Bangladesh University of Business and Technology

Automated Toll Collecting System

Project Report By

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DECLARATION OF AUTHORSHIP

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We, hereby declare that this capstone project Automated Toll Collection System is entirely our own work, unless otherwise referenced or acknowledged. The content of this project is the result of our own research and efforts, and we have complied with all ethical guidelines and academic standards. We are aware of the consequences of academic dishonesty and understand that any violation of ethical standards in this project may lead to disciplinary actions as defined by BUBT's policies.

CERTIFICATE OF ACCOMPLISHMENT

This is to certify that,

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Have successfully completed the project report titled

"Automated Toll Collection System"

This project report showcases an in-depth exploration and analysis of the Radio Frequency Identification based technology integrated with a real-time data.
The project report encompasses:

- Optimizes traffic flow, reduces congestion.
- Enhances users convenience, ensures accurate free assessment
- Integrates seamlessly with existing transportation infrastructure while maintaining robust security measures and minimizing environmental impact.

The innovative application of technology, meticulous documentation, and the systematic approach to problem-solving displayed in this report are commendable.

This certificate is awarded in recognition of the diligent effort, technical proficiency, and successful completion of the project report, which contributes significantly to the field of Machine learning, artificial intelligence, etc.

Nourin Khandaker
Supervisor
Lecturer, Department of CSE, BUBT

ACKNOWLEDGEMENTS

We would like to take the opportunity to thank and express our deep sense of gratitude to our mentor and project guide **Nourin Khandaker** for his immense support and valuable guidance without which it would not have been possible to reach at this stage of our minor project.

We also express our appreciation to the entire team involved in this project. Their dedication, hard work, and collaborative spirit were instrumental in overcoming challenges and achieving our goals. Each member's unique skills and commitment significantly contributed to the project's success.

ABSTRACT

With every passing day, we are becoming more and more dependent upon technology to carry out even the most basic of our actions. This project lays out the basic terminology required to understand the implementation of Automated Toll Collection using Arduino Uno.

It also shows the practical implementation of the Automated Toll Collection System using RFID (Radio Frequency Identification with 8051 on both Windows as well as Arduino IDE platform. The input is taken toll form account and the processes are displayed along with their instruction in real time. This project can be implemented on a larger scale to develop the toll cost were reduced, inspection control was strengthened thanks to centralized user accounts, capacity was raised without the need for new frameworks, and carrying cash was no longer necessary.

ABBREVIATIONS

ATCS- Automated Toll Collection System
RFID- Radio Frequency Identification
DC- Direct Current
LCD- Liquid Cristal Display
ETC- Electronic Toll Collection
PCB- Printed Circuit Board

CONTENTS

CHAPTER 1
INTRODUCTION

1.1 PROJECT DEFINATION

While driving along Highway, we all encounter single or multiple booths in while we have to pay a fixed amount of money. These booths are known as toll booths and the money we pay is the tax for using the rood known as the toll road or toll way. Since, most of the roads are built with the money that is raised by state or national government through the taxes. So, toll is a kind of tax that we pay to the government for the maintenance of the highways.

An Arduino Uno, a load cell amplifier, a circuit board, an RFID sensor, a servo motor and a Weigh-In-Motion sensor are all part of this project. The procedure involves generating a radio frequency (RF) tag and code to identify the vehicle, and then using a DC motion sensor to with sufficient funds in their accounts and vehicles that do not exceed amounts limits set by authorities will be allowed to proceed.

1.2 PROBLEM STATEMENT

When you have a problem that can be solved by applying microcontroller principles and techniques, then got itself a problem. There are a number of tricky problems that need fixing before this project can be completed successfully. An Arduino Uno, a load cell amplifier, a circuit board, an RFID sensor, a servo motor and a Keypad are all part of this project. The project's fundamental methodology is shaped in such a way that the system can be deployed wherever and by everyone who requires it. The project's central idea is to employ Radio Frequency Identification tags to track down which cars have arrived at the toll, and then use that data to decide whether to let them through or not. An RFID reader scans a tag worn by the car's owner. The microcontroller receives the tag ID upon scanning the tag, compares the identification to the identifier stored in the database, and then acts accordingly depending on the tag’s condition. Here, writing Arduino code to manage the entire operation is the primary goal.

