security. While every site is distinctive, they all share a typical guidelines in security and wellbeing most importantly. In any case, as an auxiliary concern is the assurance of organization resources of vital significance in guaranteeing the security.

The state-wise number of FIRs lodged for illegal mining in Coal India during 2006-2010 are summarized in Table 1.1.To secure life, guarantee wellbeing and ensure organization resources, security hazard administrations in the mining division should be aware of the horde novel security challenges in ore transportation. There has been a great deal of unapproved transport of mineral in open cast mines. There are distinctive tasks to control this unapproved transport of mineral [5].

**Table 1.1:** State-wise number of FIRs lodged for illegal mining [8].

| Company | State | 2009-10 (up to Sept'09) | 2008-09 | 2007-08 | 2006-07 |
|---|---|---|---|---|---|
| **ECL** | WB | 34 | 41 | 11 | 12 |
| | Jharkhand | 0 | 2 | 8 | 49 |
| | Total | 34 | 43 | 19 | 61 |
| **BCCL** | Jharkhand | 26 | 59 | 42 | 37 |
| | WB | 6 | 10 | 13 | 16 |
| | Total | 32 | 69 | 55 | 53 |
| **CCL** | Jharkhand | 4 | 47 | 13 | 35 |
| **NCL** | UP/MP | 0 | 0 | 0 | 0 |
| **WCL** | Maharashtra | 0 | 0 | 0 | 0 |
| | MP | 0 | 1 | 3 | 5 |
| | Total | 0 | 1 | 3 | 5 |
| **SECL** | MP | 0 | 0 | 0 | 9 |
| | Chhattisgarh | 0 | 0 | 0 | 0 |
| | Total | 0 | 0 | 0 | 9 |
| **MCL** | Orissa | 0 | 0 | 0 | 0 |
| **NEC** | Assam | 7 | 3 | 2 | 3 |
| | | | | | |
| **Coal India Ltd.** | | 77 | 163 | 210 | 166 |

## 1.3 OBJECTIVES OF THE PROJECT

The essential goal is to fabricate an equipment which can monitor the transport of ore in mines and enhance the mine security to prevent unauthorized ore transport. The following objectives were considered for the project work:

- To analyze and study the security issues and transportation of ore in open cast mines.
- To design algorithms for ANPR and biometric fingerprint modules.
- To write coding for the ANPR and biometric fingerprint module.
- To design a micro controller based gate opening system operated on the basis of outputs of ANPR and biometric fingerprint systems.
- To implement the module and verify the results for different conditions.

## 1.4 LAYOUT OF THE THESIS

**CHAPTER-1** gives a brief overview of the research area, motivation for the work, objectives identified and layout of the thesis.

**CHAPTER-2** comprises of the reveiw of the literature for the concepts associated with automatic number plate recognition and finger print biometric system.

**CHAPTER-3** comprises of block diagram of the system, algorithm of the system, algorithm for ANPR and biometric fingerprint system and flowchart of the system.

**CHAPTER-4** gives a brief idea about all the components that are associated in the project, procedure for number plate recognition, procedure for finger print identification, hardware implentation.

**CHAPTER-5** shows the efficiency of ANPR and biometric fingerprint system for different conditions, existing system in SECL, comparison of ANPR and biometric fingerprint system with the existing system and about the limitations of the module.

**CHAPTER-6** concludes the findings of the work and suggestions for future work

# Chapter 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

The security in any industry is the primary concern nowadays. Most mining industries have poor security systems. These systems are not able to prevent the illegal transportation of ore in mines. The automatic number plate recognition is the one of the mostly progressing vehicle number identification methods. The biometric fingerprint system is the most efficient technique for recognizing unauthorized entry for persons into any industry. The combination of both systems provides improved security to the mines.

## 2.2 IMAGE BINARIZATION

Picture binarization is a procedure to change a picture to highly contrasting. In this strategy, a certain limit is grouped sure pixels as dark and certain pixels as white. Be that as it may, the principle issue is the manner by which to pick right limit esteem for a specific picture. Some of the time it turns out to be extremely troublesome or difficult to choose ideal limit esteem. Versatile Thresholding can be utilized to conquer this issue. A limit can be chosen by client physically or it can be chosen by a calculation naturally which is known as programmed thresholding [9].

## 2.3 EDGE DETECTION

Edge identification is the principal strategy for highlight location or highlight extraction. By and large case the consequence of applying edge discovery of calculation is an item limit with associated bends. It turns out to be extremely hard to apply this technique to complex pictures as it may come about with article limit with not associated bends. Distinctive edge identification calculation/administrators, for example, Canny, Canny-Deriche, Differential, Sobel, Prewitt and Roberts Cross are utilized for edge discovery [9].

## 2.4 HOUGH TRANSFORM

This is a feature out taking procedure at first utilized for line discovery. Further, this has been stretched out to discover forming of discretionary shapes such as circle or oval. But it is computationally complex for articles with numerous parameters. Searches for one and only single sort of item. Can be "tricked" by "clear lines". The length and the position of a line fragment can't be resolved. Co-direct line portions can't be isolated [11].

## 2.5 BLOB DETECTION

Blob recognition is utilized to recognize focuses or locales that vary in splendor or shading when contrasted with the environment. The fundamental reason for utilizing this methodology is to discover complimentary locales that are not recognized by edge discovery or corner recognition calculations. Few normal blob finders are Laplacian of Gaussian (LoG), Difference of Gaussians (DoG), Determinant of Hessian (DoH), maximally stable extremal districts and Principle bend based area indicator.

## 2.6 REMOVING OF UNWANTED EDGES BY THRESHOLDING

First order edge recognition or gradient based edge operator can be done as
If I (a, b) is the input picture, then the following formula represents image gradient.

$$\nabla I\ (a, b) = \frac{\partial I(a,b)}{\partial a}\ \bar{\imath} + \frac{\partial I(a,b)}{\partial b}\ \bar{\jmath} \qquad \textbf{(2.1)}$$

Where

$\frac{\partial I(a,b)}{\partial a}$ is the gradient in the path of 'a'.

$\frac{\partial I(a,b)}{\partial b}$ is the gradient in the path of 'b'.

The gradient intensity can be found by the formula is

$$|Gr| = \sqrt{\left[\frac{dI}{da}\right]^2 + \left[\frac{dI}{db}\right]^2} \quad \textbf{(2.2)}$$

The angle of the gradient can be given by

$$\theta = arc\ tan\left(\frac{Ga}{Gb}\right) \quad \textbf{(2.3)}$$

The size of inclination figured above gives the edge quality and angle heading is constantly opposite to the course of edge [10].

## 2.6.1 CLASSICAL OPERATORS

Classical operators like Robert, Sobel, and Prewitt are utilized yet these are profoundly sensible to noise [10].

Robert operator,

$$Di = \begin{matrix} 1 & 0 \\ 0 & -1 \end{matrix} \quad \text{and} \quad Dj = \begin{matrix} 0 & 1 \\ -1 & 0 \end{matrix} \quad \textbf{(2.4)}$$

Sobel operator,

$$Di = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \quad \text{and} \quad Dj = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \quad \textbf{(2.5)}$$

Prewitt operator,

$$Di = \begin{matrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{matrix} \quad \text{and} \quad Dj = \begin{matrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{matrix} \quad \textbf{(2.6)}$$

## 2.6.2 RULES FOR PADDING IMAGES

Dilation: pixels past the picture outskirt are doled out the base worth managed by the information sort.

Erosion: pixels past the picture fringe are doled out the maximum esteem managed by the information sort [12].

4-neighbour rule is showed in the Figure 2.1. The coordinates (m+1, n), (m-1, n), (m, n+1), (m, n-1) are connected to pixel at (m, n).

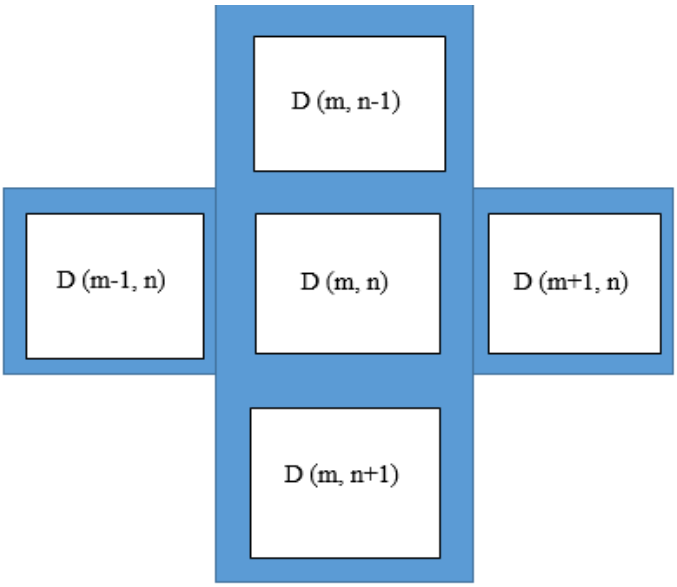



**Figure 2.1:** four-neighbor rule with r=1

## 2.7 GABOR TRANSFORM

It is texture analysis apparatus. The texture of the entire part utilizing alphanumeric and its segments is utilized for identifying the desired area. Keeping in mind the end goal to segment picture, first threshold algorithm is applied and the binary picture is created. At that point, the dilation operator is utilized to the binary picture keeping in mind the end goal to blend neighboring areas. At last Region of Interest is extracted. The intricacy of this calculation for a picture size N*N with a channel size of W*W with the thought of altered point is (N^2)*W [13]. The performance of Gabor transform is showed in Table 2.1 and graph is illustrated in Figure 2.2 by comparing performance of LPD and LPS.

**Table 2.1:** Performance comparison of LPD and LPS [13].

| OPERATION | RATE | OBTAINED ACCURACY |
|---|---|---|
| **LPD performance** | 294.0/300 | 98.00% |
| **LPS performance** | 2029.0/2154.0 | 94.20% |

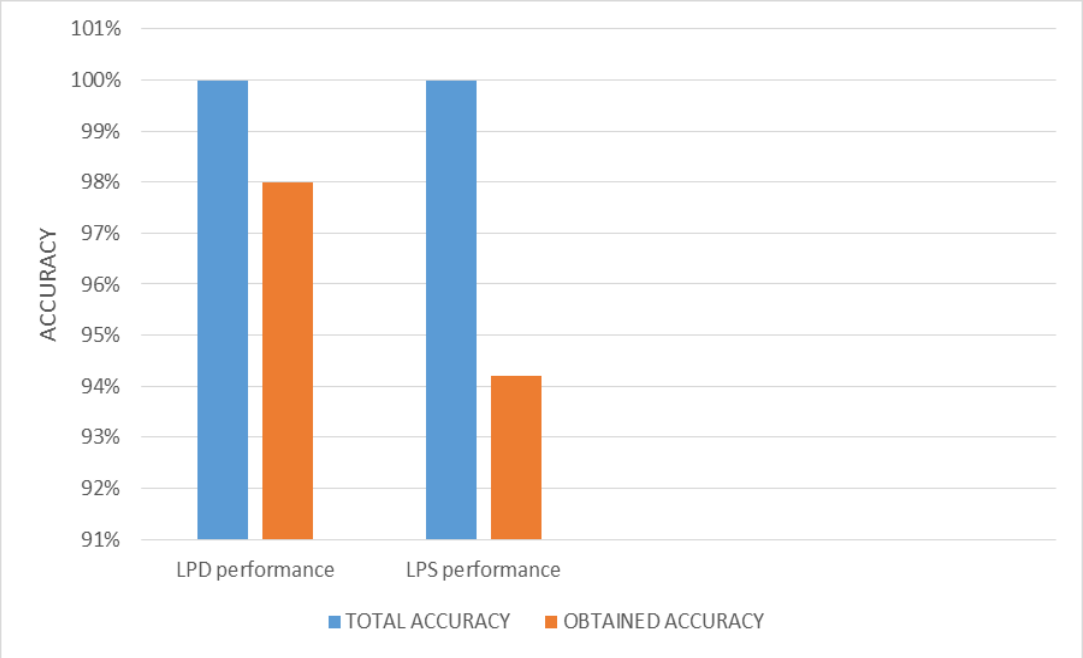



**Figure 2.2:** Chart for LPD and LPS performance comparison.

## 2.8 CONNECTED COMPONENT ANALYSIS

The pixels which are connected in one region and related to each other are called connected. The analysis of connected components is done in order to find regions connected to the point of interest.

- When the region of boundaries has recognized, it is regularly helpful to concentrate areas that are not isolated by a boundary.
- Any arrangement of pixels that are not isolated by a barrier is known to be related.
- Each maximum area of associated pixels is known as a related component.
- The arrangement of related components segments a picture into segments.

- Image segmentation is utilized for extraction of area of interest or region of interest [14].

### 2.8.1 CONNECTED NEIGHBORS

In connected neighbors, $\partial s$ is taken as a neighboring system. This neighboring system is classified into two types. They are

4-point neighboring system

8-point neighboring system

Let C(s) be an arrangement of neighboring points that are related to the point‘s’ then

For every‘s’ and ‘r’, the arrangement of C(s) must be with the relations that are

$$C(s) \subset \partial s \quad \textbf{(2.7)}$$

$$r \in C(s) \leftrightarrow s \epsilon C(r) \quad \textbf{(2.8)}$$

### 2.8.2 CONNECTED SETS

An area $R \subset s$ is told to be connected under C(h) if for all $h, r \in R$ there exists a sequence of X pixels, $H_1$ ……. $H_X$ such that

$$H1 \in C(h), H2 \in C(h1), \ldots\ldots\ldots\ldots\ldots Hm \in C(Hm-1), r \in C(Hm) \quad \textbf{(2.9)}$$

That is there has a related path from h to r.

Let picture Xh =

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 10 | 0 | 0 |
| 1 | 1 | 10 | 0 | 0 |
| 1 | 1 | 10 | 0 | 0 |
| 0 | 0 | 01 | 1 | 1 |
| 0 | 0 | 01 | 1 | 1 |
| 0 | 0 | 01 | 1 | 1 |

$$H1 = \{H: X_h = 1\} \quad \textbf{(2.10)}$$

$$H0 = \{H: X_h = 0\} \quad \textbf{(2.11)}$$

$$C(h) = \{r \in \partial h : X_r = X_h\} \quad \textbf{(2.12)}$$

In the four-point neighborhood, H0 and H1 are not connected sets.

In an eight-point neighborhood, H0 and H1 are connected sets.

## 2.9 REGION GROWING

Region growing is a straightforward locale based picture division technique. It is additionally named a pixel-based picture division technique since it includes the determination of introductory seed focuses.

This way to deal with division inspects neighboring pixels of starting seed focuses and figures out if the pixel neighbors ought to be added to the area. The procedure is iterated on, in the same way as general information bunching calculations [15].

