AUTOMATED TOLL COLLECTION SYSTEM USING RFID

by

Name	Roll No.	Registration No:
KHUSBOO SINGH	**11700314048**	**141170110230** of 2014-2015
PURBAYAN SAHA	**11700314063**	**141170110245** of 2014-2015
CHITRANIVA KARMAKAR	**11700314034**	**141170110216** of 2014-2015
SOUVIK KUMAR DUTTA	**11700314108**	**141170110290** of 2014-2015

A comprehensive project report has been submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

ELECTRONICS & COMMUNICATION ENGINEERING

Under the supervision of

Mrs. Saraswati Saha

Associate Professor

Department of Electronics & Communication Engineering
RCC INSTITUTE OF INFORMATION TECHNOLOGY
Affiliated to Maulana Abul Kalam Azad University of Technology, WestBengal
CANAL SOUTH ROAD, BELIAGHATA, KOLKATA – 700015

MAY, 2018

CERTIFICATE OF APPROVAL

This is to certify that the project titled "**AUTOMATED TOLL COLLECTION SYSTEM USING RFID**" carried out by

Name	Roll No.	Registration No:
KHUSBOO SINGH	**11700314048**	**141170110230** of 2014-2015
PURBAYAN SAHA	**11700314063**	**141170110245** of 2014-2015
CHITRANIVA KARMAKAR	**11700314034**	**141170110216** of 2014-2015
SOUVIK KUMAR DUTTA	**11700314108**	**141170110290** of 2014-2015

for the partial fulfillment of the requirements for B.Tech degree in **Electronics and Communication Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal** is absolutely based on his own work under the supervision of Mrs. Saraswati Saha. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

.....
Dr. Abhishek Basu
Head of the Department (ECE)
RCC Institute of Information Technology

.....
Mrs. Saraswati Saha
Professor , Dept. of ECE
RCC Institute of Information Technology

DECLARATION

"We do hereby declare that this submission is our own work conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute and that, to the best of our knowledge and belief, it contains no material previously written by another neither person nor material (data, theoretical analysis, figures, and text) which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text."

.....

Khusboo Singh
Registration No: **141170110230** of 2014-2015
Roll No: **11700314048**

.....

Purbayan Saha
Registration No: **141170110245** of 2014-2015
Roll No: **11700314063**

.....

Chitraniva Karmakar
Registration No: **141170110216** of 2014-2015
Roll No: **11700314034**

.....

Souvik Kumar Dutta
Registration No: **141170110290** of 2014-2015
Roll No: **11700314108**

Date:

Place:

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Name of the Examiner Signature with Date:

1. ……..

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4. ……

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.

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INTRODUCTION

As we all know that transportation is the backbone of any country's economy. Improvement in transportation systems result into the good lifestyle in which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation. Increasing number of vehicles on the road, result into number of problems such as congestion, accident rate, air pollution and many other . All economic activities for different tasks use different methods of transportation. For this reason, increasing transportation is an immediate impact on productivity of nation and the economy. Reducing the cost of transporting resource at production sites and transport completed goods to markets is one of the important key factors in economic competition. Automatic toll collection is a technology allows the automated electronic collection of toll costs. As it is studied by researchers and also applied in various expressways, bridges, and tunnels require such a process of Automatic Toll Plaza. ATP is capable of determining if the vehicle is registered or not, and then informing the management center about to process violations, debits, and participating accounts .The most excellent advantage of this ATP system is that it is capable of eliminate congestion in toll plaza, especially during those seasons when traffic seems to be higher than normal.

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.

PROBLEM DEFINITION

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.
- To monitor the traffic.

According to the survey of Karnataka Government, in Sept.2012 they have proposed to get the annual toll collection about 2500 crores/year .But in the present situation they are able to collect only 900 crores of the toll value. Means there is loss of 600 crores due to human errors. So, in this situation we have to control this leakage. Now the present system we have with us on the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just less than a minute. to complete the whole process. As there is reduction in time for completion of the process so indirectly there will be no traffic as such & as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

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.

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 microcontroller, 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.

SCOPE OF THE PROJECT

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.
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Flexibility of implementation

The main power of ATCS is the technology which is used, that is the RADIO FREQUENCY IDENTIFICATION. The basic power of this technology is that it's very flexible. Even with the slightest of change in ATCS, the product can be shaped into a completely different implementation and all that can be because RFID is independent of every other hardware that can be used to boost up the system's performance.
RADIO FREQUENCY has vast implementation areas in medical, defence and many latest products that are being developed is based on RFID solution. The main areas is animal tracking, human implants, vehicle tracking, speed tracking, physical implementation.

Following are the features and advancement of ATCS over presently existing system:

[1] RFID tag cannot be cloned, so cannot be cheated.

[2] Very efficient saving of time.

[3] Wastage of money reduced.

[4] Consumption of oil is reduced.

[5] Pollution is reduced to a large extent.

[6] Speedy transport.

[7] Less congestion on the roadways.

