AUTOMATIC TOLL COLLECTION SYSTEM

USING RFID

Final Year Project

Bachelor of Science (Electronics)

Submitted by

Hammad Ahmad Abbasi

Department of Electronics
Faculty of Natural Sciences
Quaid-i-Azam University, Islamabad

Declaration

I hereby declare that the project titled ”Automatic Toll Collection System Using RFID” submitted to the department of Electronics, Faculty of Natural Sciences, Quaid-e-Azam University Islamabad for the award of degree of Bachelor of Science in Electronics (BS-Electronics) is carried out by me under the supervision of Dr. Musarat Abbas.

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Hammad Ahmad Abbasi

Approval Certificate

A thesis titled as “Automatic Toll Collection System Using RFID” submitted by Hammad Ahmad Abbasi to the Department of Electronics, Faculty of Natural Sciences, Quaid-e-Azam University Islamabad is accepted in its present form as it is satisfying the requirement for the Degree, Bachelor of Science in Electronics (BS Electronics).

_____

Supervisor

(Dr. Musarat Abbas)

Assistant Professor

Department of Electronics

Quaid-i-Azam University

Islamabad.

_____

Chairman

(Dr. Syed Aqeel Abbas Bukhari)

Associate Professor

Department of Electronics

Quaid-i-Azam University

Islamabad.


بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

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Abbreviations

ADC	Analog to Digital Converter
AREF	Analog Reference
MISO	Master In, Slave Out
MOSI	Master Out, Slave In
PWM	Pulse Width Modulation
SCK	Serial Clock
SDA	Serial Data
SPI	Serial Peripheral Interface
SS	Slave Select
RFID	Radio Frequency Identification
LCD	Liquid Crystal Display
IR	Infra Red

Abstract

Time management is one of the major need of any human being, I have focused my project for saving time of cars while paying tax at toll station. This project is related to the concept of automatic toll collection system using RFID. As the RFID reader scans only those cars which have RFID cards so there are minimum chances of security compromise. This system also enables the user to recharge their balance in case of less amount in his account to pay toll tax. This system also display every message when vehicle comes, leaves and while staying at toll station when the user recharges his balance. All these are displayed on the LCD. This system consists of RFID module, Arduino Nano, IR sensors, Servo motor and 4x4 keypad module. Programming for Arduino is done by use of software called Arduino IDE. As vehicles don't need to stop most of the time in a line while paying tax at toll station, this system guarantees time saving, fuel conservation and also helpful in saving of money.

Chapter 1

Introduction

1.1. Introduction to Development of Electronic Toll Plaza:

Presently multi days traffic issue is an exceptionally serious issue in our nation. In Pakistan, consistently we need to face road turned parking lot for a few hours which is irritating simultaneously making an immense inconvenience in our day by day life. Due to heavy traffic this system provides ease to the driver. For the decrease of traffic issue government has made numerous extensions, fly over's and sidestep streets. Individuals need to give toll when they pass these by any vehicle. Because of RFID innovation this framework will lessen the congested road. Here, the installment will be taken from the ledger of the vehicle proprietor and he will get a message from the server that the toll installment has been taken. Moreover, this framework will likewise settle the traffic serious accidents, which is principally brought about by over speeding and utilized speed breaker to hinder the speed of the vehicles when RFID label will peruse the data of the vehicles.

Problem Statement:

Conventional toll gathering framework or manual toll accumulation framework is the least complex type of toll gathering. This strategy is slower and in some cases not impeccable too. A couple of people sit in the toll gathering stall and stop every vehicle to gather the toll physically. The authority gives a reminder to the drivers as a record of toll installment. Besides, in Asia bunches of defilements are occurring in this segment. There is no focal controlling framework for the toll accumulation, all the data with respect to installments are stored in a database or site.

Problems:

- This system is slower.
- Creates traffic jam as every vehicle has to stop.
- Corruption is happening.

1.3. Advantages of Electronic Toll Collection System:

Advantages of electronic toll collection system are as follows

1.3.1. Expanded Capacity:

Electronic Toll Collection System will set the limit of vehicle when passing the toll square as it is partitioned by four paths. In addition this framework is mechanize in such a way that it will expand the limit of vehicle when passing the toll corner.

1.3.2. Fuel Sparing:

The deceleration, increasing speed and lingering is totally wiped out. This results in fuel saving for the benefactors utilizing Electronic Toll Collection System. The disposal of speeding up and deceleration brings about decrease of the working expense of the vehicles.

1.3.3. Working Cost Sparing:

Over a timeframe, the toll gathering cost becomes lesser. There is decrease in the man hour required therefore framework does not need such human association for the toll station. Efficient ETC clients don't stop for paying toll, consequently there is significant sparing in the movement time.

1.4. Inspiration and Goals:

1.4.1. Inspiration:

The inspiration towards working on this project is to solve the traffic problems and also to control the flow of traffic during working hours also in toll station. The target is to make a digital toll collection system which will be time savior and more productive.

1.4.2. Goals:

The goals are:

1. Introduce Electronic Toll Plaza System.
2. Comparison of our system with the old traditional toll plaza system.
3. Sharing of all the benefits of this system.

1.5. Thesis Plan

This report contains a comprehensive study of the undergoing project discussing each and every step till completion. Chapter 2 presents an overview of the hardware components present in our project. Implementation of the system based on information overviewed is present in chapter 3. Working procedure of the project and conclusions are discussed in chapter 4.

Chapter 2

Hardware Components

2.1. List of Components:

1) Microcontroller Atmega328P
2) Arduino NANO
3) RC522 RFID Module
4) 16x2 LCD
5) 4x4 keypad Module
6) IR Sensor
7) Servo motor
8) Buzzer
9) Resistors
10) Wires

2.1.1. Atmega328P

ATmega328P is a 8 bit micro-controller embedded on an Arduino NANO board. It has following parameters [1]

Parameters	Value
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz
Flash memory	32 KB
SRAM	2KB
EEPROM	1 KB
Pins	28
Max Op frequency	20MHz
Maximum I/O pins	23
External interrupts	2
Crystal Oscillator	16MHz

Figure 2.1 Specifications of Atmega328P

It has total 28 pins. 6 pins can be used as PWM outputs and it has 6 analog input pins. The figure below gives a description for each of the pins, along with their function.[2]

Pin Number	Description	Function
1	PC6	Reset
2	PD0	Digital Pin (RX)
3	PD1	Digital Pin (TX)
4	PD2	Digital Pin
5	PD3	Digital Pin (PWM)
6	PD4	Digital Pin
7	Vcc	Positive Voltage (Power)
8	GND	Ground
9	XTAL 1	Crystal Oscillator
10	XTAL 2	Crystal Oscillator
11	PD5	Digital Pin (PWM)
12	PD6	Digital Pin (PWM)
13	PD7	Digital Pin
14	PB0	Digital Pin
15	PB1	Digital Pin (PWM)
16	PB2	Digital Pin (PWM)
17	PB3	Digital Pin (PWM)
18	PB4	Digital Pin
19	PB5	Digital Pin
20	AVCC	Positive voltage for ADC (power)
21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

Figure 2.2 Description of Pins of Atmega328P

2.1.2 Arduino NANO

Overview:

It is microcontroller board which is supported by ATmega328P. It contains 14 I/O digital pins , 8 analog inputs, a cable and two reset pins. [3]

- Following figure shows the specifications of Arduino NANO board

Microcontroller	Atmega328p/Atmega 168
Operating Voltage	5V
Input Voltage	7 – 12 V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512bytes or 1KB
USART	Yes

Figure 2.3 Specifications of Arduino Nano

Arduino Nano Pinout

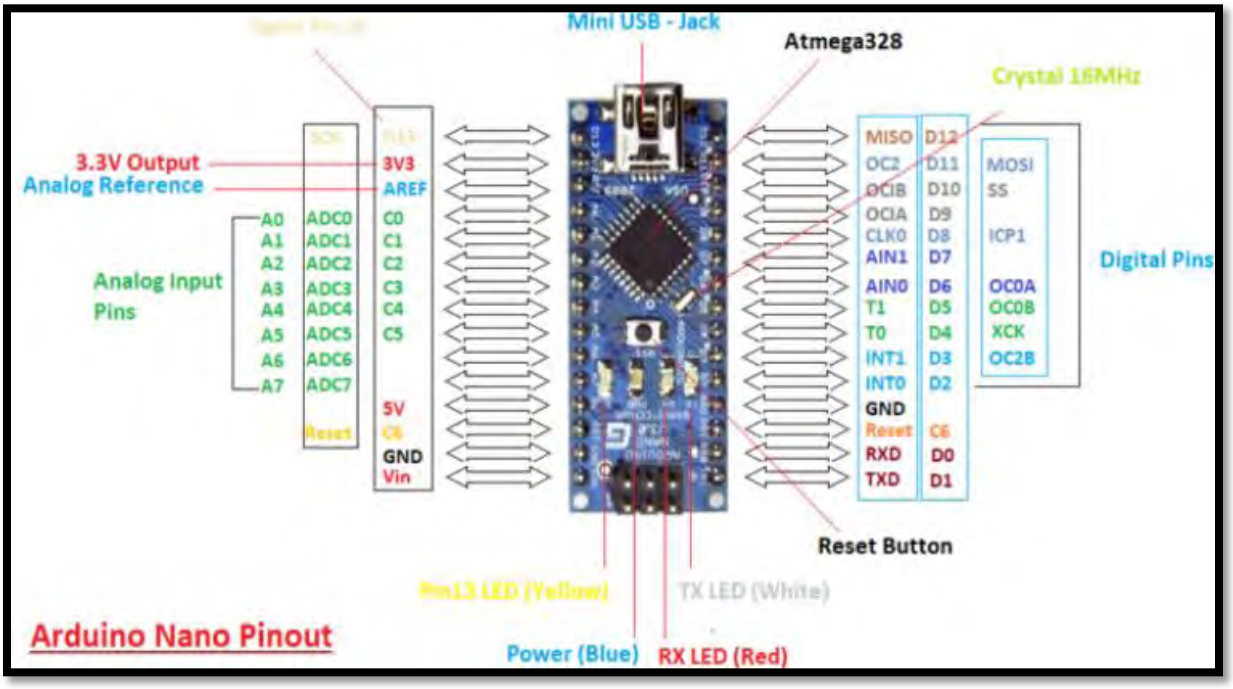


Figure 2.4 Pinout of Arduino Nano

As seen in the figure on the left side of the board there are analog pins ranging from A0 to A7. Also there are voltage and ground pins are available on left side of Arduino Nano board. On the right side of the board there are digital pins, reset pin, receiver pin, transmitter pin and a reset pin.[4]