Finding a connected arrangement by developing an area from a seed point S0 and the algorithm for it can be done as follows:

Let C(s) is taken

Label = 1

Initialize $Z_r = 0$ for all $r \in s$

Connected set (S0, Z, Label)

{

$D \leftarrow \{S0\}$

While D is unemptied

{

S =any element of D

$D = D - \{S\}$
Zs = label
$D = D \cup \{r : r \in C(s) \; and \; Z\, r = 0\}$
}
Return (Z)
}

## 2.10 CONNECTED COMPONENT EXTRACTION

Associated segment marking is utilized as a part of PC vision to recognize associated locales in paired advanced pictures, albeit shading pictures and information with higher dimensionality can likewise be processed. When coordinated into a picture acknowledgment framework or human-PC cooperation interface, associated segment naming can work on an assortment of information. Blob extraction is, for the most part, performed on the subsequent twofold picture from a thresholding step. Blobs might be tallied, separated, and followed [15]. The algorithm for connected component extraction can be done as in the following steps

- Iterate through every pixel on the picture.
- Get the connected arrangement for every pixel which is not labeled.

  Label = 1
  Initialize Zr = 0 for $r \in s$
  For each $s \in S$
  {
  If (Zs = 0)
  {
  Connected sets (s, Z, Label)
  Label = label + 1
  }
  }

## 2.11 RECOGNITION OF PATTERNS

Pattern recognition is concerned basically with the depiction and characterization of estimations taken from physical or virtual procedures. Our discourse depends on the above free definition. Keeping in mind the end goal to give a viable and effective portrayal of examples, preprocessing is frequently required to-uproot clamor and repetition in the estimations. At that point, an arrangement of trademark estimations, which could be numerical and/or no numerical, and relations among these measurements, are separated for the representation of examples. Grouping and/or portrayal of the examples concerning a particular objective is performed on the premise of the representation. With a specific end goal to decide a decent arrangement of trademark estimations and their relations for the representation of examples so great acknowledgment execution can be normal, a watchful examination of the examples under study is fundamental.

Learning about the factual and auxiliary attributes of examples ought to be complete. Used. Starting here of perspective, the investigation of example acknowledgment incorporates both the examination of example attributes and the configuration of acknowledgment systems. The a wide range of numerical methods used to take care of example acknowledgment issues might be assembled into two general methodologies. They are the choice theoretic (or discriminant) approach and the syntactic (or basic) approach.

Pattern recognition is the process of matching generated binary image with existing template of the template library. For this purpose, the obtained binary image is partitioned into tracks and every into sectors. In such a way, a related track-sector matrix is obtained and number of pixels in each area is identified.

- Find the center of the matrix
- Calculate radius "r" by knowing pixel that has a maximum distance from the center by utilizing the formula for distance.
- Perform division of radius with n i.e. radius/n to find the size of every track. Where n represents the number of tracks.
- Find imaginary sectors.
- Generate track-sector matrix by calculating the count of 1's in every intersection of sector and track.

## 2.12 FINGERPRINTS AS BIOMETRIC

A unique mark is stream edge designs in the tip of the finger. The edge stream displays oddities in nearby locales of the fingertip, and it is the position and introduction of these abnormalities that are utilized to speak to and coordinate fingerprints.

### 2.12.1 FINGER PRINT IDENTIFICATION

The process of comparing two instances of the skin impression's friction ridge of fingers is called finger print identification. It is to determine whether these prints came from one individual. And also to find whether different impressions taken at different times are originated from the same finger.

### 2.12.2 FINGERPRINT MINUTIA

Minutia, in fingerprint terms, are the area of interests for unique finger impression. The different area of interests involved in fingerprint minutia are showed in the Figure 2.3

- Ridge endings - an edge that finishes suddenly
- Ridge bifurcation - a solitary edge that partitions into two edges
- Short ridges, island or autonomous edge - an edge that starts, ventures a short separation and afterward closes.
- Ridge enclosures - a solitary edge that bifurcates and reunites in a matter of seconds a short time later to proceed as a solitary edge.
- Spur - a bifurcation with a short edge fanning out a more drawn out edge.
- Crossover or bridge - a short edge that keeps running between two parallel edges

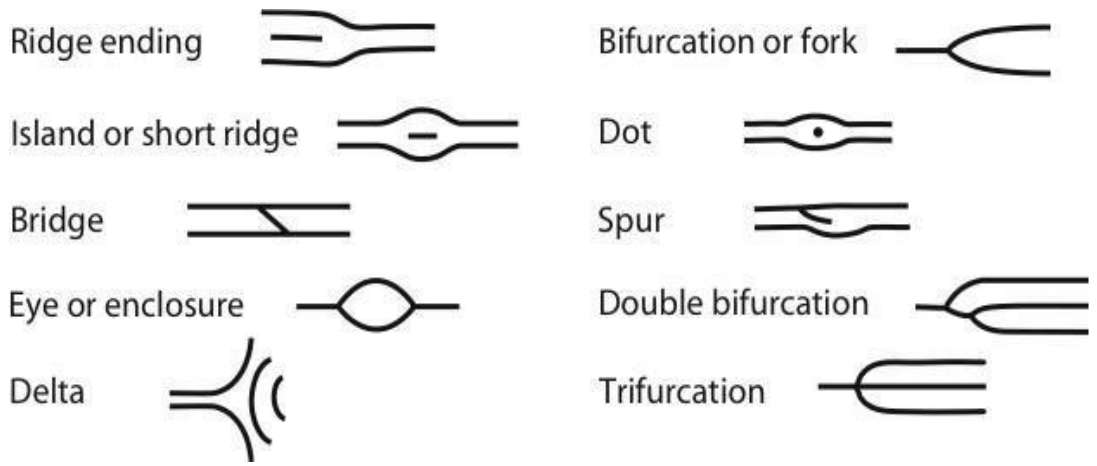



**Figure 2.3:** Various minutia of fingerprint [31].

### 2.12.3 MINUTIA MARKING

Minutiae marking is done utilizing layouts of 3*3 pixel window as, if the focal pixel is 1 and has precisely three one worth neighbors, then the focal pixel is ridge branch [17].

- On the off chance that the focal pixel is 1 and has stood out one-esteem neighbor, then the focal pixel is ridge finishing
- One situation where a general branch might be triple checked.
- on the off chance that both the highest pixels quality is 1 and the furthest right pixel worth is 1 have another neighbor outside 3*3 window because of some remaining spikes, so the two pixels will be set apart as branches as well, however, one and an only branch is situated in the little area.

### 2.12.4 FINGERPRINT RECOGNITION

The R305 fingerprint module is a fingerprint recognizer/identifier. The principle of working of R305 has two parts, enrollment of fingerprint and matching of a fingerprint that may be one to one or one to many. In order to enroll, the fingerprint should be entered two times by the user. The two-time fingerprints will be processed by the R305 system and depending on the processing results a template is generated and the generated template is stored in the finger library. When any user enters the fingerprint through an R305 optical sensor, the template of that user will be generated by the system and that template is compared with the templates of the fingerprint library in order to identify.

## 2.13 HISTOGRAM EQUALIZATION OF FINGERPRINT

Histogram evening or histogram equalization out is a strategy of enhancing the worldwide complexity of a picture by modifying the force dissemination on a histogram. This permits the zones of smaller near to the difference to pick up a larger differentiation without effecting the entire complexity. Histogram evening out fulfills this by adequately spreading out the most continuous power values. The first histogram of a unique finger impression picture has bi-modular sort, the histogram after the leveling possesses all the extent from 0 to 255 and the perception impact is improved.

## 2.14 OVERVIEW OF PREVIOUS RESEARCH WORK

The Automatic Number Plate Recognition (ANPR) is one of the efficient methods for surveillance of vehicles. This method is used in many areas like enhancement of safe traffic, automatic fare collection in toll gates, vehicle parking system etc. The algorithms used for ANPR has classified into four parts: capturing the image, number plate recognition, segmentation of characters, recognition of characters.

Capture of image looks so easy but it is the most difficult task in the process, because picture of the moving vehicle has to be taken. The least time taken for the recognition process is 50msec. The ANPR is based on many methods like Artificial Neural Networking, Probabilistic Neural Networking, Optical Character Recognition, Extraction of the Features, MATLAB, Configurable process, Window with Sliding Concentration, Machine with Support Vectors, Segmentation of Color, Fuzzy method, Invarying Scale Feature Transformation, Triple Chromatic Imaging etc. [24].

Fingerprint is the unique identity that matches 1 in $1.9*10^{15}$ [31]. Biometric fingerprint detection is used in many fields like Forensic department, Person Identification, Laptops, Mobile phones, Lockers etc. A limited number of works have been studied on the security issues in mines and the restorative measures to moderate the issue by utilizing ANPR and bio-

metric module. This portion gives a brief idea regarding number plate extraction, number plate segmentation, number plate recognition, fingerprint recognition and various strategies in different areas of security concern. It gives a reasonable idea on ANPR and fingerprints as bio-metric, its adjustment techniques, and distinctive procedures in mining and different commercial ventures.

**Hu et al. (2002)** proposed a Gabor filter-based feature extraction process. After applying Gabor filter to the image, the dominant orientation matrix for the characters in the image was obtained and this matrix was compared with the library to match the character. By using 2-D Gabor filters of 7*7, 9*9, 11*11, 15*15 they have obtained 90.11%, 94.54%, 96.25%, 96.86% of accuracy for 32*32 sized character and 92.25%, 94.26%, 96.13%, 96.28% of accuracy for 16*16 characters respectively [18].

**Ravi et al. (2009)** proposed Fingerprint identification by matching of minutia score. The Block Filter was used for thinning of fingerprint, by scanning the boundaries of image, to preserve the picture quality and extraction of the minutiae from the thinned picture. The proposed method showed better Fingerprint Minutia Recognition (FMR) values compared to the existing method [19].

**Kulkarni et al. (2009)** worked on the identification of number plate for Indian conditions. The framework contains associated algorithms such as: 'feature-based localization of number plate' for number plate identification, 'picture segmentation' for partition of character and statistical feature recognition of character, are mainly utilized for Indian number plates. The framework identifies single lined and double lined number plates under varying illumination conditions with accuracy of 82% [20].

**Gnanasivam and Muttan (2010)** proposed a productive preprocessing calculation to accomplish great vertical orientation and high ridge curvature area and flow zone around the center point for the fingerprint validation and examination. The calculation was actualized in two stages. Centre point recognition trails the acquired vertically arranged fingerprint. The proposed algorithm was tested on a line based highlight extraction calculation with a substantial internal database and samples of unique Finger impression. The proposed algorithm resulted in 94% for the low-quality pictures and broken edges [21].

**Zhai et al. (2010)** proposed number plate recognition by morphological open and close operations and various structural elements like rectangular shape and diamond shape were operated in order to take out the non-plate region. They achieved 98.7% of detection rate which is more than other methods as compared [22].

**Bana and Kaur (2011)** studied and implemented a unique finger impression acknowledgement framework based on Minutiae based matching. The approach has the detection of minutia points from the fingerprint impression and then identifying matching fingerprint based on the total number of minutia matchings among two fingerprints. The results indicated that the proposed algorithm was not very efficient and was vulnerable to effects like scaling and elastic deformations [17].

**Kolour and Asadollah (2011)** studied and evaluated six LPD algorithms techniques dynamic programming, Hough transform, Gabor transform, Morphology-based, AdaBoost, and Edge-based models. The results showed that the dynamic programming algorithm is the fastest and the Gabor transform is the most accuracy algorithm [13].

**Gill and Kaur (2012)** presented number plate detection based on edge detection by using Sobel operator, along with dilution and template matching methods and achieved 95% accuracy [23].

**Patel et al. (2013)** discussed different ANPR techniques by considering image size, the success rate and processing time as parameters. The comparison results showed 95.6%, 96.5% and 98.7% success rate with ANN and self-organizing (SO) recognition, PNN and Open source OCR Tesseract respectively [24].

**Aggarwal & Aggarwal (2013)** implemented number plate recognition by using row and column profile of the image and license plate extracted by positioning of row and columns. The result was obtained for 1200*1600 sized color images under various environmental conditions like cloudy, sunny and daytime [25].

**Karthikeyan et al. (2013)** proposed novel procedures towards identification of characters of number plate using Connected Component Analysis (CCA). Binary Thresholding procedure was used for differentiating the object from the background. Morphological methods were utilized for identification of number plate. CCA scans and labels the pixels of a binarized image into components based on pixel connectivity Quantization and glossy compression was obtained by compressing a range of values to a single quantum value [14].

**Sonavane et al. (2013)** proposed a technique for an invariant system that works under different lighting conditions while capturing the images of the vehicles. Enhanced Connected Component Analysis method was used for number plate localization & segmentation. The authors had used Skeletonization method for feature extraction and Support Vector Machine for character recognition [26].

**Alani and Aloosi (2013)** developed a method to recognize the images of fingerprint and extract the features based on the Discrete Cosine Transform (DCT) technique. They categorized the image of the fingerprint into small blocks and statistical features are from the Discrete Cosine Transform (DCT) coefficients [27].

**Mohammad et al. (2014)** represented an algorithm for implementation of Optical Character Recognition (OCR) to convert typewritten/handwritten pictures into electronically editable format by preserving font properties. The author had proposed Pattern Matching for optical character recognition and the experiment results showed 70-75%-character recognition rate. The character recognition rate for the images of the same font after upscaling was 100% while for downscaling the recognition rate reduced [16].

**Chouhan and Govindan (2014)** demonstrated the characteristic-based method for Indian number plates that can segment number plate even if it is in any corner of the image. Their method can process number plate of any color and even with text vulnerability and stickers. The localization of number plate was done by using inverted 'L' masking and reverse 'L' filter and white pixel density. Through this process, they achieved 90% accuracy [28].

**Sandbhor et al. (2014)** implemented a cross-correlation based fingerprint recognition algorithm that uses the values of the fingerprint image pixels. The developed procedure operated in less time and undergone less processing techniques and obtained the results [29].

**Kaur (2014)** proposed an efficient procedure for extraction of number plate from preprocessed image using morphological operators, thresholding, Sobel vertical edge detection and connected component analysis. They tested this procedure on 120 vehicle images and achieved 98.33% of accuracy [30].

**Mohan and Kodgire (2014)** developed a touchless fingerprint detection system that uses high-resolution web camera instead of the optical sensor. The obtained images were processed in Matlab for fingerprint identification [31].

**Patel et al. (2014)** improved identification of fingerprint by utilizing minutia based and pattern based method. Core point, delta points and features of minutia were recognized first and matching was done. They used Weiner low pass filter for recognizing fingerprints with poor quality [32].

**Kaur et al. (2014)** presented the variation of Fast Fourier Transform on fingerprint recognition by fast fingerprint minutiae extraction and identification. This approach enhanced the clarity of the edge and valley structures of the input fingerprint images based on the frequency and the orientation of the neighboring ridges and consequently extracting correct minutiae. The author combined many techniques to form a minutia extractor and a minutia matcher. The outcomes of the process indicated variation in FFT values produced 100% accuracy [33].

