

Automated Toll Collection System Using Raspberry Pi

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The Report Presented in Partial Requirements of the Requirements for the
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APPROVAL

This project titled “**Automated Toll Collection System Using Raspberry Pi**”, submitted by Shifat Rahman Minar, ID No: 151-15-5426, Md Imran, ID No: 151-15-4734 and Nusrat Jahan Urmi, ID No: 151-15-4874 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 9-12-18.

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DECLARATION

We hereby declare, this project has been done under the supervision of Ms. Nazmun Nessa Moon, Assistant Professor, Department of CSE, Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Our project titled “Automated Toll Collection System Using Raspberry Pi”. In our project, we have showed it by interfacing servo motor RFID card and raspberry pi. When a vehicle arrives, it checks the owner have registered RFID card and sufficient balance on his/her card. User need to punch the card on RFID sensor, the gate/barrier will be open automatically. When a car arrives at first IR sensor will detect the car and start counting. If the owner of car wouldn't punch card or haven't any registered card or haven't sufficient balance the system order to leave the queue and pay manually showed in display. In this case any owner needs to pay manually. If the owner has registered card with balance, the barrier rises up to 90 degree and wait for the car to go. After leaving the car the barrier again gets down by 90 degree. If any user hasn't registered card he/she can register here. There also can be recharge balance in his/her account on recharge point. The system of rise and down barrier is full automatically, so it will reduce some waste of time.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Now Bangladesh is known as “The Emerging Tiger of Asia”. Day by day all sector including the road transport system develop very highly. People use road transport for different purpose like business or personal use. The number of vehicle also increasing rapidly. For huge vehicle the pressure goes to different sector including toll booth system. The system of manual toll system too much slow.

So there make a long jam. This jam waste our valuable time also create negative effect of our economy. We want to come out this problem. We develop toll booth system where all the toll system done automatically. The system checks registered card and balance. If card registered and have sufficient balance the car passes the barrier. When car arrive punch his card on RFID sensor, it will take the toll amount and open barrier. After leaving the car the barrier closed again.

To develop this system, we use Raspberry Pi B+ Our system can solve the jam problem on toll booth and reduce the waste of time.

1.2 Motivation: “Save the Time”

In recent year we saw a common news in newspaper that was a long jam in toll both. One of them headline was - “**32km tailback on Dhaka-Chittagong Highway**” by Dhaka Turibune [1].

This type of problem occurs before and after any public holiday like Eid, Puja etc. Normally this time people want more travel by road transport. Huge number of vehicle create extra pressure on human toll collector. And it is really a big challenge for human. Because human collector stop bus, collect toll then the car can go. But this process very lengthy and create big line of car. Another suffering case of **toll booth system Tailbacks stretched to 110km near Feni** for almost five days due to bottlenecks caused by the construction work of a flyover at Fatehpur [2]. According to “STUDY ON HISTORICAL COMMUTER TRAFFIC PATTERN OF DHAKACHITTAGONG

HIGHWAY (NH-1) OF BANGLADESH” the Bi-directional Flow Variation on Meghna-Gomoti Bridge was:

Table 1.1: Flow of vehicles in each year

Year	Number of Vehicles Passed
2010	5,915,501
2011	6,045,819
2012	6,239,174
2013	6,464,564
2014	7,018,983

From the above table 1.1, it's very clear that the number car flow rising every year. So, the collection of tolls also increased. If we remain the same number of human collectors, then the situation will become very complex and traffic problem also be increased.

This s the scenario of Meghna-Gomoti Bridge which is situated at Dhaka Chittagong Highway. Our country has also some other toll system similar Meghna-Gomoti Bridge. All the Human toll collector create traffic maximum time and it increase day by day.

So, if we implement here our system the problem will be reduce much. Our system doesn't need any human help for collect toll.

1.3 Objective

At present all system is about digitalization. Keeping this in mind, we try to make automatic toll collection system that is IoT based. Now a day's maximum person we used many cards for shopping, withdraw money, door security purpose. We want to enable people to meet with digitization. Time is more valuable in every person's life. For this reason, we made this system that makes possible to pay very fast which is reduce their valuable time. Now a day's people are very busy, any time they forget many things, or they are busy their phone or others, this time creating much jam beside the toll booth, our system will remove this situation. That's why we make this automatic toll system. The driver can pay their money using a card and they will go easily.

- To help the government or any private company who are connected in government manually.
- To make user-friendly and attractive interface.
- To earn money from commercially use this system.
- To earn money any government or private bank because if they want, they can issue this card and money cash-in this card
- To help earn money for govt. or private bank because if they want, they can make a small booth to instant renew an expired card.

1.4 Expected Outcome

By using our system people/driver can give their payment easily. As a result, there is no need to stay in the toll house and those people/drivers who need to urgent just press the card and go. This automatic toll system is very easy and user-friendly. When we sell this system or control this system, we must earn money. When a person in the toll house is there, he may be barred by money. But there will be no problem if we run this system. If the money is deposited in the toll house it will take a lot of time to reach the government. But through this system, the government take this money easily. It's a great advantage for the government. Our automatic toll system is better than present toll system because reducing the time and pay money without any trouble, so definitely people use our system easily. Expected outcome, people/driver can get good service and the government also can get good service by using our automatic tool system. Commercial sector when our service system will popular then we earn money.

Our system will provide better service and it will also better for people/driver because we have a rated system by different vehicles. So, new driver/people who don't know the exact rate for his vehicle, he just presses his card and exact money will be deducted at this time. So, people can easily pay money.

1.5 Report Layout

Chapter 1: Introduction

In chapter 1 we introduce our system. We also describe the reason why we select this project. This chapter also contains the objectives, expected outcome that means the aspect of our project and report layout.

Chapter 2: Background

In this chapter we discuss the background of our project. We describe the related work, comparative study that means compare our system with other related system. Here also discuss about the faces problem and challenges.

Chapter 3: Requirements Specification

In chapter 3 we discuss the flow of our system. Our system develops based on this this flow. Here contain BPM, requirement collection and analysis, use case model with description, logical data model and design requirements.

Chapter 4: Design and Methodology

We show the front deign and back end design of our system. In this chapter also discuss interaction design and user experiences. We also describe requirements for implementation.

Chapter 5: Implementation of Hardware and Software

In this chapter we describe follow up the implementation of database. Here we show how the system looks and front-end design. We express the relationship between different components.

Chapter 6: Conclusion and Future Scope

In the last chapter we show the summery of our project and discuss about our future plan. Describe how we can develop our system in future.

CHAPTER 2

BACKGROUND STUDY

2.1 Introduction

Our automatic toll system project is online based which can be controlled by a web server. We have a web server that can control the registration and payment system. It's easy for people and government because of there are no need people, no public harassment. At present, there is always a person to stay in the current toll rooms. If he is busy with other activities, then there may be the delay in taking money. Many times, he can take more money. So definitely, that is an uncomfortable situation for drivers/others people. For this reason, if we made a system that can help people/driver. That's why we tried to build a service system name as "Automated Toll Collection System Using Raspberry Pi" and it's an IOT platform.

The driver will press the card, cut the money automatically, they can take away their vehicles just like as touch to pay. It will reduce our valuable time.

2.2 Related Works

At present most of the countries use IoT service from their home to office, shopping, car parking, bill payment etc. Recently in our country, most of this sector uses IoT based project service and continue working it to make digital Bangladesh. Now maximum developed countries like Malaysia, Singapore, Canada, Australia etc. already uses automated toll collection system. Besides in our neighbor country India also uses this system in different states. Japan started this system at first in East Asia in 2001. In our country have also few systems like ours.

