

1. INTRODUCTION

Automatic toll collection using Optical Character Recognition (OCR) aims at successfully removing unnecessary traffic delays, faster and reliable processing and transaction of toll tax aiming to go cashless. In this, OCR is widely used technology which converts scanned images of printed text, handwritten text characters into machine encoded text information such as ASCII. It has three major parts: vehicle number plate extraction, character segmentation and OCR. Number plate extraction is that stage where vehicle number plate is detected. The detected number plate is pre-processed and then the result is passed to the segmentation part to segment the individually characters from the extracted number plate. The segmented characters are normalized and passed to an OCR algorithm. At last the optical character information will be converted into encoded text. The characters are recognized using Template matching. The final output must be in the form of string of characters along with comparison of the characters (number plate) with the database for a successful transaction of toll tax. ^[1]

Existing System:

The concept of automatic toll collection has been studied since 1992 and is based on the RFID Tags. The research paper titled “Electronic Toll Collection System Using Passive RFID Technology” ^[1] gives the overview of the toll collection system using RFID. The concept is based on existing toll booths; however human intervention is no longer required. The vehicles will be given a passive tag in the form of a sticker which could be affixed on the windshield, just like in the existing road tax system. Each time the vehicle passes the toll booth, the tag will be read and information will be transmitted to the main computer. The tax amount will be either deducted by prepaid or credited by postpaid. “Automated Toll Collection System Using RFID” in this identification is done with the help of radio frequency. A vehicle will hold an RFID Tag. Reader will be strategically placed at toll plaza. When the vehicle passes the toll naka, the tax amount will be deducted from his prepaid balance. ^[6]

2. LITERATURE SURVEY

A. Automatic Number Plate Recognition (ANPR) System: Proposed by Shriram

Kishanrao Waghmare, A. K. Gulve, Vikas N. Nirgude that automatically recognizes the number plate of the vehicle. In this paper proposed approach is present. It has considered the Indian number plates, where rear follows the number plate standards. This system consist of few algorithm like “Feature based number plate Localization” for locating the number plate, “Image Scissoring” algorithm for character segmentation and proposed algorithm for character recognition using Support Vector Machine (SVM).System can recognize single or double line number plate. An algorithm for license plate recognition (LPR) applied to the intelligent transportation system is proposed on the basis of a novel shadow removal technique and character recognition algorithms. This paper has two major contributions. One contribution is a new binary method, i.e., the shadow removal method, which is based on the improved Bernsen algorithm combined with the Gaussian filter. r. This paper also presents improved techniques for image tilt correction and image grey enhancement. [4]

B. Automated Toll Collection System Using RFID: Proposed by Satyasrikanth P,

Mahaveer Penna, and Dileep Reddy Bolla Automatic. It is one of the easiest methods used to organize the heavy flow of traffic. When the car moves through the toll gate on any road, it is indicated on the RFID reader that it has crossed the clearing. The need for manual toll based systems is completely reduced in this methods and the tolling system works through RFID. The system thus installed is quite expedient reducing the time and cost of travelers since the tag can be deciphered from a distance^[4]

C. Automated Toll Collection System Using RFID QR Code: Proposed by Vinod

Suryawanshi, Aditya Gosavi, Unmani Joshi, Sagar Suri. This paper aims to design and develop a new efficient toll collection system using QR Codes which will be a low cost alternative among all other systems. On the other hand user generates a QR code for his vehicle and pastes it on the windscreen of his vehicle. Depending on the area occupied by the vehicle, classification of vehicle is done as light and heavy. When server comes to know the type of vehicle, then it accesses the information and accordingly, appropriate toll is charged.^[4]

D. Automated Toll Booth System: Proposed by Rama Takbhate, Prof. S. D. Chavan, Volume 1, Issue 3, IJIRCCE, July 2014 in the journal the technique is to collect the toll tax with the help RFID base system to collect the toll tax automatically.^[7]

E. Number Plate Detection With Application To Electronic Toll Collection

System: Proposed by Kannan Subramanian, Volume 1, Issue 1, IJIRCCE, March 2013 The detection of the number plate is the part of the image processing domain, the detection of the number plate in the above journal is done with the help of the camera and then process by using the OCR image processing algorithm and the collection of the toll is with the help of RFID system is done here.^[7]

F. Automated Toll Booths And Tracking System For Thief Vehicle: Proposed by S. R. Jog, S. D. Chavan, Rama Takbhate, Volume 1, Issue 2, 2013 the major problem of the Country is the stolen vehicles. The journals make the tracking system like that it will capture the stolen or the theft vehicle easily and collect the toll tax.^[7]

G. Automated Toll System For Number Plate Detection And Collection: Proposed by Ankita Bhore, Bhawana nimbhorkar, Punam Pure, Priya Thombre, Volume 5, Issue 9, October 2016 The journal is to overcome the drawback of vehicle congestion, money corruption, time consumption and stolen vehicle. It uses the technique called image processing to detect the number plate and input the video and having the collection of number plates in the video.^[7]

H. Automated Toll Gate System Using Advance RFID And GSM Technology: Proposed by S. Nandini, P. Premkumar, IJAREEIE The system is implemented for the toll tax collection automatically and eliminates the possible human efforts and sends the “sms” to the owner of vehicle by the GSM modem.^[7]