[8] Comparatively less maintenance cost

EQUIPMENTS REQUIRED:

- Arduino Uno (Atmega 328P Microcontroller)
- MFRC522 RFID Module
- LCD 16X2
- Switch
- RTC DS1307
- Motor Driver L293D
- IR Obstacle Sensor

Atmega 328P Microcontroller:

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

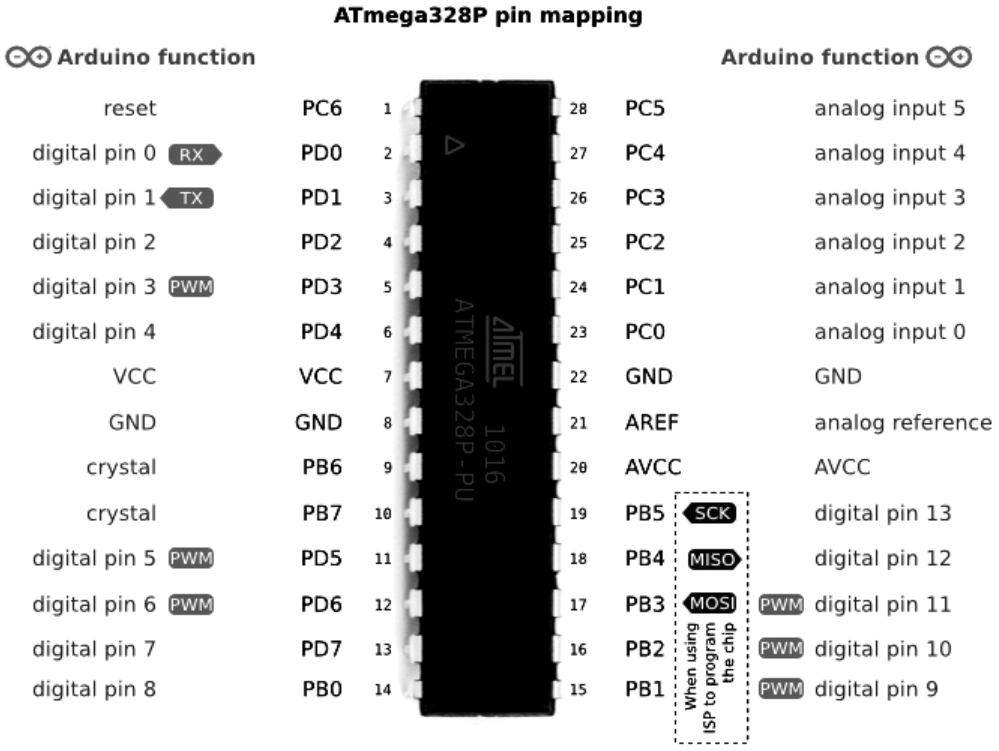


FIGURE 2: Pin diagram of Atmega 328P Microcontroller

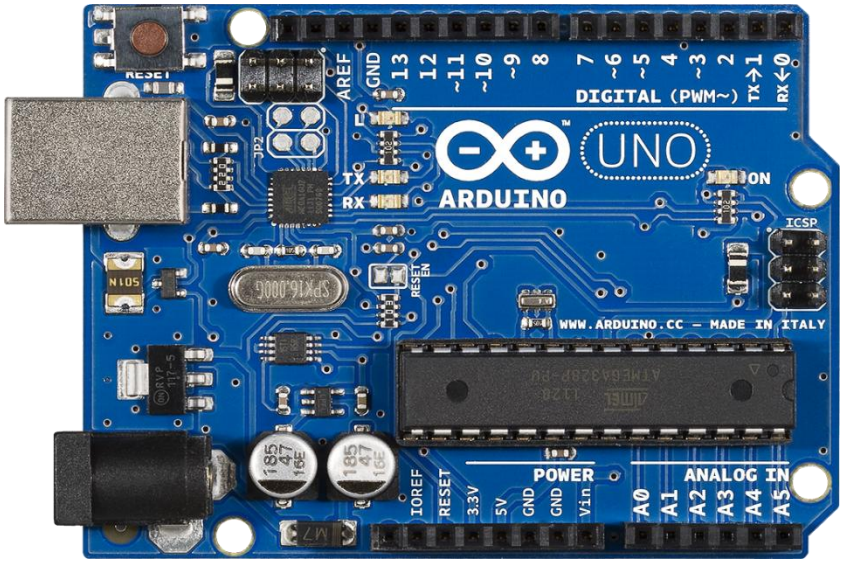


FIGURE 3: Arduino Uno(Atmega 328P Microcontroller)

Specifications:

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6 DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB of which 0.5 KB used by boot loader
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz

The power pins are as follows:

• VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). We can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

• The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

• A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

• GND. Ground pins.

Input Output Pins:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- The Uno has 6 analog inputs, each of which provides 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality:
- I 2C: 4 (SDA) and 5 (SCL). Support I2C communication using the Wire library. There are a couple of other pins on the board:
- AREF. Reference voltage for the analog inputs. Used with analog Reference().
- Reset. Bring this line LOW to reset the microcontroller.

MFRC522 RFID Module:

Mifare RC522 is the high integrated RFID card reader which works on non-contact 13.56 MHz communication, is designed by NXP as low power consumption, low cost and compact size read and write chip, is the best choice in the development of smart meters and portable hand-held devices.

MF RC522 use the advanced modulation system, fully integrated at 13.56MHz with all kinds of positive non-contact communication protocols. Support 14443A compatible answer signal. DSP deal with ISO14443A frames and error correction. Furthermore, it also supports rapid CRYPTO1 encryption to validate Mifare series products. MFRC522 support Mifare series higher speed non-contact communication, duplex communication speed up to 424 kb/s. As a new family member in 13.56MHz RFID family, MF RC522 has many similarities to MF RC5200 and MF RC530, and also has more new features.