1.3 PROJECT OBJECTIVES

- RFID-based an automatic toll collection system has to be used to improve the efficiency.
- To develop the project with low of cost.

Implementing a real-time tracking system would improve traffic management and monitoring for the toll authorities.

- be possible for toll authorities to collect tolls from buses and trucks without the requirement of manual labor by developing an automated toll collection system.

CHAPTER 2
BACKGROUND STUDY

2.1 EXISTING SYSTEM:

Traditional toll collection systems often rely on manual methods such as paper-based registers or direct cash payment systems. These methods can be time-consuming, prone to errors, and lack the ability to adapt to changing environments. The Automated Toll Collection System addresses these issues by leveraging collection technologies to streamline the payment tracking process. I2C LCD Display F18-D80NK

2.2 NEED FOR THE SYSTEM:

Component	Quantity
Arduino UNO Board	1
RC522 RFID Reader	1
13.56 MHz RFID Card	5
I2C LCD Display	1
4*4 Keypad Module	1
IR Sensor Module F18-D80NK	2
Servo Motor MG995	1
Resistor (1K & 4.7K)	7
Zero PCB	1
9V DC Power Supply	1

2.3 PROPOSED SYSTEM:

The implementation of an Automated Toll Collection System (ATCS) offers a comprehensive solution to the challenges posed by traditional toll collection methods. The ATCS utilizes Radio-frequency Identification (RFID) and Optical Character Recognition (OCR) technology to automatically identify vehicles and capture license plate information, eliminating the need for manual intervention. Commuters can make toll payments seamlessly using contactless payment methods such as RFID tags, mobile applications, or online accounts linked to their vehicles, reducing wait times and improving overall user experience. The ATCS integrates real-time data analytics capabilities to monitor traffic flow, predict congestion, and optimize toll plaza operations, enhancing traffic management efficiency and reducing congestion. The ATCS prioritizes user convenience and satisfaction through intuitive interface design, personalized payment options, and seamless integration with existing transportation infrastructure and payment systems. By leveraging automation, the ATCS offers a comprehensive solution to the inefficiencies and challenges associated with traditional toll collection methods.

2.4 SCOP OF THE PROJECT

- **Technical Scope:**

The main scope of the project is technical scope. We need to hardware infrastructure, software processing and network infrastructure.

- **Operational Scope:**

- Electronic toll Collection (ETC): Fully automated, allowing vehicles to pass through toll points without stoping.
- Open road tolling: Toll collection without physical toll booths, using overhead gantries equipped with sensors.

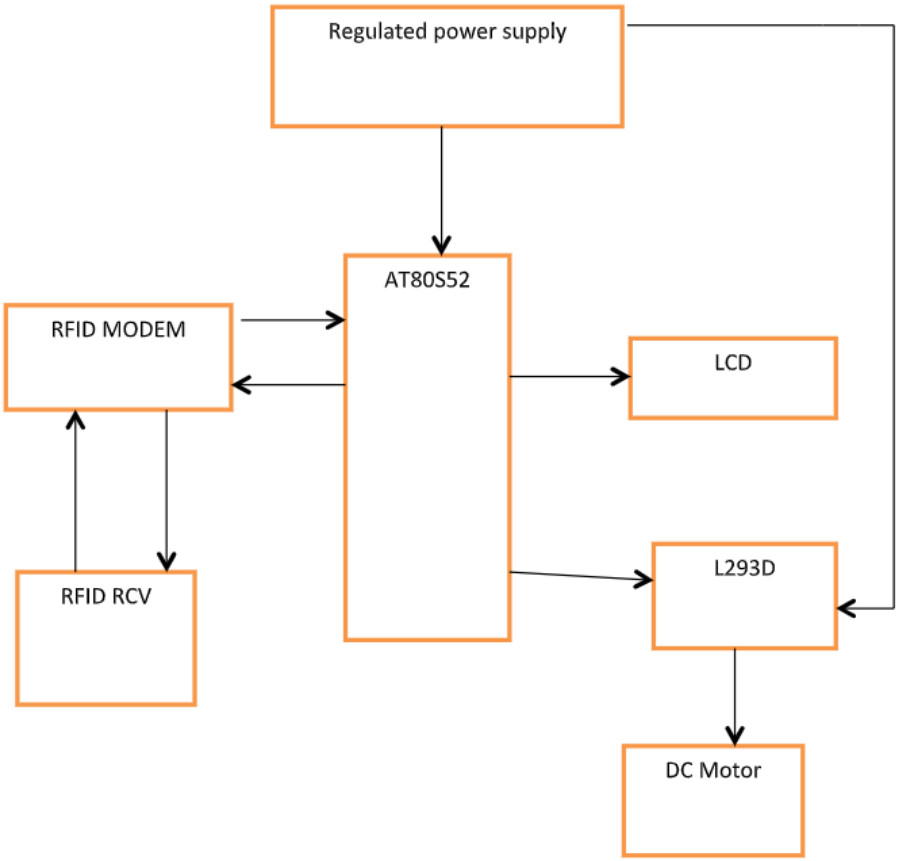
- Security and Compliance:
  - Ensure secure transmission and storage of user data and transaction information.
  - Implements measures to protect user privacy and comply with data protection regulations.