2.2.1 Muktapur Toll Collection System

This system was developed in 6th Bangladesh China Friendship Bridge by Modern Computerized Toll Management System. Here sensor identify the vehicles and, on this basis, calculated the toll. When a vehicle come sensor first check it from few distance. Then the user come to the toll collection booth user pay the bill and one officer take the toll manually.

2.2.2 Meghna and Meghna-Gomoti Bridge

This system developed in Meghna and Meghna-Gomoti Bridge by Computer Network System Limited. In this system full web-based system. 24hours monitories from the national tax office. In this system, when a vehicle come the user pay the toll bill and it's collected by human. The bill directly saves in national income. It's called digital toll collection system and develop for make digital Bangladesh [4].



Figure 2.1: The toll collection System of Meghna-Gomoti Bridge

In figure 2.1 show the real display of toll collection system at Meghna Bridge. The calculation of toll manage by a computer but collecting bill done by human. In this system maintain the corruption.

2.2.3 Bangabandhu Bridge Toll Collection System

In this bridge use automated toll collection system. This system uses 16-bits smart cards. First 3-bits use for header and other 13-bits for information. This system when vehicles come the user show the 16-bits smart card. If he/she has sufficient balance for one way the gate will be open and update the balance. After leaving the vehicle the gate again be closed. This system after recharging the fund the balance again be updated. The card consists a header, balance and the types of car [5].



Figure 2.2: Bangabandhu Bridge Toll Booth

Figure 2.2 represent the overview of Bangabandhu Bridge toll collection zone. Here contain three toll booth. But for collecting the toll by human create a long jam vehicles.

2.2.4 Automated Toll Collection System

This project developed by Md Jahidul Islam and Dewan Mofassor Hossain from East West University. The system also like Bangabandhu Bridge Toll Collection System. They use RFID card and Arduino Uno microcontroller. Here something more added that was they identify the vehicle and the timer was on. After a few times if the user doesn't show the RFID card system suggest to pay manually from human toll collection system. This system also mentioned that if anyone couldn't pay by card the user must be added some fine with toll [6].

2.3 Comparative Studies

The developed countries use this system highly. Our country also tries to use yet since Bangabandhu Bridge Toll Collection and many others also try to develop this system. Though some similar project also been developed, maximum of them are don't work correctly or not too much user friendly. The difference of our system from others are given bellow.

2.3.1 Meghna and Meghna-Gomoti Bridge

Though the system is known as Digital collection system. But still it works like analog system. This system just adds more security, but the collection of toll done by human. There is no automated system. Our project fully automated system. If a user has card with sufficient balance there are no need to human. One of the main aspect of the smart toll collection is reduced the queue of vehicles but this project fail. Maximum time there create a long queue of vehicles.

2.3.2 Muktapur Toll Collection System

This system just does only one thing automatically that is identify the vehicles automatically. But the pay system process is analog. The collection system is fully done by human. In our project the identification and collection of toll all thing done automatically. User just show the card, system take the sufficient toll bill from card.

2.3.3 Bangabandhu Bridge Toll Collection System

This system approach was outstanding. It fully developed according to the other countries system. But the system wasn't reached the proper goal. Still user choice to the manual process and make a long queue in toll collecting system. Though the basis

aspect same, the working process of our system different and user interested to choose the toll paying process automatically.

2.2.4 Automated Toll Collection System

This system uses Arduino Uno as host and RFID card. But the memory size of Arduino Uno very small. Just store only few card number. The number of vehicles is high. So, the system can use only for a demo project. We use Raspberry Pi and it's a small computer. Here we store a lot of card number with user basic details.

2.4 Scope of the Problem

Our system is an IOT base project. At the initial stage total project fully complete. When it implements few problems come out and we must solve all the problem in future. After few days our system running successfully. But here some scope to create problem.

The scope of Problem given bellow:

- Our project full internet based. When system check the card balance it required to check from database. But if somehow internet connection get lost system can't check card balance.
- Electricity another important thing. In our country have still lack of electricity. Our system required all time electricity. If electricity lost entire system get closed.
- This system required trusted and secure database.

2.5 Challenges

Several components should be addressed for implementation this project. The most important challenges are given bellow:

- IoT based project means connection between human to device. There many devices for connection but their capability different.
- Data integrity, unique identification, and encryption are main challenges.
- Protection the user data.
- Update the system regular very hard task.
- Day by day the technology features increased. When update devices provide more facility it's difficult to change the devices.
- 24hours internet service required.
- Implement all the toll booth because maximum toll booth hasn't enough space. So, after implement there aren't sufficient place for manual toll system.
- Provide recharge system everywhere like bank booth.
- When a driver registers we can't check validity his driving license.

CHAPTER 3

REQUIREMENT SPECIFICATION

3.1 Business Process Modeling

Business Process Modeling (BPM) is the process which represent how project management works and represent a system. It analysis, improved automated the system. BPM provide the project flow in discipline, focused the subject matter. This process shows how the system work in cyclic order.

The objective of our project is reduced the queue line from toll collection system, make the toll collection system automatically, save time, make toll system user friendly, give digital platform. The final aspect is make an earning project and help the government to collect the toll easily as possible. For example, if our system implements on busy bridge for collect toll, it reduces the queue of long vehicle line. The toll directly stores in the government earning account. There is no need to take it manually. User mostly like the collection system. Figure 3.1 shows the system for a user registration.

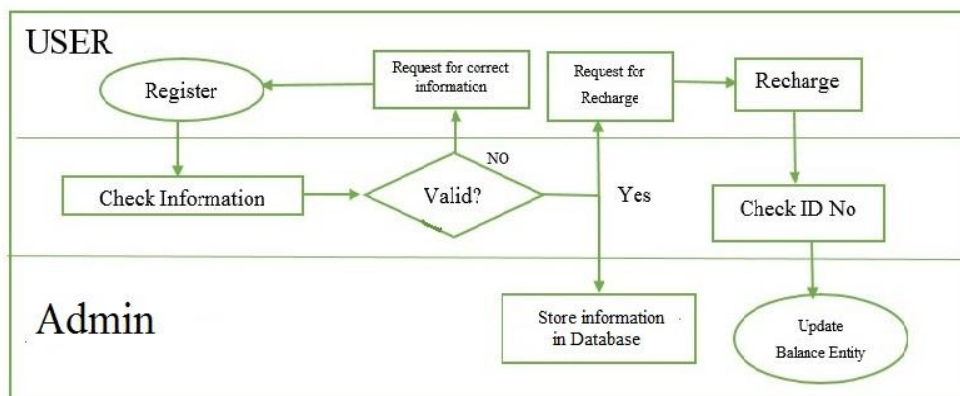


Figure 3.1: Register & Recharge Process

Figure 3.1 is representing the step by step process for a new user. A new user required to register first. When a user registers the system check registration information. After checking store, the data and give a unique card number for every single user. After

complete the register need to recharge balance. Figure 3.2 show how the user, system and admin interact each other.