- I. Automated Toll Collection Using Satellite Navigation:** The toll system explained in the above journal is the automated toll tax collection system in which the advanced satellite navigation system is explained and used for the location of the vehicle to track^[7]

3. ANALYSIS AND DESIGN

3.1 Software / Design of architecture / Technique used:

The overall system is based on scanning the number plate very precisely and then capture the image of the number plate. For efficient capturing of image the camera should be placed perpendicular to the vehicle. Then after capturing, the image is processed using OCR (Optical Character Recognition) technique which will convert the image containing text and number to machine-encoded language. The OCR technique used for image processing has several steps:

- A) Acquisition of image
- B) Conversion of image into grey image
- C) Dilation the captured image
- D) Horizontal edge and vertical edge processing
- E) Segmentation of image for region of interest
- F) Extraction of the required image from region of interest
- G) Conversion of image into binary image
- H) Segmentation of image in alphanumeric characters
- I) Recognition of individual character in the extracted image

Due to which, only the character and number are recognized and other part of the plate is eliminated. Once we get the extracted data, it is compared with the database. As the vehicle number is linked with the user's bank account, the toll amount is automatically deducted from his account.

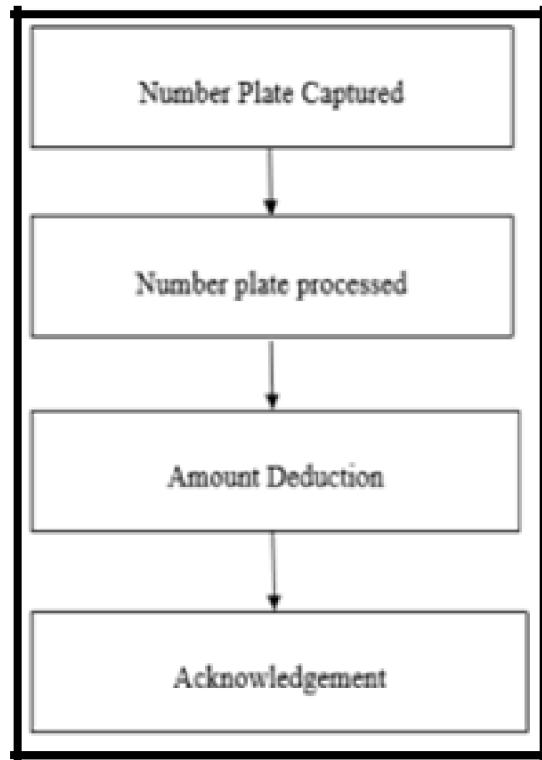


Fig 3.1: Design Implementation

AUTOMATIC TOLL COLLECTION SYSTEM

3.2 Data Flow Diagram:

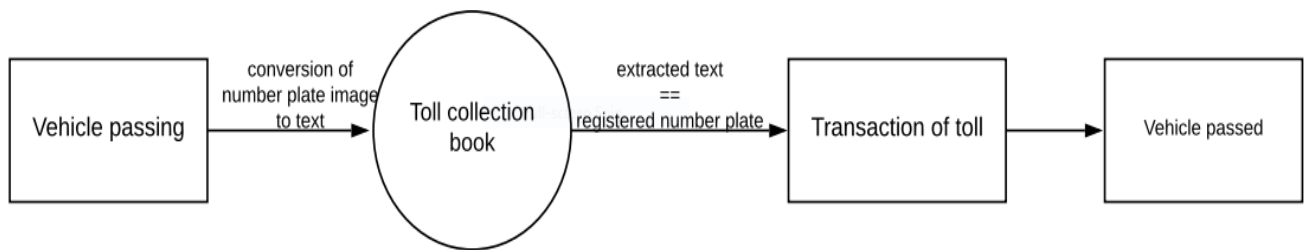


Fig 3.2.1: Level 0 DFD of the implemented system

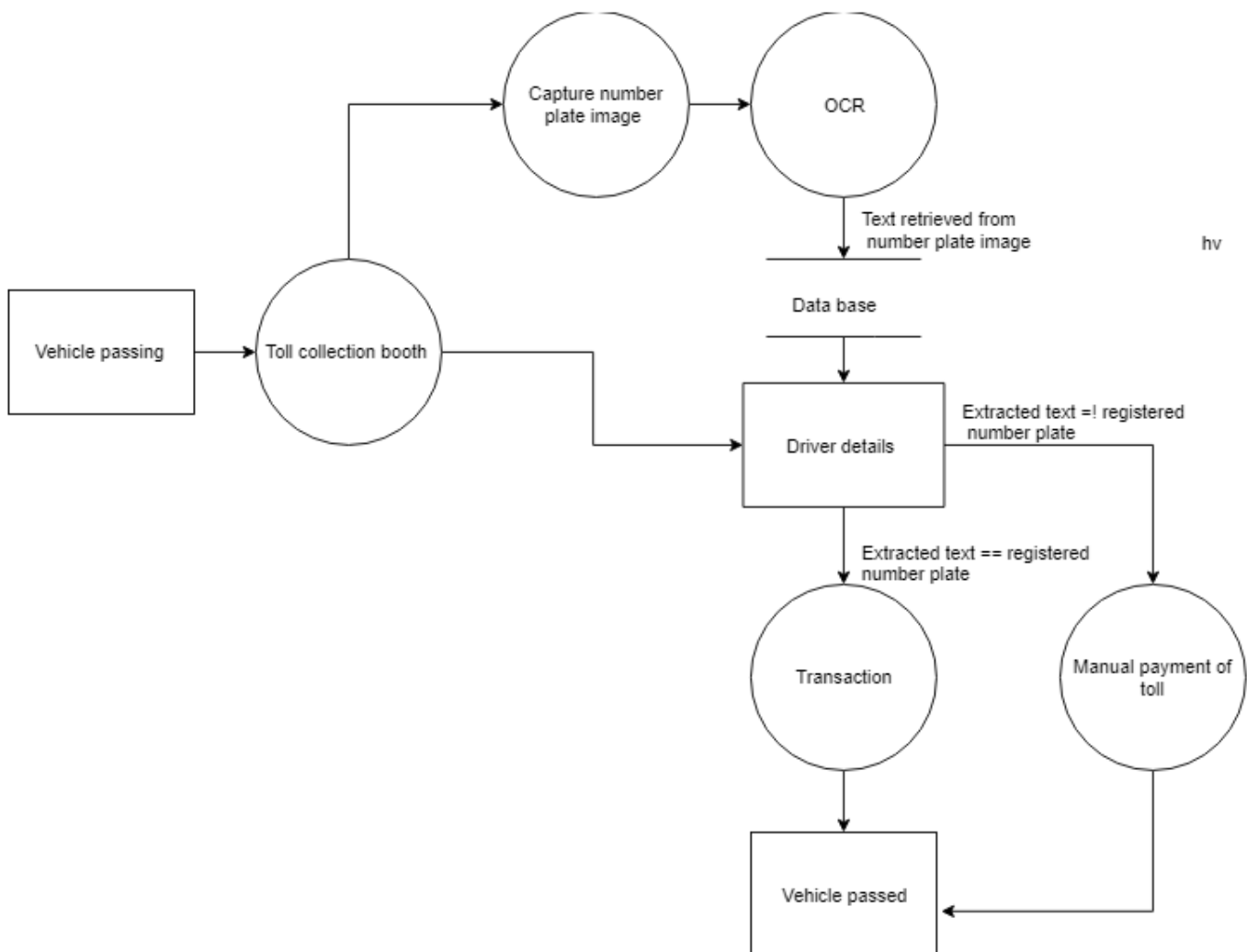


Fig 3.2.2: Level 1 DFD of the implemented system

3.3 Flow Chart:

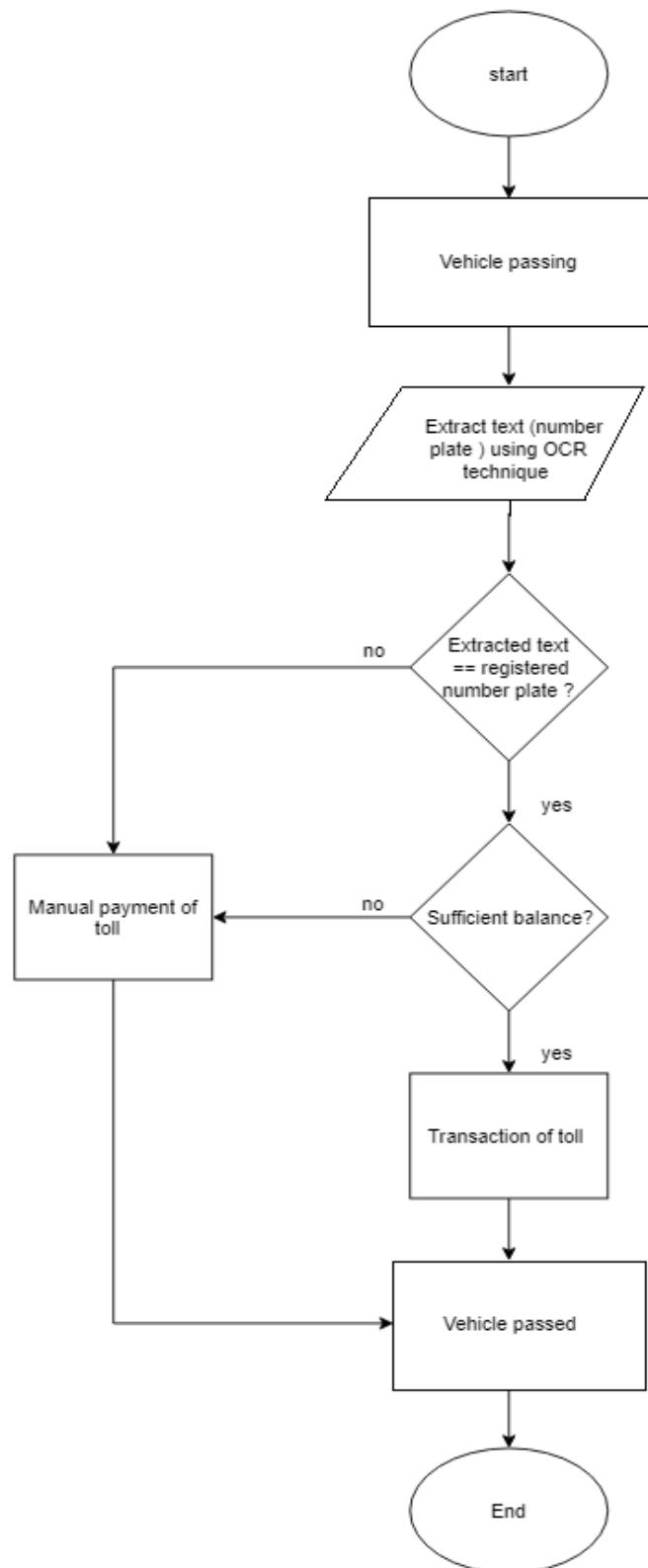


Fig 3.3: Flow chart of the implemented system

3.4 Gantt chart

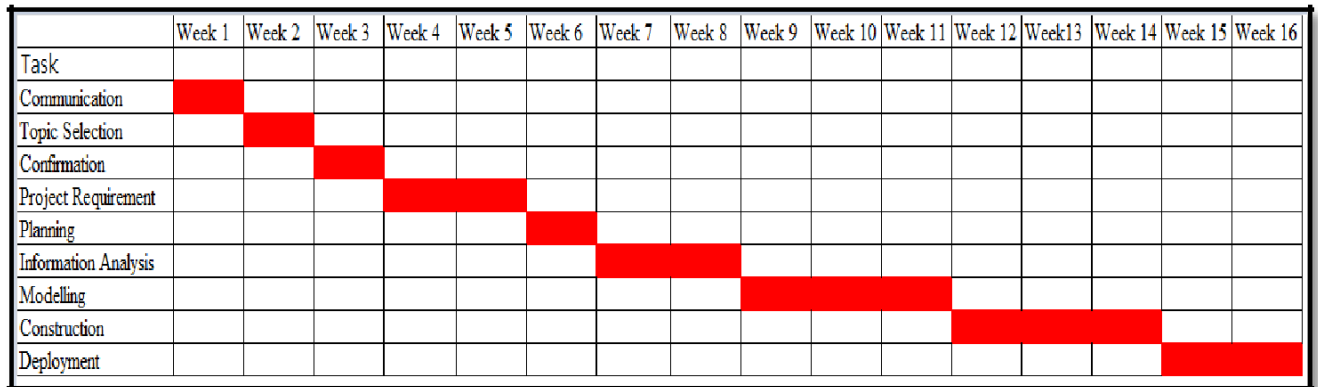