**Harpreet and Garg (2014)** proposed the technique of recognition of number or characters from vehicle number by feature extraction and recognition with two classifiers -Back Propagation Neural Network and K-mean on text and numeral objects of number plates. The experiment resulted in 95.6% and 83.8% accuracy for the neural network and K-mean classifier [34].

**Tukur (2015)** analyzed an integrated problem solving technique for recognition of fingerprints. They generated a percentage score of the fingerprints, that tells if the two fingerprints are matched or not [35].

**Swati (2015)** proposed region of extraction technique by the use of histogram oriented gradient. The area of the number plate was detected by various algorithms in this paper [36].

**Sharma (2015)** carried out a systematic study of existing ANPR according to features used. An algorithm for localization of yellow colored license plates using morphological operations, character segmentation using histogram and intensity projections and Optical Character Recognition using Template matching. Number plate validation using Excel database to control a real-time gate/buzzer with LCD and notification on email for invalid vehicles was proposed [37].

**Rajput (2015)** implemented the correlated matching algorithm for number plate recognition for images with 512*512 size. The edge detection was done by image dilation and image erosion. The correlated coefficient matrices were used for matching the number plate with template library [38].

**Kumar et al. (2015)** proposed a novel touchless fingerprint detecting module capturing three distinct impressions at one time. For this experiment, three images, frontal, left and right finger were captured. To decrease the impact of perspective distortion, the area with minimal ridge interval variations was chosen in a final mosaic picture. The outcomes demonstrated genuine minutiae and vast quality area for collected images. The side view images gave more matched minutiae than the frontal view images. The proposed method reduced the contrast problem and increased the usable region of a touchless fingerprint image [39].

# Chapter 3

# DESIGN METHODOLOGY

## 3.1 INTRODUCTION

The Automatic number plate recognition framework was manufactured utilizing advanced picture preparing as a part of Matlab to portion the picture of the number plate and recognize the content in it. The bio-metric unique mark gadget is likewise added to the framework to coordinate the finger impression of the driver with pre-stacked prints. The both gadgets are utilized to upgrade the security in the mine environment. The block diagram of entire system is showed in the Figure 3.1.

## 3.2 BLOCK DIAGRAM

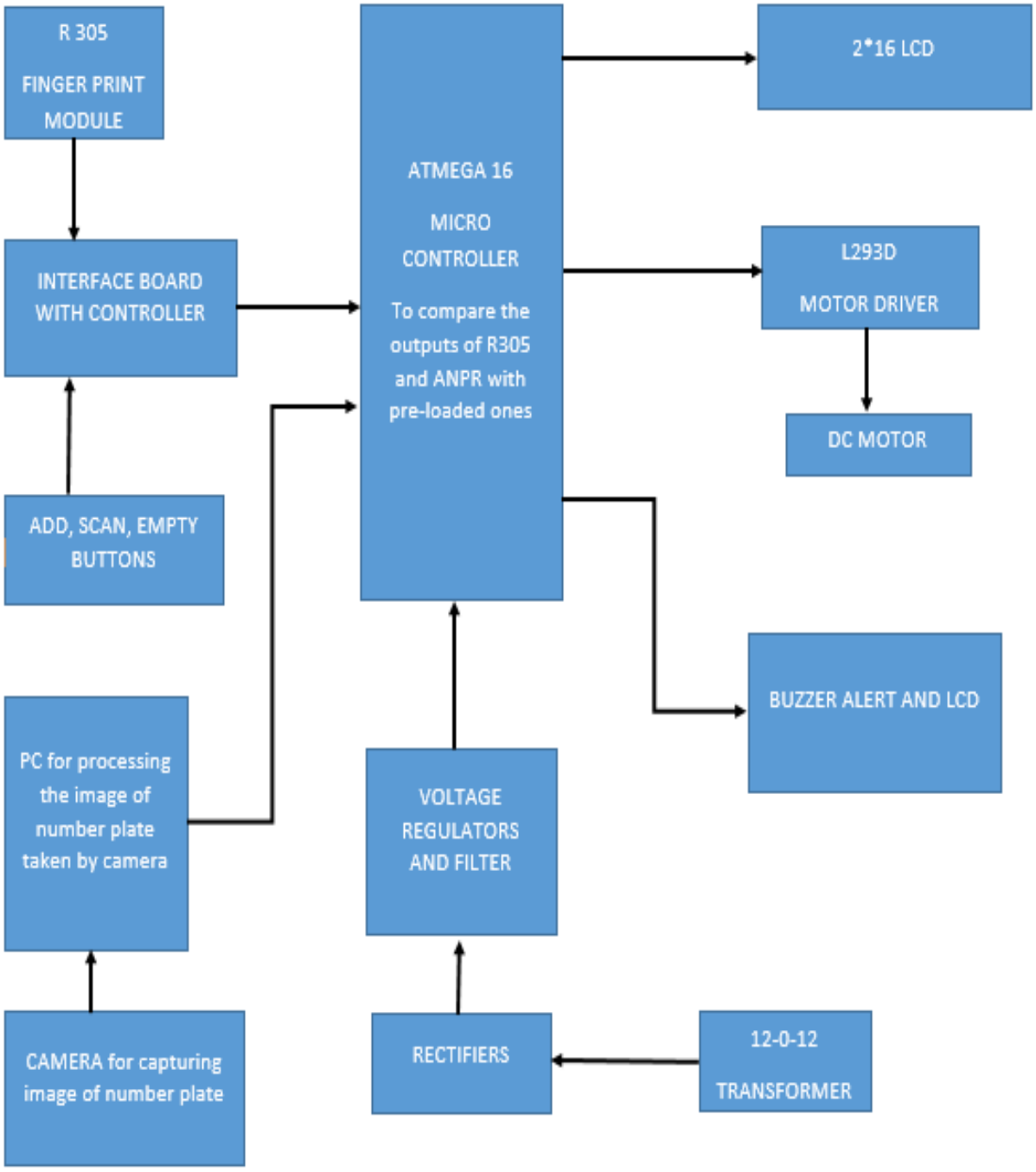



**Figure 3.1:** Block diagram of the system

## 3.3 ALGORITHM

Step-1: The camera is initiated to capture the image of the vehicle number plate.
Step-2: The fingerprint of the driver is taken through the biometric fingerprint module.
Step-3: The image of the number plate and fingerprint of the driver are further processed in Matlab.
Step-4: The processed output from Matlab is sent as an input to the microcontroller.
Step-5: The microcontroller takes compares both the outputs with pre-loaded data and if the both the outputs are matching then it initiates the motor.
Step-6: The motor or gate will open only when it gets initiation from the microcontroller.
Step-7: The process starts from step-1 when a new vehicle arrives.

### 3.3.1 ALGORITHM FOR ANPR

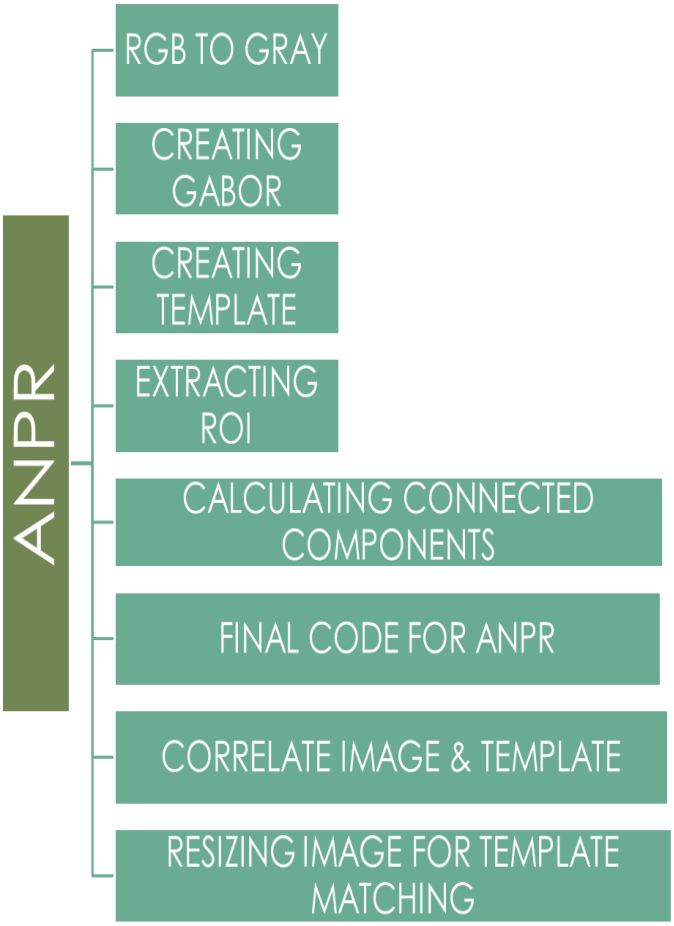



**Figure 3.2:** Algorithm for ANPR

The steps involved in Automatic number plate recognition is shown in the Figure 3.2 and the algorithm for ANPR is explained below.

- Converting RGB to the grayscale image in order to reduce data.
- Removing unwanted edges by applying adaptive threshold method by passing the image through low pass filter.
- The Gabor filter is used for texture analysis. The texture of whole number plate and its components along with alphanumeric characters is utilized for finding required location.

- A template is created which contains all the alphanumeric characters.
- In the number plate, the alphanumeric characters are our region of interest. It is extracted by using Feature extraction technique.
- Connected component analysis is done in order to find the area connected with our region of interest.
- The segmented image is correlated with the template and the character is found.
- The found number plate through template matching is stacked in an excel sheet and the database of the vehicles is stored.

### 3.3.2 ALGORITHM FOR BIO-METRIC FINGERPRINT SYSTEM

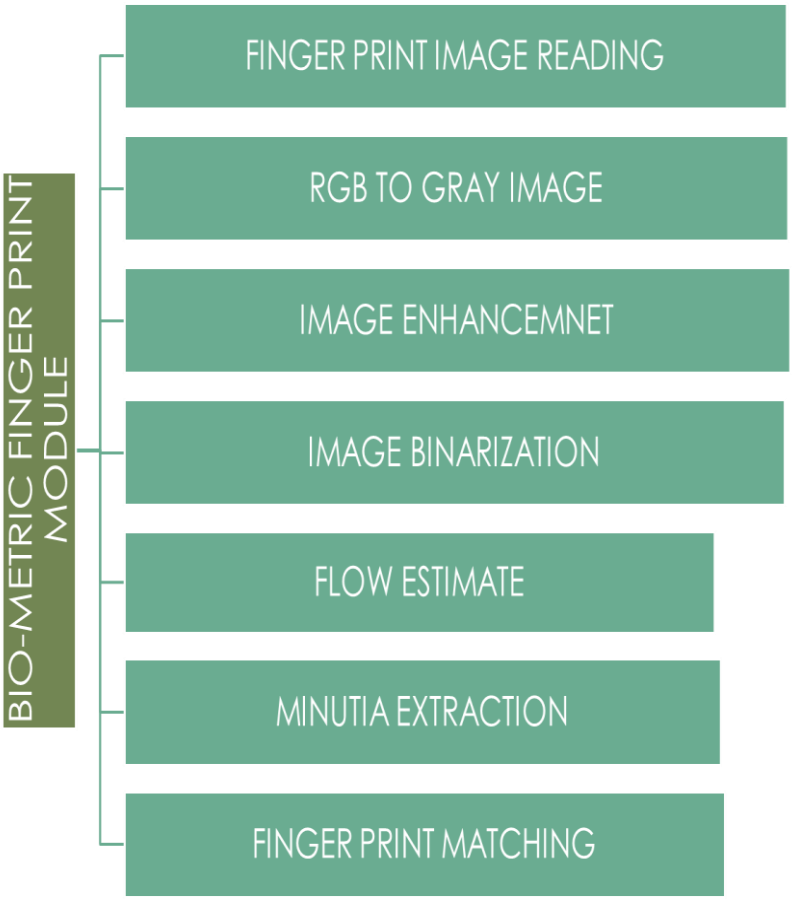



**Figure 3.3:** Algorithm for bio-metric fingerprint module

The steps involved in biometric fingerprint system is shown in the Figure 3.3 and the algorithm for it is explained below.

- Fingerprint image is read from the fingerprint module.
- The read image is converted into the gray image for data reduction.
- The image is enhanced by using histogram equalization.
- The image binarization is done.
- The flow direction of fingerprint ridges is estimated.
- Minutia of the fingerprint is extracted by minutia marking and using filters.
- The processed fingerprint image is compared with the pre-loaded image.