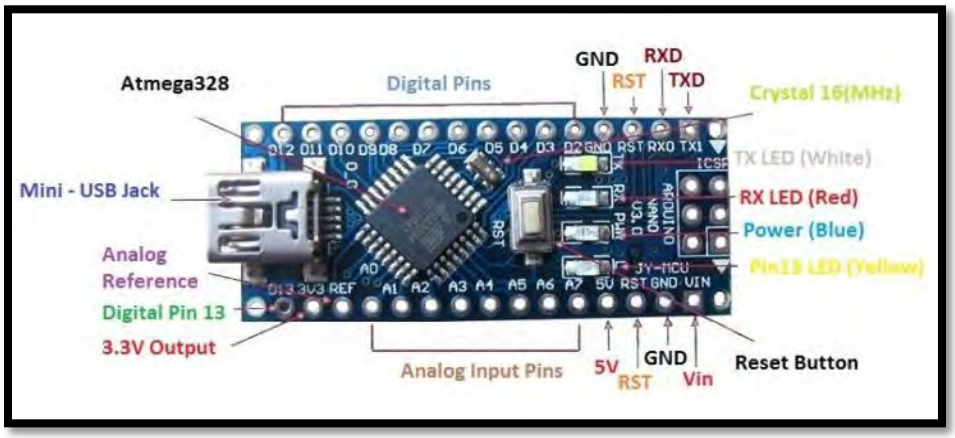


Figure 2.5 Arduino Nano Board

2.1.3. RC522 RFID Module:

The RC522 is a radio frequency module that contains a" RFID reader", "RFID card" and a "key chain". Whenever a person needs to use a unique identification, he use RFID.

Memory of the keychain is 1KB. It is used to reserve data and make it unique. This module is able to read and write data simultaneously.

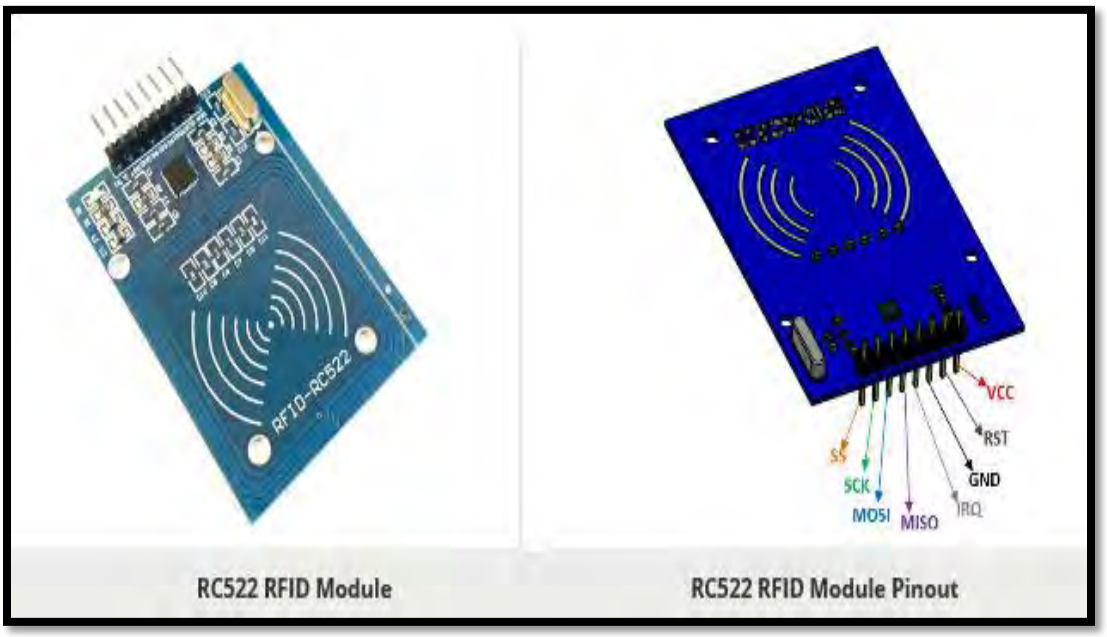


Figure 2.6 RFID Module

How to use RFID Module?

This module requires normally 3.3 volts to operate properly. Most of the times it waits for the tag to come into its range and it detects that. With the help of "IRQ" pin present on module we can power down the reader. 10uA is the amount of current used by this module while power down mode.

Pin Configuration

- "VCC" is the first pin and it is used to give voltage to module normally 3.3V is preferred.
- "RST" is the second pin used to bring the module in reset mode.
- "GND" is the third pin and it is connected normally to system's ground pin
- "IRQ" Interrupt pin is the fourth pin used to let module active when some device comes near the module.

- “MISO” pin and “MOSI” pin are both used for serial peripheral interface communication.
- “SCK” is the second last pin and it is a source of providing clock.
- “SS” pin is termed as serial input and used for SPI communications

RC522 Features

1. Voltage is operated at 2.5V to 3.3V
2. It can read a card nearly 5cm
3. Current which we can provide to it is 13-26 milli amp.

2.1.4. LCD Display (16x2)

LCD stands for Liquid Crystal Display. It is an electronic display module which is extremely used in many devices and circuits. The reasons why we are using LCDs are these are cheaper to buy, easy to handle while coding and easily mounted on breadboard or helpful in final year projects.

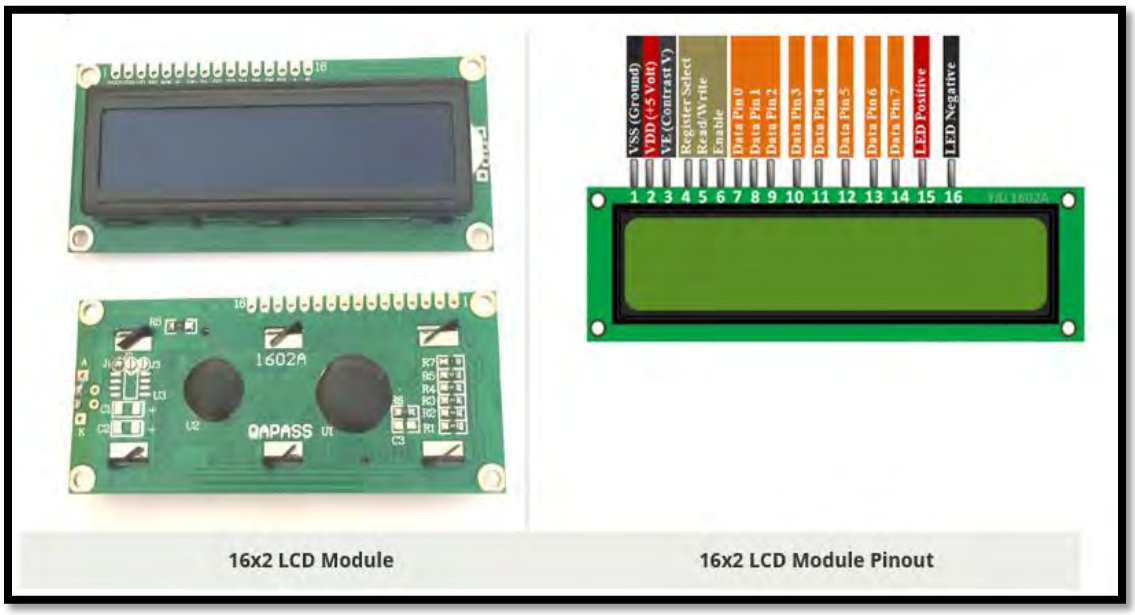


Figure 2.7 16x2 LCD

16x2 depicts that it has total two lines and in each line there is a display of maximum sixteen characters. Every character is displayed in “5x7 pixels”.

Pin Configuration

Pin No:	Pin Name:	Description
1	Vss (Ground)	Ground pin connected to system ground
2	Vdd (+5 Volt)	Powers the LCD with +5V (4.7V – 5.3V)
3	VE (Contrast V)	Decides the contrast level of display. Grounded to get maximum contrast.
4	Register Select	Connected to Microcontroller to shit between command/data register
5	Read/Write	Used to read or write data. Normally grounded to write data to LCD
6	Enable	Connected to Microcontroller Pin and toggled between 1 and 0 for data acknowledgement
7	Data Pin 0	
8	Data Pin 1	Data pins 0 to 7 forms a 8-bit data line. They can be connected to Microcontroller to send 8-bit data. These LCD's can also operate on 4-bit mode in such case Data pin 4,5,6 and 7 will be left free.
9	Data Pin 2	
10	Data Pin 3	
11	Data Pin 4	
12	Data Pin 5	
13	Data Pin 6	
14	Data Pin 7	
15	LED Positive	Backlight LED pin positive terminal
16	LED Negative	Backlight LED pin negative terminal

Figure 2.8 Pin Description of 16x2 LCD

Pin number 7 to pin number 14 are all data pins which can be interfaced with digital pins of Arduino.

