Report On

Automatic Toll Collection System

Submitted in partial fulfillment of the requirements of the Mini project in
Semester VI of Third Year Computer Engineering

by

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(2019-20)

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CERTIFICATE

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Abstract

ATCS is an Automated Toll Collection System used for collecting tax automatically. In this we do the identification with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. In accordance with this number we will store, all basic information as well as the amount he has paid in advance for the TOLL collection. Reader will be strategically placed at toll collection center. Whenever the vehicle passes the toll collection center, the tax amount will be deducted from his prepaid balance. New balance will be updated. In case if one has insufficient balance, his updated balance will be negative one. To tackle this problem, we are alarming a sound, which will alert the authority that this vehicle doesn't have sufficient balance and that particular vehicle can be trapped. As vehicles don't have to stop in a queue, it assures time saving, fuel conservation and also contributing in saving of money. Automatic Toll Collection systems have really helped a lot in reducing the heavy congestion caused in the metropolitan cities of today. It is one of the easiest methods used to organize the heavy flow of traffic.

The Benefits of this System are:

- Shorter queues at toll plazas by increasing toll booth service rates.
- Faster and more efficient service
- The ability to make payments by keeping a balance on the card itself and
- The use of postpaid toll statements
- Other general advantages include minimization of fuel wastage and reduced emissions by reducing deceleration rate, waiting time of vehicles in queue and acceleration.

For Toll Operators, the benefits include:

- Lowered toll collection costs
- Better audit control by centralized user account
- Expanded capacity without building more infrastructures

Thus, the ATP system is useful for both the motorists and toll operators, this is the reason of extended use of ATP system throughout the world.

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Problem statement

Whenever the matter of Integration of systems comes to mind, we think of a system having the following important features viz.
Accuracy: All the functionally bonded logical dependencies must be integrated.
Efficiency: The whole system should work under all circumstances and on a long run it should work efficiently irrespective of their proprietary format.
Cost Effectiveness: As our software do not require any special software for implementation hence is less costly as compared to other existing system.
Any Prerequisite for the use: As the existing systems are not altered, and integration is done at the background hence there is no need for any training.
The base idea behind implementing RFID Based Toll System is to automate the toll collection process and their by reducing manual operation in toll booths and the long queues at toll booths using RFID tags installed on the vehicles. In addition to we can not only help the vehicle owners and system administrators from vehicle theft detection but also can track over speeding vehicles, and crossing the signals. Here we are going to see some points regarding to purpose behind choosing this topic & what is the requirement of this type of the project in our day to day life.
- Automatic collection of toll tax.
- Free flow of traffic.
- Time saving.
- Record maintenance.
- Problems with pursuing toll evaders.
- Avoid the fuel loss.
- Saving of time in collecting toll.
- Avoid financial loss.

Background overview

A. Existing System:

There are two methods of collecting tax presently used they are First is the traditional manual method where one person collects money and issues a receipt. The other one is the Smart Card method where the person needs to show the smart card to the system installed at the toll tax department to open the Gate.

B. Drawbacks of Existing System:

Both the above mentioned method for collecting tax is time consuming method. Chances of escaping the payment of tax are there. It leads to queuing up of following vehicles.