- **Feasibility Study:**

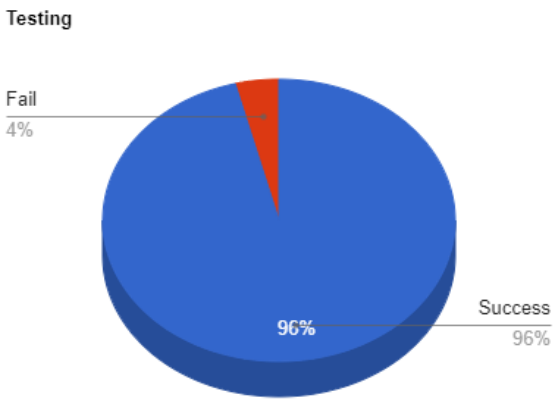
- **Vehicles Identification:** Utilizes technologies such as RFID (Radio-frequency identification) or OCR (Optical Character Recognition) to automatically identify vehicles as they approach the toll plaza.
- **Contactless Payment:** Enables commuters to make toll payments seamlessly using contactless methods such as RFID tags, mobile apps, or online accounts linked to their vehicles, reducing wait times and improving user experience.
- **Real-time Data Analytics:** Integrates real-time data analytics capabilities to monitor traffic flow, predict congestion, and optimize toll plaza operations, enhancing traffic management efficiency and reducing congestion.
- **Automated Free Calculation:** Automatically calculates toll fees based on various factors such as vehicle type, distance traveled, and toll rates, ensuring accurate and transparent revenue collection while minimizing errors and revenue leakage.
- **User-Centric Design:** Prioritizes user convenience and satisfaction through intuitive interface design, personalized payment options, and seamless integration with existing transportation infrastructure and payment systems.
- **Security and Fraud Prevention:** Implements robust security measures to protect user data, prevent unauthorized access, and detect fraudulent activities, ensuring the integrity and trustworthiness of the toll collection system.
- **Remote Monitoring and Management:** Enables remote monitoring and management of toll plaza operations, allowing authorities to track system performance, analyze data, and make informed decisions in real-time.

CHAPTER 3
SYSTEM DIAGRAM

3.1 BLOCK DIAGRAM OF THE SYSTEM:



3.2 TESTING POSIBILITY:



SYSTEM IMPLEMENTATION AND TESTING

4.1 EXPERIMENTAL CODE:

This code appears to be a Arduino Uno script that utilizes various libraries like OnewireKeypad, Servo, LiquidCristal etc.

Arduino Uno

Ardunio_project.ino

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

#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

Servo servo;
int servoPos = 0;

#define sensorPin1 A2
#define sensorPin2 A3

int senVal1 = 0;
int senVal2 = 0;

#define RST_PIN 8
#define SS_PIN 10

int card1Balance = 40000;
int card2Balance = 2000;

#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 );

void setup () {

  lcd.begin();
  lcd.backlight();
  Serial.begin(9600);

  servo.attach(9);

  servo.write(30);

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

  KP2.SetKeypadVoltage(5.0);