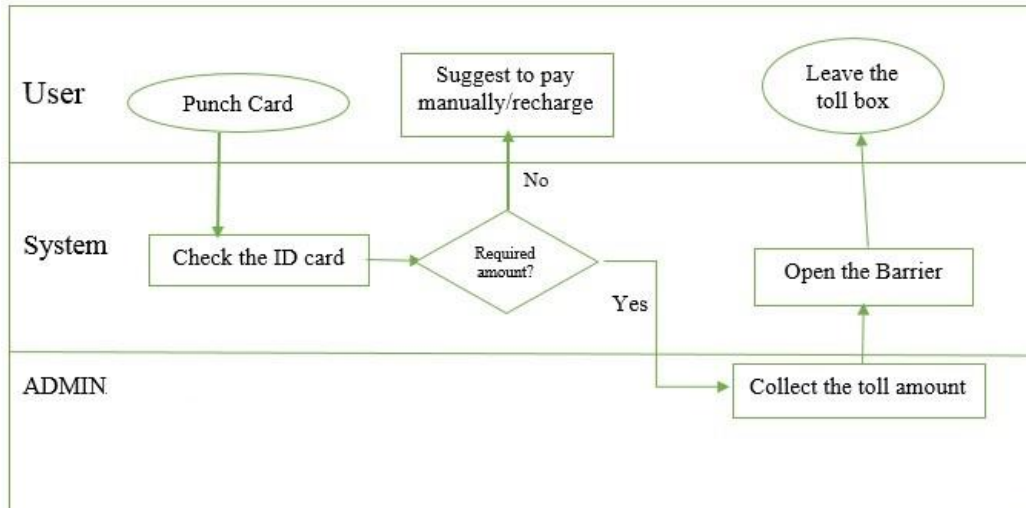


Figure 3.2: Business Process Model

After registration a user can use card and the using process of card is shown in Figure 3.2. Here show the formal descriptions to represent core aspects of our system. All the command manage by the system. System check id number, amount and open the barrier. User just swipe the card and follow the display command. Admin only collect the toll fees.

3.2 Requirement Collection and Analysis

Every system has some must requirements. The actual needed requirement of our system given bellow

- At first user need a valid card. For this card user may registration with proper information.
- When user fill registration forms he/she must give vehicle type, vehicle no, user's license no. If anyone give wrong information to registration the card can't use.
- Card must contain sufficient balance.
- Carry the card whenever user want to use it.

At first user need to apply for registration. In registration form user need to give Name, National ID Number, License Number, Vehicle type, Vehicle Number, Contract Number. When admin receive the registration form, it checks the information validity. If all information is correct, admin will provide a card with unique number. Our system is prepaid system, so user need to recharge balance. Then he/she can use the card in toll booth anytime. But if any user gives wrong information admin give message on his/her number and wait for 2 days. Within this period, if no correction will receive from user the registration will be canceled.

3.3 Use Case Modeling and Description

Use case diagram is a simplest and easiest representation of user's interaction with system. It shows the relationship between user and different cases. The purpose of the use case diagrams is simply to provide the high level view of the system and convey the requirements in laypeople's terms for the stakeholders. Additional diagrams and documentation can be used to provide a complete functional and technical view of the system.

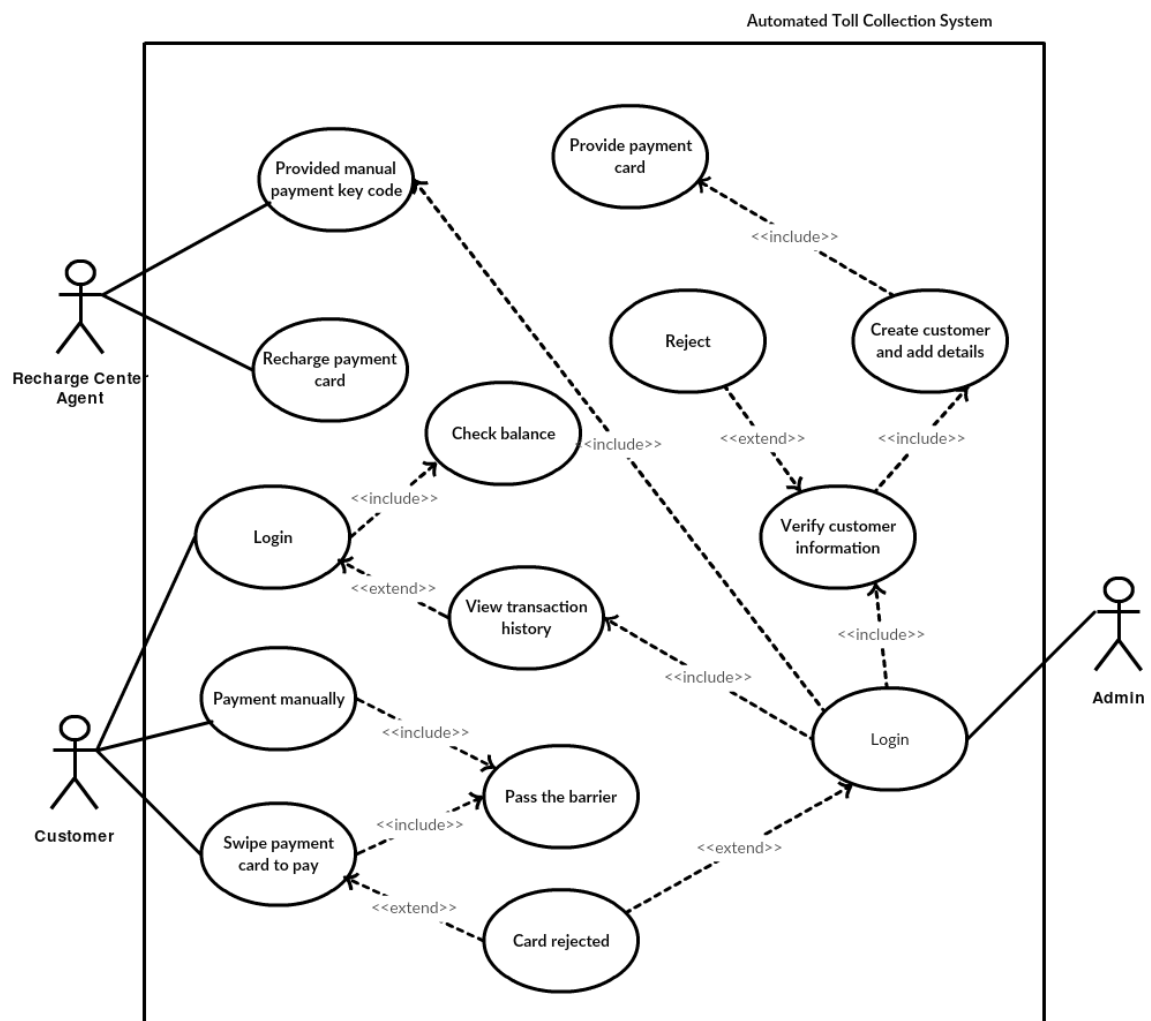


Figure 3.3 Use Case Diagram

In Figure 3.4 Use Case Diagram for the whole system is show. There are 3 user for the system such as Customers (Drivers), Recharge Point Agent and the Admin.

3.4 Logical Data Model

Logical data model shows the abstract structure of domain information. It is the basis of a physical data model and a design of database. This model provide foundation for database and helps to decrease time and cost. ER diagram shows the relationship between entities, relationship their attributes. ER diagrams mostly design to solve the database debug easily. In Figure 3.4 our project ER diagram is given.