C. History of Automatic Toll Tax:

Design and development of a "RFID Based Automatic Toll Plaza" which is based on Micro-controller, RFID technology and load cell to save the time at toll plaza and having cashless operation As the name implies "RFID Based Automatic Toll Plaza" the key theme of our project is the automation. So here we will just take the overlook of what is mean by Automation. In simple words the Automation means the human being from the process with the machines. Before going further we just take the overlook of history of the toll plazas. So before the 90's decade the toll plazas were fully manual controlled. Means there are total four people for operating the Toll gate in this two people will be used for opening & closing of the gate & another two are for reception of the money & data keeping etc. Semi Automatic Toll plazas were launched after the introduction of Express ways in 1995, in which data is stored in computers and gate operation is automatic, only two personals are required for single booth. But here we are going to see the human less toll plaza. Active wave Inc has currently deployed a system of active tag vehicle monitoring solution. Active wave vehicle products have a range of 30 meters and operate in the 916 – 927 MHz for the transmit operations and 433 MHz for the receive link. Active wave products are currently equipped with 256 Kbits of fixed memory. The tag is powered with a replaceable 3V battery and the total weight is 14 grams. Elementary signals are shown with the help of blinking LEDs and beeping sounds. Smart key Access Control Systems have a client – server model based system with an SQL server handling multiple vehicle monitoring systems. They have designed a user interface using the Microsoft .NET Framework. Smart key also operate in the 900MHz band but have a small range of 30 meters. RFID based toll collection system uses active RFID tag which uses car battery power. The implementation is divided into the design of two modules- the Vehicle Module (Active Tag) and the Base Module. The two modules communicate via RF modem connected to each module.

Proposed system

This project gives the simplified procedure to passengers to pay toll at toll booths by making them automated, vehicle theft detection, signal breaking avoidance, tracking over speed vehicles. All these activities are carried using single RFID tag thus saving the efforts of carrying money and records manually.

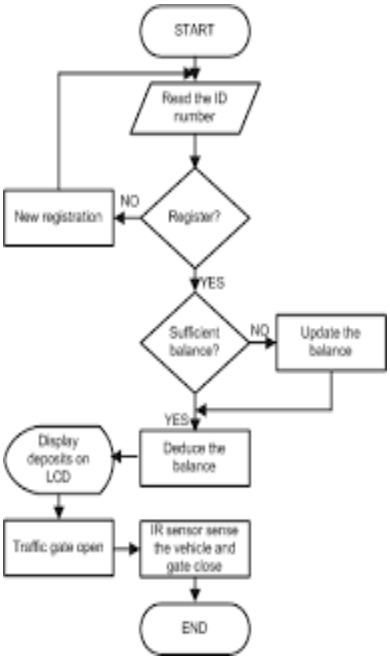
A. Automatic Toll Collection: The RFID Readers mounted at toll booth will read the prepaid RFID tags fixed on vehicles' windshield and automatically respective amount will be deducted. If the tag is removed from the windshield then cameras fixed at two sites at toll plaza take snaps of the front and back number plate. Since every vehicle registration ID is linked to users account, toll can be deducted from the account bank directly.

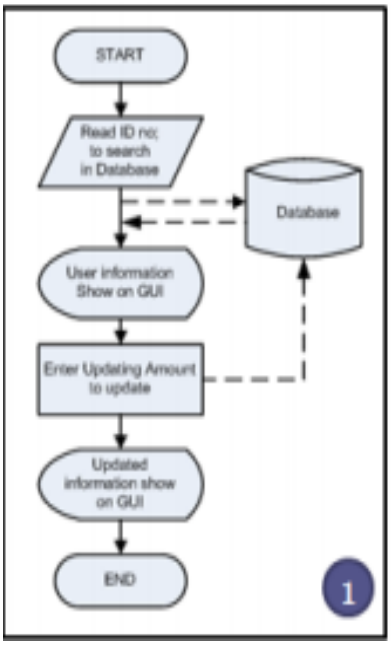
B. Vehicle Theft Detection: When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.

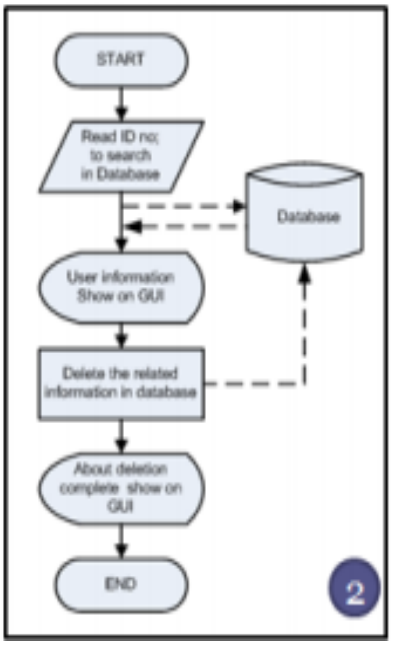
C. Signal Breaking Avoidance: The vehicle ignoring the traffic signal will be detected by the RFID readers fixed at signal crossing and will be notified to the traffic police. This can be done efficiently and great accuracy.