This module can fit directly in hand held devices for mass production. Module use 3.3V power supply, and can communicate directly with any CPU board by connecting through SPI protocol, which ensure reliable work, good reading distance.

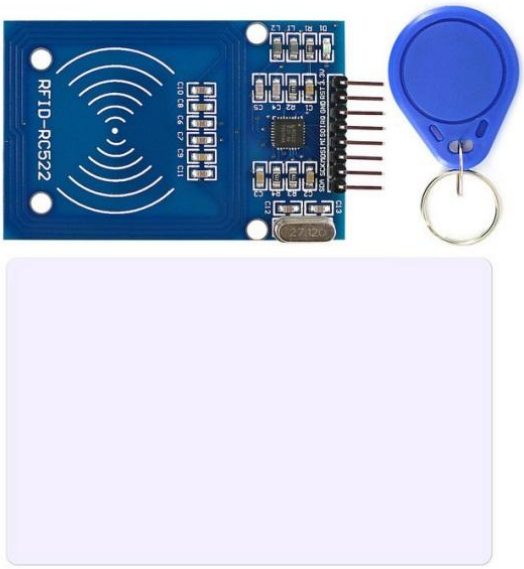
Specifications

- Voltage: DC 3.3V
- Operating Current :13-26mA
- Idle Current :10-13mA
- Sleep current: <80uA
- Peak current: <30mA

- Operating Frequency: 13.56MHz
- Supported card types: mifare1 S50, mifare1 S70, mifare UltraLight, mifare Pro, mifare Desfire
- Dimensions: 40mm × 60mm
- Module Interface SPI Data Transfer Rate: Max. 10Mbit/s
- Card reading distance ：0～30mm （Mifare1 card）

RFID Technology:

The RFID reader is one kind of wireless module used for transferring the data to identify and track tags which are connected to objects. The RFID tag mainly includes the stored information. Some of the RFID tags are run by electromagnetic induction from magnetic fields formed nearby the reader. RFID reader comprises an RF module that works as a transmitter as well as a receiver of RF (radio frequency) signals.



The TX of the RF module is inbuilt with an oscillator to make the carrier frequency. A modulator to intrude commands upon this carrier signal and an amplifier to raise the signal sample to wake the tag. The RX (receiver) of the RFID module contains a demodulator to remove the returned information and also grips an amplifier for supporting the signal of processing. A microprocessor is used for forming the control unit, which uses an operating system, a memory of the module filter and also stores the data.

What are Real Time Clocks?

Real time clocks (RTC), as the name recommends are clock modules. The DS1307 real time clock (RTC) IC is an 8 pin device using an I2C interface. The DS1307 is a low-power clock/calendar with 56 bytes of battery backup SRAM. The clock/calendar provides seconds,

minutes, hours, day, date, month and year qualified data. The end date of each month is automatically adjusted, especially for months with less than 31 days.
They are available as integrated circuits (ICs) and supervise timing like a clock and also operate date like a calendar. The main advantage of RTC is that they have an arrangement of battery backup which keeps the clock/calendar running even if there is power failure. An exceptionally little current is required for keeping the RTC animated. We can find these RTCs in many applications like embedded systems and computer mother boards, etc. In this article we are going to see about one of the real time clock (RTC), i.e. DS1307.

Pin Description of DS1307:

Pin 1, 2: Connections for standard 32.768 kHz quartz crystal. The internal oscillator circuitry is intended for operation with a crystal having a specified load capacitance of 12.5pF. X1 is the input to the oscillator and can alternatively be connected to an external 32.768 kHz oscillator. The output of the internal oscillator, X2 is drifted if an external oscillator is connected to X1.

Pin 3: Battery input for any standard 3V lithium cell or other energy source. Battery voltage should be between 2V and 3.5V for suitable operation. The nominal write protect trip point voltage at which access to the RTC and user RAM is denied is set by the internal circuitry as 1.25 x VBAT nominal. A lithium battery with 48mAhr or greater will backup the DS1307 for more than 10 years in the absence of power at 25ºC. UL recognized to ensure against reverse charging current when utilized as a part of conjunction with a lithium battery.

Pin 4: Ground.

Pin 5: Serial data input/output. The input/output for the I2C serial interface is the SDA, which is open drain and requires a pull up resistor, allowing a pull up voltage upto 5.5V. Regardless of the voltage on VCC.

Pin 6: Serial clock input. It is the I2C interface clock input and is used in data synchronization.

Pin 7: Square wave/output driver. When enabled, the SQWE bit set to 1, the SQW/OUT pin outputs one of four square-wave frequencies (1Hz, 4 kHz, 8 kHz, and 32 kHz). This is also open drain and requires an external pull-up resistor. It requires application of either Vcc or Vb at to operate SQW/OUT, with an allowable pull up voltage of 5.5V and can be left floating, if not used.

Pin 8: Primary power supply. When voltage is applied within normal limits, the device is fully accessible and data can be written and read. When a backup supply is connected to the device and VCC is below VTP, read and writes are inhibited. However at low voltages, the timekeeping function still functions.