  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);
```

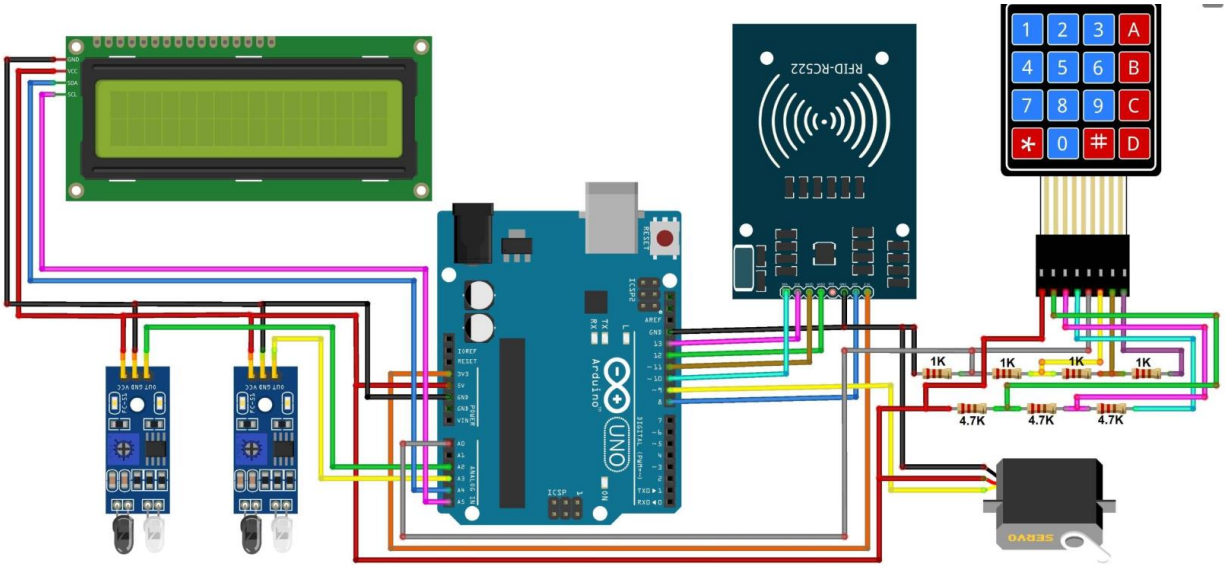
```
    delay(5);
  }
}

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) == "F2 11 90 2E")
  {
    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) == "14 F3 51 73")
  {
    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   {
    lcd.setCursor(0, 0);
    lcd.print("Unknown Vehicle");
    lcd.setCursor(0, 1);
    lcd.print("Access denied");
    delay(1500);
    lcd.clear();
  }
}