## 3.4 FLOW CHART

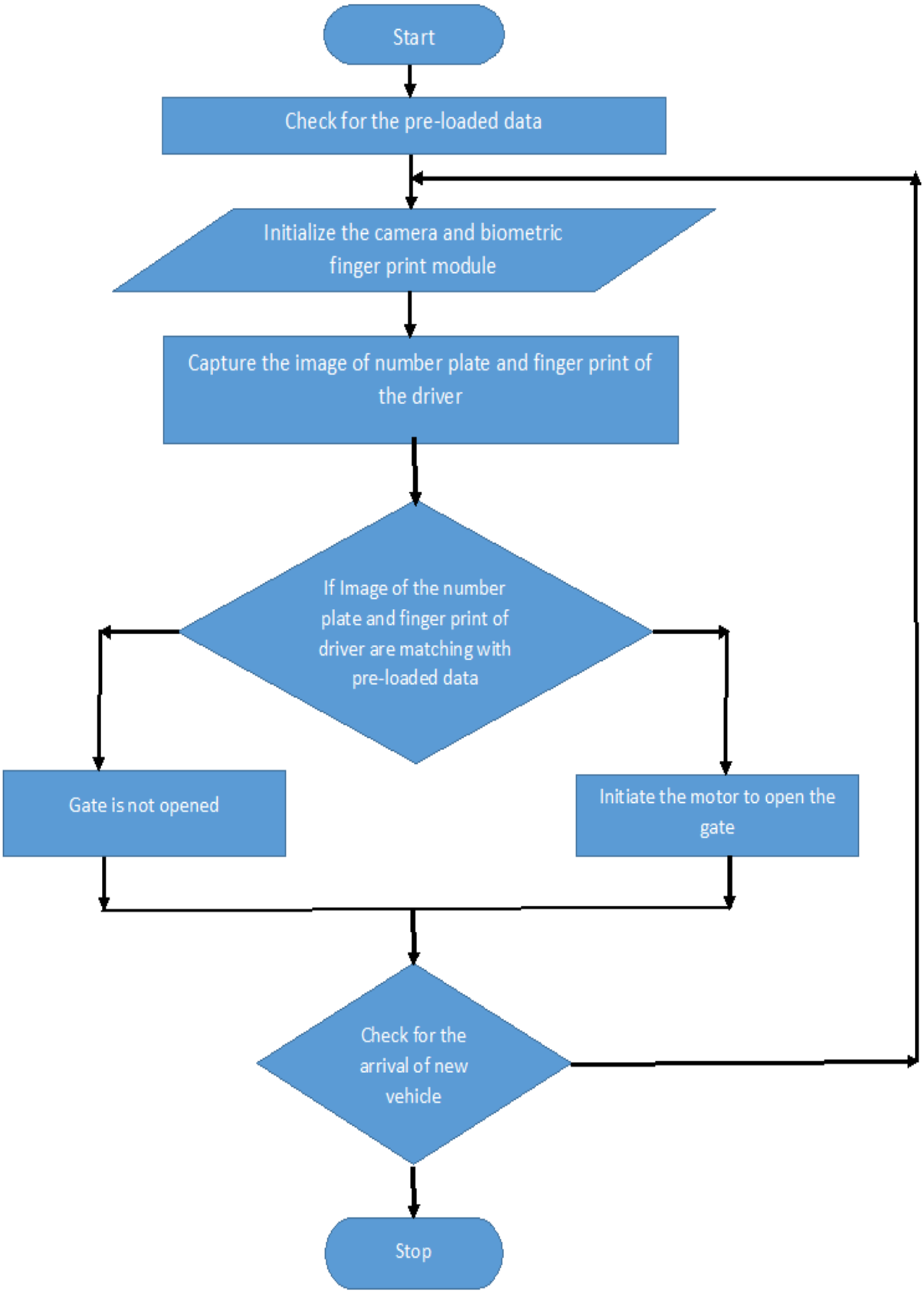


**Figure 3.4:** Flow-chart of the system.

## 3.5 FLOW CHART OF ANPR

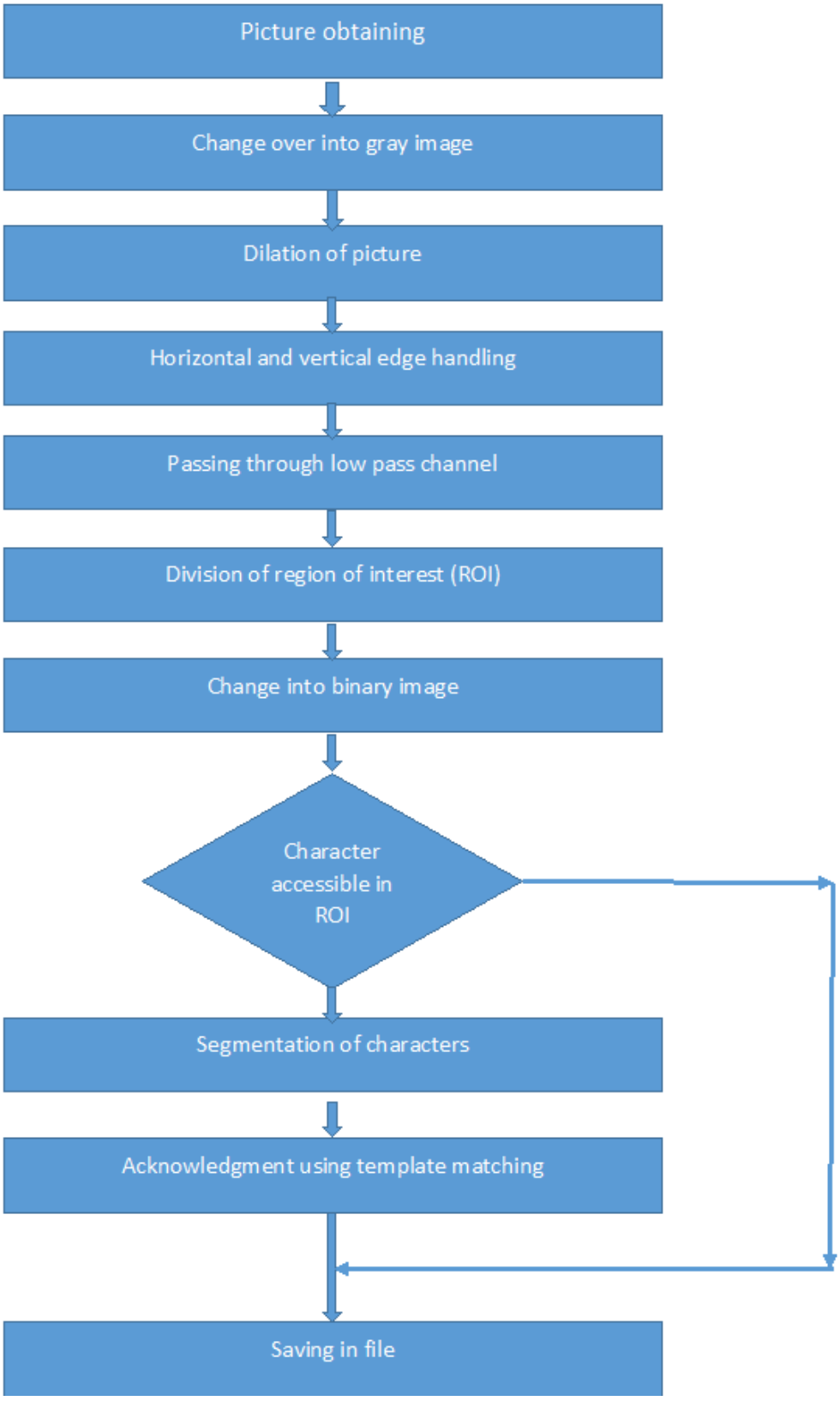



**Figure 3.5:** Flow-chart of ANPR system

# Chapter 4
# DESIGN & IMPLEMENTATION

# 4.1 INTRODUCTION

This section portrays the detailed configuration of the proposed ANPR model and bio-metric unique mark gadget alongside the working of every part. Every piece comprises of a few parts associated in the obliged approach to give the coveted yield. The complete circuit chart is given toward the end taking into account which the creation was finished. Extraordinary consideration was taken amid the manufacture to stay away from any short out of the short circuit.

# 4.2 TRANSFORMER

Transformers modifies AC power initializing with one potential to the next potential with a minute loss. The potential transformer (PT) shown in Figure 4.1, utilizes a stage down transformer to lessen the high potential to a safer low potential (normally 110 Volts) in any substation. The PT utilized here strides down the supply voltage of 230 Volts to 12 Volts as required by the circuit to work. The yield of a PT is utilized for all estimation and checking purposes in conjunction with hand-off operation.

The data curl is said as the essential and the yield loop is known as the optional. These curves are electrically not related but these two curves are related by a rotating attractive field made by the sensitive iron center in the transformer. The two lines at the circuit picture relate to the center. Transformers relate next to no energy so the energy out is (practically) equivalent to the energy in. The area of the amount of turns for every loop, called as the proportion of turns, indicates the amount of the potential. A stage down transformer has uncountable loop essential on its data that is related to the high potential mains supply, and a small number of turns on its auxiliary (yield) curl to have a less yield potential.

$$\text{TURN RATIO} = \frac{Vp}{Vs} = \frac{Np}{Ns} = \frac{Is}{Ip} \quad \textbf{(4.1)}$$

Where
$V_p$ = Potential of initial windings
$V_s$ = Potential of lateral windings
$N_p$ = Turns number in initial windings
$N_s$ = Turns number in lateral winding
$I_p$ = Current in initial winding
$I_s$ = Current in lateral winding

**Figure 4.1:** Potential transformer [40].

## 4.3 LCD 2*16 MODULE

LCD (Liquid Crystal Display) display is a digital display equipment & locate a wide variety of uses. A 16*2 LCD shown in Figure 4.2 is certainly essential equipment and is normally used as a component of different modules and internal circuits. These modules are having not less than seven and many other fragment LED. The causes for these are LCD being sparing, effectively codable, has limitless of providing exceptional and even character custom movements.

A 16x2 LCD can show 16 characters for every line and it has two more such lines. Every character is displayed in 5x7 pixel framework. Every LCD has two certain registers which are specific for Commanding and maintain Data. The pin configuration of LCD 2*16 is shown in the Table 4.1.

The summon guidelines sent to the LCD are stored in the order register. The direction which is known as the charge is sent to the LCD for having a pre-defined assignment like instating it, erasing the screen, positioning the cursor, showcase control and so on. The information to be displayed is stored in the information register, which is ASCII estimation of the number displayed on LCD. Snap for taking more about internal side of an LCD.

**Table 4.1:** Pin configuration of LCD

| Pin no. | Symbol | External connection | Function |
|---|---|---|---|
| **1** | Vss | Power supply | Signal ground for LCM |
| **2** | Vdd | Power supply | Power supply for logic for LCM |
| **3** | Vo | Power supply | Adjusting contrast |
| **4** | RS | MPU | Register opting signal |
| **5** | R/W | MPU | Read/write opting signal |
| **6** | E | MPU | Operation (data read/write) enabling signal |
| **7~10** | DB0~DB3 | MPU | 4 low order dual-directional three-level data bus lines. Used for info transfer between the MPU and LCM. These 4 are not utilized during 4-bit operation. |
| **11~14** | DB4~DB7 | MPU | 4 high order dual-directional three-level info bus lines. Utilized for info transfer between the MPU. |
| **15** | LED+ | LED BKL power supply | Supply of power for BKL |
| **16** | LED- | LED BKL power supply | Supply of power for BKL |

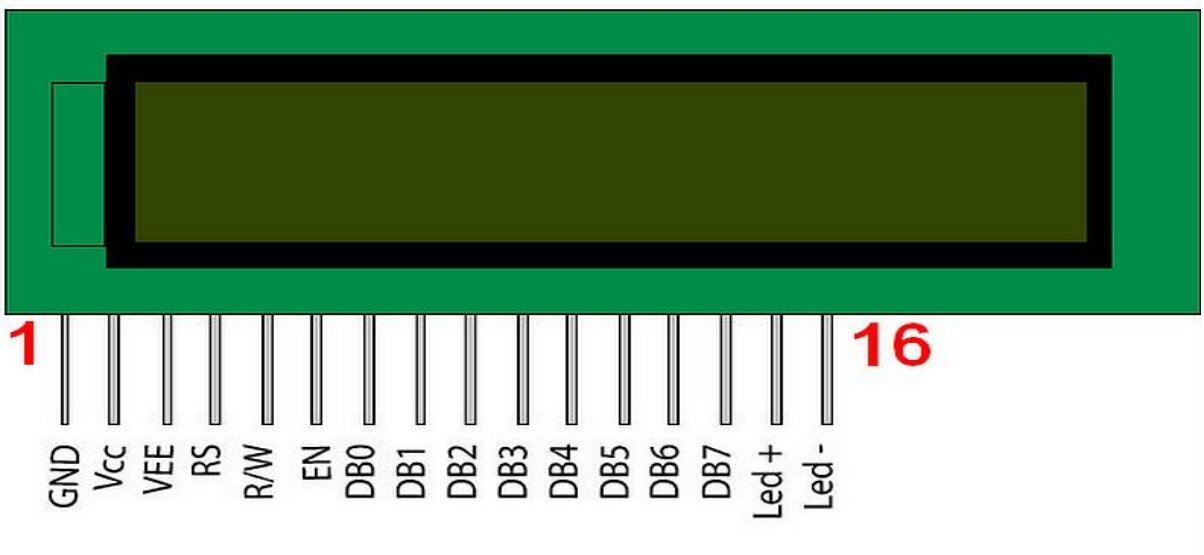



**Figure 4.2:** LCD display along with pins [41].

## 4.4 VOLTAGE REGULATORS

Voltage regulator is an electrical or electronic part that enhances the voltage of a potential source inside the required points of an area. The potential controller shown in Figure 4.4 is expected to manage the potentials inside the required level that can be used. Such a device is normally used as a part of vehicles engine of various types to co-ordinate the yield potential of the generator to the load and the charging requirements of the battery. Along with this potential controllers are used as a part of electronic gear in which over the top variations in potential shall be adverse.

In motor vehicles, potential controllers rapidly change beginning with one then onto the following of three circuit states by strategy for a spring-stacked, twofold shaft switch. At low speeds, some current from the generator is used to help the generator's alluring field, along these lines extending potential yield. At higher speeds, impedance is implanted into the generator-field circuit so that its potential and current are coordinated. At still higher speeds, the circuit is traded off, cutting down the alluring field. The controller trading rate is commonly 50 to 200 times every second.

Electronic potential controllers use solid state semiconductor devices to smooth out assortments in the surge of current. A great part of the time, they fill in as variable impedances; that is, impedance reduces when the electrical weight is considerable and increases when the load is lighter.

Voltage controllers perform the same limit in far-reaching scale power-course systems as they do in motor vehicles and diverse machines; they minimize assortments in voltage remembering the deciding objective to guarantee the rigging using the force. In power movement systems the controllers are either in the substations or on the feeder lines themselves. Two sorts of controllers are utilized: step controllers, in which switches direct the present supply, and prompting controllers, in which an affectation engine supplies an optional, constantly balanced voltage to try and out current varieties in the feeder line.

A basic voltage controller can be produced using a resistor in arrangement with a diode (or arrangement of diodes). Because of the logarithmic state of diode V-I bends, the voltage over

the diode changes just somewhat because of changes in current attracted or changes the data. At the point when exact potential control and proficiency are not vital, this configuration may work fine. The basic circuit diagram of the voltage regulator is shown in the Figure 4.3, it has a core, a solenoid, capacitor and a spring.

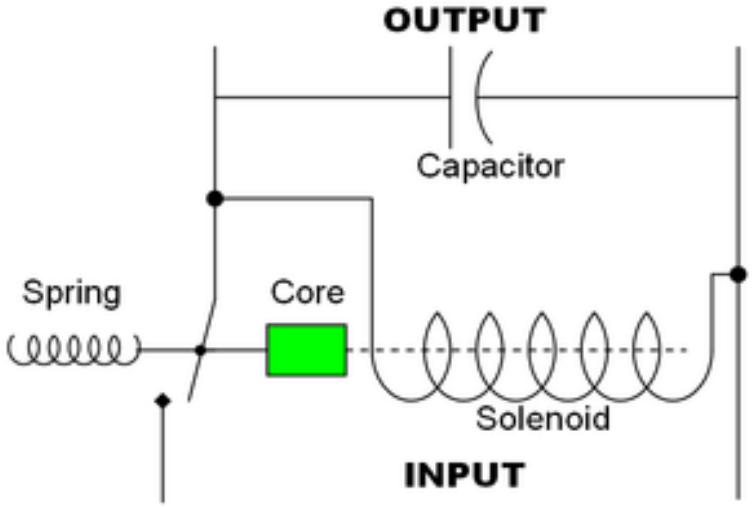



**Figure 4.3:** Circuit of voltage regulator [42].

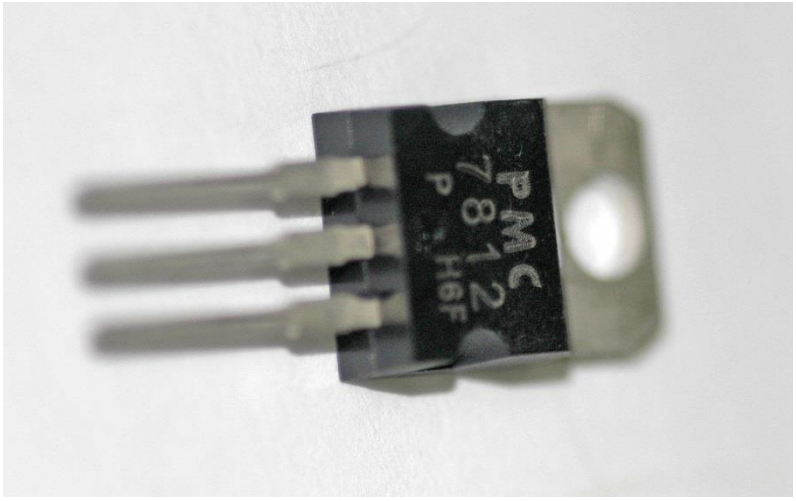


**Figure 4.4:** Voltage regulator [43].

## 4.5 L293D MOTOR DRIVER

L293D is a double H-span engine driver incorporated circuit (IC) that is shown in Figure 4.5. Engine drivers go about as ebb and flow speakers as they get a low-ebb and flow control flag and give a larger-momentum signal. This larger current sign is used in order to initiate the engines.