Features:

- Programmable square wave output signal
- Automatic power-fail detect and switch circuitry

- Consumes less than 500nA in battery backup mode with oscillator running
- Available in 8-pin DIP or SOIC
- Underwriters Laboratory (UL) recognized
- Real-time clock (RTC) counts seconds, minutes, hours, date of the month, month, day of the week, and year with leap-year compensation valid up to 2100
- 56-byte non-volatile RAM for data storage
- Two-wire interface (I2C)

Using the DS1307 is primarily written to and read the registers of this chip. The memory contains all 64 DS1307 8-bit registers are addressed from 0 to 63 (from 00H to 3FH the hexadecimal system). The first eight registers are used for the clock register the remaining 56 vacant can be used as RAM contains temporary variable if desired. The first seven registers contain information about the time of the clock including: seconds, minutes, hours, secondary, date, month and year. The DS1307 include several components such as power circuits, oscillator circuits, logic controller and I2C interface circuit and the address pointer register (or RAM). Let's see the working of DS1307.

Working of DS1307:

In the simple circuit the two inputs X1 and X2 are connected to a 32.768 kHz crystal oscillator as the source for the chip. VBAT is connected to positive culture of a 3V battery chip. Vcc power to the I2C interface is 5V and can be given using microcontrollers. If the power supply Vcc is not granted read and writes are inhibited. START and STOP conditions are required when a device wants to establish communication with a device in the I2C network.

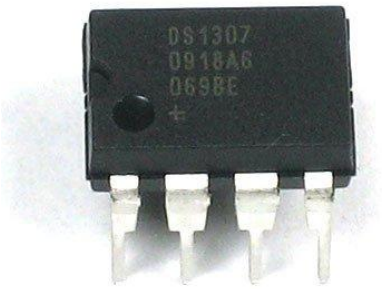
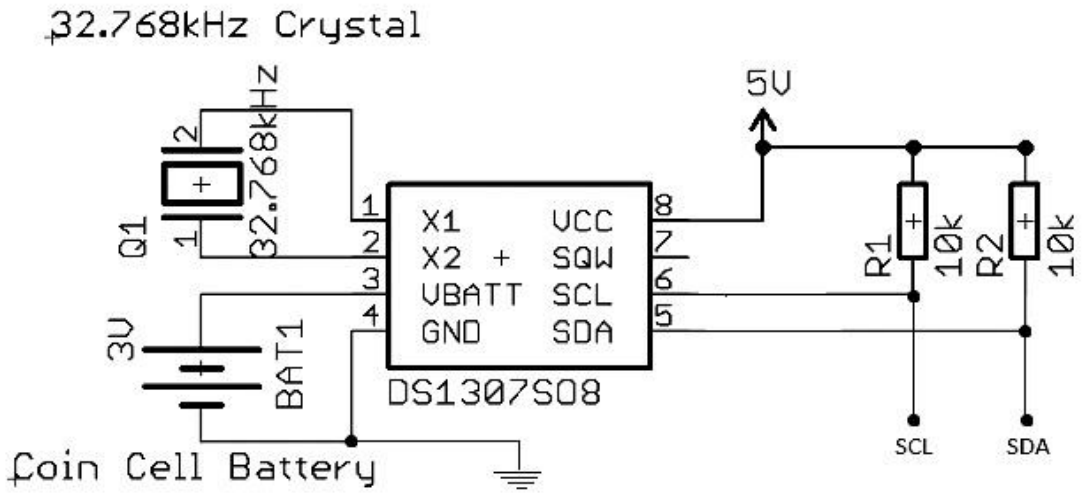


FIGURE 5: i) DS1307
ii) Circuit Diagram



Liquid Crystal Display(LCD):

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

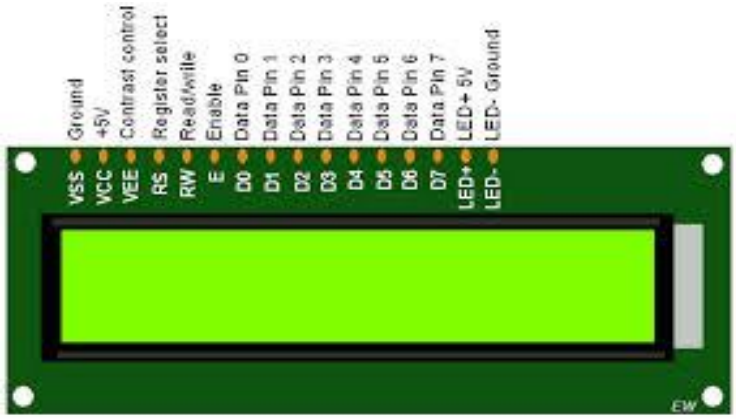
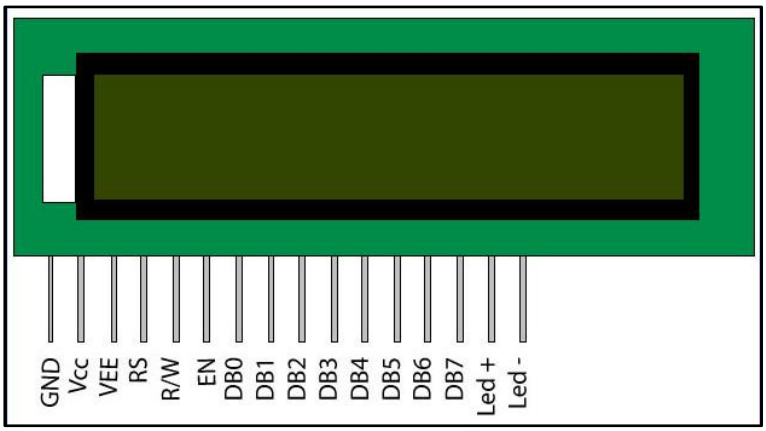


FIGURE 6: i) & ii) LCD Screen

FIGURE 6: iii) Pin diagram of LCD



Pin Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

In this project we will be constructing a simplest RFID based attendance system which does not overcomplicate the project.
In this project we will be using RTC module, which is utilized for enabling and disabling the attendance system within a given time period, so that we can keep the late comers at bay. The RFID module "RFID-RC522" which can do read and write operations on NXP based RFID tags. NXP is lead producer of RFID tags in the world and we can get them on online and offline stores easily. A 16 x 2 LCD display is used, which is to showcase information such as time, date, number of attendance, etc. And finally an Arduino board is utilized which is the brain of the project.