Fig 3.4: Gantt chart representation

3.5 Block Diagram:

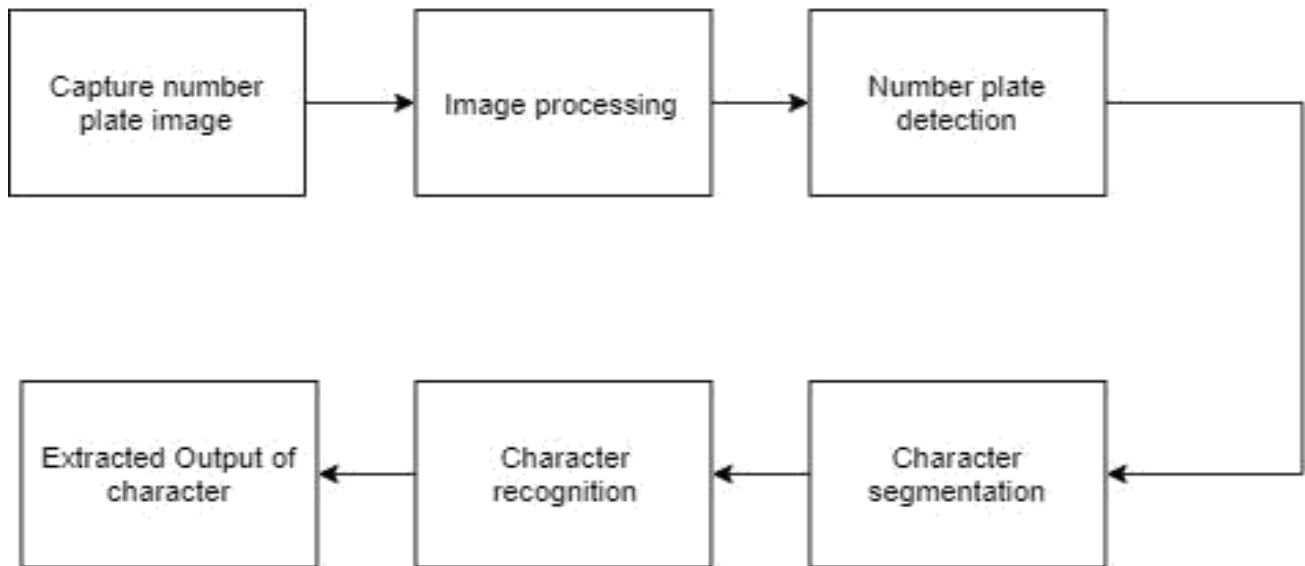


Fig 3.5.1: Block diagram for the number plate detection

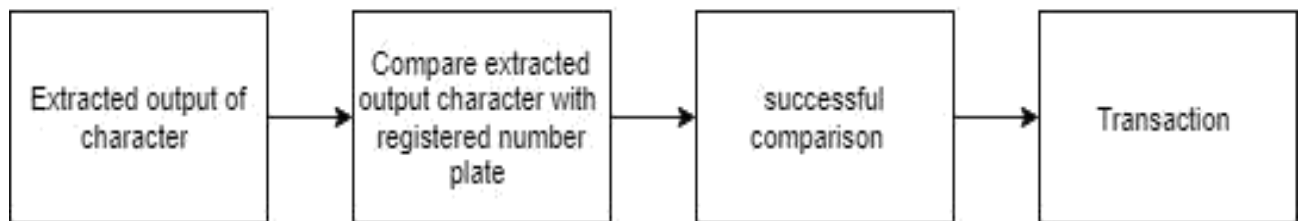


Fig 3.5.2: Block diagram for the transaction process

3.6 Algorithm:

Step 1: Start.

Step 2: Capture image of the number plate of the vehicle passing the toll booth.

Step 3: Detect the number plate from image.

Step 4: Convert the number plate image to text.

Step 5: Extract the number plate text.

Step 6: Compare the extracted text with the register number plate in database.

Step 7: Check extracted text == register number plate.

Step 8: If match found then check balance, if no match found go to step 12.

Step 9: If sufficient balance available go to step 10, if not go to step 12.

Step 10: Deduct toll amount

Step 11: Transaction of toll.

Step 12: Manual payment of toll.

Step 13: End.

4. IMPLEMENTATION TECHNIQUES

We have chosen the **Waterfall Model** for the development for our project.