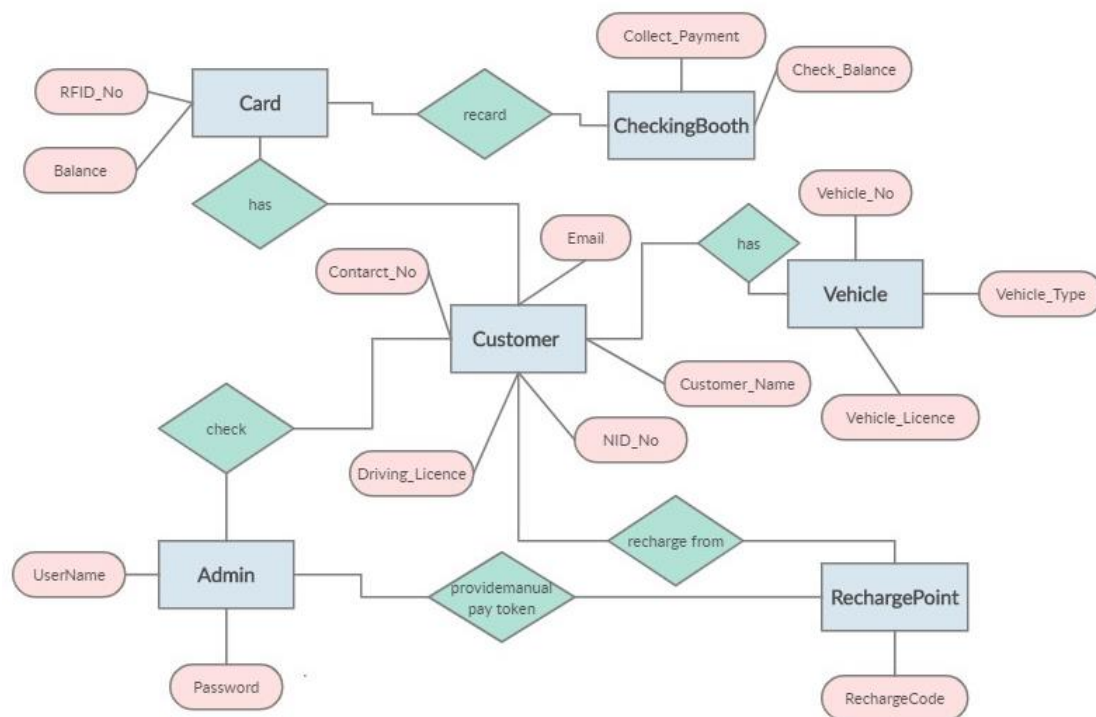


Figure 3.4 ER Diagram

In Figure 3.4 show the entity relationship diagram. It's described which entity has how many properties. Each entity connects other entity. Card, Checking Booth, Customer admin, vehicle etc. are the main entity. They are connected with other entity in different direction.

3.5 Design Requirements

Design requirements may vary in a project. Because it's depends on specific problem statement. Requirements specific and directly depends on the use of project. It states the important role because it increases the successful rate. Our project design requirements given bellow:

- This system consists 2 types of user. They are: a) Customer/user and b) Admin.
- Admin provide card when he/she get new vehicle no from authority.
- Others user/customer can apply for new card number. When they apply, they required to give correct information.
- Admin check the card request application and check. After checking admin decide to accept or reject.
- Admin can provide offer for user. It's totally depends on admin.
- User can recharge balance any recharge point.
- User use the card every bridge where this system implemented.
- Admin can reject any card anytime. If any user tries to make any lawful activity, admin take proper punishment against crime.
- Without card driver can buy one-way token to pass the bridge.

CHAPTER 4

DESIGN & METHODOLOGY

4.1 Introduction

In this toll collection system, there are more than one device and platform are interconnected between them to build a reliable and flexible system. So, a user can easily pay his/her toll payment in smart way. To develop the system, we used some selected hardware component, platform and web pages.

4.2 Selection of Platform

There are many platforms we used to implement our project. The currently available platform in our project are Raspberry Pi, NodeMCU, MySQL which were found at great reliability and simplicity. We used Raspberry Pi as our main platform to interconnect and control other devices and also works as a web server. NodeMCU works on Arduino IDE platform, it wirelessly sent data to Raspberry Pi.

4.3 Selection of Hardware Component

4.3.1 Raspberry Pi 3 B+

Raspberry is used as a core device in this system. Basically, this device is a single based computer which is cheaper than a normal computer. It has some 40-general purpose input output (GPIO) pin to connect and control other devices. These pins take inputs from sensor and deliver outputs for other devices [7]. In this system raspberry contain main coding part and also work as a web server.

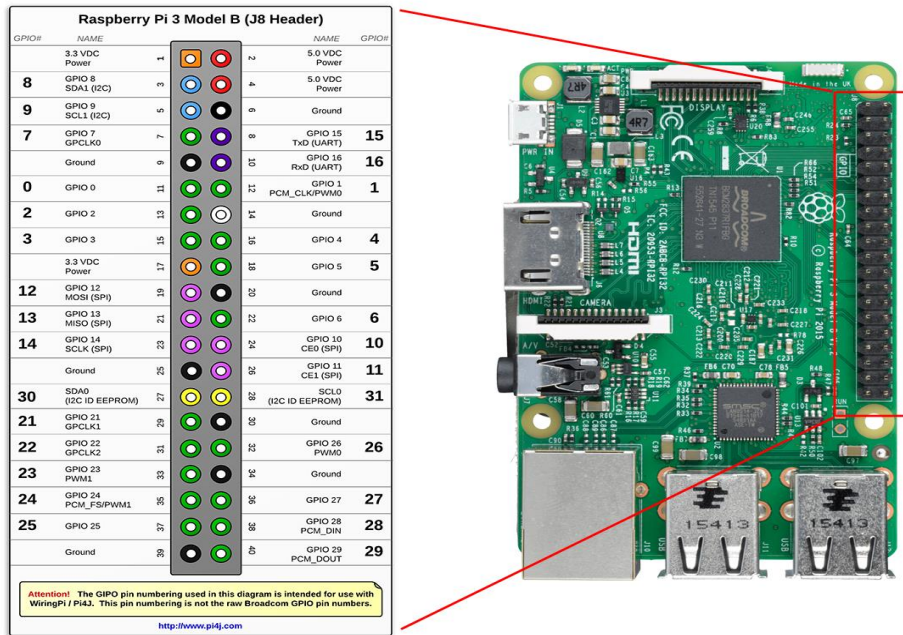


Figure 4.1 Raspberry Pi with GPIO

Figure 4.1 is the general-purpose input output pin of raspberry pi. Each pin has specific function. There are 40 pin and different pin use for take input and use as output pin.

4.3.2 RFID (Radio Frequency Identification)

RFID is used for auto identification for different vehicles that generate different radio frequency.



Figure 4.2 RFID RC522

In figure 4.2 is a RFID card. Here contain manly two parts in RFID system. Those are 1) RFID Reader or Interrogator 2) RFID Tags. Each vehicle has a RFID tags with a unique ID. The card contains the driver and vehicle information and helps to pay the toll bill. In the toll booth, when a driver swipes the card on RFID Reader, it will receive the unique card number.

4.3.3 NodeMCU

NodeMCU is open source IoT platform which includes the firmware runs on the ESP8266 WIFI Soc [8].