2.1.5. 4x4 Keypad Module

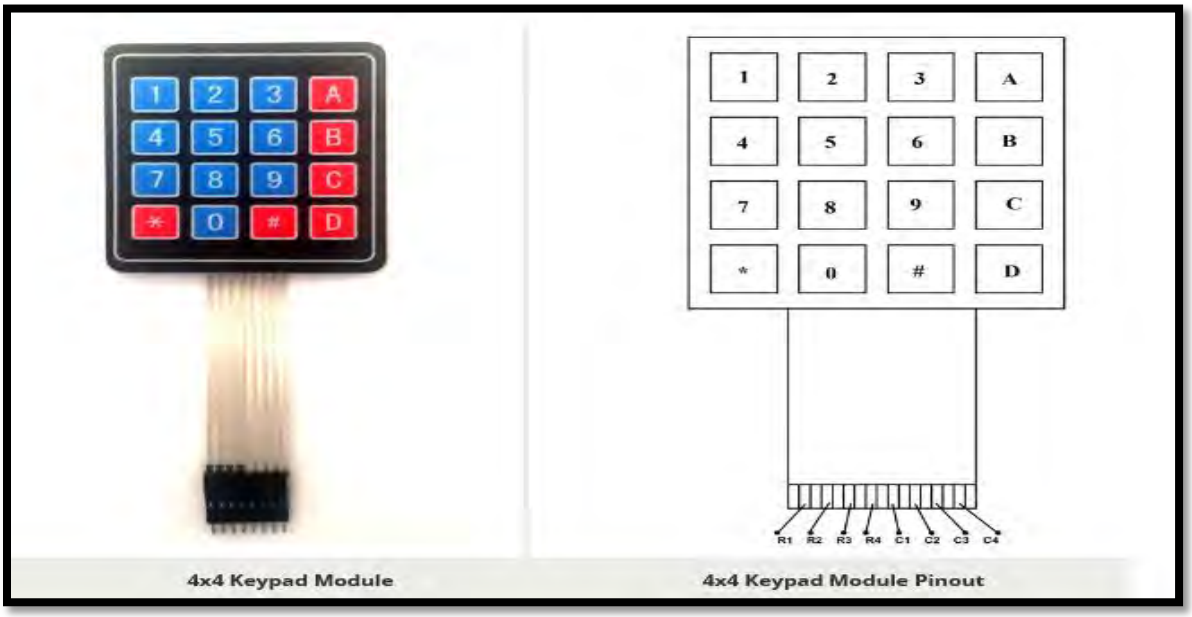


Figure 2.9 4x4 Keypad

4X4 KEYPAD Pin Configuration

PIN1 is represented by R1

PIN2 is represented by R2

PIN3 is represented by R3

PIN4 is represented by R4

PIN5 is represented by C1

PIN6 is represented by C2

PIN7 is represented by C3

PIN8 is represented by C4

These 8 PINS are ejected from 16 buttons present in the keypad.

Specifications

1. Total voltage across any button is 24V
2. Number of maximum current passes through every button is 30 milli amp.
3. Temperature range for operation is 0°C to + 50°C
4. Slim and smart design

2.1.6. IR Sensor

IR sensor uses “Infrared” radiations to emit and detect the amount of light that returns. IR sensor detects the amount of heat and motion of object as well.[5]

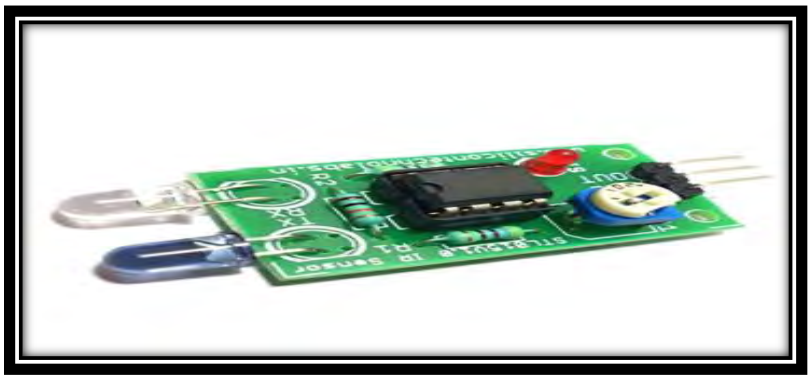


Figure 2.10 IR Circuit

Operation of IR Sensor:

IR Sensors works in such a way that there are two led’s present in it. Initially when some object comes near the IR sensor its first led detects the object by throwing light on that object. Then that light strikes with that object and bounces back and allow second led to glow. This indicates the working of IR sensor. This can also help in controlling blink of a led.

Detecting

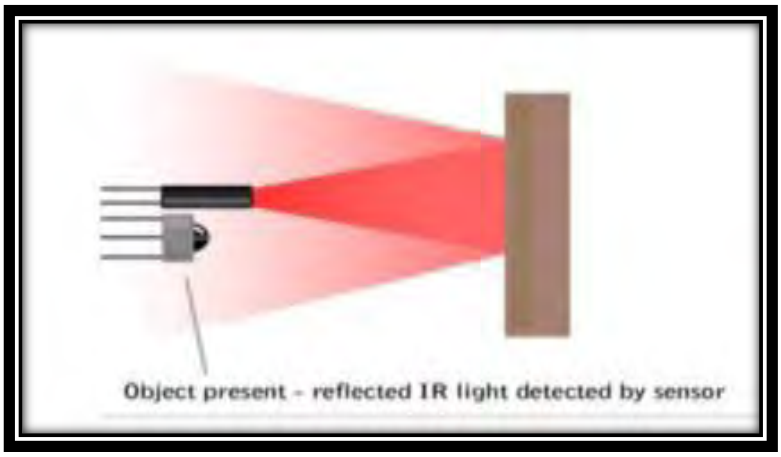


Figure 2.11 IR Detection

2.1.7 Servo Motor

Sometimes production of big power on output side is mandatory for that purpose a small and less weight motor is required. This is known as servo motor. It has metal gears for adding extra strength and make it long lasting. Its rotation is almost “180 degrees”. It is best suitable for remote control helicopters and in robotics.

Specifications

1. Its weight is almost “13.4 g”
2. Dimension is “22.5 x 12 x 35.5”
3. Operated at a speed of “0.1 s/60 degree”
4. Operated at a voltage of “4.8 V”

Wire Configuration:

- First wire is brown in colour and it is connected to ground of the system.
- Second wire is red in colour and it is connected to 5V of the system.
- Third wire is orange in colour and PWM signal is given in through it to drive the motor.

2.1.8 Buzzer:

Buzzer is a mini component used to include audio features in this project. It has only 2 pins therefore can be easily implemented on breadboard.

It only needs voltage in between 5-9V.

Figure 2.12 Buzzer

Chapter 3

Interfacing of components and Implementation

3.1. Arduino IDE

- It is a software used for writing and compiling the code on board.
- It is feasible for operating systems like Windows, Linux etc.
- Sketch which is also known as the main source code written in Arduino IDE produces a “Hex File”. Then this Hex file is uploaded on the board.
- The Arduino IDE supports both C and C++ languages.

When Arduino IDE is opened it appears as

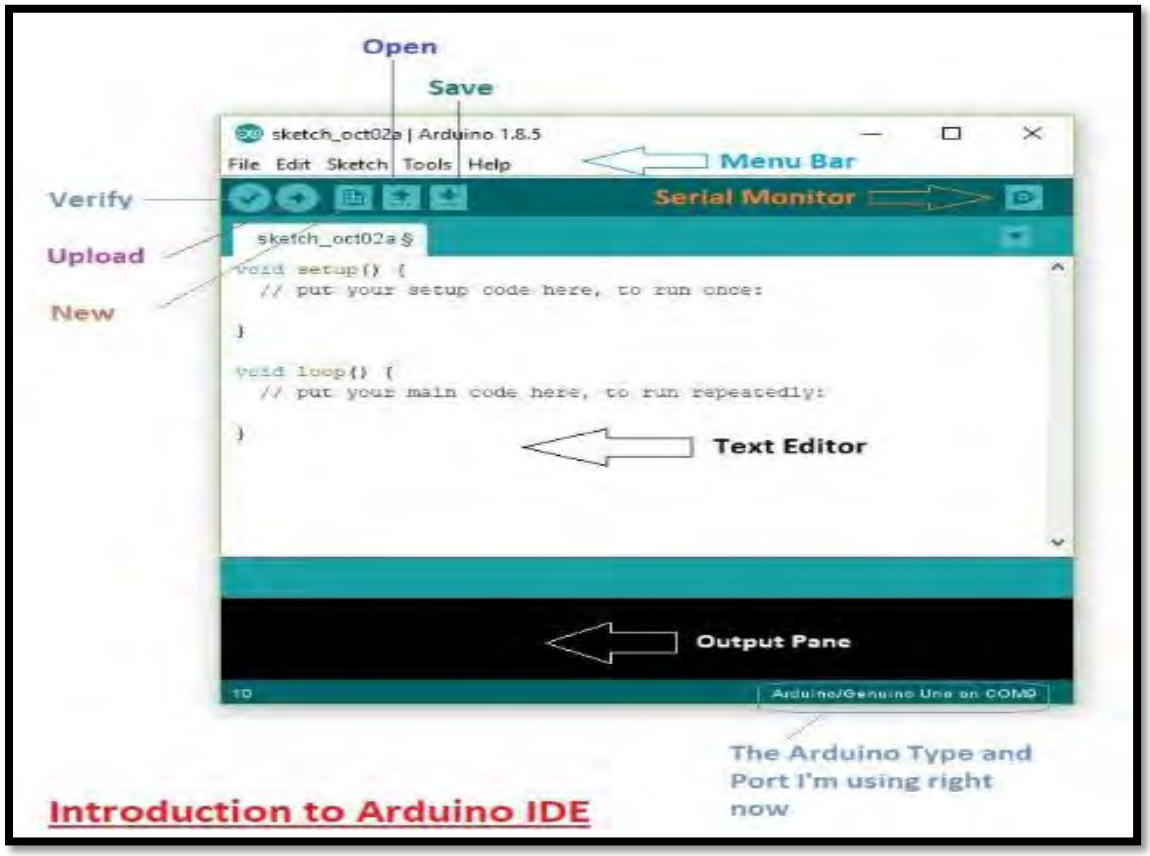


Figure 3.1 Arduino IDE Main Page

Menu Bar present on the top of page have the following five options.

- **File** : To write new code or to change the existing code file option is used. On clicking file option following sub options appear.