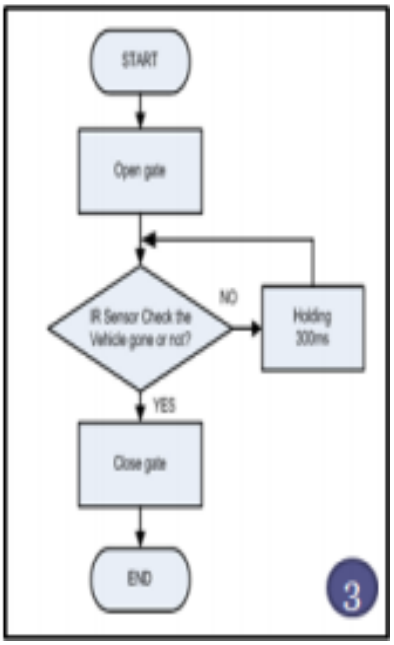
D. Tracking Over speeding Vehicle: Vehicle travelling above speed limit can be tracked with 100 % accuracy.

Block diagram









Flow chart for :

(1) User updating form

(2) User deleting form

(3) IR section for gate control

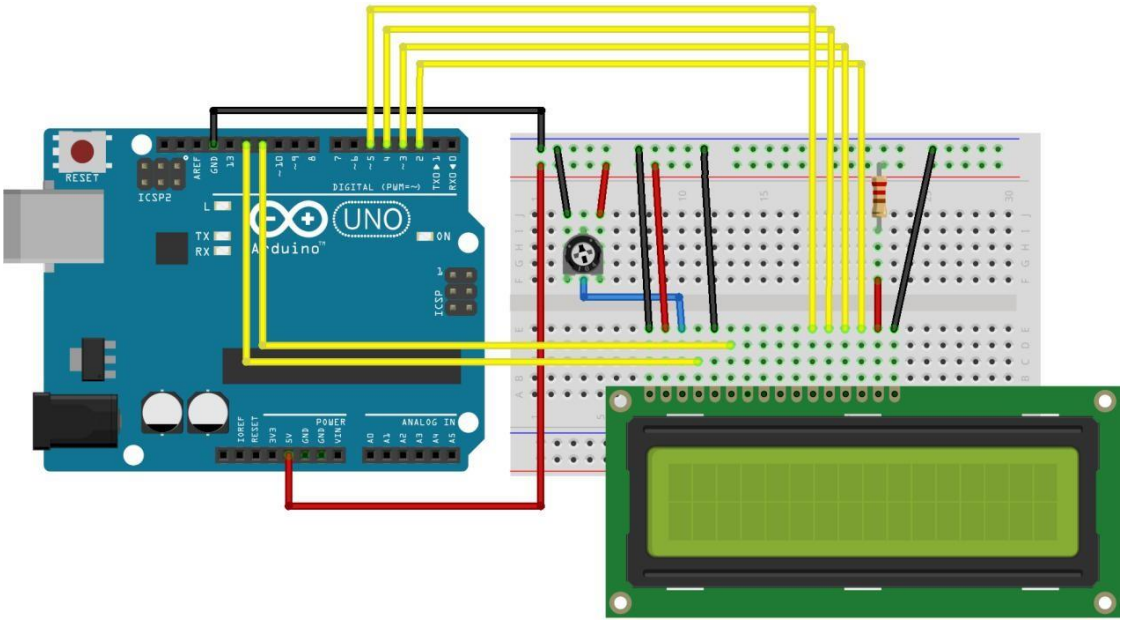
Methodology

Flow of RFID based toll tax are:

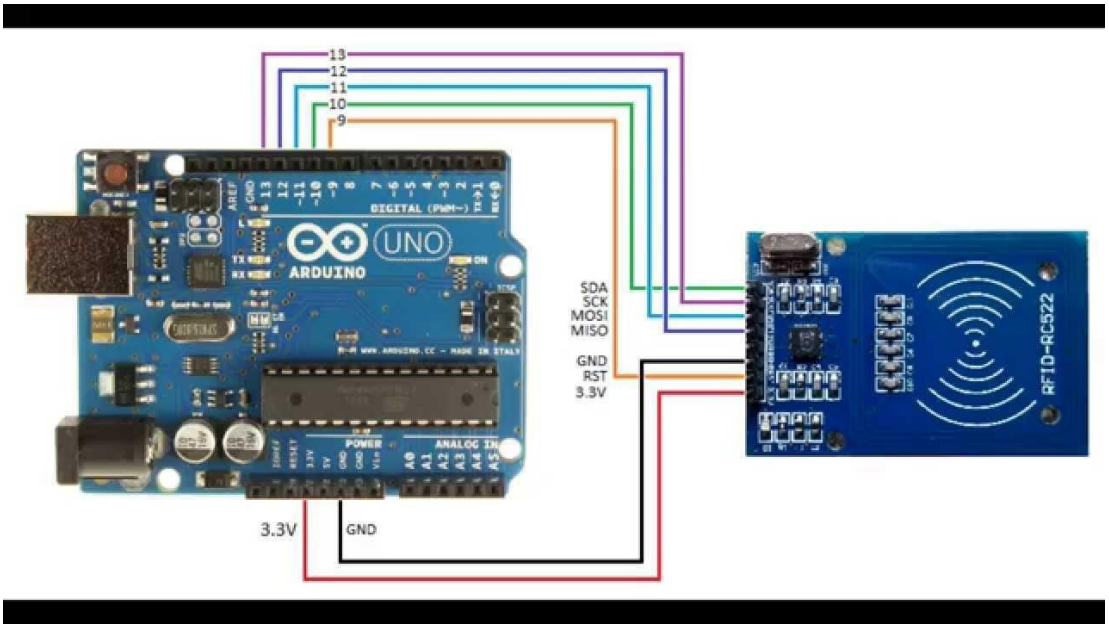
--- Detection of vehicle
--- Display of toll
--- Payment through RFID card

Whenever any person buys a vehicle, first he/she need to do her vehicle registered at the RTO office. RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for that particular smart card and maintain transaction history in database. Owner of the vehicle needs to deposit some minimum amount to this account. Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the vehicle which in turn activates the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted directly or the vehicle will be directed towards another lane to pay tax manually. The software further updates the details in the Centralized database server. It also triggers mechanism to generate the bill and will be sent to user as a text message. On the other hand, whenever any vehicle owner registers a complaint at the RTO office regarding theft of the vehicle respective entry is made in the database. Now any vehicle arriving at toll booth with same ID as already present in stolen vehicle category will be easily identified as the ID assigned with it is unique. All the toll plazas will be connected to each other along with the centralized server in the form of LAN. Updates of any sort of transaction will be immediately updated to local database and centralized server.

Arduino to LCD display connection:

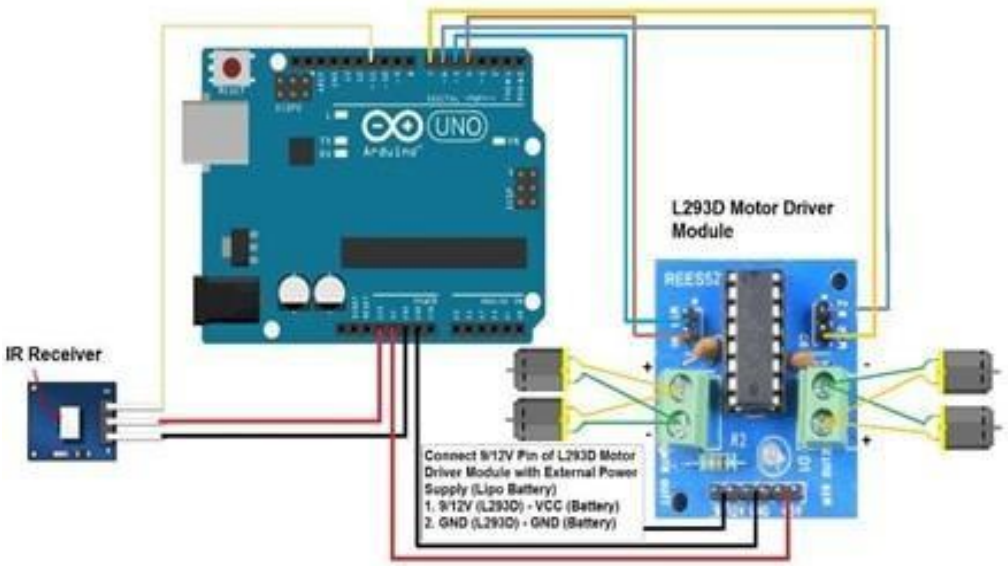


Arduino to RFID module connection:



The RFID module must be powered by 3.3V and 5V can damage the on board components. The RFID-RC522 module works on SPI communication protocol while communicating with Arduino.

Rest of the circuit:
The Arduino can be powered from 9V wall adapter. There is a buzzer and LED to indicate that the card is detected. There are 4 buttons provided for viewing the vehicle attendance, clearing the memory and “yes” and “no” buttons.



Now we have to set the correct time to RTC module to do this, follow the below steps with completed hardware setup.

- Open the Arduino IDE.
- Navigate to File> Examples> DS1307RTC> SetTime.
- Upload the code.

Once the code is uploaded to Arduino, open the serial monitor. Now the RTC is synchronized with the time of your computer. Now we have to find UID or unique identification number of all 12 RFID cards/tags. To find UID, upload the below code and open the serial monitor.

- Open serial monitor.
- Scan the card/tag on RFID module.
- Now you will see some hexadecimal code for each card.
- Write it down, we will be entering those data in the next program.