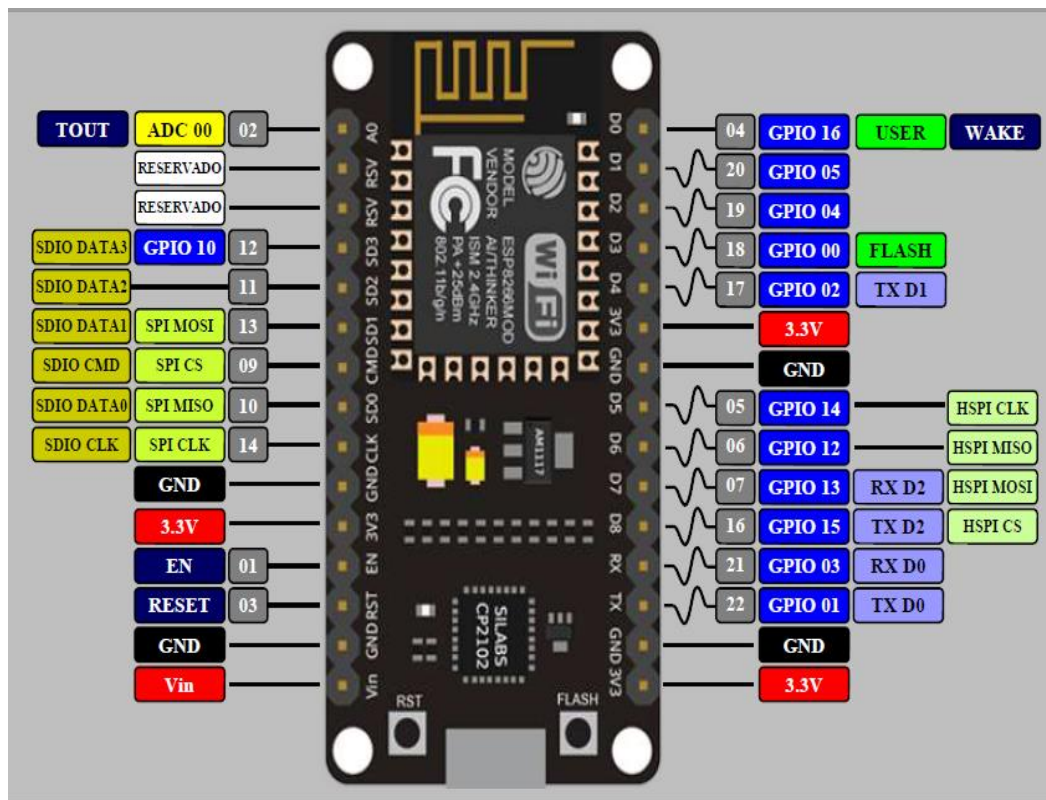


Figure 4.3 NodeMCU ESP8266

In figure 4.3 shows the NodeMCU. It connected under same network where raspberry pi also connected. This hardware basically connected with the RFID reader and receive the unique card number that RFID reader read from the card. Then the NodeMCU pass the card number to raspberry pi wirelessly.

4.3.4 Servo Motor

Servo motor works on PWM principle. That means the rotation angle of the motor is controlled by the duration of pulse. Our used servo motor is SG90, it can rotate only from 0 degree to 180 degree. This motor is used for our road barrier. When a user completes his/her toll payment with the command of raspberry pi, the servomotor rotate 90 degree to open the barrier.

4.3.5 Display

An LCD display is an output device which is showing some text information. Here we used 20x4 LCD display which is shown in Figure 4.4. Basically, we used it for showing charged amount after payment and then showing update balance. Unfortunately, if there is no balance in card, then “Insufficient Balance” will be shown in the display.

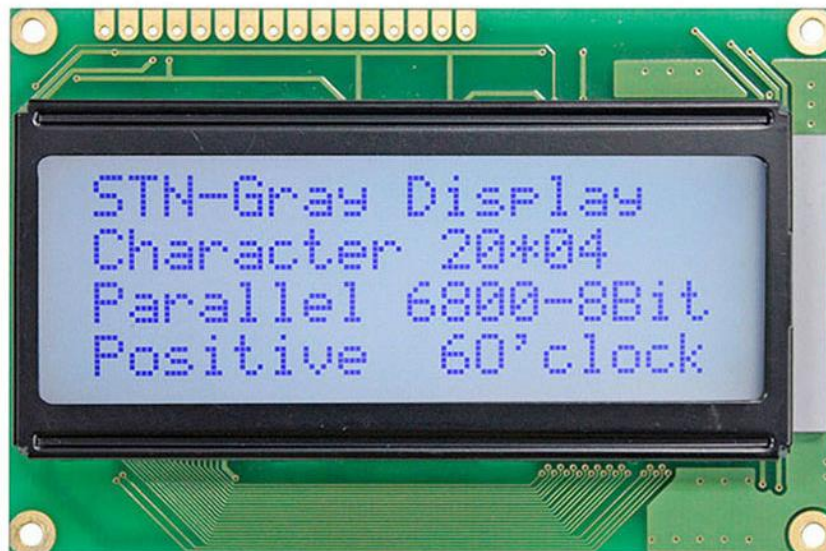


Figure 4.4 20x4 LCD Display

4.3.6 IR Module

An IR (Infrared Radiation) sensor is an electronic instrument. It used to capture certain properties of its surrounding by either detecting IR. It also can measure heat detect by an object and detect motion.

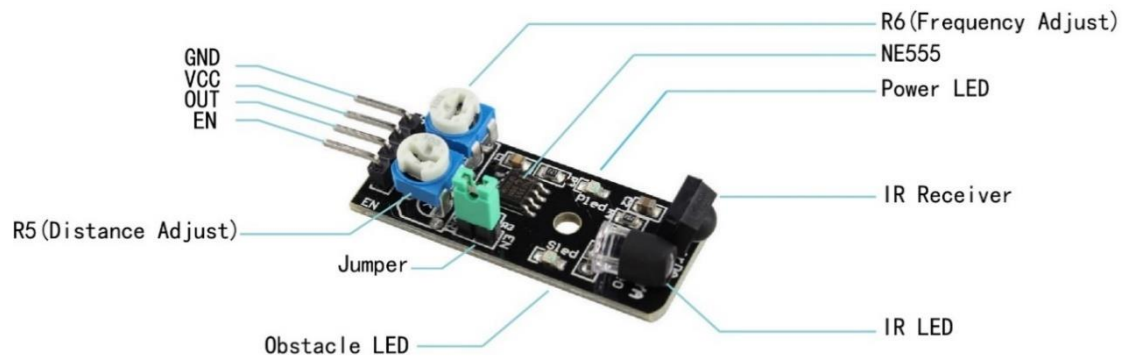


Figure 4.5 Infrared Sensor Module

Figure 4.5 is Infrared Sensor and mentioned the different ports. We used an IR module which has an infrared transmitter and infrared receiver. It can detect and present of a vehicle and inform raspberry pi.

4.3.7 Other Components

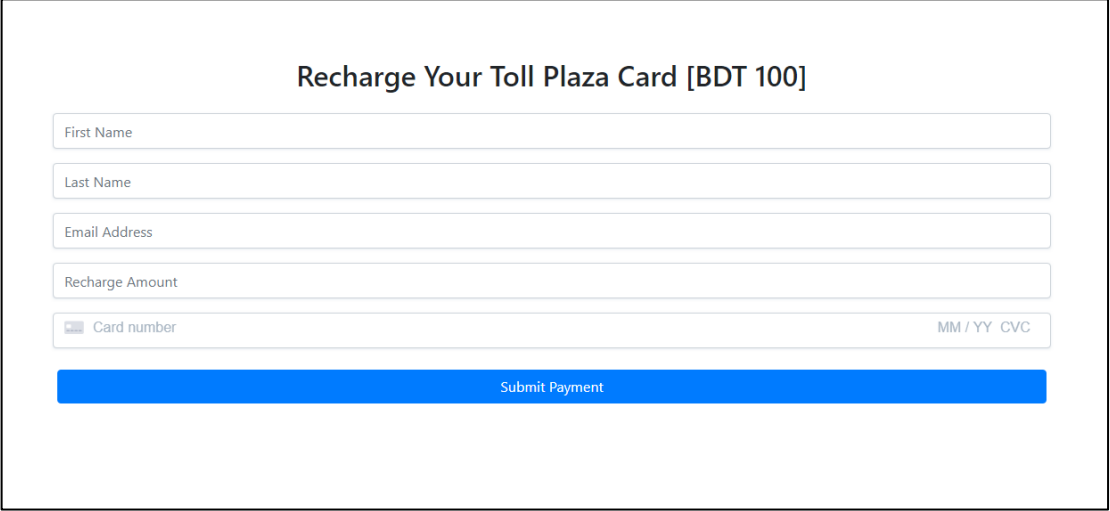
There are also some other components used in our project. The other component given bellow.