File	
New	This is used to open new text editor window to write your code
Open	Used for opening the existing written code
Open Recent	The option reserved for opening recently closed program
Sketchbook	It stores the list of codes you have written for your project
Examples	Default examples already stored in the IDE software
Close	Used for closing the main screen window of recent tab. If two tabs are open, it will ask you again as you aim to close the second tab
Save	It is used for saving the recent program
Save as	It will allow you to save the recent program in your desired folder
Page setup	Page setup is used for modifying the page with portrait and landscape options. Some default page options are already given from which you can select the page you intend to work on
Print	It is used for printing purpose and will send the command to the printer
Preferences	It is page with number of preferences you aim to setup for your text editor page
Quit	It will quit the whole software all at once

Figure 3.2 File Options

- **Edit** : For increasing/decreasing of font size, copy and paste options are available.
- **Sketch** : For Compile, Upload and include library options.
- **Tools** : For Selecting board, ports and serial monitor options.
- **Help** : It is useful to help the users who are using it first time.

Just below Menu bar following six options are available.

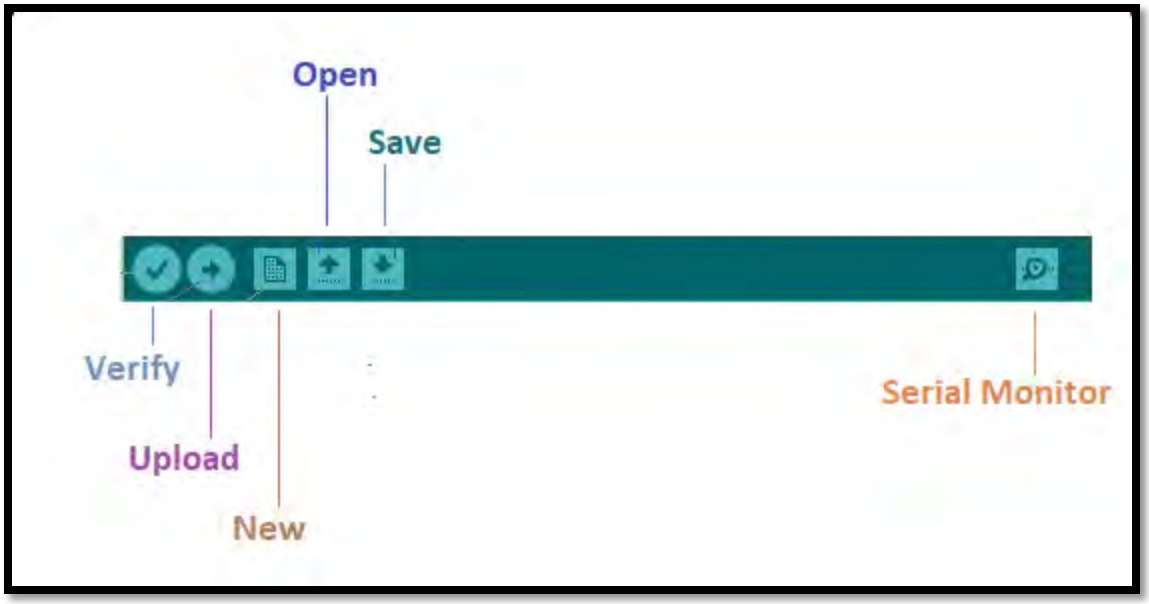


Figure 3.3 Menu Tab Details

- The tick mark button is used for checking that either the source code for particular circuit diagram is error free or not.
- The arrow button is used for uploading the desired code on board.
- The dotted paper option is accounted for making a new code.
- The upward arrow is used for opening an existing code.
- The downward arrow is accounted for saving of source code which is currently written.
- Just after this option there is a serial monitor option. A new page appears that shows the serial output of our code.[6]

Libraries

Although there is a list of libraries which are in-built in the Arduino IDE software but still there is an option of downloading extra libraries via internet. The libraries can be added in the source code just by opening the option of sketch by clicking on “include library option”. When this option is opened just click on “Add .ZIP library” option and then double click on the library where it is present.

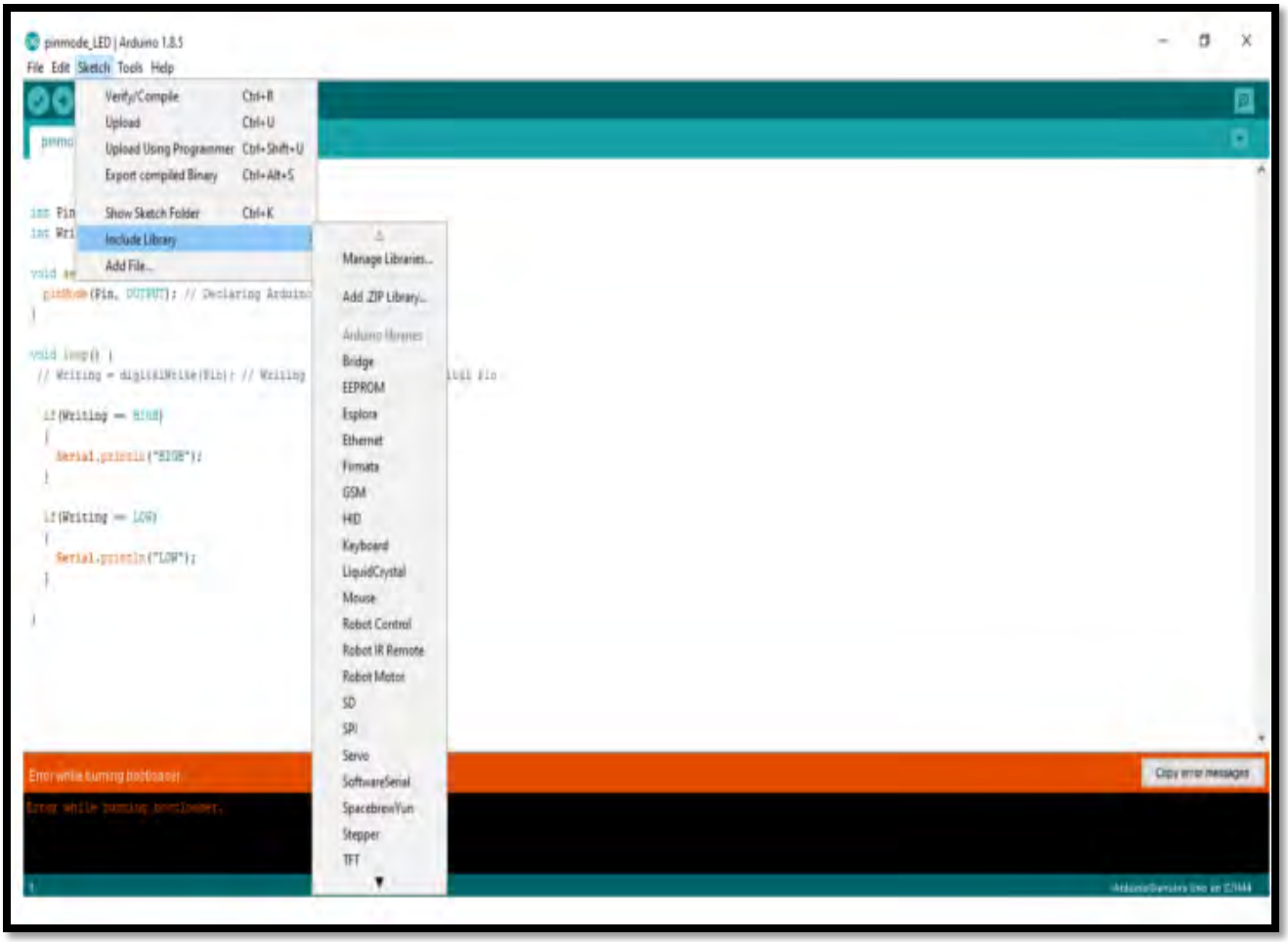


Figure 3.4 Method of Including Library

Making Pins Input or Output

For taking input or output from pins of the Arduino IDE, “digitalRead” and “digitalWrite” commands are used in this software. e.g digitalWrite(13,HIGH)

Disconnect Arduino from Computer

It is important to disconnect the Arduino port from computer before making any further changes in the connection of the required components and the Arduino board.

3.2. Interfacing of Components with Arduino

The interfacing of components with Arduino is listed below.

3.2.1. RFID and Arduino:

First of all Arduino and RFID reader is connected. The source code for proper working of the RFID is developed and uploaded on the Arduino board. By executing the source code, working of RFID with Arduino board is checked.