//SOURCE CODE

```
#include <SPI.h>
#include <MFRC522.h>
#include <OnewireKeypad.h>
#include <LiquidCrystal.h>
#include <Servo.h>

LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

Servo servo;
int servoPos = 0;

#define sensorPin1 A2
#define sensorPin2 A3
#define buzzerPin A4

int senVal1 = 0;
int senVal2 = 0;

#define RST_PIN 8
#define SS_PIN 10

int card1Balance = 5000;
int card2Balance = 300;

#define num 7
char Data[num];
byte data_count = 0;

String num1, num2, card, card2;
int a, b;
char Key;

bool recharge = true;

MFRC522 mfrc522(SS_PIN, RST_PIN);

int state = 0;

char KEYS[] = {
  '1', '2', '3', 'A',
  '4', '5', '6', 'B',
```

```
  '7', '8', '9', 'C',
  '*', '0', '#', 'D'
};

OnewireKeypad <Print, 16 > KP2(Serial, KEYS, 4, 4, A0, 4700, 1000, ExtremePrec );

void setup () {
  lcd.begin(16, 2);
  Serial.begin(9600);

  servo.attach(9);

  servo.write(30);

  pinMode(sensorPin1, INPUT);
  pinMode(sensorPin2, INPUT);
  pinMode(buzzerPin, OUTPUT);

  KP2.SetKeypadVoltage(5.0);

  while (!Serial);
  SPI.begin();
  mfrc522.PCD_Init();

  lcd.setCursor(0, 0);
  lcd.print(" Automatic toll");
  lcd.setCursor(0, 1);
  lcd.print("colection system");
  delay(3000);
  lcd.clear();
}
void loop()
{

  if (recharge == 0)
  {
    reCharge();
  }
  else
  {
    lcd.setCursor(0, 0);
    lcd.print("   Welcome!!!");
    sensorRead();
    rfid();
```

```
    KeyPad();
    if (senVal1 == 0)
    {
      servoDown();
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Vehicle detected");
      delay(1000);
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Put your card to");
      lcd.setCursor(0, 1);
      lcd.print("the reader.....");
      delay(2000);
      lcd.clear();

    }
    else if (senVal2 == 0 && state == 1)
    {
      servoUp();
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Have a safe");
      lcd.setCursor(0, 1);
      lcd.print("journey");
      delay(1000);
      lcd.clear();
      state = 0;
    }
  }
}

void servoDown()
{
  servo.attach(9);
  for (servoPos = 30; servoPos <= 120; servoPos += 1)
  {
    servo.write(servoPos);
    delay(5);
  }
}

void servoUp()
{
```

```
  servo.attach(9);
  for (servoPos = 120; servoPos >= 30; servoPos -= 1)
  {
    servo.write(servoPos);
    delay(5);
  }
}

void sensorRead()
{
  senVal1 = digitalRead(sensorPin1);
  senVal2 = digitalRead(sensorPin2);
}

void rfid()
{
  if ( ! mfrc522.PICC_IsNewCardPresent())
  {
    return;
  }
  if ( ! mfrc522.PICC_ReadCardSerial())
  {
    return;
  }

  String content = "";
  for (byte i = 0; i < mfrc522.uid.size; i++)
  {
    content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
    content.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  content.toUpperCase();

  if (content.substring(1) == "80 40 E6 2A")
  {
    if (card1Balance >= 500)
    {
      lcdPrint();
      card1Balance = card1Balance - 500;
      lcd.setCursor(9, 1);
      lcd.print(card1Balance);
      delay(2000);
      lcd.clear();
      state = 1;
```

```
  }
  else
  {
    card = content.substring(1);
    LcdPrint();
    lcd.setCursor(9, 1);
    lcd.print(card1Balance);
    lcd.print(" Tk");
    delay(2000);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Please Recharge");
    delay(1000);
    lcd.clear();
    state = 0;
  }
}
else if (content.substring(1) == "59 B0 28 B9")
{
  if (card2Balance >= 500)
  {
    lcdPrint();
    card2Balance = card2Balance - 500;
    lcd.setCursor(9, 1);
    lcd.print(card2Balance);
    delay(2000);
    lcd.clear();
    state = 1;
  }
  else
  {
    card = content.substring(1);
    LcdPrint();
    lcd.setCursor(9, 1);
    lcd.print(card2Balance);
    lcd.print(" Tk");
    delay(2000);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Please Recharge");
    lcd.clear();
    delay(1000);
    state = 0;
  }
```

```
  }

  else   {
    digitalWrite(buzzerPin, HIGH);
    lcd.setCursor(0, 0);
    lcd.print("Unknown Vehicle");
    lcd.setCursor(0, 1);
    lcd.print("Access denied");
    delay(1500);
    lcd.clear();
    digitalWrite(buzzerPin, LOW);
  }
}

void KeyPad()
{
  byte KState = KP2.Key_State();

  if (KState == PRESSED)
  {
    Key = KP2.Getkey();
    if (Key)
    {
      if (Key == 'A')
      {
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print("Recharging Mode.");
        lcd.setCursor(0, 1);
        lcd.print(".....");
        delay(1500);
        lcd.clear();
        recharge = 0;
      }
    }
  }
}

void clearData()
{
  while (data_count != 0)
  {
    Data[data_count--] = 0;
  }
```

```
  return;
}

void reCharge()
{

  lcd.setCursor(0, 0);
  lcd.print ("Enter the amount");

  byte KState = KP2.Key_State();

  if (KState == PRESSED)
  {
    Key = KP2.Getkey();
    if (Key)
    {
      if (Key == 'D')
      {
        if (card == "73 50 76 2E")
        {
          num1 = Data;
          card1Balance = num1.toInt() + card1Balance;
          lcd.clear();
          lcd.setCursor(0, 0);
          lcd.print("Your current");
          lcd.setCursor(0, 1);
          lcd.print("balance: ");
          lcd.setCursor(9, 1);
          lcd.print (card1Balance);
          lcd.print(" Tk");
          delay(3000);
          clearData();
          lcd.clear();
          recharge = 1;
        }
        else if (card == "F4 C2 37 BB")
        {
          num2 = Data;
          card2Balance = num2.toInt() + card2Balance;
          lcd.clear();
          lcd.setCursor(0, 0);
          lcd.print("Your current");
          lcd.setCursor(0, 1);
          lcd.print("balance: ");
```

```
          lcd.setCursor(9, 1);
          lcd.print (card2Balance);
          lcd.print(" Tk");
          delay(3000);
          clearData();
          lcd.clear();
          recharge = 1;
        }
       }
       else
       {
        Data[data_count] = Key;
        lcd.setCursor(data_count, 1);
        lcd.print(Data[data_count]);
        data_count++;
       }
     }
   }
}
void lcdPrint()
{
  digitalWrite(buzzerPin, HIGH);
  delay(200);
  digitalWrite(buzzerPin, LOW);
  delay(100);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("  Successfully");
  lcd.setCursor(0, 1);
  lcd.print(" paid your bill");
  delay(1500);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Your Remaining");
  lcd.setCursor(0, 1);
  lcd.print("balance: ");
}

void LcdPrint()
{
  digitalWrite(buzzerPin, HIGH);
  delay(200);
  digitalWrite(buzzerPin, LOW);
  delay(100);
```

```
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("  Your balance");
  lcd.setCursor(0, 1);
  lcd.print(" is insufficent");
  delay(1500);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Your Remaining");
  lcd.setCursor(0, 1);
  lcd.print("balance: ");
}
```