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()
{

```

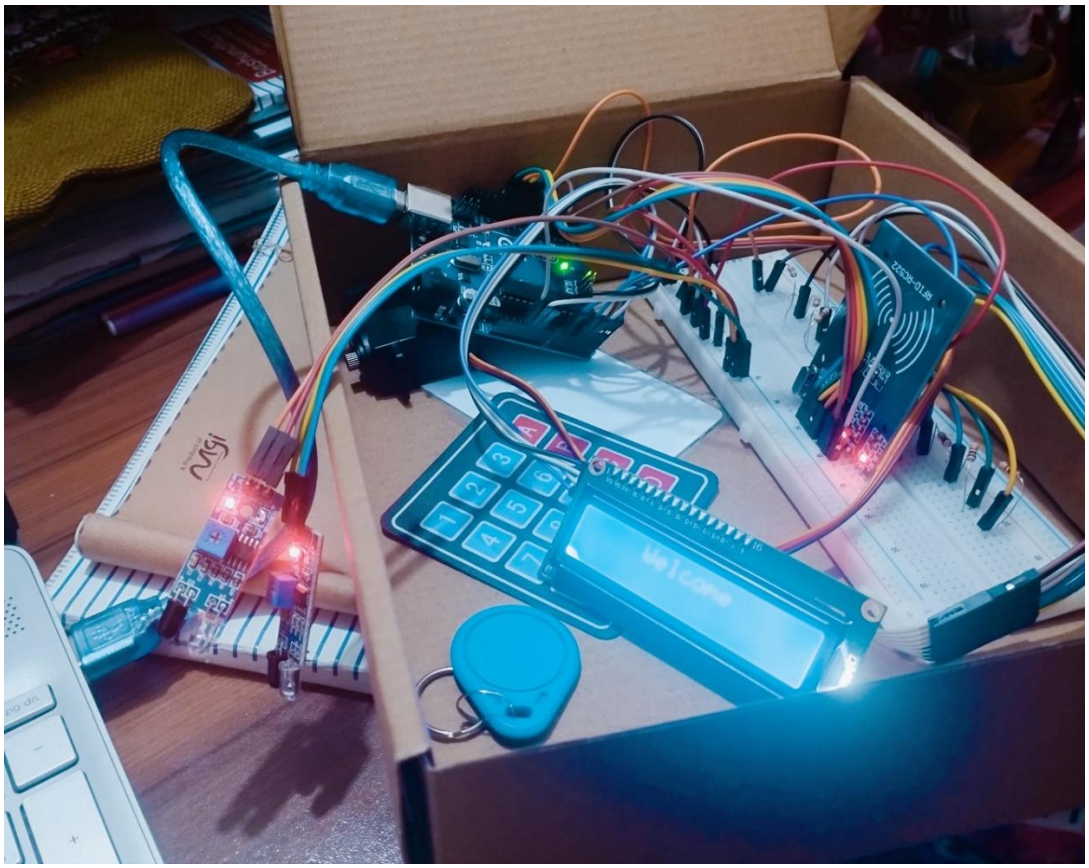
```
265   lcd.setCursor(0, 0);
266   lcd.print ("Enter the amount");
267
268   byte KState = KP2.Key_State();
269
270   if (KState == PRESSED)
271   {
272     Key = KP2.Getkey();
273     if (Key)
274     {
275       if (Key == 'B')
276       {
277         if (card == "F2 11 90 2E")
278         {
279           num1 = Data;
280           card1Balance = num1.toInt() + card1Balance;
281           lcd.clear();
282           lcd.setCursor(0, 0);
283           lcd.print("Your current");
284           lcd.setCursor(0, 1);
285           lcd.print("balance: ");
286           lcd.setCursor(9, 1);
287           lcd.print (card1Balance);
288           lcd.print(" Tk");
289           delay(3000);
290           clearData();
291           lcd.clear();
292           recharge = 1;
293         }
294         else if (card == "14 F3 51 73")
295         {
296           num2 = Data;
297           card2Balance = num2.toInt() + card2Balance;
298           lcd.clear();
299           lcd.setCursor(0, 0);
300           lcd.print("Your current");
301           lcd.setCursor(0, 1);
302           lcd.print("balance: ");
303           lcd.setCursor(9, 1);
304           lcd.print (card2Balance);
305           lcd.print(" Tk");
306           delay(3000);
307           clearData();
308           lcd.clear();
309           recharge = 1;
310         }
311       }
312       else
313       {
314         Data[data_count] = Key;
315         lcd.setCursor(data_count, 1);
316         lcd.print(Data[data_count]);
317         data_count++;
318       }
319     }
320   }
321 }
322 void lcdPrint()
323 {
324   lcd.clear();
325   lcd.setCursor(0, 0);
326   lcd.print("  Successfully");
327   lcd.setCursor(0, 1);
328   lcd.print(" paid your bill");
329   delay(1500);
330   lcd.clear();
```

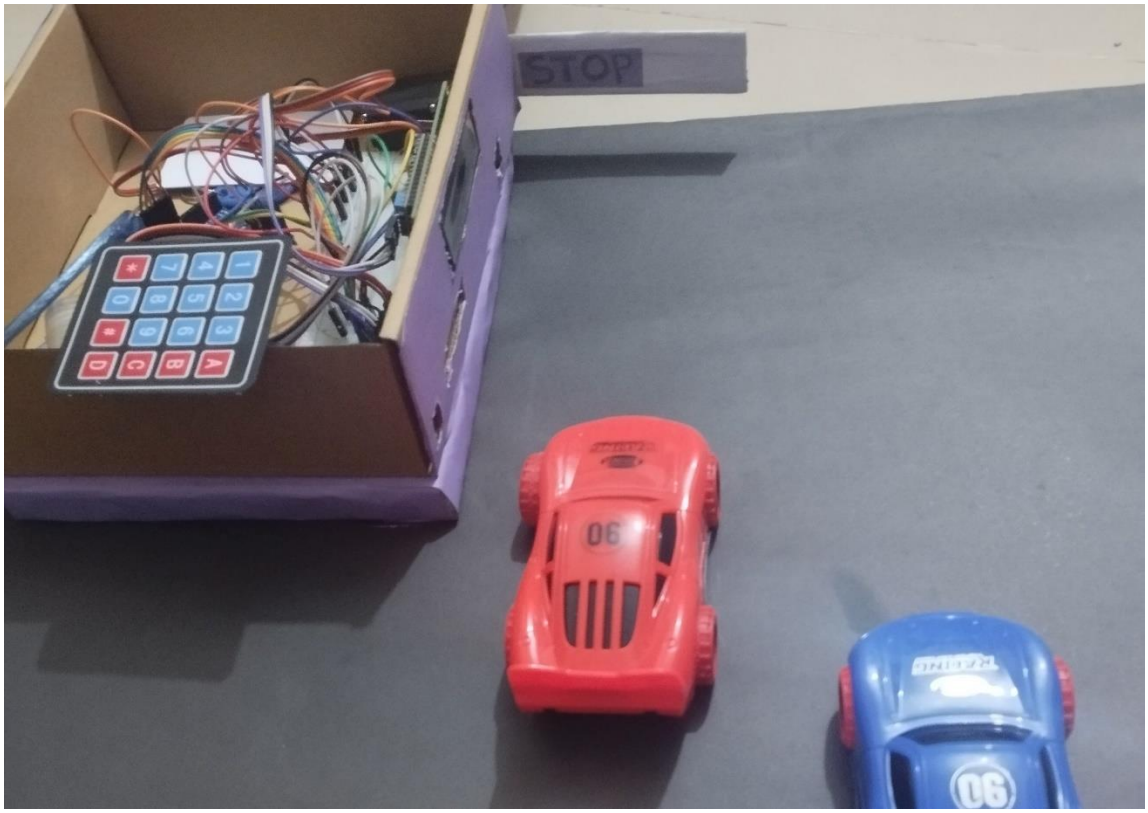
```
331     lcd.setCursor(0, 0);
332     lcd.print("Your Remaining");
333     lcd.setCursor(0, 1);
334     lcd.print("balance: ");
335   }
336
337   void LcdPrint()
338   {
339     lcd.clear();
340     lcd.setCursor(0, 0);
341     lcd.print("  Your balance");
342     lcd.setCursor(0, 1);
343     lcd.print(" is insufficent");
344     delay(1500);
345     lcd.clear();
346     lcd.setCursor(0, 0);
347     lcd.print("Your Remaining");
348     lcd.setCursor(0, 1);
349     lcd.print("balance: ");