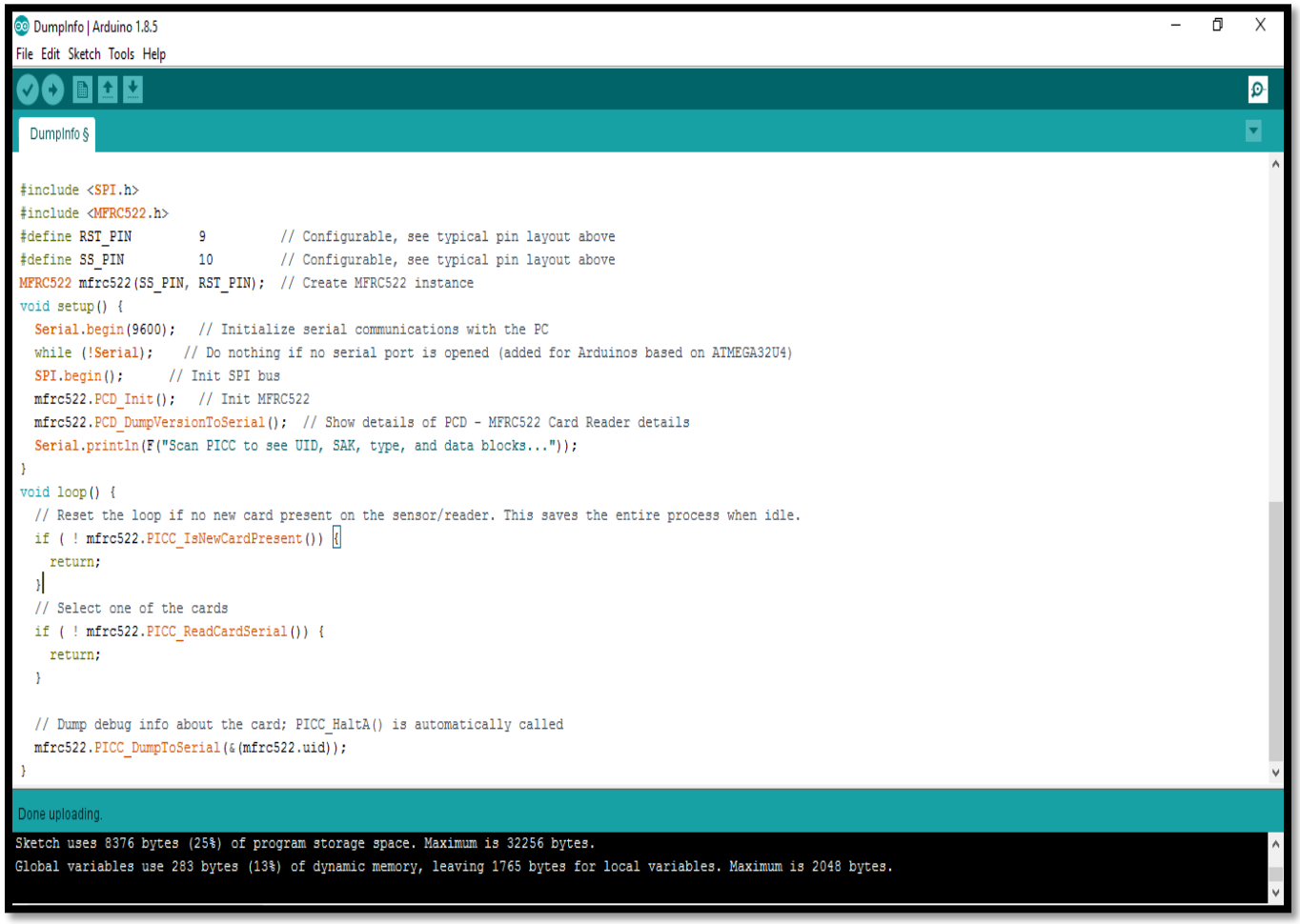
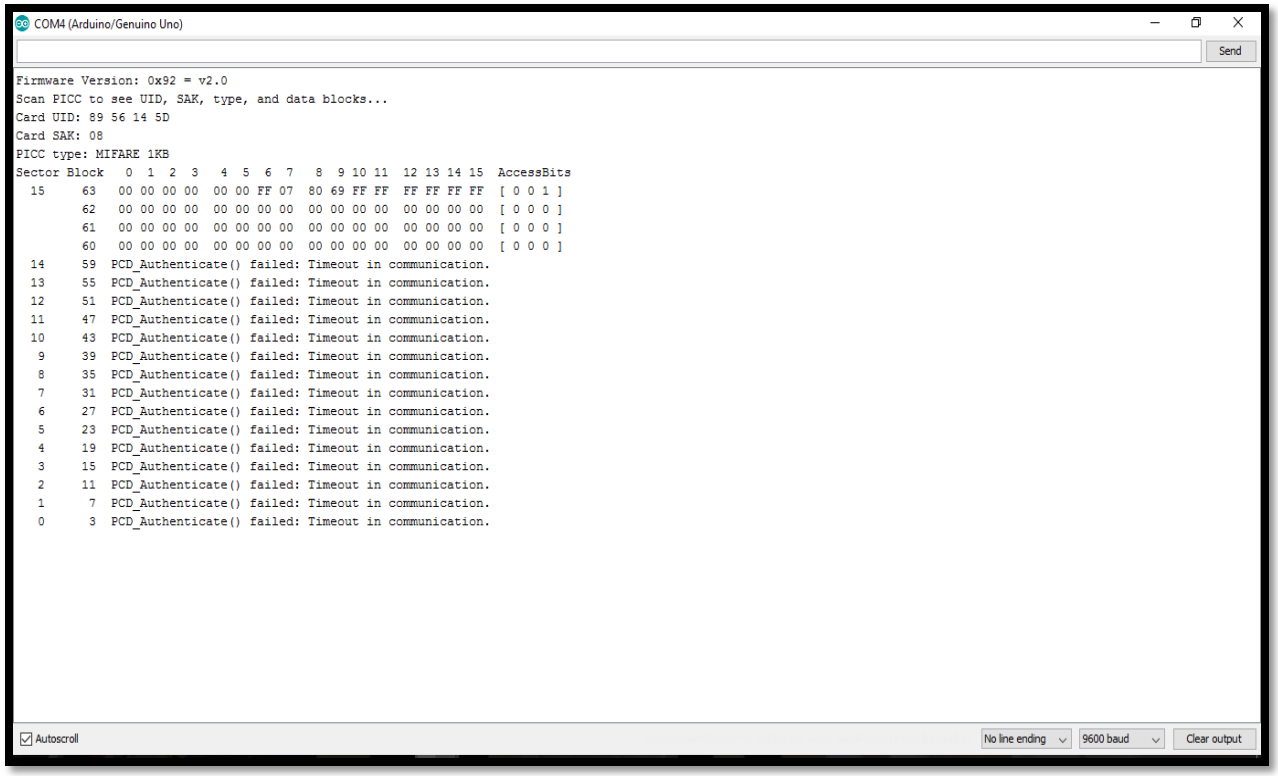


Figure 3.5 Code for RFID Test

The key chain and RFID card are scanned through the RFID reader. The results of the scanned keychain and RFID card are displayed on the serial monitor in the following ways.



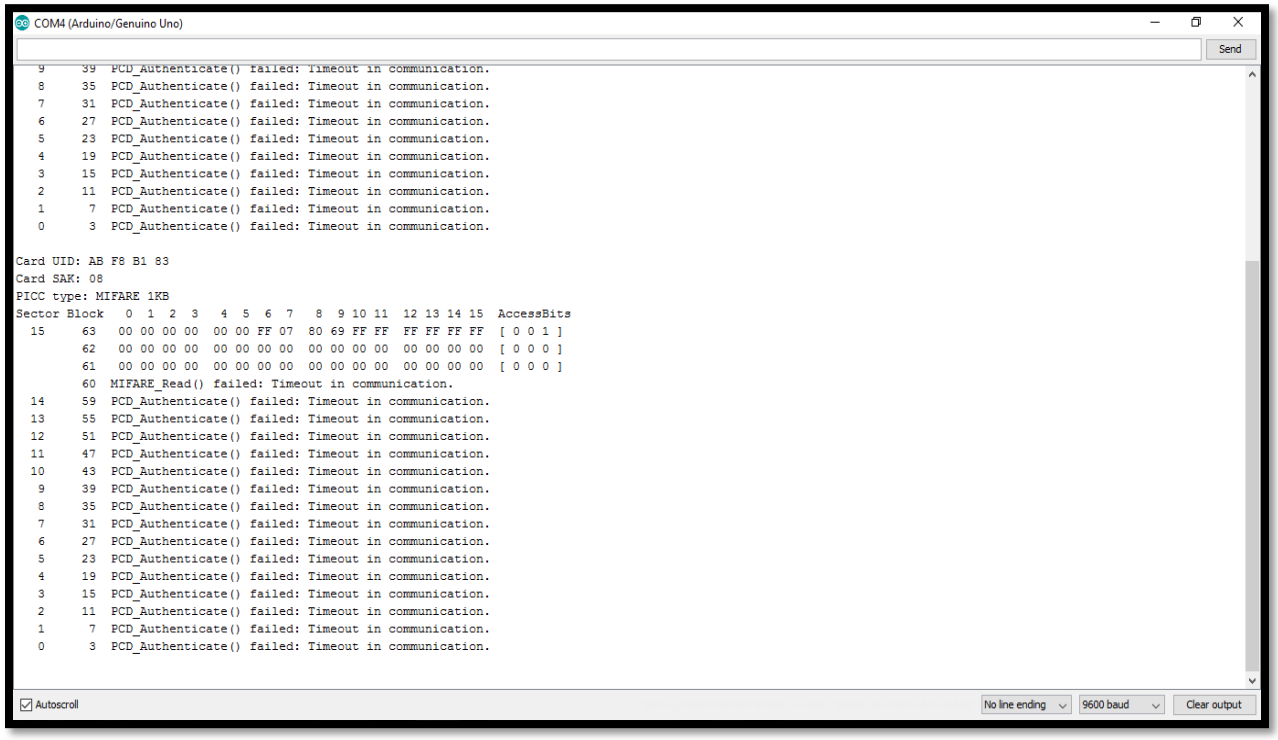


Figure 3.6 RFID Output on Serial Monitor

The keychain number “Card UID: 89 56 14 5D” and the RFID card number “Card UID: AB F8 B1 63” appeared on the screen are used in the project code.

3.2.2. IR Sensors and Arduino Board

Arduino board and IR sensors are connected and the proper working of the IR sensors is checked by uploading and executing the source code of the Arduino board.