DC Motor Driver:

L293D is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction we can control speed of each dc motor by giving PWM to enable pin .L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.
As we can see in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). If we want to control speed enable pin is connected to the PWM pin of microcontroller. We have connected only one motor and used the enable pin to control the speed of dc motor.

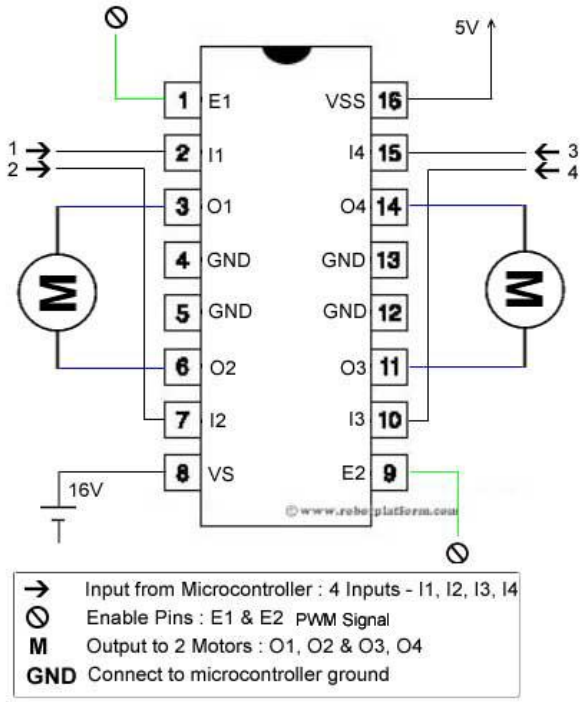


FIGURE 7: Pin diagram of L293D

L293D Logic Table:
Let's consider a Motor connected on left side output pins (pin 3, 6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

- Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi-Impedance state]
- Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

In a very similar way the motor can also operate across input pin 15,10 for motor on the right hand side.

IR LEDs:

IR LED emits infrared light, means it emits light in the range of Infrared frequency. We cannot see Infrared light through our eyes; they are invisible to human eyes. The wavelength of Infrared (700nm – 1mm) is just beyond the normal visible light. Everything which produces heat emits infrared like our human body. Infrared have the same properties as visible light, like it can be focused, reflected and polarized like visible light.

Other than emitting invisible infrared light, IR LED looks like a normal LED and also operates like a normal LED, means it consumes 20mA current and 3vots power. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feet's, it depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in meters.

FIGURE 8: IR LED

IR Receiver (TSOP17XX):

TSOP17XX receives the modulated Infrared waves and changes its output. TSOP is available in many frequency ranges like TSOP1730, TSOP1738, and TSOP1740 etc. Last two digits represent the frequency (in Khz) of modulated IR rays, on which TSOP responds. Like for example TSOP1738 reacts when it receives the IR radiation modulated at 38Khz. Means it detects the IR which is switching On and Off at the rate of 38Khz. TSOP's output is active low, means its output is remains HIGH when there is no IR, and becomes low when it detects IR radiation. TSOP operates on particular frequency so that other IRs in the environment can't interfere, except the modulated IR of particular frequency. It has three pins, Ground, Vs (power), and OUTPUT PIN.

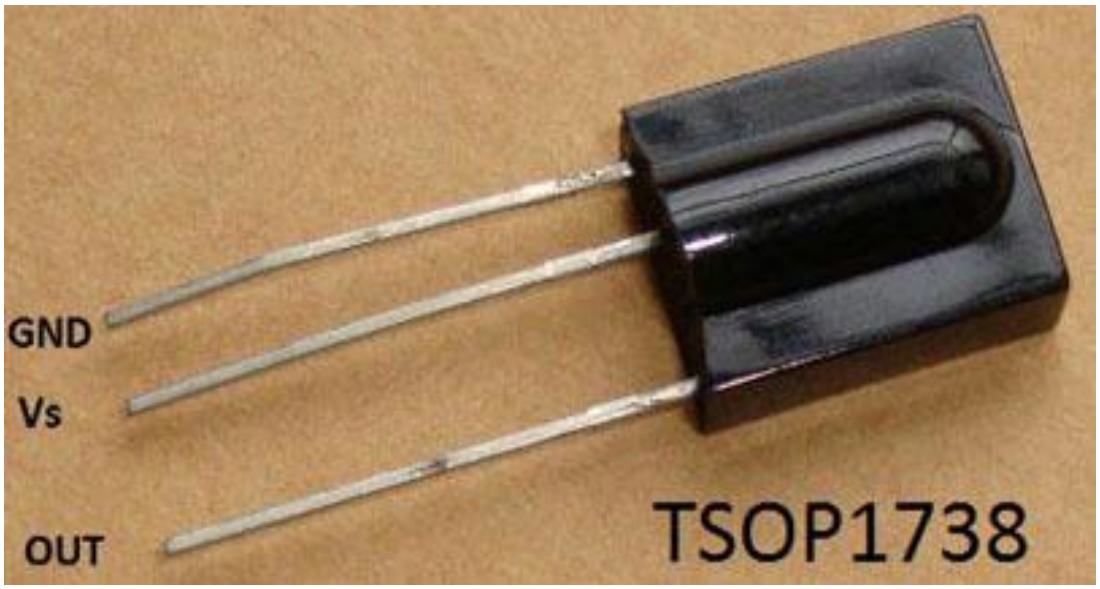


FIGURE 9: IR Receiver TSOP1738

IR Transmitter Circuit Diagram:

We are using TSOP1738 for receiver, so we need to generate the modulated IR of 38 kHz. You can use any TSOP, but you need to generate IR of respective frequency as TSOP. So we are using **555 timer in astable mode** to oscillate the IR at 38KHz frequency. As we know oscillation frequency of 555 timer is decided by resistor R1, R2 and capacitor C1. We have used 1k R1, 20K R2 and 1nF capacitor to generate the frequency of approx. 38 KHz. It can be calculated using this formula: 1.44/((R1+2*R2)*C1).

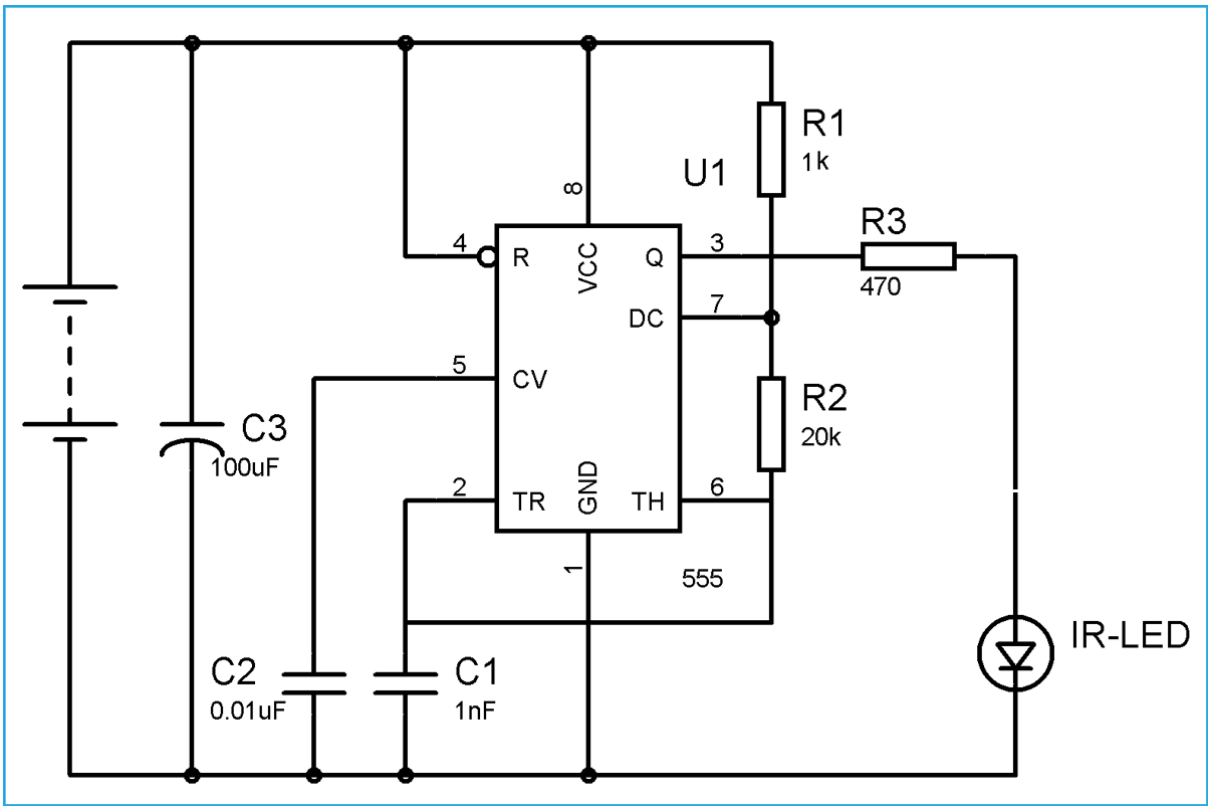


FIGURE 10: IR Transmitter Circuit Diagram

Output Pin 3 of the 555 Timer IC has been connected to IR LED using 470 resistors and a push button switch. Whenever we press the button, circuit emits modulated IR at 38 KHz. A 100uF capacitor is connected across the supply to provide the constant supply to the circuit, without any ripple.

IR Receiver Circuit Diagram:

IR Receiver circuit is very simple we just need to connect a LED to the output of the TSOP1738, to test the receiver. We have use BC557 PNP transistor here, to reverse the effect of TSOP, means whenever the output is HIGH LED will be OFF and whenever it detects IR and output is low, LED will be ON. PNP transistor behaves opposite to the NPN transistor, it acts as open switch when a voltage applied to its base and acts as closed switch when there is no voltage at its base. So normally TSOP output remains HIGH and Transistor behaves as open switch and LED will be OFF. As soon as TSOP detects Infrared, its output becomes low and transistor behaves as closed switch and LED will be ON. A 10k resistor is used for provide proper biasing to transistor and a 470ohm resistor is used at LED for limiting the current. So whenever we press the Button at IR transmitter, it is detected by TSOP1738 and LED will glow.