Future scope of the project

1. **Automatic Vehicle Identification:** The automatic vehicle identification (AVI) component of this system refers to the technologies that determine the identification or ownership of the vehicle so that the toll will be charged to the corresponding customer.
2. **Automatic Vehicle Classification**: Vehicle type and class may have differentiated toll amount. The vehicle type may include light vehicles like the passenger car or heavy vehicles like recreational vehicles. A vehicle's class can be determined by the physical attributes of the vehicle, the number of occupants in the vehicle, the number of axles in the vehicles and the purpose for which the vehicle is being used at the time of classification.
3. **Video Enforcement System:** When used for electronic toll collection, the video enforcement system (VES) captures images of the license plates of vehicles that pass through an electronic tollbooth without a valid electronic tag. Although the deployment of these technologies makes the initial cost of installation very high, but there exits huge benefits accompanied with such high investment. These benefits are discussed in the upcoming section.

Conclusion

Time is changing at fast pace even though the Manual Technique for Taxation at toll station is still being used, but now with the rapid advent of technology as people are more demanding with their comfort whole heartedly accepting and imposing such new and emerging technologies in day today life and also in taxation. Digitization and automation is now in every field from television broadcasting to banking service and so on in different government sectors also. These are the prime requirements which are accomplished by new technologies and trends. RFID is powerful technology and it is likely to see worldwide deployment within the coming years, continuous technological advancements have also resulted reduced cost of installation and maintenance of RFID based Devices.

So, we can conclude this prototype is more suitable for the travelers and also for the toll gates governing bodies as the RFID technology seems to be an innocuous technology on the technical surface, wide range of issues can be explored successfully.We are seeing great promise and signs that the RFID and future upcoming sensor network technologies will help to change the way we think about our manufacturing processes and the interactions with the people and customers. On the concluding node, we can say that we have successfully implemented our project, but still have some advancement to be done.

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