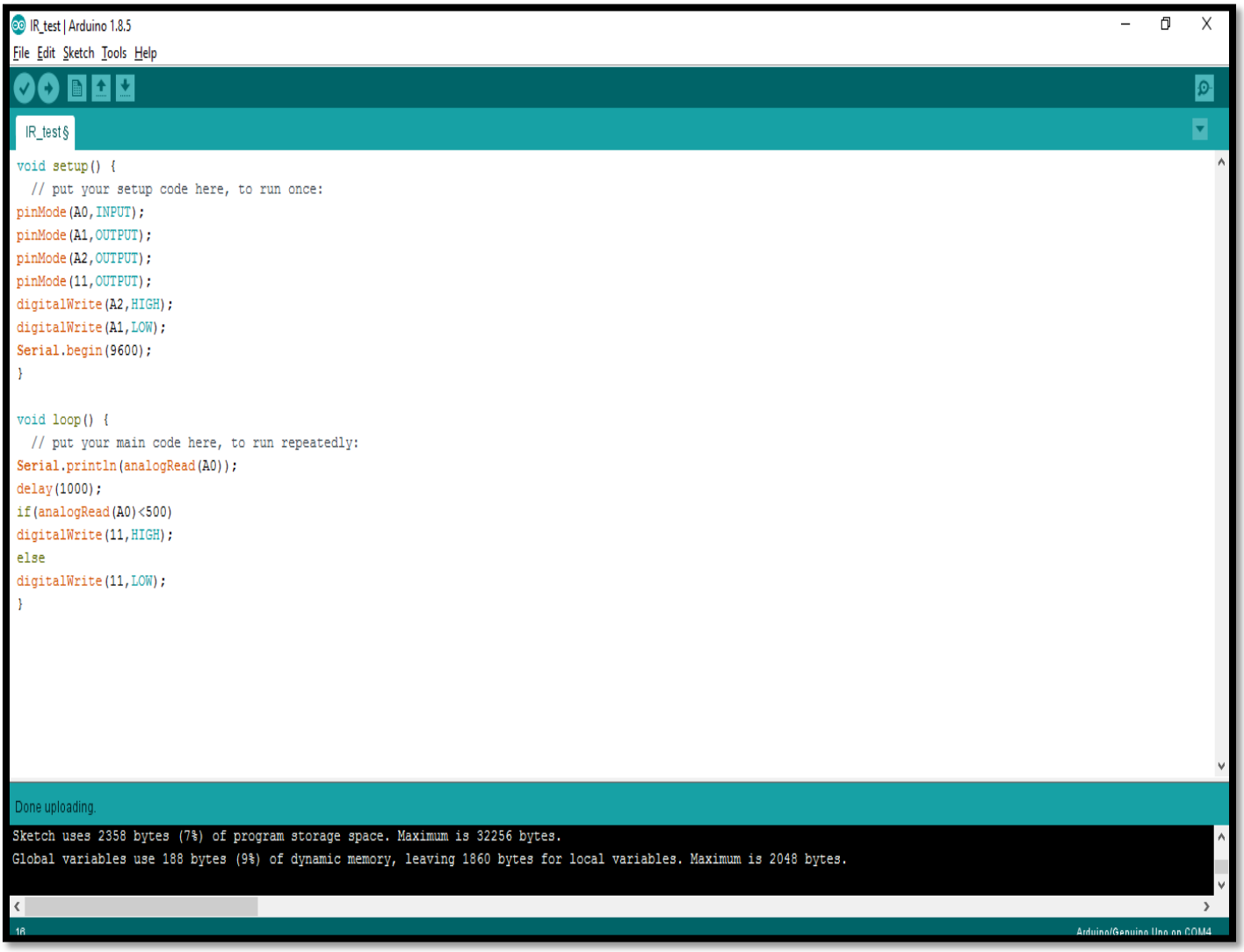


Figure 3.7 Code for LED Blink Control via IR

The ranges of 142-152 and 170-178 for the two sensors are displayed on the serial monitor for barrier obstacle at less distance and barrier at more distance respectively.

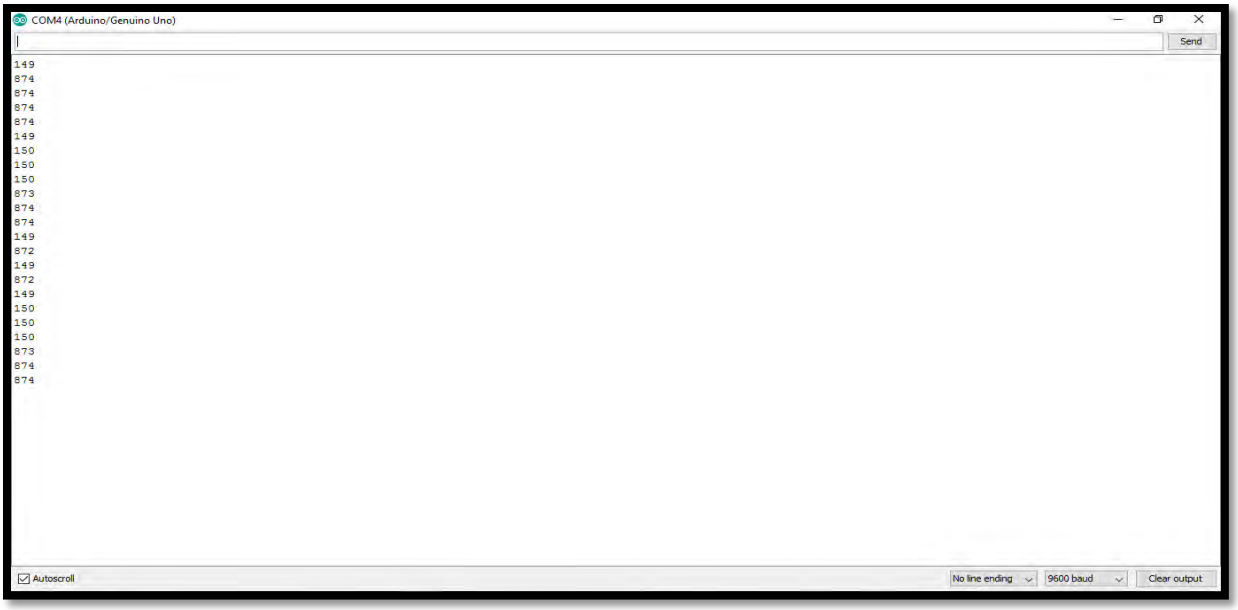


Figure 3.8 Output of IR Sensor at Serial Monitor

3.2.3. Servo Motor and Arduino

Similarly Arduino board and Servo motor are connected. The source code is developed and uploaded on the board. The execution of the code confirms the proper working of the servo motor.

Figure 3.9 Codes of Servo Motor

Different cases of servo motor like varying the speed of rotation and altering the angle of movement are observed.

3.2.4. 4x4 Keypad and Arduino

Here Arduino board and 4x4 keypad are connected. The source code for proper working of the 4x4 keypad is developed and uploaded on the board. By executing the source code, 4x4 keypad working with Arduino is checked.

For example on pressing 1 it shows 1 on serial monitor or not. There are 4 rows and 4 columns on the keypad. The objective is to display all of the buttons on the serial monitor.

Figure 3.10 Code for 4x4 Keypad Display

The output of the serial monitor looks like as.

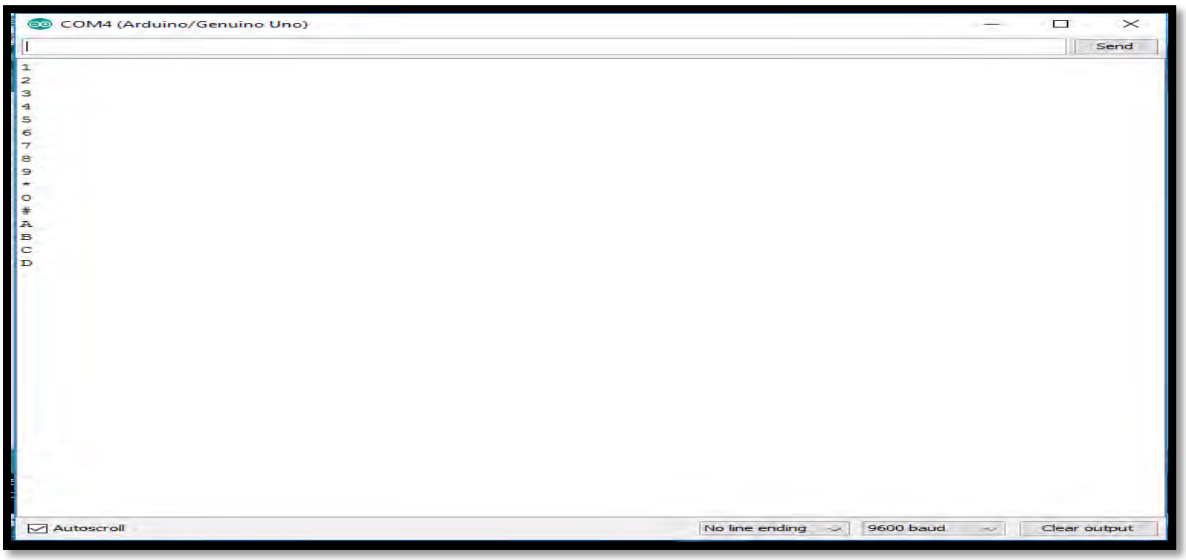


Figure 3.11 Output of Keypad on Serial Monitor

3.2.5. 16x2 LCD and Arduino

There is an inbuilt library of LCD in Arduino IDE. After developing and uploading the code on Arduino board the message is displayed on the LCD screen and its working is confirmed.

Figure 3.12 Arduino Code for LCD

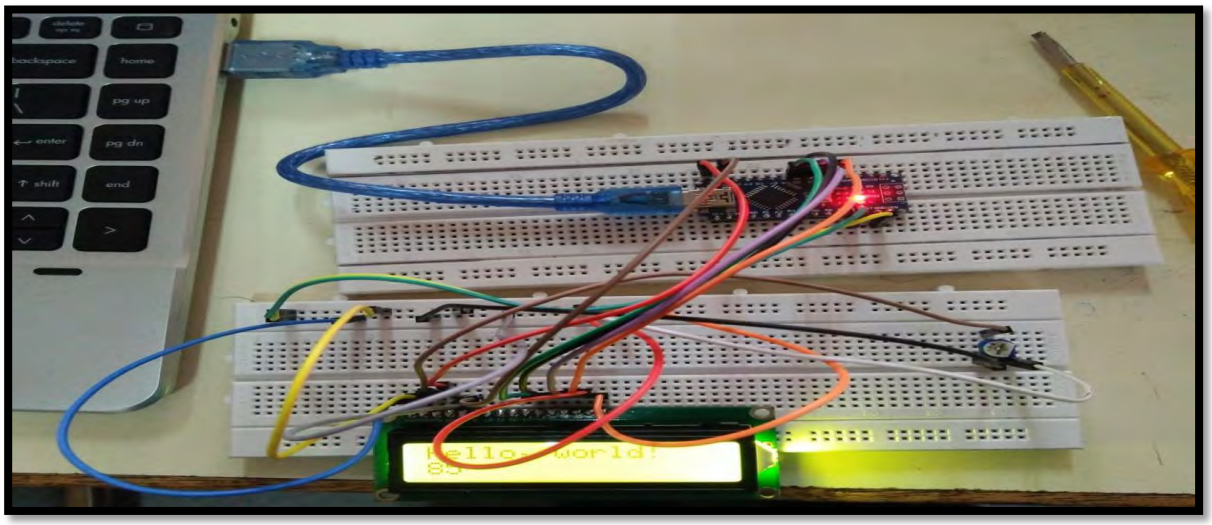


Figure 3.13 16x2 LCD Output

Chapter 4

Automatic Toll Collection System Using RFID

4.1. Working

In the beginning car comes on the track and IR sensor 1 detects it's presence. After detecting its presence it sends a message to the microcontroller board after which sends a signal to the LCD. Then a message is displayed on the LCD "Vehicle Detected". Then the LCD shows next message "Put your card on the reader". Barrier stays up when there is no vehicle and it gets down when vehicle is detected by using servo motor. Now the driver gets his RFID card scanned. IR sensor 2 is used to keep track of the vehicle movement and scanning of the RFID card. There is a barrier available for keeping vehicle stop which is controlled by a servo motor. RFID reader scans the card and send a signal to the microcontroller which passes its signal to the IR sensor 2. If the driver have enough balance to pay the toll tax then his tax is being deducted and LCD shows a message " Your remaining balance is …". Car passes through second IR sensor and the barrier gets opened and driver safely passes through the barrier. Then the LCD displays a new message "Have a safe journey".