1. LED
2. Bread Board
3. Power Supply
4. Buzzer
5. Keypad
6. Connecting Cable
7. Wires
8. Memory Card etc.

4.4 Web Interface

4.4.1 Recharge Page

Payment page is for recharging the RFID Card. The payment goes through and submitted to our 'charge.php' which uses a Strip API. We basically recharge the card through online payment.



The screenshot shows a web form titled "Recharge Your Toll Plaza Card [BDT 100]". The form contains the following fields:

- First Name
- Last Name
- Email Address
- Recharge Amount
- Card number (with a small card icon on the left and "MM / YY CVC" on the right)

At the bottom of the form is a prominent blue button labeled "Submit Payment".

Figure 4.6 Recharge Page

In figure 4.6 shows the recharge page. When a user want recharge the card balance, he/she fill the name, email, recharge amount and card number. Recharge amount and card number must be correctly fill up. Otherwise the recharge process won't successful.

4.4.2 Recharge Success Page

This page add balance on user account and create a transection history with a success massage.

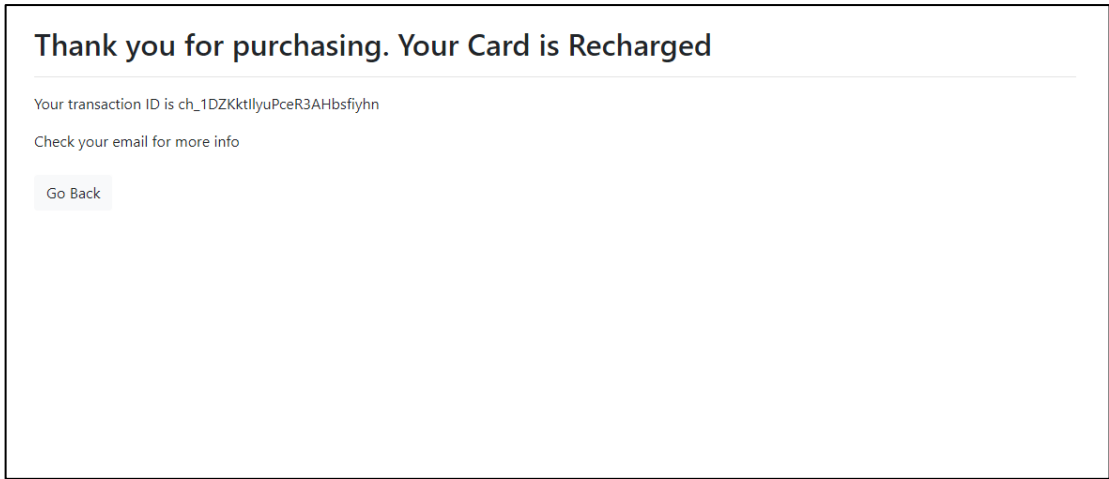


Figure 4.7 Recharge Success Page

Figure 4.7 is received by the user. After a successful recharge user get the conformation message with unique transaction ID number.

4.4.3 Customer Page

In this page display the basic information of a customer. It will show name, vehicle information, email and the current balance of user.

Customers Transactions

Customers

Customer ID	Name	Email	Vehicle No	Current Balance	Date
cus_E1NgzB1hLXE97B	Nusrat Jahan Urmi	jahan15-4874@diu.edu.bd	DHA2345	50	2018-11-22 22:20:26
cus_E1NePMmhkJAKK	Md Imran	imran15-4734@diu.edu.bd	DHA1234	50	2018-11-22 22:18:56
cus_E1NVuHJLQCFTP2	Shifat Rahman Minar	minar43@gmail.com	DHA0123	200	2018-11-22 22:10:17

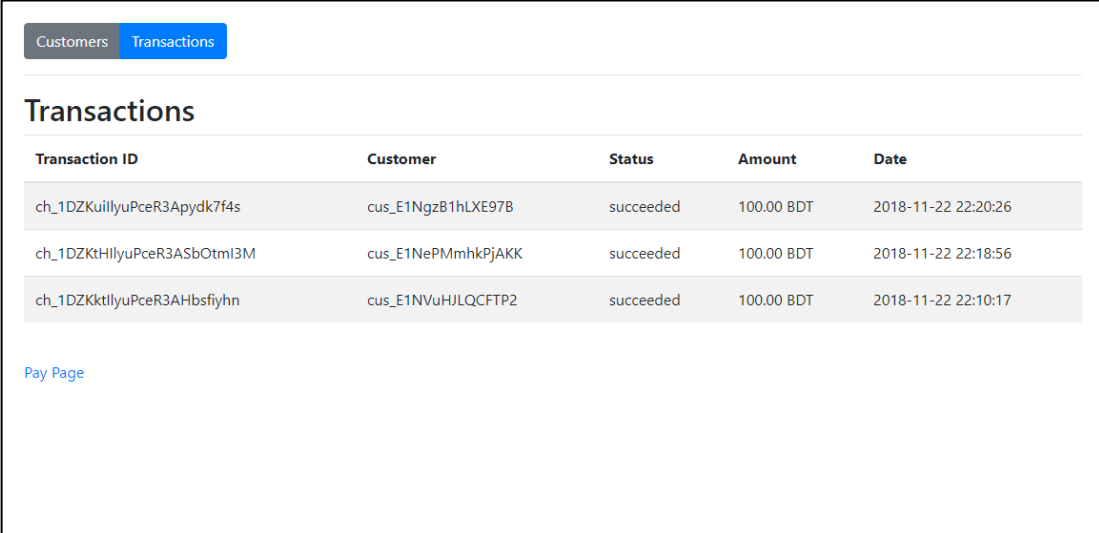
[Pay Page](#)

Figure 4.8 Customer Page

Figure 4.8 is the database table for customer. Database contain the customer id, name, email, vehicle no, card balance and the date when last update any information of user.

4.4.5 Transaction Page

Each and every transaction like recharging the balance and payment in toll booth and updated current balance will show in the transaction page. It will also display the transaction ID and the created time.



The screenshot shows a web interface with a navigation bar at the top containing two tabs: 'Customers' and 'Transactions'. The 'Transactions' tab is active. Below the navigation bar, the title 'Transactions' is displayed. A table with five columns is shown: 'Transaction ID', 'Customer', 'Status', 'Amount', and 'Date'. The table contains three rows of transaction data. Below the table, there is a link labeled 'Pay Page'.

Transaction ID	Customer	Status	Amount	Date
ch_1DZKtHllyuPceR3Apydk7f4s	cus_E1NgzB1hLXE97B	succeeded	100.00 BDT	2018-11-22 22:20:26
ch_1DZKtHllyuPceR3ASbOtmI3M	cus_E1NePMmhkPjAKK	succeeded	100.00 BDT	2018-11-22 22:18:56
ch_1DZKtHllyuPceR3AHbsfiyh	cus_E1NVuHJLQCFTP2	succeeded	100.00 BDT	2018-11-22 22:10:17

[Pay Page](#)

Figure 4.9 Transaction Page

In Figure 4.9 is the page of transaction details. After a transaction it store with unique random id, customer id, amount of money. The admin can also check status of transaction whether it successful or not with transaction actual date and time.

CHAPTER 5

IMPLEMENTATION OF HARDWARE AND SOFTWARE

5.1 Introduction

Combining several hardware components and implementing in different stages is required to design this system.

Firstly, in Figure 4.1 a use case diagram was developed to design the processes model.

The following Figure 5.1 shows the flow chart of the system.