L293D contains two inbuilt H-span initiating circuits. In its regular method of performance, two DC engines can be initiated all the while, both in front and turn around the course. The engine performances of two engines can be maintained by info rationale at pins two and seven and ten and fifteen. Information rationale 00 or 11 will stop the differentiating engine. Rationale 01 and 10 will turn it in clockwise and anticlockwise headings, one by one.
Empower pins 1 and 9 (relating to the two engines) must be high for engines to begin performing. At this point when an obtained information is high, the related driver gets empowered. Accordingly, the yields get to be dynamic and perform in stage along with their

inputs. Correspondingly, when obtained info is low, that driver is debilitated, and their yields are off and in the larger-impedance level.

### 4.5.1 WORKING OF L293D

There are two drive pins on L293D. First pin (left H-scaffold) and 9th stick (right H-span). To turn ON the comparing engine, first pin or 9th should be set to HIGH. In the event that either stick 1 or pin 9 goes low then the engine in the comparing area will go OFF (high impedance). These inputs (1 and 9) are the ones that ought to be utilized to control engine START/STOP and engine speed under PWM, since there would be high impedance yield amid low semi-period of PWM, it would not incite over-burden of the L293D when the engine is turning. In this manner, PWM or engine ON/OFF control ought to never be data to pins 2, 7, 15, 10, which ought to just be utilized to control heading (Clockwise - Counterclockwise).

The course characterizing four Input pins for the L293D are pin 2 and 7 on the left and stick 15 and 10 on the great on the pin outline. Left information pins will decide the turn of the engine associated on the left side and right data for the engine on the right-hand side. The engines are pivoted on the premise of the inputs gave at the data pins as LOGIC 1 or LOGIC 0.

Logic table:
Expecting an engine associated on left side yield pins (pin 3, 6).

- Pin 2 = Binary 1 and Pin 7 = Binary 0 | Clockwise Direction
- Pin 2 = Binary 0 and Pin 7 = Binary 1 | Anticlockwise Direction
- Pin 2 = Binary 0 and Pin 7 = Binary 0 | Brake (this is not high impedance) (power stop pivot utilizing electric brake = same voltage both pins of the engine = over-burden while the engine is as yet running)
- Pin 2 = Binary 1 and Pin 7 = Binary 1 | Brake (this is not high impedance) (power stop turn utilizing electric brake = same voltage both pins of the engine = over-burden while the engine is as yet running)

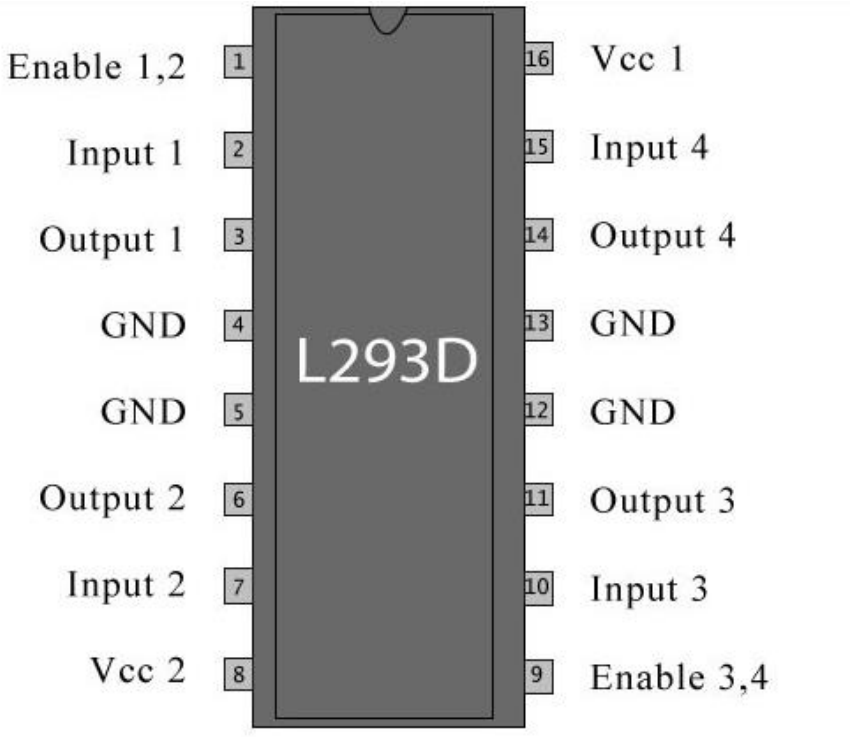



**Figure 4.5:** Pin configuration of L293D [44].

## 4.6 DC MOTOR

A DC motor is any of a class of electrical machines that devotee's immediate current electrical power into mechanical power. The most broadly perceived sorts rely on upon the qualities conveyed by appealing fields. Around an extensive variety of DC motors have some inside structure that is shown in Figure 4.6, either electromechanical or electronic, to once in a while adjust the course of the current stream in part of the motor. Most sorts produce turning development; an immediate motor clearly conveys oblige and development in a straight line.

DC motors were the essential sort comprehensively used, since they could be filled from existing direct-current lighting power movement structures. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the nature of current in its field windings. Little DC motors are used as a piece of instruments, toys, and machines. The comprehensive motor can take a shot at direct present yet is a lightweight motor used for helpful power instruments and machines. Greater DC motors are used as a piece of impulse of electric vehicles, lift and raises, or in drives for steel moving production lines. The methodology of power contraptions has made supplanting of DC motors with AC motors possible in various applications.

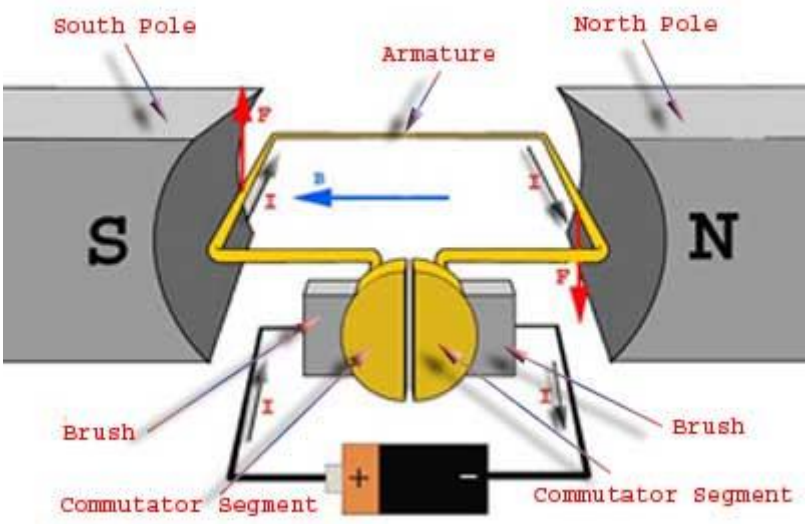



**Figure 4.6:** Internal working of DC motor [45].

## 4.7 UNIVERSAL SYNCHRONOUS ASYNCHRONOUS RECEIVER TRANSMITTER (USART)

Correspondence between two elements is critical for the data stream to happen. All in all the data transport framework could be parallel in that the total byte of information is sent at once, with every piece having a different devoted line or that can be serial that stand out correspondence line is accessible which is shared with every one of the bits consecutively. The upsides and downsides of these two frameworks are comparable and choice between the two relies on upon the application.

Information can be traded utilizing parallel or serial strategies. Setup for parallel information exchange is not financially savvy but rather is a quick strategy for correspondence. Serial correspondence is financially savvy since it requires just a solitary line of association yet then again is a moderate procedure in contrast with parallel correspondence. This article clarifies serial correspondence of AVR microcontroller (ATmega16) with PC. The information is

transmitted from the controller utilizing RS232 standard and showed on the PC utilizing Hyper Terminal.

There are two strategies for serial information correspondence (i) Synchronous and (ii) Asynchronous correspondence. In Synchronous specialized strategy complete square (characters) is sent at once. It doesn't require any extra bits (begin, stop or equality) to be included for the synchronization of the casing. The gadgets are synchronized by a clock. Also, in non-concurrent correspondence information transmission is done byte by byte i.e., one byte at once. The extra bits are added to finish an edge.

## 4.8 BUZZER

A buzzer or beeper is a sound making gadget that can be mechanical, electromechanical, or piezoelectric. Ordinary installations of beepers and beepers inbuilt caution gadgets, clocks and conformation of information regarding clients, for example, any input from a mouse or keyboard.

### 4.8.1 ELECTROMECHANICAL

Initial gadgets connect on an electromechanical outwork in differentiable to an electric ringer that is not having a metal gong. So on, transformation can be related with interfering with its own particular inciting current, creating the buzz contacts. Normally these items were moored to a roof to use it as a board that sounds. "Buzzer" has originated from the grating commotion that electromechanical ringers prepared.

### 4.8.2 MECHANICAL

A signal is an illustration of an easy and normal mechanical beeper which require drivers.

### 4.8.3 PIEZOELECTRIC

**Figure 4.7:** Piezoelectric plate beeper [46].

A piezoelectric gadget shown in Figure 4.7 could be found by a wavering circuit or other signs of beep, initiated by a piezoelectric beep sound intensifier. Sounds generally utilized for showing that a requirement has been made are a tick, a ring or a beep.

### 4.8.4 CUTTING EDGE APPLICATIONS

While mechanical headways have made signals unreasonable and undesirable, there are still occurrences in which ringers and comparative circuits might be utilized. Present day applications include:

- Novelty employments
- Educational purposes
- Annunciator boards
- Electronic metronomes
- Game show lock-out gadget

- Microwave broilers and other family machines
- Sporting occasions, for example, ball games
- Electrical alerts
- Joy signal a mechanical bell utilized for tricks

## 4.9 CAMERA

A camera is an optical equipment for taking or catching pictures, which can be stored privately, transmitted any area, or both. The pictures can be singular until photos or groupings of pictures combined with recordings or movies. The camera is a remote finding gadget as it provides anything without touching that. The word camera comes from the Camera Obscura, which means "dull chamber" and is the Latin name of the first gadget for taking the picture in the real time environment on different surfaces. The modern day photographic camera improvised from the Camera Obscura. The performance of the camera is basically the same to the performance of the human eye.

## 4.10 AVR EVALUATION BOARD

The AVR board shown in Figure 4.8, is produced using twofold sided PTH PCB board to give additional quality to the connector joints for expanded dependability.


**Figure 4.8:** AVR evaluation plate [47].

Determinations:

- power: 7 to 15 volts, AC or DC , heat sink 7805 for the current rating
- for converse extremity assurance
- for boot, reset, power switches
- it gives RS232 serial interface
- it is good with universally useful prototyping board for improvement board for stackable configuration
- it gives 10 pin FRC connectors and binding cushions on all ports

## 4.11 FINGERPRINT MODULE R305

Biometric distinguishing module takes the print made by an impression of the edges of the skin layer of a finger is regularly utilized as confirmation as a part of criminal investigations. This is an optical biometric unique mark sensor (R305) module shown in Figure 4.9 that has TTL UART compatible for direct associations with a microcontroller UART. The client can store the unique finger impression information in the module and can arrange it in one to one or one to many modes for distinguishing the individual. This module can specifically compatible with any 3.3V or 5V microcontrollers, yet a suitable level converter/serial connector is needed for connecting with the serial port of a PC.

### 4.11.1 WORKING PRINCIPLE

Bio-metric distinguishable module has two sections of finger impression enlistment and coordinating can be from one to one or one to many. While enlisting, a user needs to enter the fingerprint two times. The module will handle the two-time finger pictures and produce a layout of the print of two-time finger images for preparing the results and stored in a particular format. While coordinating, user enters the finger impression by using optical sensor and framework will produce a layout of the finger and contrast it and stored in the finger library.

For one to one coordinating, module will enhance the live finger and particular layout given in the Module; for one to many coordinating, or seeking, the module will search the entire fingerprint library for the matching fingerprint. In both circumstances, the module will give back the coordinating results.

The module itself does every mind boggling errand behind perusing and distinguishing the fingerprints with an on-board optical sensor and unique finger impression calculation. The database of prints can even be downloaded from the unit and appropriated to different modules. And additionally the unique finger impression layout, the broken down form of the print, you can likewise recover the picture of a unique mark and even draw crude pictures from the optical sensor.

### 4.11.2 INTERFACING WITH PC

The module can be connected to the PC through USB and using an FTDI Breakout or through RS-232 along with a level-shifter to store fingerprints.

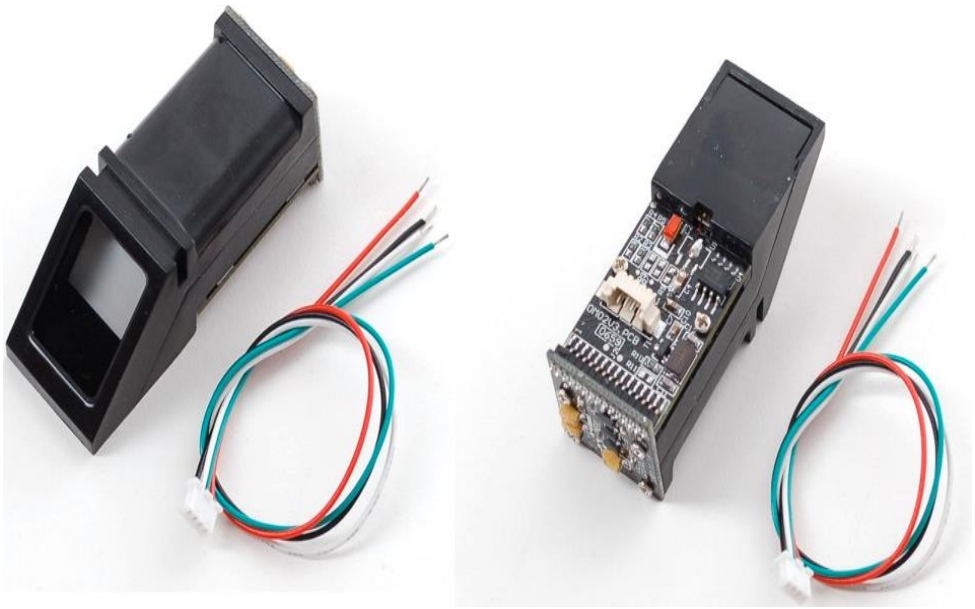


**Figure 4.9:** R305 module [48].

## 4.12 ATMEGA 16 MICROCONTROLLER

The AVR is an altered Harvard design 8-bit RISC single-chip microcontroller, which was produced by Atmel in 1996. The AVR uses chip streak memory is the only microcontroller that uses it among the primary microcontroller families. It uses this for stock-piling of the system, instead of one-time programmable ROM, EPROM, or EEPROM utilized by a variety of microcontrollers at the time. ATMEGA AVR chips got to be prevalent after they were attempted into the 8-bit Arduino level.