The **Waterfall Model** illustrates the software **development process** in a linear sequential flow.

Following a sequential design process, often used in software development processes, we preceded our project in downwards direction through the phases of development.

- Communication
- Planning
- Modeling
- Construction
- Deployment

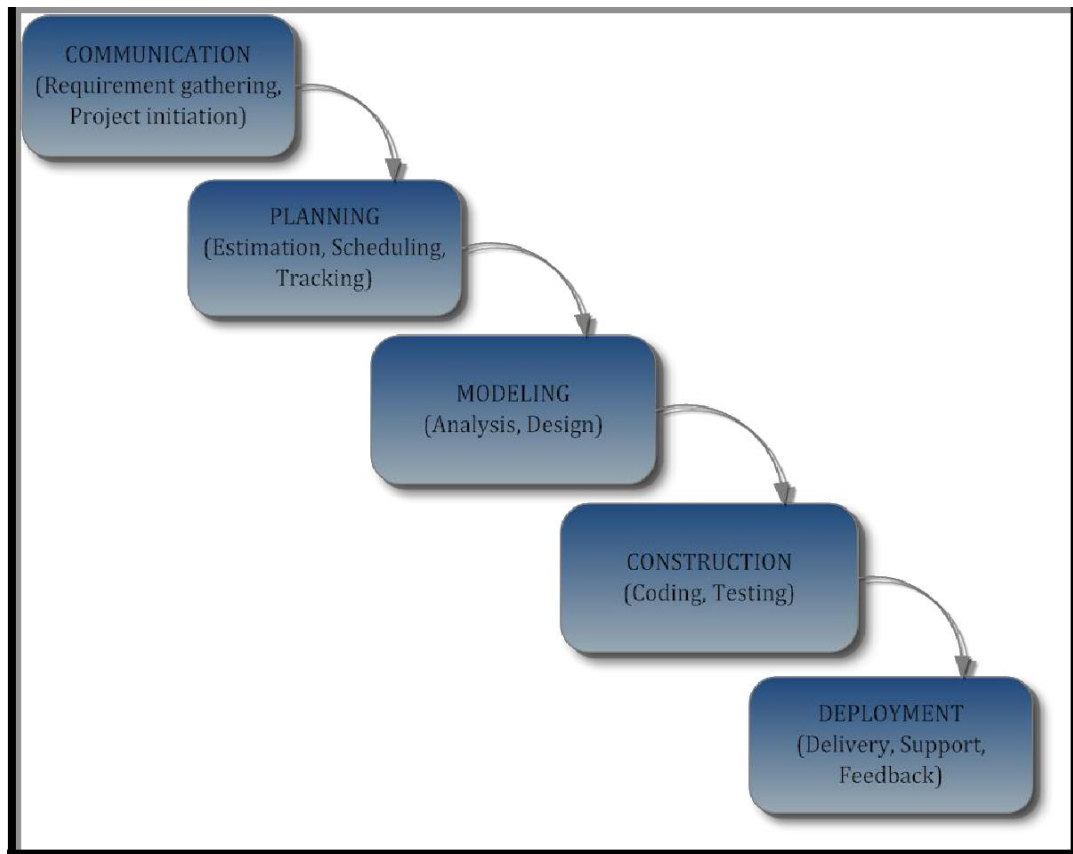


Figure 4.0: Waterfall Model

5. RESULTS OF IMPLEMENTATION

5.1 Number plate detection phase:

The following stage/phase is the number plate recognition phase that does several functions such as resizing of the image to a feasible aspect ratio. As well as converting the colored image into a grey scale, image. Number plate detection searches an input image in order to identify specific features that contain the number plate. The number plate can be found anywhere within an image, it is impractical to check all the pixels of the image in order to locate the number plate. Therefore, we only focus on those Pixels that have the number plate.