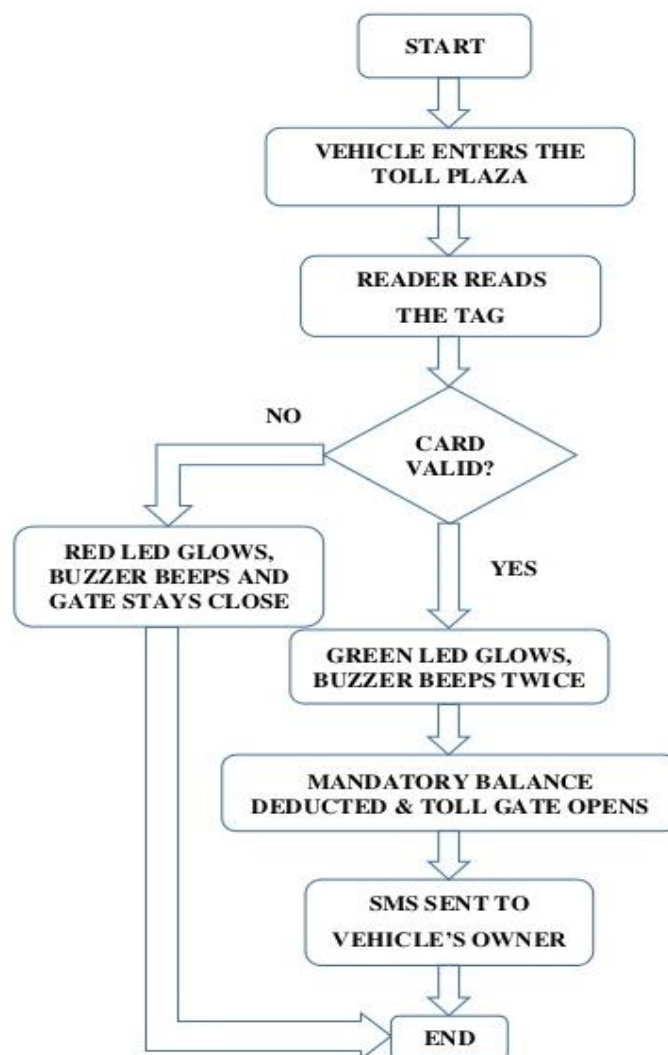


Figure 5.1 Flow Chart of Project Procedure

In the figure 5.1 show the algorithm or work flow of our project. Rectangle box show the activity and each box connect other boxes. The direction of working process

mention by arrow sign. After complete entity work jump the next entity which indicate by arrow sign.

5.2 Hardware Configuration

For communication between different devices we have connect them through wiring. This section is wiring layout of the system. The hardware configuration is given below.

5.2.1 RFID-RC522 with NodeMCU

The pin connection of the circuit between RFID-RC522 and NodeMCU is given in Table 5.1.

Table 5.1: Circuit Connection of RFID-RC522 and NodeMCU

RFID-RC522	NodeMCU
SDA(SS)	GPIO2 (D4)
SCK	GPIO14 (D5)
MOSI	GPIO13 (D7)
MISO	GPIO12 (D6)
IRQ	not connected
GND	GND
RST	GPIO4 (D2)
3.3V	3.3V

5.2.2 NodeMCU with Raspberry Pi

NodeMCU connect with Raspberry Pi wirelessly. But only the purpose of the power supply, the NodeMCU is connected to the Raspberry Pi through micro-usb cable which is shown in figure 5.2.

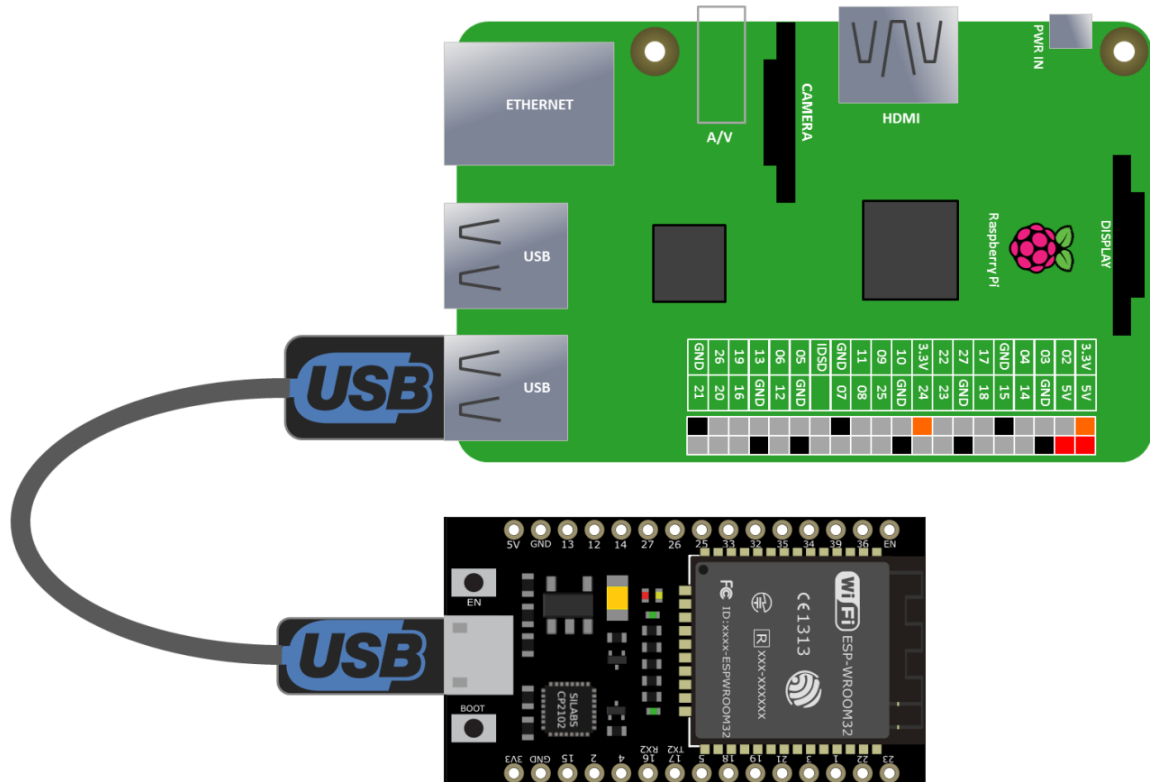


Figure 5.2 USB Connection between NodeMCU with Raspberry Pi

5.2.3 Display with Raspberry Pi

Usually to provide data to Bits 0-7 the 20x4 LCD display requires 8 data lines. However, using a “4 bit” mode, this LCD display can be configured. It allows to send data in two chunks of 4 bits. This reduces the number of GPIO connections with the Raspberry Pi. Here in Table 5.2 is how we wired up our LCD with Pi:

Table 5.2: Circuit Connection of Display and Raspberry Pi 3

LCD Pin	Function	Pi Pin	Pi Function
01	GND	P1-06	GND
02	+5V	P1-04	+5V
03	Contrast		
04	RS	P1-26	GPIO7
05	RW	P1-06	GND
06	E	P1-24	GPIO8
07	Data 0		
08	Data 1		
09	Data 2		
10	Data 3		
11	Data 4	P1-22	GPIO25
12	Data 5	P1-18	GPIO24
13	Data 6	P1-16	GPIO23
14	Data 7	P1-12	GPIO18
15	+5V via 560 ohms		
16	GND	P1-06	

5.2.4 Servo motor with Raspberry Pi

To connect the Servo motor with Raspberry Pi 3, we need 3 pins from the Raspberry Pi. The servo motor controls the barrier gate to block the road by rotating 90° up and down. In Table 5.3 the pin connections of Servo motor and Raspberry Pi are shown.