Atmega16 is an 8-bit elite microcontroller shown in Figure 4.10 is of Atmel's Mega AVR family with low power utilization. Atmega16 depends on improved RISC (Reduced Instruction Set Computing) design with 131 intense directions. The greater part of the directions execute in one machine cycle. Atmega16 has high-speed clock frequency that can work at a most extreme recurrence of 16MHz.

Atmega16 has 16 KB codable blaze memory, static RAM of 1 KB and EEPROM of 512 Bytes. The continuance cycle of blaze memory and EEPROM is 10,000 and 100,000, individually. Atmega16 is a 40 pin microcontroller. There are 32 I/O (info/yield) lines which are separated into four 8-bit ports assigned as PORTA, PORTB, PORTC, and PORTD.

Atmega16 has a wide range of inbuilt peripherals like USART, ADC, Analog Comparator, SPI, JTAG and so forth that are shown in Figure 4.11. Every I/O pin has an option of undertaking identified with fabricated peripherals. The accompanying figure demonstrates the pin depiction of Atmega16.

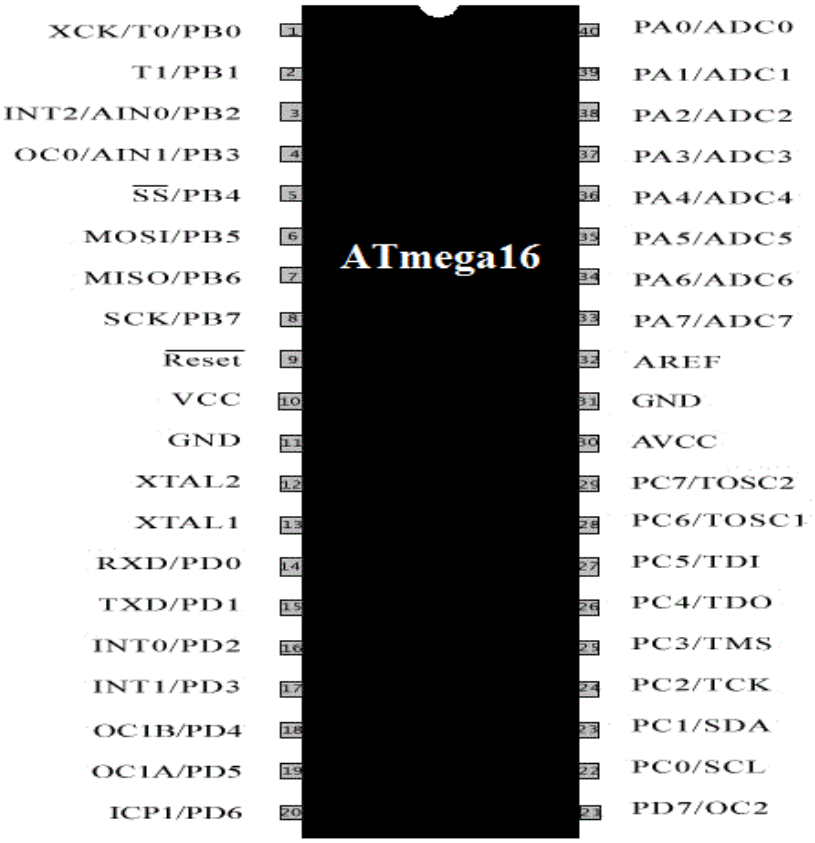



**Figure 4.10:** Pin configuration of ATMEGA16 [49].

### 4.12.1 FEATURES OF AVR MICROCONTROLLER

- Multifunction, dual-directional extensively useful I/O ports that can be configurable, developed in draw resistors
- Many inward oscillators, along with RC oscillator but not having outside components
- Internally and self-codable direction streak memory until 256 kB (384 kB on XMega)
  i) In-framework codable utilizing serial/parallel low-potential exclusively interfaced or JTAG
  ii) We can have optional boot code region with autonomous lock bits for assurance
- On-chip investigating (OCD) supported by JTAG or troubleshoot WIRE on general gadgets
  i) The JTAG signals (TMS, TDI, TDO, and TCK) can be multiplexed on GPIOs. These pins are arranged to work as JTAG or GPIO relying upon the fixing of a breaker bit that can be modified by means of ISP or HVSP. As a matter of course, AVRs with JTAG accompany the JTAG interface empowered.
  ii) Debug WIRE utilizes the/RESET pin as a dual-directional correspondence access width to on-chip troubleshoot hardware. It is available on gadgets having lower pin checks, as it just need only one pin.
- Internal information EEPROM until 4 kB
- Internal SRAM until 16 kB (32 kB on XMega)
- External 64 kB has small information area on prescribed models, along with the Mega8515 and Mega162.
  i) The outer information area is overlaid with the inner information area, so that the address area does not exceed 64 kB outside transport and gets to e.g. address 010016 will get to inside RAM, not the outer transport.
  ii) In some individuals from the XMega arrangement, the outside information area has been developed to bolster both SRAM and SDRAM. Too, the information tending to modes have been extended to permit until 16 MB of information memory to be straightforwardly tended to.
  iii) AVRs by and large don't bolster performing code from outer memory. Some ASSPs utilizing the AVR center do bolster outer system memory.
- 8-bit and 16-bit clocks
  i) PWM yield (a few gadgets have an upgraded PWM fringe which incorporates a generator dead-time)
  ii) Input catch that has a period stamp activated by an edge sign
- Analog comparator
- 10 or 12-bit A/D converters, with multiplex until 16 channels
- 12-bit D/A converters
- An assortment of serial interfaces along with
  i) I²C good Two-Wire Interface (TWI)
  ii) Synchronous/non-concurrent serial peripherals (UART/USART) (utilized with RS-232, RS-485, and that's only the tip of the iceberg)
  iii) Serial Peripheral Interface Bus (SPI)
  iv) Universal Serial Interface (USI): a multi-reason equipment correspondence module that can be utilized to actualize a SPI, I2C or UART interface.
- Identification of brown-out
- Watchdog clock (WDT)
- Multiple power-sharing rest modes
- Lighting and engine control (PWM-particular) models
- CAN supported controller

- USB supported controller
  i) Proper high-speed (12 Mbit/s) equipment and controlled hub with installed AVR.
  ii) Also unreservedly accessible low-speed (1.5 Mbit/s) (HID) bit wise programming copies

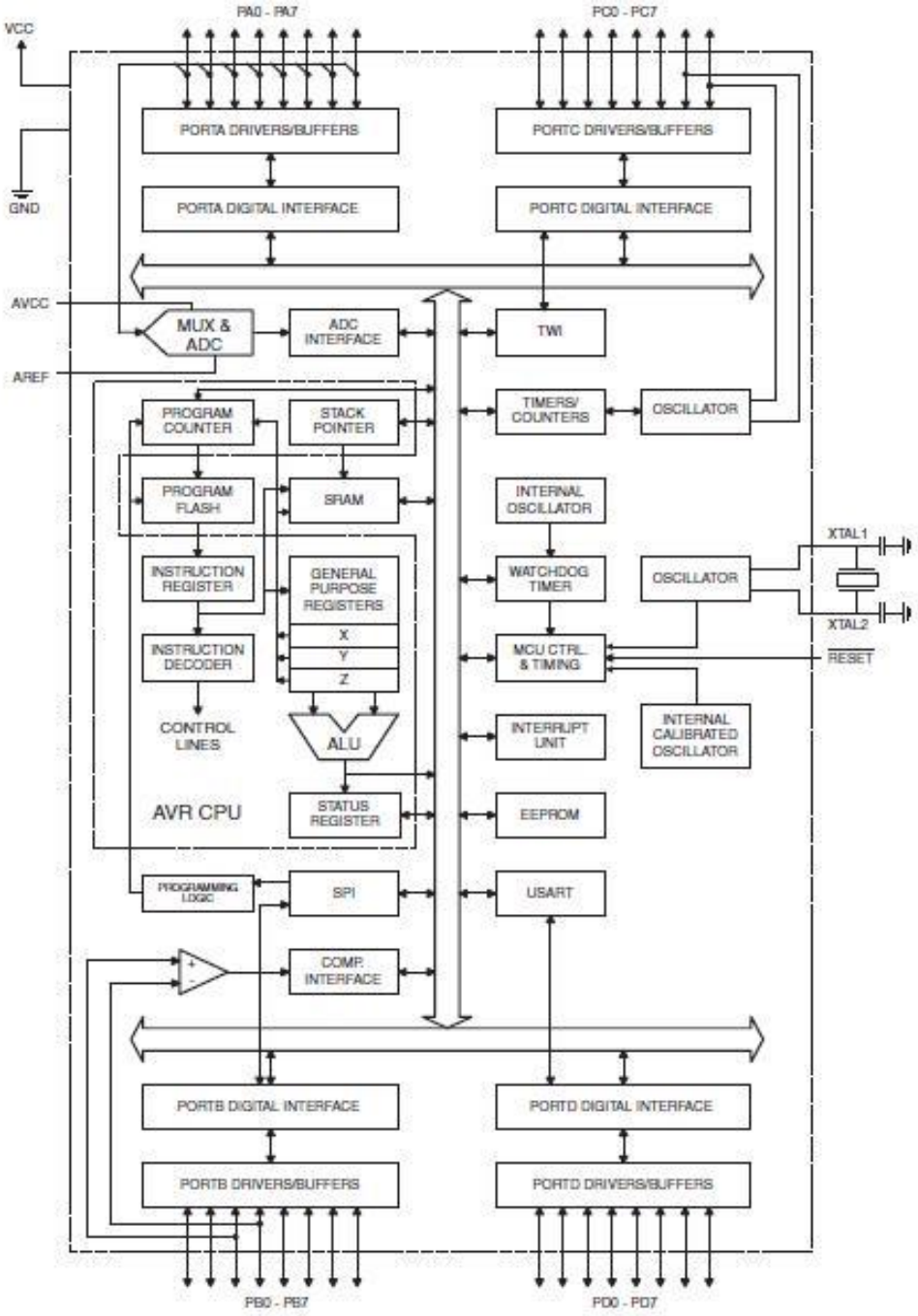



**Figure 4.11:** Internal block configuration of ATMEGA16 [49].

- Ethernet supported controller
- LCD supported controller
- Low-potential gadgets working under 1.8 V (to 0.7 V for parts with inherent DC–DC high-converter)
- Gadgets having Pico power
- DMA controlled and "occasion framework" fringe correspondence.
- Fast cryptography support for AES and DES

## 4.13 SOFTWARE IMPLEMENTATION OF ANPR

The software implementation of ANPR system has four basic procedures shown in Figure 4.12, in which image has captured by camera, extraction of area of concern from the captured image, partition of characters from the extracted area and identifying the partitioned characters.

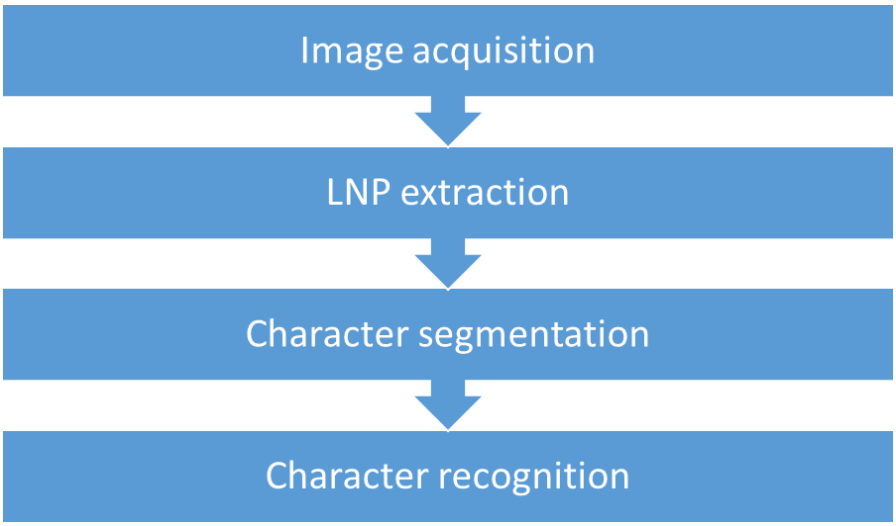



**Figure 4.12:** Procedure for ANPR

### 4.13.1 IMAGE ACQUISITION

There are different approaches in which image is given as input to the system like through analog camera or digital camera. The best way of taking images is through digital camera or direct digital photos because digital technology is more beneficial than other technologies. The captured image is shown in Figure 4.13.


**Figure 4.13:** Captured image by camera

### 4.13.2 LICENSE NUMBER PLATE (LNP) EXTRACTION

#### 4.13.2.1 CONVERSION OF RGB TO GRAYSCALE IMAGE

The RGB to grayscale conversion of image is not compulsory but it is usually done for simplicity and data reduction. The grayscale image has flexibility of working on entire image

plane and the data on to be operated is also reduced. The converted grayscale image is shown in Figure 4.14.

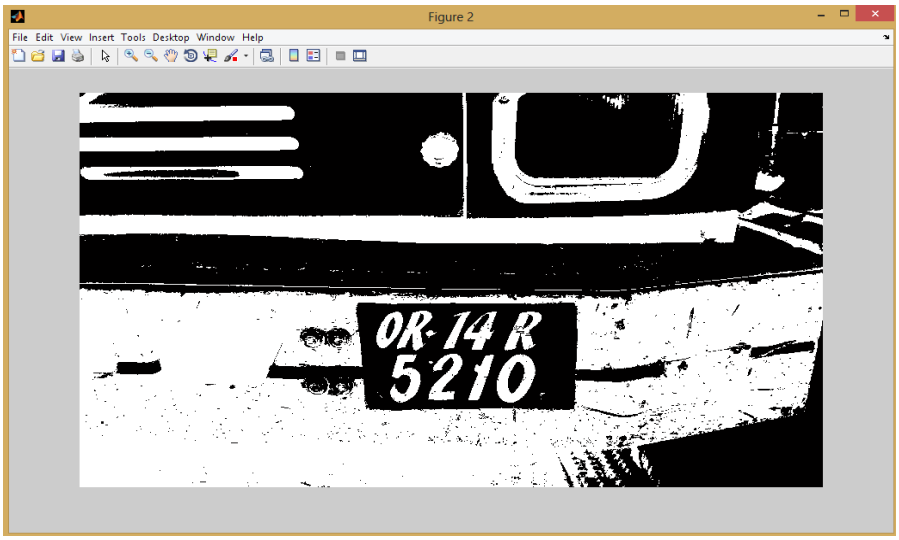



**Figure 4.14:** Gray scale image

### 4.13.2.2 REMOVING UNWANTED EDGES BY THRESHOLDING

The adaptive thresholding filtering is used to remove unwanted edges. Initially the image is low pass filtered in order to smoothen out the unwanted region and later threshold is applied accordingly to get the required region. The image after thresholding is shown in Figure 4.15.