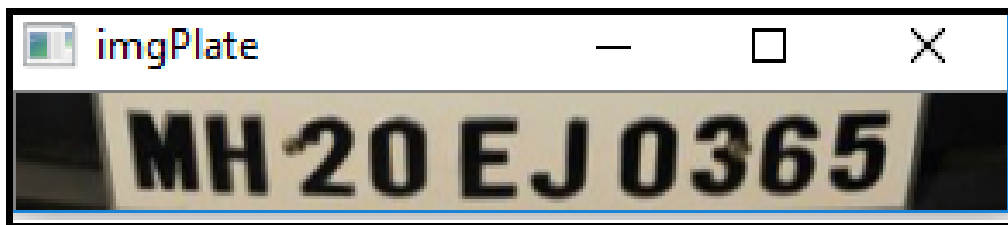


Fig 5.1: Detection of the number plate

5.2 Gray scale conversion:

It involves conversion of color image into a gray image as shown in the fig 5.2. The method is based on different color transform. According to the R, G, B value in the image, it calculates the value of gray value, and obtains the gray image at the same time.



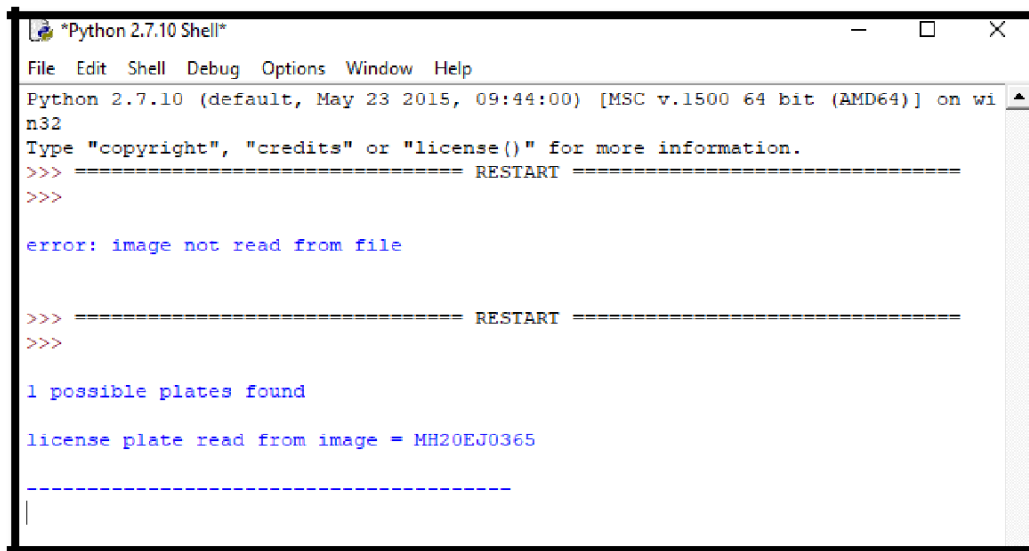
Fig 5.2: Gray Processing

5.3 Extracted Number plate:

In this phase the number plate is recognized as shown in the fig.5.3.1 and extracted fig.5.3.2.



Fig 5.3.1: Recognized number plate



```
Python 2.7.10 Shell
File Edit Shell Debug Options Window Help
Python 2.7.10 (default, May 23 2015, 09:44:00) [MSC v.1500 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ===== RESTART =====
>>>
error: image not read from file

>>> ===== RESTART =====
>>>
1 possible plates found
license plate read from image = MH20EJ0365
-----
|
```

Fig 5.3.2: Extracted number plate

AUTOMATIC TOLL COLLECTION SYSTEM

5.4 Database:

The following snapshot of the database will give an idea about how the user's details are storing in database. The extracted number plate will be checked in the database. Here, the name of the owner, license number, car number, credit in the account and timestamp is saved.