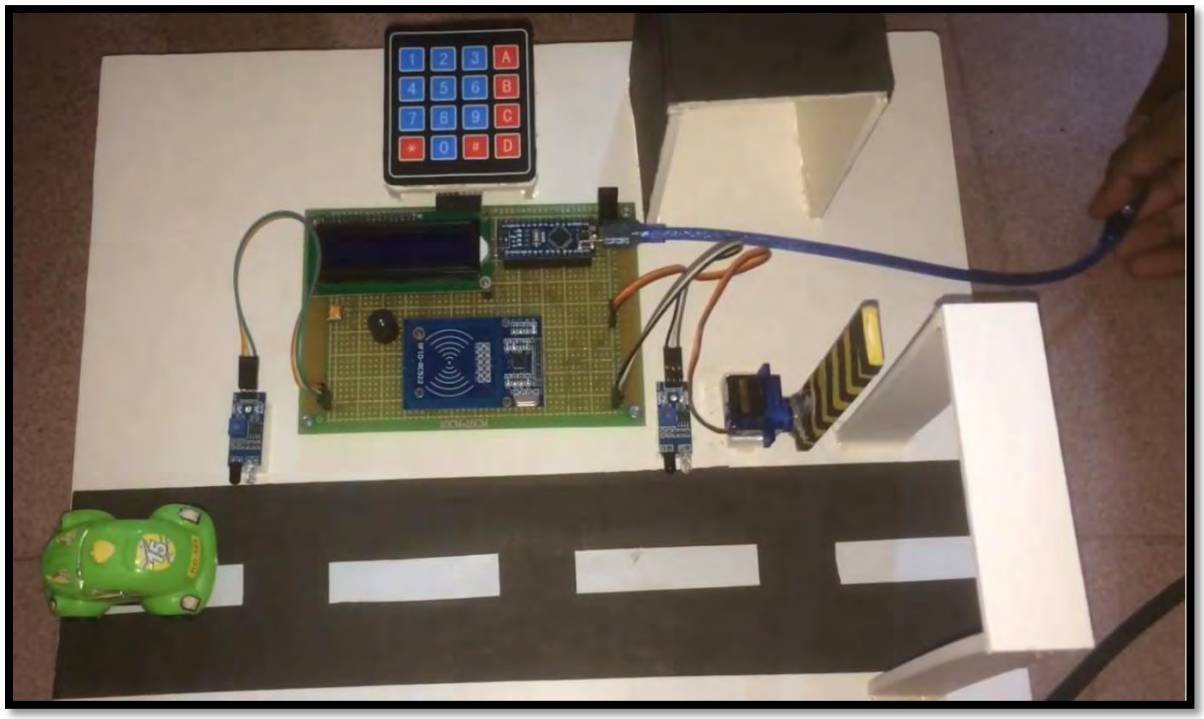


Figure 4.1 Prototype Model [7]

Here are some cases when a driver enters toll station.

Case 1: When registered car entered the track means it has RFID card. The vehicle easily passes the barrier if RFID card has enough balance to pay the toll tax.

Case 2: When registered car entered the track and unfortunately has not enough balance in the RFID card to pay the toll tax, the system provides option of recharging RFID card for its usage. After recharging the RFID card the car may pay the toll tax and cross the barrier. The driver recharges his balance, again scans his RFID card and pay the tax. Respective amount is deducted from the balance and he easily passes through. Barrier does not opens until the driver pays the toll tax till then he has to wait to recharge and move on.

Case 3: When a non-registered car enters the track. In this case the first IR sensor detects the vehicle and let it go. But the barrier stops it and demands the scanning of RFID card. Due to non-availability of RFID card a message is displayed on the LCD "Unauthorized vehicle Access denied". In this case the driver will have to contact the person available on the toll station to pay the tax manually.