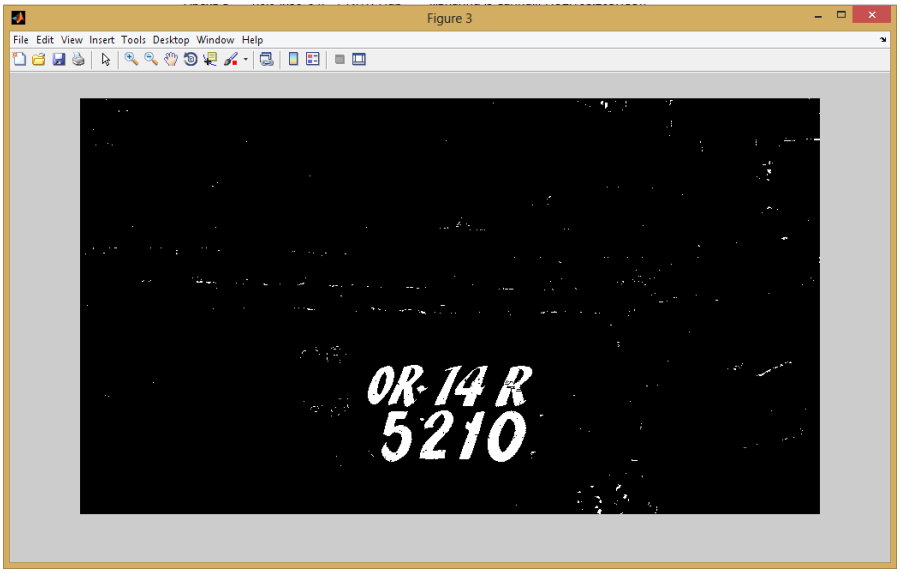



**Figure 4.15:** Image after thresholding

## 4.13.3 CHARACTER SEGMENTATION

Character segmentation is done in order to partition the number plate into its individual characters. The factors that are considered during character segmentation are noise of the image, plate frame, rivet, rotation of the plate and variance in illumination. Gabor filters are used for segmentation of number plate. This analyzes the texture in every direction and scale. The Gabor filters are worked as license plate detectors after convoluting with filter responses [12]. The segmented characters are taken individually as shown in Figure 4.16.

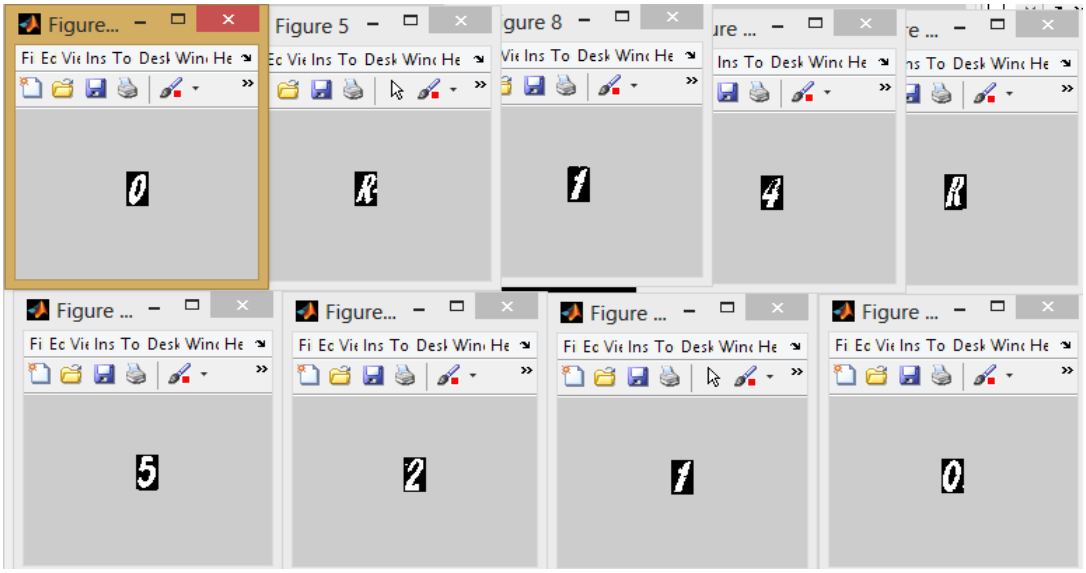


**Figure 4.16:** Partitioned characters

## 4.13.4 CHARACTER RECOGNITION

The input image containing characters is to be classified into single character in order to recognize the character.

### 4.13.4.1 FEATURE EXTRACTION

The image scanned for the initial darker pixel at the top corner of the first character and also for the darker pixel at the bottom corner with leaving space between each character, the characters are determined by scanning from top to bottom and from left to right.

### 4.13.4.2 PATTERN RECOGNITION

The extracted character from the feature extraction is compared with templates by dividing the extracted character into sectors and tracks as shown in Figure 4.17. Accordingly a track-sector matrix is generated by considering number of pixels in each region. This track-sector matrix is matched with existing template to identify the character [15].

**Figure 4.17:** Partition into track-sector

The partitioned track-sector region is compared with templates stored in the template library. The existing templates in template library are shown in Figure 4.18. The amount of pixels in each region is matched with the amount of pixels of templates and the character is identified through matched template.

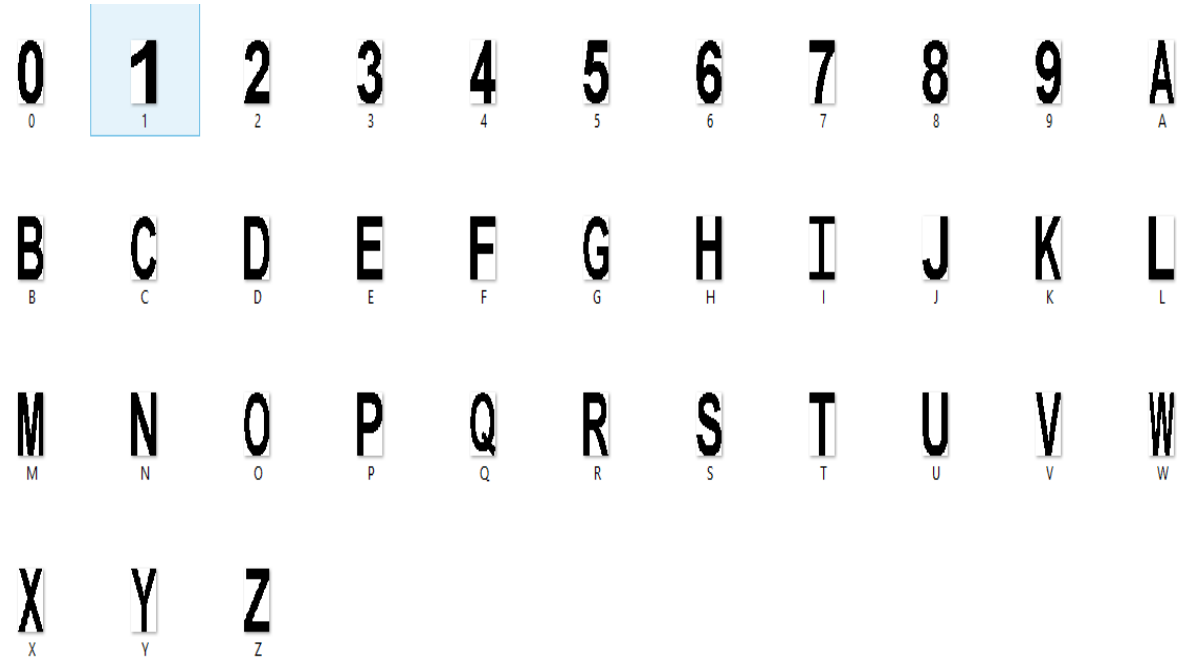



**Figure 4.18:** Existing templates

## 4.14 SOFTWARE IMPLEMENTATION OF FINGERPRINT BIO-METRIC SYSTEM

A fingerprint is a stream edge designs in the tip of the finger. The edge stream displays oddities in nearby locales of the fingertip, and its position and abnormalities that are utilized to speak to and coordinate finger prints. The steps involved in biometric fingerprint system are shown in Figure 4.19.

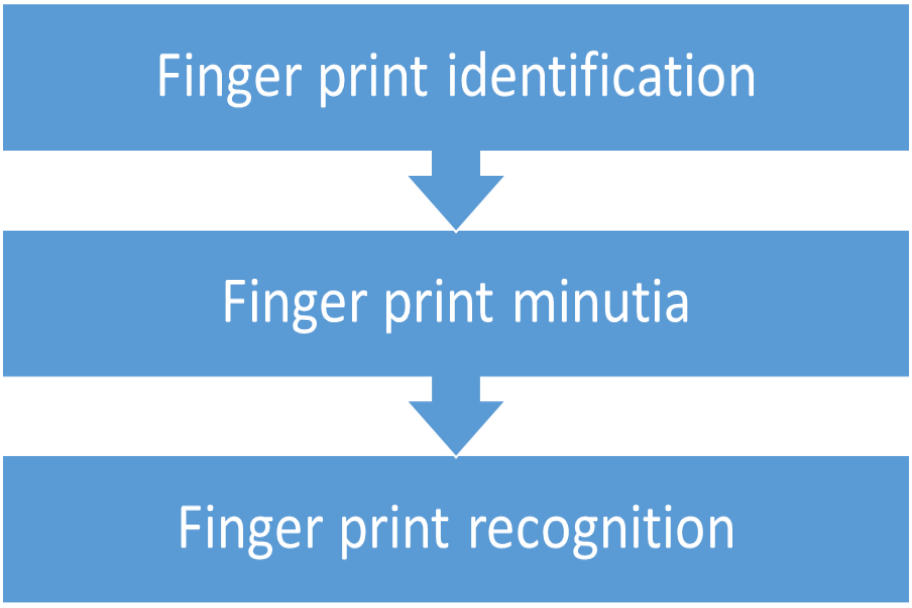



**Figure 4.19:** Procedure for finger print bio-metric system

### 4.14.1 FINGERPRINT IDENTIFICATION

The process of comparing two instances of the skin impression's friction ridge of fingers is called fingerprint identification. It is to determine whether these prints came from one individual. And also to find whether different impressions taken at different times are originated from the same finger.

### 4.14.2 FINGERPRINT MINUTIA

Minutia, in fingerprint terms, are the area of interests for unique finger impression. The different area interests involved in fingerprint minutia are

- Ridge endings - an edge that finishes suddenly.
- Ridge bifurcation - a solitary edge that partitions into two edges.
- Short ridges, island or autonomous edge - an edge that starts, ventures a short separation and afterward closes.
- Ridge enclosures - a solitary edge that bifurcates and reunites in a matter of seconds a short time later to proceed as a solitary edge.
- Spur - a bifurcation with a short edge fanning out a more drawn out edge.
- Crossover or bridge - a short edge that keeps running between two parallel edges.

### 4.14.3 FINGERPRINT RECOGNITION

The R305 fingerprint module is a fingerprint recognizer/identifier. The principle of working of R305 has two parts, enrollment of fingerprint and matching of fingerprint, the may be one to one or one to many. In order to enroll, the fingerprint should be entered two times by the user. The two time fingerprints will be processed by the R305 system and depending on the processing results a template is generated and the generated template is stored in the finger library. When any user enters the fingerprint through R305 optical sensor, the template of that user will be generated by the system and that template is compared with the templates of the fingerprint library in order to identify.

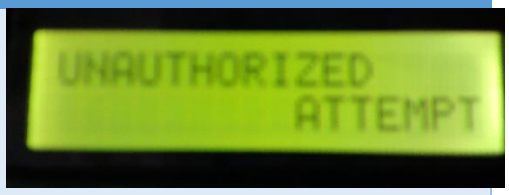
## 4.15 VALIDATION AND ACKNOWLEDGMENT

R305 is am optical bio-metric fingerprint recognizer/identifier module which is having TTL UART interface in order to have direct connection to the UART of the micro-controller. The fingerprint data stored in the module is configured into one to one or one to many mode of comparing the finger prints. When any of the user's fingerprint is matched with the fingerprints stored in the library then the micro-controller takes response as binary 1 and if not matched then binary 0.

When template matching is done in order to recognize the character of the number plate then the binary 1 is send to the micro-controller if and only if templates are matched and binary 0 if templates are not matched.

These binary outputs from the both the processes are taken by the micro-controller and logical AND operation is done. The output from the logical AND operation is given to the motor driver to initiate the gate and a logical table is drawn for gate and LCD responses that is shown in Table 4.2.

**Table 4.2:** Logical table for gate and LCD responses

| | O/P FROM ANPR | O/P FROM R305 | LOGICAL AND OPERATION BY MICRO-CONTROLLER | OUTPUT AT THE GATE | LCD RESPONSES |
|---|---|---|---|---|---|
| **BOTH THE OUTPUTS ARE NOT MATCHED** | 0 | 0 | 0 | GATE IS CLOSED |   |
| **OUTPUT OF ANPR NOT MATCHED BUT OUTPUT OF R305 MATCHED** | 0 | 1 | 0 | GATE IS CLOSED |   |
| **OUTPUT OF ANPR MATCHED BUT OUTPUT OF R305 NOT MATCHED** | 1 | 0 | 0 | GATE IS CLOSED |   |
| **BOTH THE PROCESSES HAS MATCHED RESPONSES** | 1 | 1 | 1 | GATE IS OPENED |   |

# Chapter 5

# RESULTS AND DISCUSSIONS

## 5.1 INTRODUCTION

The usefulness of any module designed can only be verified after it is used and desired results are achieved. After the design of circuit, it is required to verify the working of the module and also it should be verified for desired results. For this purpose the module should tested for different users accompanied by a regular monitoring of desired output.

## 5.2 ANALYSIS OF ANPR WITH CLEAN NUMBER PLATES

As the number plates captured for the process are not dusty hence the results are not varied much. The captured images were further processed in ANPR system and the results are obtained. The analysis of ANPR with clean number plates is shown in Table 5.1.