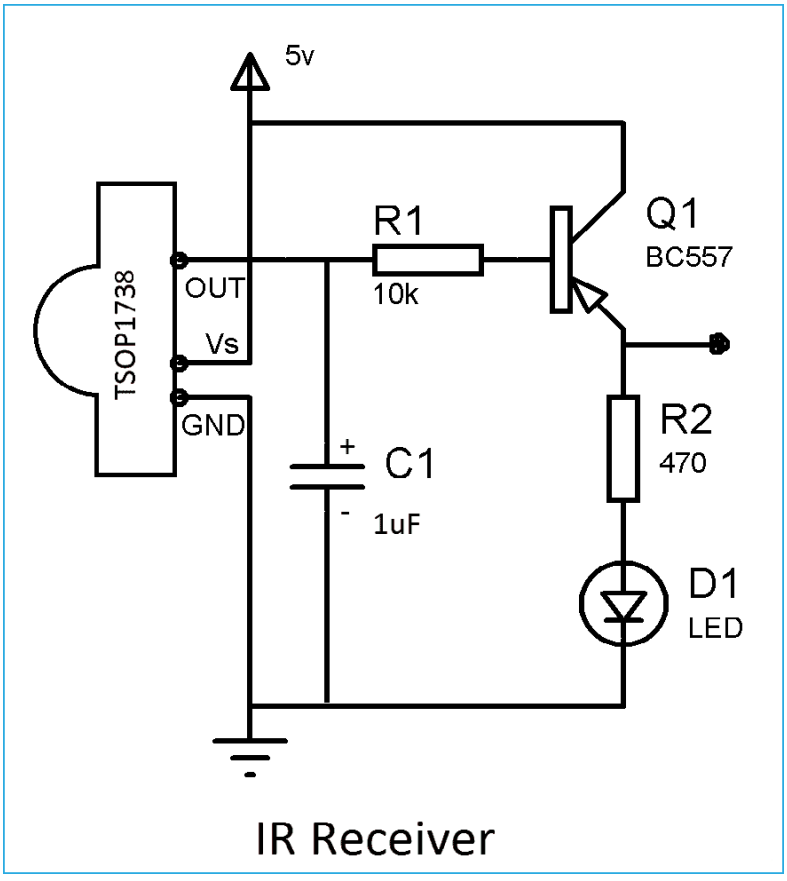


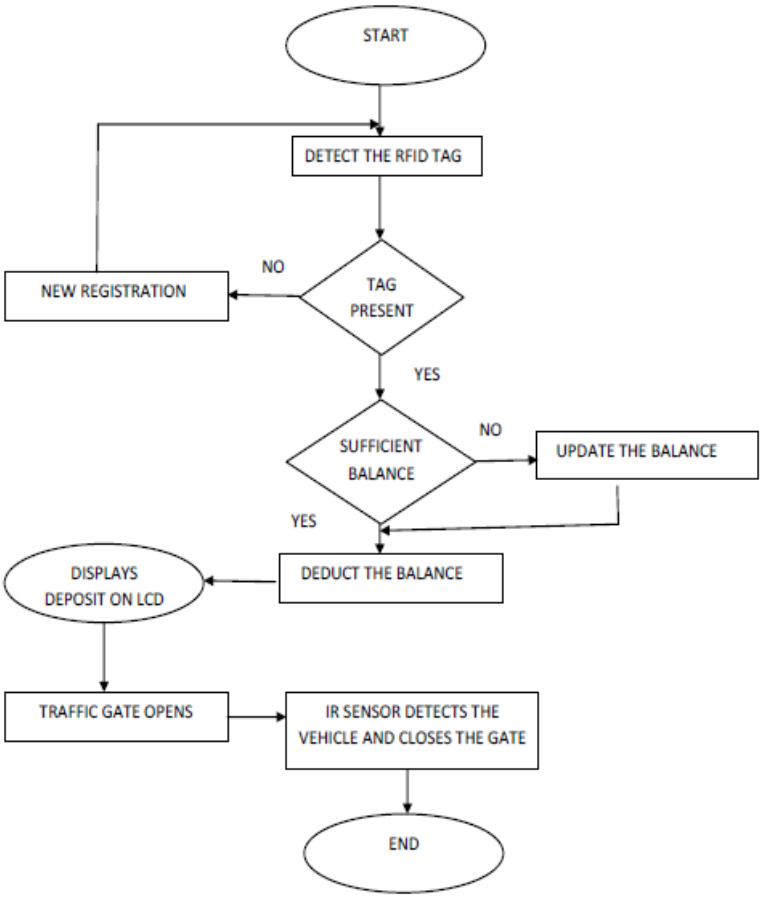
FIGURE 11: IR Receiver Circuit Diagram

METHODOLOGY

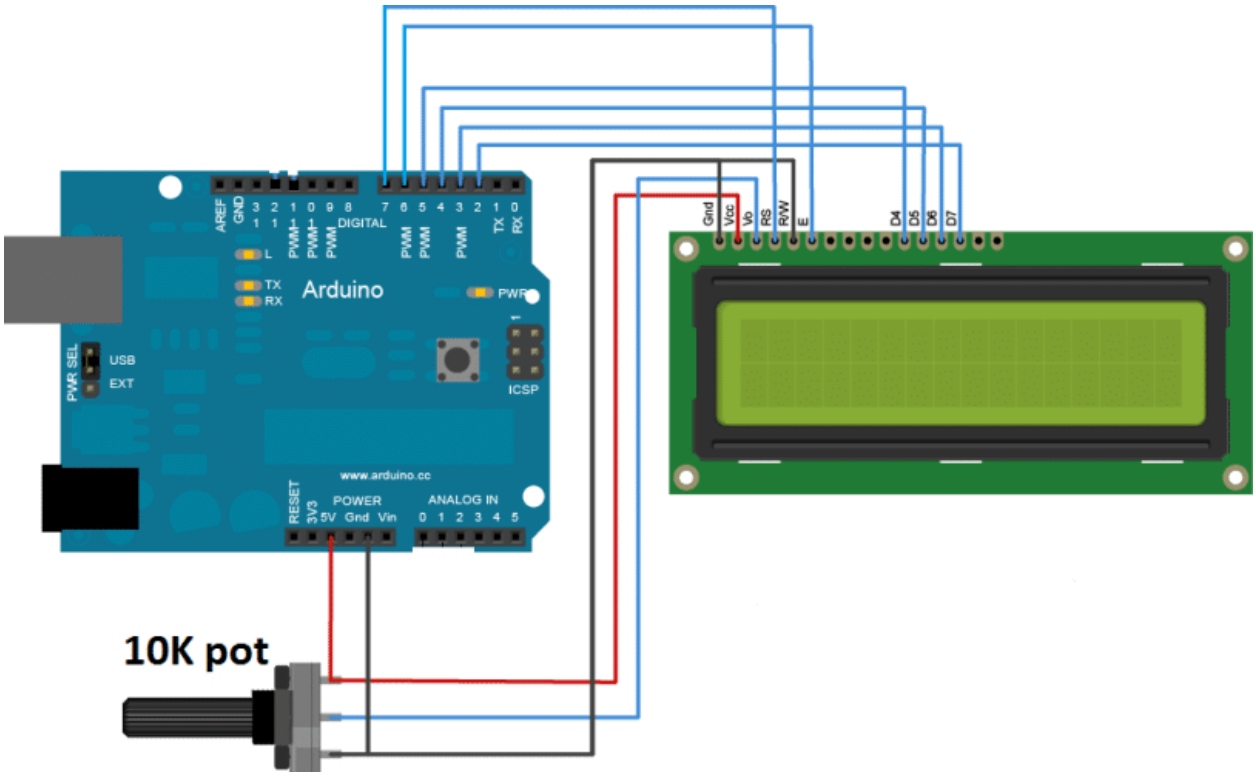
Flow of RFID based toll tax are:

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