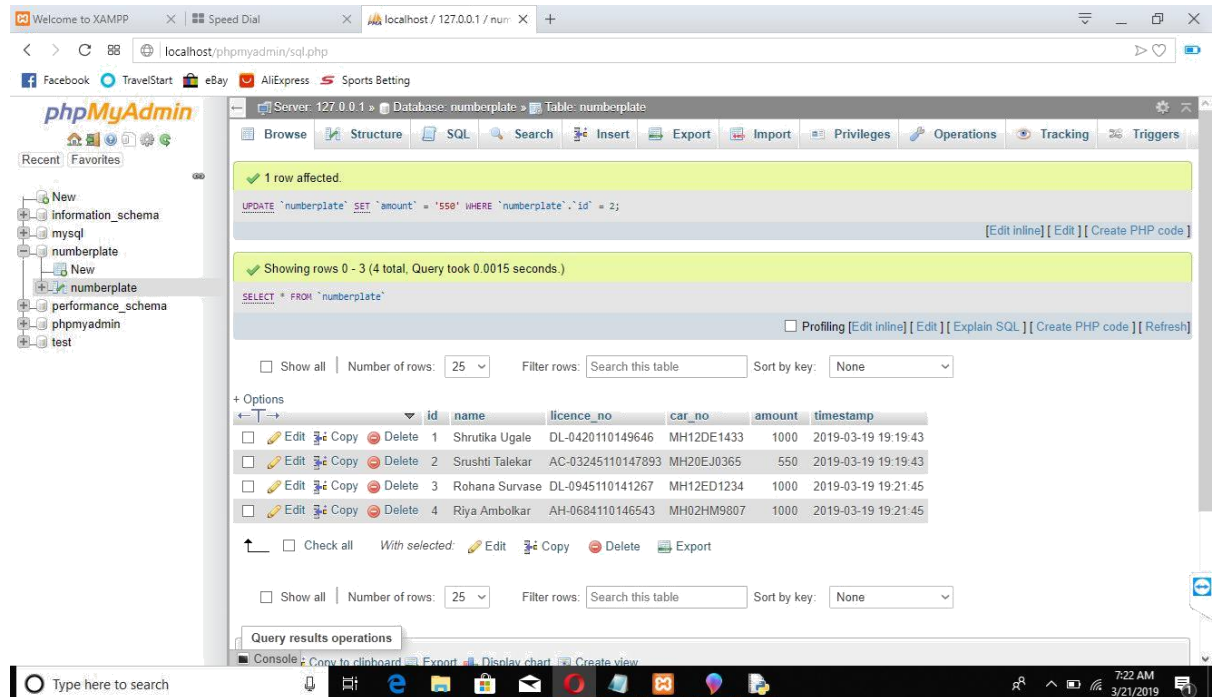


Fig 5.4: Database

6. TEST CASES REPRESENTATION

Test Cases:

Test cases for number plate detection module:



Fig 6.1: Number Plate Detection

Test case ID	Test objective	Input data	Expected output	Actual output	Status
TC_01	Image field	Number plate image	It should detect the number plate	It detects the number plate	Pass
TC_02	Image field	Number plate image	Number plate should be readable	Number plate is readable	Pass

Table 1: Test cases for Number Plate Detection module

Test cases for Gray Scale module:



Fig 6.2: Gray Scale

Test case ID	Test objective	Input data	Expected output	Actual output	Status
TC_03	Threshold field	Number plate image	It should convert the image in grey scale.	It converts the image in grey scale.	Pass
TC_04	Threshold field	Number plate image	It should highlight the dark colour pixels	It highlights the dark colour pixels	Pass

Table 2: Test cases for Gray Scale module

Test cases for extracted image:

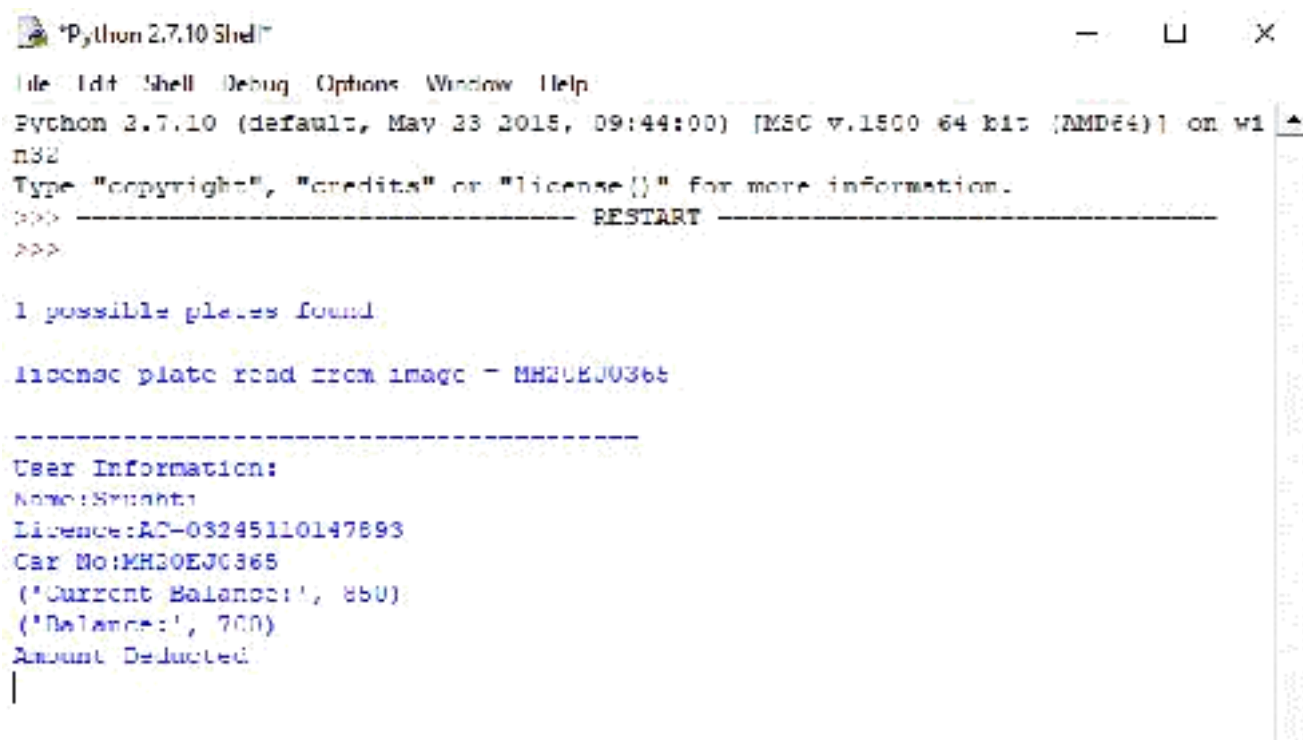


Fig 6.3: Extracted Image

Test case ID	Test objective	Input data	Expected output	Actual output	Status
TC_06	Extracted text field	Grey scale image	It should extract the text from the grey scale image	Text is extracted from the grey scale image	pass
TC_07	Extracted field	Grey scale image	It should extract complete text	It extracts complete text	pass

Table 3: Test cases for Extracted Image module

Test cases for Transaction:



```

Python 2.7.10 Shell
File Edit Shell Debug Options Window Help
Python 2.7.10 (default, May 23 2015, 09:44:00) [MSC v.1500 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> ----- RESTART -----
>>>

1 possible plates found

license plate read from image - MH20EJ0365

-----
User Information:
Name: Sridhar
Licence: AC-03245110147893
Car No: MH20EJ0365
('Current Balance:', 850)
('Balance:', 700)
Amount Deducted:
|
    
```

Fig: 6.4 Transaction module

Test case ID	Test objective	Input data	Expected output	Actual output	Status
TC_08	OCR field	Extracted text from OCR	Extracted text should be identical to registered number plate	Extracted text is identical to registered number plate	pass

AUTOMATIC TOLL COLLECTION SYSTEM

TC_09	Amount deduction field	Comparison of extracted number plate and the registered number plate	Amount should be deducted after comparison	Amount deducted after successful comparison	pass
TC_10	Amount deduction field	sufficient amount	Toll amount should be deducted	Amount deducted after	pass

Table 4: Test cases for transaction module

7. APPLICATIONS

- A. **Applicable at toll roads or highways** - The proposed proposal is for the toll booths to make them automotive and advanced for the time saving and it applicable really for the toll roads.
- B. **Applicable at parking areas** - The parking areas at companies having regular employees for that the amount of parking is will get possible to deduct by the e-wallet system.
- C. **Applicable in stolen vehicle identification** - The stolen vehicles are get catch up with the help of the image processing domain, by matching the passing vehicle number plate with the police admin database.
- D. **E-Wallet system applicable at the parking areas** - The amount deduction is get applicable at parking areas for overcoming the problem of vehicle congestion

8. HARDWARE & SOFTWARE REQUIREMENTS

Hardware:

- Minimum hard disk space required 500GB
- Minimum RAM required 2GB Processor Intel Core i3
- Operating system Windows 7,8,10

Software:

- Python 2.7
- XAMPP
- OpenCV

9. MERITS AND DEMERITS

Merits:

- It is reliable and an efficient toll collection system.
- No Traffic congestion as the process is fast.
- Reducing the number of personnel required for toll collection.
- It does not require any special tag such as RFID tags.
- It is cheaper as compared to RFID technology.

Demerits:

- Number plates with fancy font styles are difficult to recognize.
- Not all OCR software are 100% accurate.

10. CONCLUSION

The simulation results showed that the proposed algorithm of Number Plate Recognitions using OCR is executed well. Thus a system for Image Processing Based Automatic Toll Collection is very secure and highly reliable and can be obtained easily. It can be used to remove all drawbacks in the current system such as time and human effort. It also doesn't require any tag, it only requires best quality camera and fixed font number plate. Automatic Toll Collection System using Optical Code Recognition technique is cheap as compared to RFID Tags and avoids the chances of forgery. In addition, it provides faster processing, avoids traffic congestion, pollution and an efficient toll collection system.

11. FUTURE SCOPE

As the automatic toll collection systems eliminate manual operations by toll receivers and payers, the demand for automatic toll collection is likely to witness an upsurge. Cashless transactions offered by automatic toll collection systems do not only save travel time, but also minimizes traffic congestion near toll collection booths across roads and highways. The need for multiple toll plazas is ruled out owing to the installation of automatic toll collection systems, saving additional costs. As we are using automatic toll collection using OCR technique, we are eliminating the high installation costs. A number of emerging economies are increasingly addressing the need to adopt time and cost efficient automatic toll collection systems throughout the major cities. For instance, in India, the National Payments Corporation of India has been encouraging several highways to install automatic toll collection systems with a view to increase digital payments across the country, supporting the cashless economy initiative of the government.

12. REFERENCES

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- [3] Swati Sagar, Jayshri Jori, Aishwarya Kale, and Kalyani Khodade, "System using Image Processing" <http://ijcsn.org/IJCSN-2016/5-2/Vehicle-Counting-and-Automated-Toll-Collection-System-using-Image-Processing.pdf>
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