350   }
```

4.2 SIMULATION MODEL



4.3 HARDWARE MODEL





CHAPTER 5
CONCLUSION AND RECOMONDATION

5.1 CONCLUSION

The digital conversion of conventional collection practices into automated collection systems is the process of automating collections. Automating collections boosts earnings while also accelerating cash reserves, increasing productivity and customer happiness. A new RFID-based automated toll collection system has been implemented in an effort to ease congestion and maintain process transparency.

By reducing wait times and congestion at toll plazas, the ATCS enhances traffic flow on highways and main thoroughfares, leading to smoother and more efficient transportation routes. With streamlined toll collection processes and minimized delays at toll booths, commuters experience shorter travel times, resulting in improved productivity and quality of life. The ATCS ensures accurate and transparent toll revenue collection, minimizing revenue leakage and optimizing revenue streams for infrastructure maintenance and development projects. By reducing congestion and eliminating manual toll transactions, the ATCS improves safety on highways and toll roads, minimizing the risk of accidents and collisions associated with queuing at toll plazas. So, the project outcome an Automated Toll Collection System encompasses a wide range of benefits.

5.2 FUTURE RECOMMENDATION

Using facial recognition technology in conjunction with the Electronic Toll Collection system would allow toll authorities to identify drivers. Implementing a real-time tracking system would improve traffic management and monitoring for the toll authorities. Putting in place an automatic payment system would enable drivers to pay using their credit cards or mobile phones and eliminate the need for manual payment. Introducing dynamic pricing would allow toll authorities to change the toll costs in accordance with the volume of traffic. It would be possible for toll authorities to collect tolls from buses and trucks without the requirement of manual labor by developing an automated toll collection system. By implementing a realtime data analytics system, toll authorities would be able to learn more about traffic patterns and pinpoint areas for improvement.

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[2] Electronic Toll Collection System Using RFID by K.J. Rahman, M. Mahmud Hasan.