**Table 5.1:** Analysis of ANPR with clean number plates

| Number of images captured | Number of images matched | Efficiency |
|---|---|---|
| **30** | 26 | 86.67% |

## 5.3 ANALYSIS OF ANPR WITH DUSTY AND FADED NUMBER PLATES

As the number plates captured for the process are dusty and these plates has faded characters hence the results will be varied and these images captured are processed in ANPR to obtain the results. The analysis of ANPR with dusty number plates is shown in Table 5.2.

**Table 5.2:** Analysis of ANPR with dusty plates

| Number of images captured | Number of images matched | Efficiency |
|---|---|---|
| **30** | 23 | 76.67% |

## 5.4 ANALYSIS OF ANPR WITH VARYING DISTANCE

The image of number plate is captured with varying the distance and the captured images for each distance are processed through ANPR system and the efficiency for each distance is found. The total efficiency for varying distance is calculated from the results obtained. The analysis of ANPR with varying distance is shown in Table 5.3 and the graph is illustrated in Figure 5.1.

**Table 5.3:** Analysis of ANPR with varying distance

| Distance | Total images taken | Number of images matched | Efficiency for each distance |
|---|---|---|---|
| **1 meter** | 30 | 25 | 83.33% |
| **2 meters** | 30 | 25 | 83.33% |
| **3 meters** | 30 | 24 | 80% |
| **4 meters** | 30 | 24 | 80% |
| **5 meters** | 30 | 23 | 76.67% |
| **6 meters** | 30 | 22 | 73.33% |

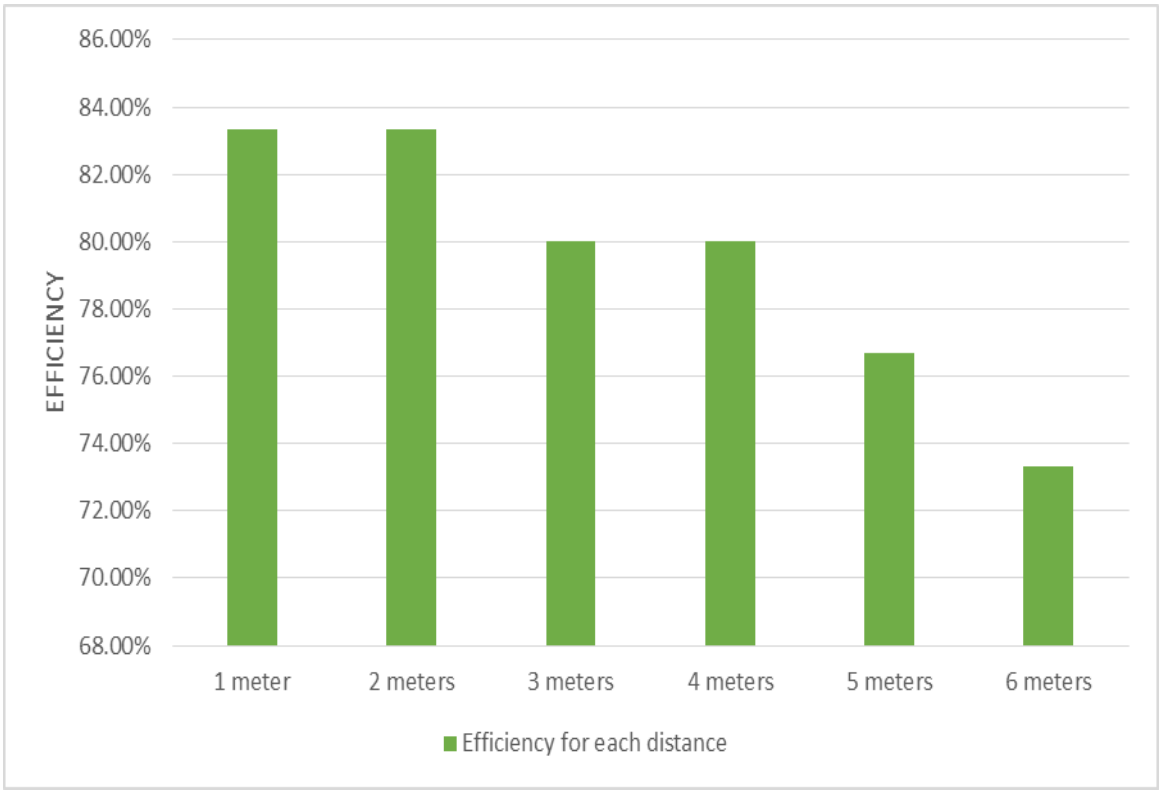



**Figure 5.1:** ANPR efficiency for each distance.

## 5.5 ANALYSIS OF ANPR BY CONSIDERING ALL THE PARAMETERS

The efficiency of ANPR is compared by considering all the parameters like varying distance, dusty number plates and clean number plates. This analysis gives a brief overview on the efficiency of ANPR for different environmental variations. The analysis of ANPR by considering all parameters is shown in Table 5.1 and the graph is illustrated in the Figure 5.2.

**Table 5.4:** Analysis of ANPR for all parameters

| s.no | Parameter | Number of images taken | Number of images matched | Obtained efficiency |
|---|---|---|---|---|
| **1** | Clean number plate | 30 | 26 | 86.67% |
| **2** | Dusty number plate | 30 | 23 | 76.67% |
| **3** | Varying distance | 30 | 24 | 80% |

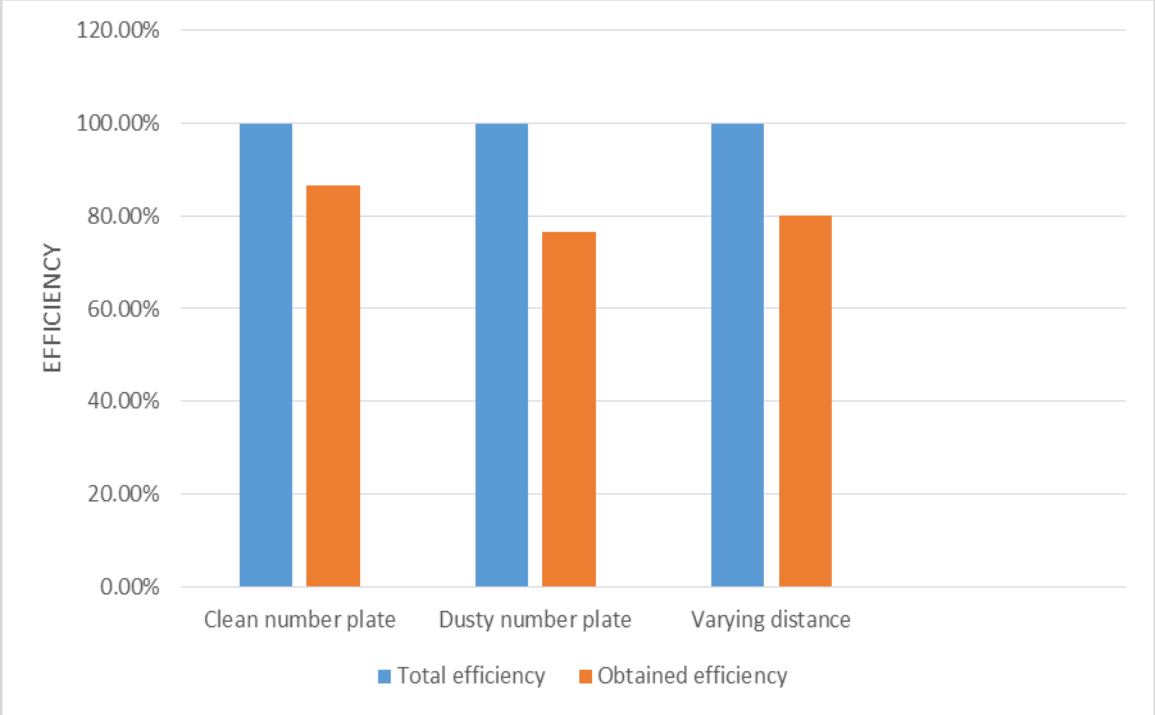



**Figure 5.2:** Efficiency of ANPR for various parameters.

## 5.6 ANALYSIS OF FINGERPRINT MODULE WITH DIFFERENT PARAMETERS

The efficiency of fingerprint module for clean fingers and for dusty fingers is compared. The output of the finger print module for clean fingers is not varied much but for the dusty fingers depends totally on the dust covered on the minutia of finger. If the minutia is totally filled by dust without revealing any points of interest then the finger print cannot be processed. The analysis of fingerprint module with different parameters is shown in Table 5.5 and the graph is illustrated in the Figure 5.3.

**Table 5.5:** Finger print module efficiency for clean and dusty prints

| s.no | Parameter | Number of finger impressions taken | Number of finger impressions matched | Obtained efficiency |
|---|---|---|---|---|
| **1** | Clean finger impression | 30 | 29 | 96.7% |
| **2** | Dusty finger impression | 30 | 24 | 80% |

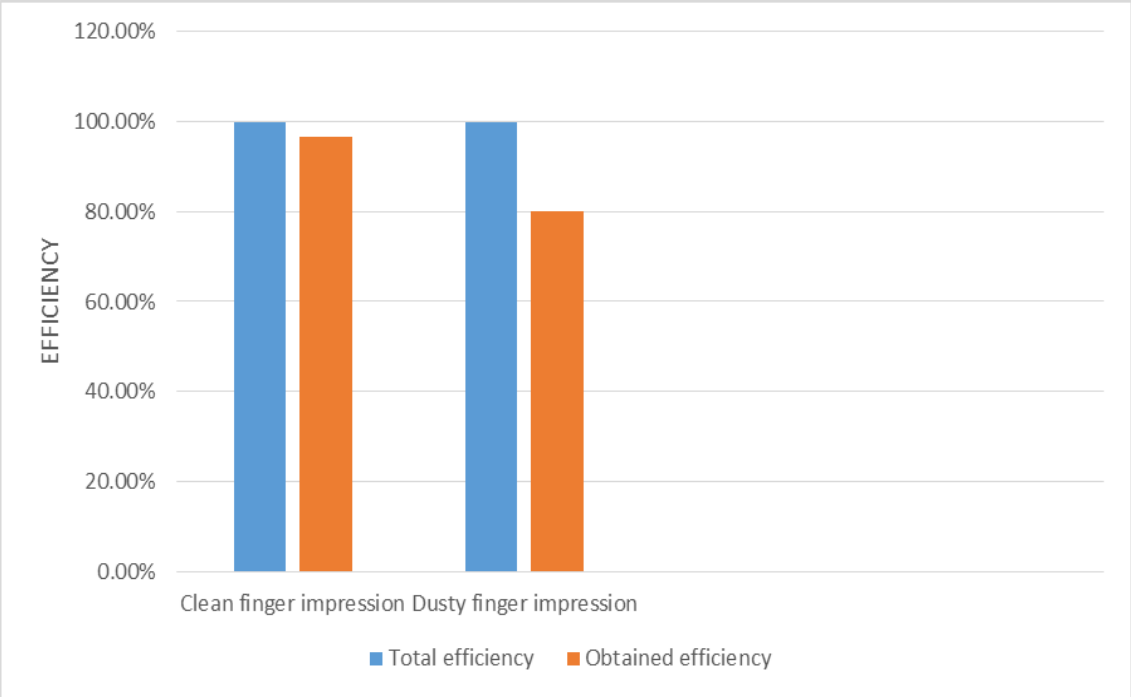



**Figure 5.3:** Finger print module efficiency for clean and dusty prints.

## 5.7 EXISTING SYSTEM IN SECL MINES

South Eastern Coalfields Limited (SECL) is one of the country's major coal mining industry. In SECL, large quantities of coal is mined and transported daily. SECL involves its own trucks and those of contracted vendors for coal transport. In order to track these trucks and to verify entry/exit of the trucks, SECL installed RFID based truck identifying system. This tracking system uses Multiple Tracking via Integrated Reader/Antenna modules.

This RFID tags are mounted on the windshield of the trucks. The antenna-reader reads these tags and checks the details of the truck in the database library. Depending on these RFID tags, the boom-barriers are opened/closed to allow/restrict the truck into the mines. Details of every truck, its owner, driver, check-in time, check-out time and date are added to the database.

## 5.8 COMPARISON OF ANPR AND BIOMETRIC FINGER PRINT SYSTEM WITH RFID BASED TRACKING SYSTEM

The RFID based tracking system is compared with ANPR and biometric fingerprint system and is showed in the Table 5.6.

**Table 5.6:** RFID based and ANPR based systems comparison.

| RFID based tracking system | ANPR and biometric fingerprint system |
|---|---|
| The RFID tag mounted on the vehicle can be detached and used by any other unauthorized vehicle. | As the number plate is by ANPR system, no other vehicles other with authorized number plates can enter into the mines. |
| The vehicle with RFID tag can be used by any unauthorized driver and the ore can easily theft. | As there is biometric fingerprint system, only the authorized person can enter with the authorized vehicle. |
| The stored data is loaded into the current file when the system recognizes the RFID tag. | The live data is loaded into the current file that obtained from ANPR and biometric fingerprint processes. |

## 5.9 LIMITATIONS OF THE SYSTEM

There are some limitations while using this system.

- The designed module does not have truck tracking system, hence it cannot monitor the transport of load by the truck to the destination.
- As this system is operated in mines where the environment is dusty, there is a chance of having dusty number plates too. In this case the efficiency of the segmentation of number plate reduces a little.
- The vehicle drivers operating in mines may contain dust in their hands which acts as noise in biometric module and the module may not detect the completely dusty finger print.
- As mines are operated in large areas multiple monitoring points are to be installed, which increases the number of modules to be used.

# Chapter 6
# CONCLUSIONS

## 6.1 CONCLUSIONS

Intelligent unauthorized transportation control uses license plate recognition and biometric fingerprint system and the following conclusions were obtained:

- The ANPR system detected 26 out of 30 images giving 86.67% efficiency, for clean number plates and detected 23 out of 30 images giving 76.67% efficiency, for dusty & faded number plates.
- The ANPR system has shown 83.33%, 83.33%, 80%, 80%, 76.67%, and 73.33% efficiency for distances 1 m, 2 m , 3 m , 4 m , 5 m s, and 6 m respectively.
- The biometric fingerprint system detected 29 out of 30 impressions giving 96.7% efficiency, for clean fingerprints and detected 24 out of 30 impressions giving 80% efficiency, for dusty fingerprints.
- The checkpoint gate is closed/open based on the output provided by the microcontroller and the acknowledge display on LCD. The data of the vehicle number plate and driver name along with the date and time are stored in an excel sheet for further references.

## 6.2 SUGGESTIONS FOR FUTURE WORK

The designed module was designed and studied in the lab. It can be implemented in the opencast mines in order to find the performance in real time environment.

In future, the GPS module can be installed in trucks for tracking, which enhances the efficiency of the overall system and security in the mines. This ensures us, whether the truck has reached the desired destination or not. Further communication can be built to send acknowledgment to the authority regarding transport of the trucks.

The picture of the driver and different subtle elements of the driver like identity proof, permit etc. can likewise be added to the procedure of identification alongside ANPR system.

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