4.2. Block Diagram

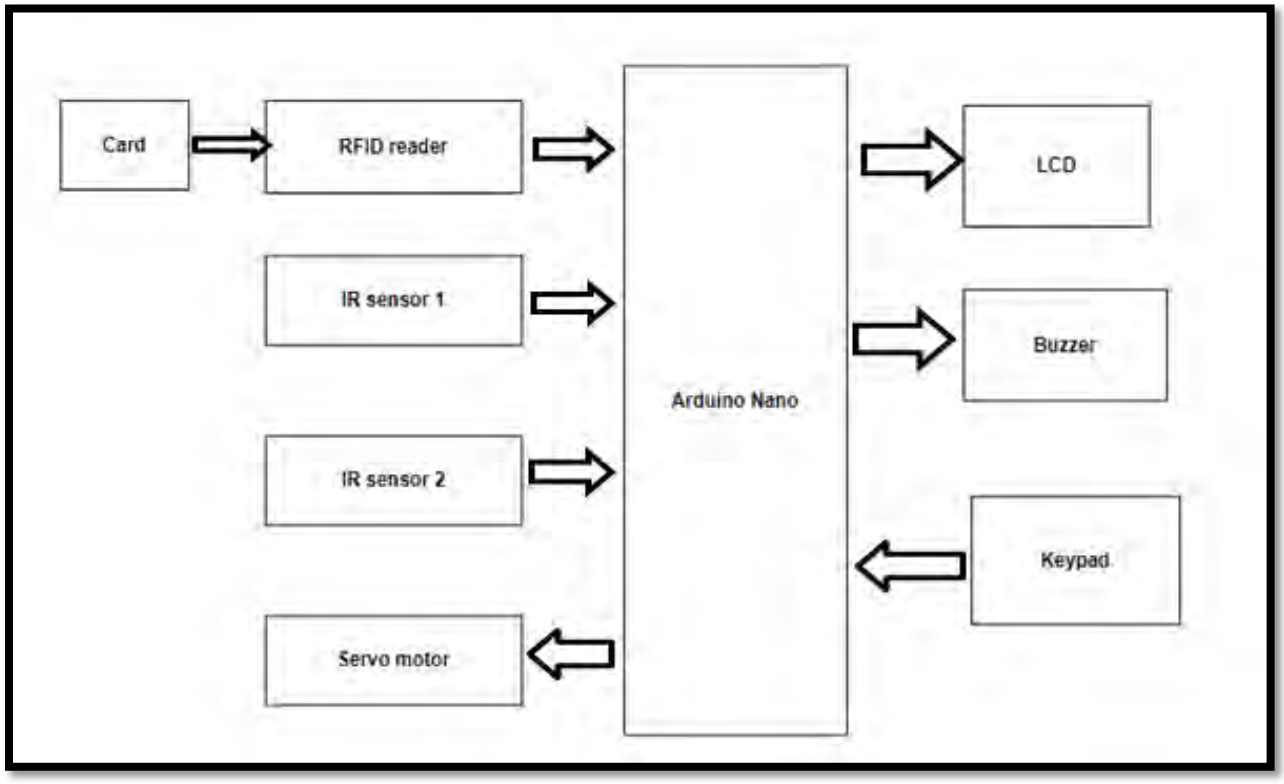


Fig. 4.2 Block Diagram of the Project

4.3. Flow Chart

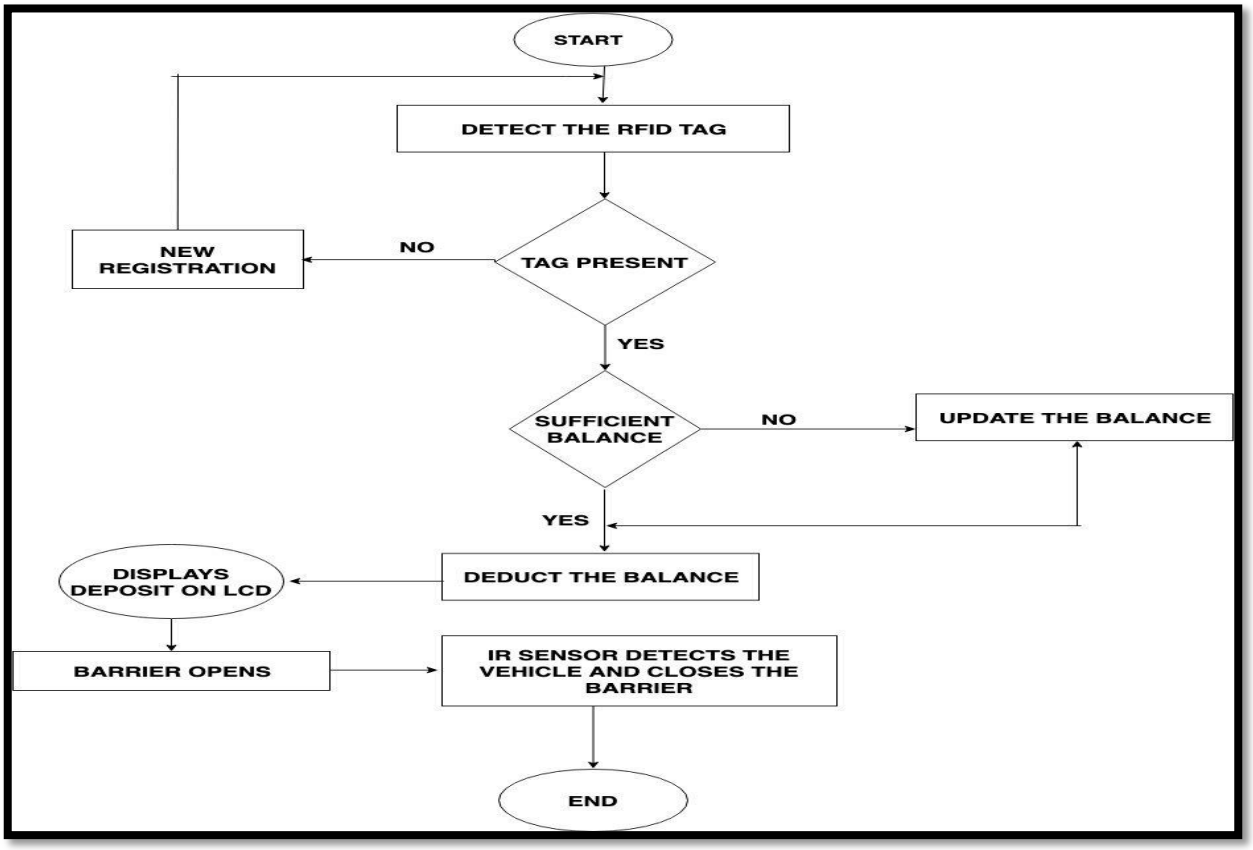


Fig. 4.3 Flow Chart of the Project

4.4. Circuit Explanation

Arduino Nano is the heart of the project. Rest of the components are attached with it. IR sensor 1 have 3 pins i.e Out, Gnd and Vcc. Ground pin is interfaced with ground of Arduino Nano, Vcc pin is joined with the 5V pin of the Arduino and the Out pin is joined with the analog pin A2 of Arduino. Purpose of this Out pin is to give output to Arduino to detect the vehicle and display it's message on the LCD with 16 pins. Out of these 16 pins 12 pins are used. Pin 1 is grounded, pin 2 is connected with the 5V of Arduino, pin 3 is connected with the center pin of potentiometer, pin 4 is connected with the D7 pin of Arduino, pin 5 is connected with ground of Arduino, pin 6 is connected to the D6 pin of Arduino, pin 11- pin 14 are connected with D5-D2 of the Arduino, pin 15 is connected with the 220 ohm resistor which is connected with one pin of potentiometer and then with 5V of Arduino and pin 16 is joined with the ground of Arduino as well as with the 4.7K resistor. LCD is used to display the messages when the car enters, leaves or when there are some issues regarding paying of toll tax.

When the car reaches near second IR sensor the driver faces the obstacle. To remove this obstacle RFID card is scanned to pay the tax. RFID card reader having 8 pins is used to scan the card which has 8 pins. Pin 1 is connected to the voltage pin of servo motor and with the 3.3V pin of the Arduino. RST pin (reset pin 2) is connected to D8 of Arduino, pin 3 is connected to the pin of potentiometer and with the PWM pin of servo motor. Pin 5- Pin 8 are connected with D10-D13 of the Arduino. It scans the RFID card and sends a message to the microcontroller. Tax is deducted from the RFID card of the car. The remaining balance of the RFID card is displayed on LCD. After this IR sensor 2 detects the movement of the car to let the servo motor to up the barrier until the car crosses it. While scanning the RFID card buzzer beeps. Buzzer has 2 pins one is connected to the IR sensor's ground pin while the other one is connected to analog input pin A4 of the Arduino.

Servo motor has 3 pins, pin 1 is in connection with the D9 of Arduino, pin 2 is connected with the 5V of Arduino and pin 3 is joined with the ground of RFID reader. The function of this servo motor is to make the barrier open or close for the vehicle. In case of less balance in the RFID card the driver needs to recharge his account by using 4x4 keypad installed on the toll station. This keypad has 8 pins. Pin1-pin4 are connected to 4.7k resistors and pin5-pin8 are connected with 1k resistors. Pin 1 is also connected with the 5V of Arduino. Connections of IR sensor 2 are also same like IR sensor 1.

4.5. Circuit Diagram

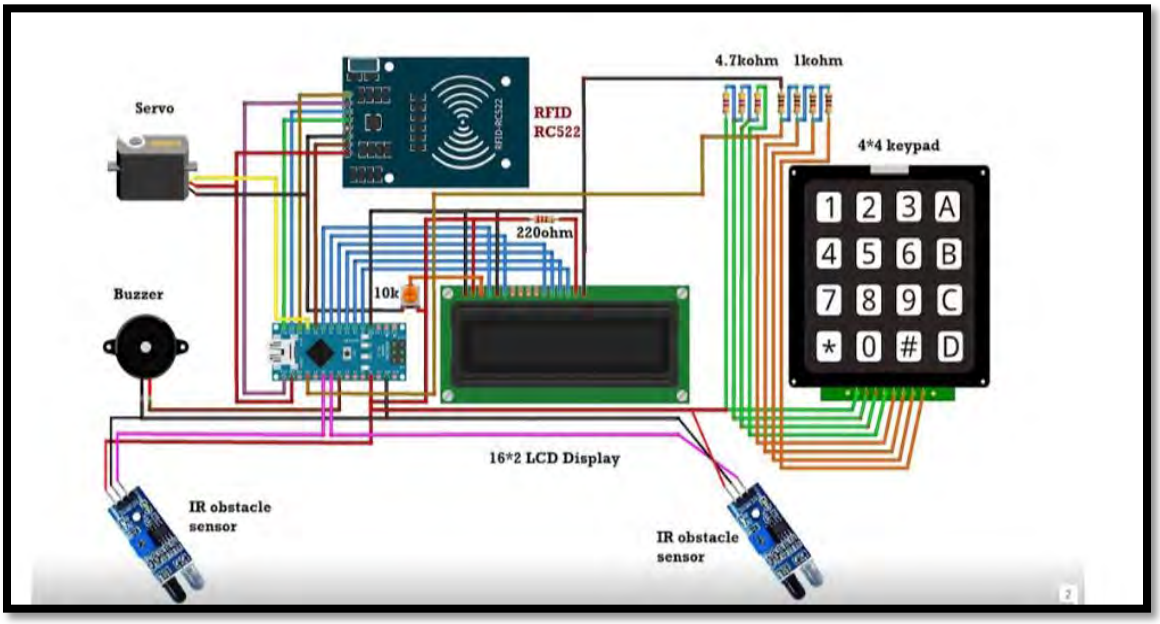


Figure 4.4 Schematic Diagram of the Project

4.6. Project Code:

```
#include <SPI.h> //including the library of serial peripheral interface to communicate with devices
#include <MFRC522.h> //including the library of RFID
#include <OnewireKeypad.h> //including the library of 4x4 keypad
#include <LiquidCrystal.h> //including the library of lcd
#include <Servo.h> //including the library of servo motor
LiquidCrystal lcd(7, 6, 5, 4, 3, 2); //lcd connected to following arduino pins
Servo servo;
int servoPos = 0; //setting servo position
#define sensorPin1 A2 //IR sensor's pin "out" is connected to analog pin of arduino
#define sensorPin2 A3 //second IR sensor's pin "out" is connected to analog pin of arduino
#define buzzerPin A4 //Buzzer voltage pin is connected to the analog pin of Arduino
int senVal1 = 0;
int senVal2 = 0;
#define RST_PIN 8 //defining reset pin as pin no. 8 of arduino
#define SS_PIN 10 //defining signal pin as pin no. 10 of arduino
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's PWM pin is connected to Arduino's pin 9
 servo.write(30);
 pinMode(sensorPin1,  INPUT);  //arduino takes input from IR sensor 1
 pinMode(sensorPin2,  INPUT);  //arduino takes input from IR sensor 2
 pinMode(buzzerPin,  OUTPUT);  //arduino takes output  from buzzer
 SPI.begin();  //beginning of serial peripheral interfacing
 mfrc522.PCD_Init();
 lcd.setCursor(0, 0);
 lcd.print(" Automatic toll");  //lcd shows a message
 lcd.setCursor(0, 1);
 lcd.print("colection  system");  //lcd shows a message in next line
 delay(3000);
 lcd.clear();
}
void loop()
{
 if (recharge == 0)
```

```
{
 reCharge();
}
else
{
 lcd.setCursor(0, 0);
 lcd.print("   Welcome!!!"); //Lcd displays a message
 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)  //second ir sensor activates
 {
```

```
    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);
```

```
            lcd.print (card2Balance);
            lcd.print(" Rs");
            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); //buzzer beeps
  delay(200);
  digitalWrite(buzzerPin, LOW); //buzzer stops beeping
  delay(100);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print(" Successfully"); //message of paying tax
  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); //buzzer beeps
  delay(200);
  digitalWrite(buzzerPin, LOW); //buzzer stop beeping
  delay(100);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("  Your balance");  //message that you have not enough balance to pay toll tax
  lcd.setCursor(0, 1);
  lcd.print(" is insufficent");
  delay(1500);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Your Remaining");//showing remaining balance
  lcd.setCursor(0, 1);
  lcd.print("balance: ");
}
```

Chapter 5

Conclusion and Future Work

Conclusion

RFID is a ground-breaking innovation. It is probably going to expand in many organizations in the coming years. RFID have brought about diminished expense of establishment and with the support of gadgets it marks a good impression in electronic industry. Looking at points of interest and impediments of this framework this can be inferred that the framework is gainful for day by day voyagers and Toll station specialists. By performing RFID based hardware toll assessment project achievements that can be made are save time, money, fuel and decreased mishap rates as it's a completely programmed framework. For this RFID procedure one man is sufficient because it is needed only for recharge to increment if balance gets low. If balance becomes low one can recharge his balance in time by using 4x4 keypad shown in circuit diagram. Barrier can be closed or opened with the help of servo motor by using switches.

Future Work

The security compliance of users may be improved by installing cameras as security control. This will be convenient if RFID scanner is installed above the car track so that driver does not need to come out of the car. He just needs to take out his hand to scans his RFID card to ensure the identification. Moreover this can be expanded for two cars passing simultaneously to scan their RFID. For this there will be need to install another RFID scanner for other car. This may save time and toll station may be looking more functional.

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