Table 5.3: Circuit Connection of Servo Motor and Raspberry Pi 3

Servo Motor Pin	Function	Pi Pin	Pi Function
Brown	GND	P1-09	GND
Red	+5V	P1-02	+5V
Orange	Control (PWM)	P1-07	GPIO07

5.3 Software Configuration

Configuring the Raspberry Pi:

1. Download the raspbian OS for the raspberry pi. Boot it in a Memory Card and install the operating system image.
2. Upgrade the python packages into the Raspberry Pi.
3. Install Arduino IDE
4. Install XAMPP for the local host.
5. Install the Visual Studio Code for PHP script editing
6. Enabling Raspberry Pi GPIO functions

Arduino IDE: RFID tag reader configured on NodeMCU which works on Arduino IDE platform. At first the NodeMCU connect our private network. When the reader receives a unique number by RFID tags, it passes the id to the Raspberry Pi using HTTP protocol.

PHP: In this system PHP done different types of part. We compiled the php script Visual Studio Code editor.

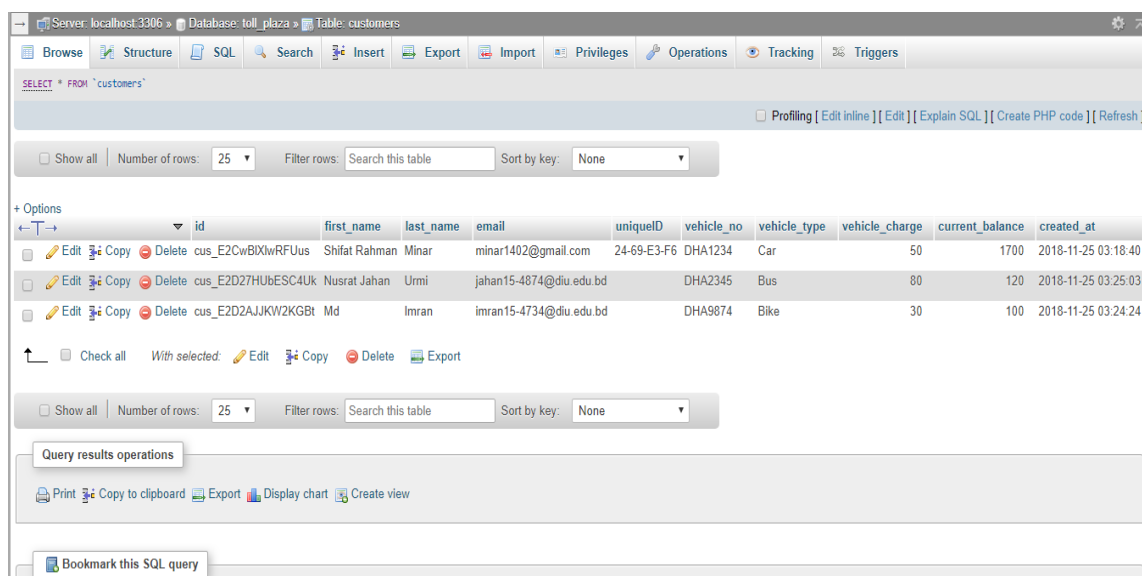
1. Paying the toll charge.
2. Recharge process.
3. Viewing customer and transection information.

Python: The python language is used for configuring different devices and sensor like display, IR module, servo motor, LED etc. which are connected with the GPIO pins.

5.4 Server & Web Design

The web pages for this system are working through the support of back-end development. The server side of a system is the main sector that communicates between the database and the browser. In the back-end it works as the logical part of the system. In our system the total server and the localhost database are stored in the Raspberry Pi B+ which contains the server-side language, database management, authorization, authentication, security, code, controlling connected devices, etc.

For the whole we use one database named “toll_plaza.db”. There are two tables in this database. One is “customers” which for customers details.



	id	first_name	last_name	email	uniqueID	vehicle_no	vehicle_type	vehicle_charge	current_balance	created_at
<input type="checkbox"/>	cus_E2CwBXlwRFUus	Shifat Rahman	Minar	minar1402@gmail.com	24-69-E3-F6	DHA1234	Car	50	1700	2018-11-25 03:18:40
<input type="checkbox"/>	cus_E2DZ7HUbESC4Uk	Nusrat Jahan	Urmi	jahan15-4874@diu.edu.bd		DHA2345	Bus	80	120	2018-11-25 03:25:03
<input type="checkbox"/>	cus_E2DZAJJKW2KGBt	Md	Imran	imran15-4734@diu.edu.bd		DHA9874	Bike	30	100	2018-11-25 03:24:24

Figure 5.3 Customers Table

In figure 5.3 contains the information of every customer like name, email, vehicle details, customer id, balance information, etc.

Another table name is “transactions” which for every transaction’s details. It contains the information of every transaction’s date, time, amount, status, customer id, transaction id, etc. In every payment and recharge a transaction id is given which are unique from each other to identify them. Along with the transaction process the balance is updated in the customers table when a customer pays or recharges his/her payment card. In Figure 5.4 the transactions tables is shown from the database.

	id	customer_id	amount	currency	description	status	created_at
	ch_1Da8476802195c08b570eabc	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:36:48
	ch_1DeFWMIlyuPceR3Adz4Za0yg	cus_E2D2AJJKW2KGBt	13000	bdt	Your Card is Recharged.	succeeded	2018-12-06 11:35:35
	ch_1DeFVQIlyuPceR3AMgXeXSX6	cus_E2CwBIXwRFUus	50000	bdt	Your Card is Recharged.	succeeded	2018-12-06 11:34:37
	ch_1DeFUellyuPceR3AJ1H7g9NJ	cus_E2D27HUBESC4Uk	15000	bdt	Your Card is Recharged.	succeeded	2018-12-06 11:33:49
	ch_1DeFTillyuPceR3ALY53W9CR	cus_E2CwBIXwRFUus	125000	bdt	Your Card is Recharged.	succeeded	2018-12-06 11:33:02
	ch_1Da5408263795c08b3f2e95a0	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:30:26
	ch_1Da12295956585c08b3eae6ea2	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:30:18
	ch_1Da9005217065c08b3d68b27b	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:29:58
	ch_1Da15571128015c08b3c4ecb2d	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:29:40
	ch_1Da16260934865c08b3be85c0	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:29:34
	ch_1Da13968609735c08b3b79c3eb	cus_E2CwBIXwRFUus	5000	BDT	Payment Successful	Successful	2018-12-06 11:29:27

Figure 5.4 Transaction Table

In figure 5.4 show the database where store user unique card id no, customer id, account balance, description. Here also store the transection details.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Discussion and Conclusion:

Our project is IOT based project and we developed it so that without any hassle, even without the help of a person, it is easy to pay the toll money only through a card. We started our journey to implement our project since 17 may and really we learned a lot. We worked hard to implement our system and for which we learned many things. We wish, one day our project will be very popular in Bangladesh and it will be used in all toll systems.

6.2 Scope for Further Developments

In our system we must have to make more comfort and easy. We improve our system later. We add camera for capture the vehicle image and collect toll depends on vehicle size. We also check any vehicle doing wrong or unethical activity in road and report nearest traffic police. We will add real time database which is connected with highway database. Try to exchange RFID with our national smart card. This time we can't use digital NID card because still people use analog NID card. When every citizen uses digital card, we use driver NID card number for punch. We try to card recharge from all government and private bank. We add "One Chance" post payment system. "One Chance" system means if anyone haven't sufficient balance, he can use the card for one payment and when recharge deduct the due payment. But if any "one chance" user won't recharge or pay he will be fined and his car number sent to the all traffic booth.

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Appendices

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