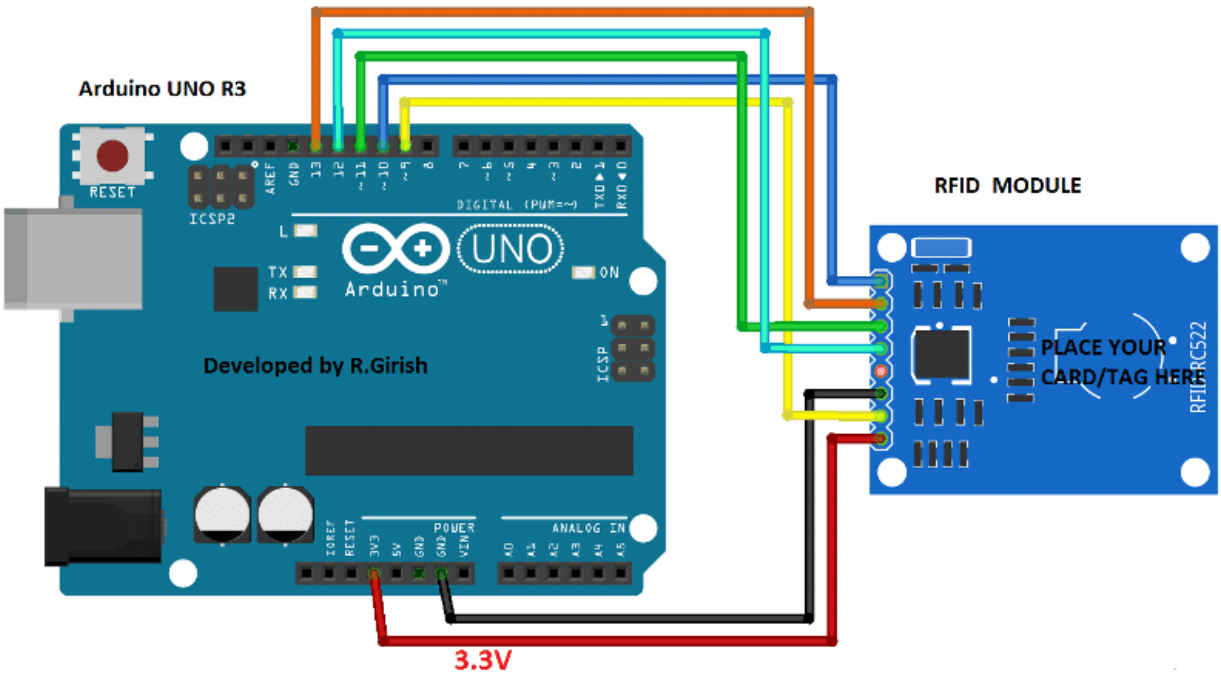
Whenever any person buys a vehicle, first he/she need to do her vehicle registered at the RTO office. RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for 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:



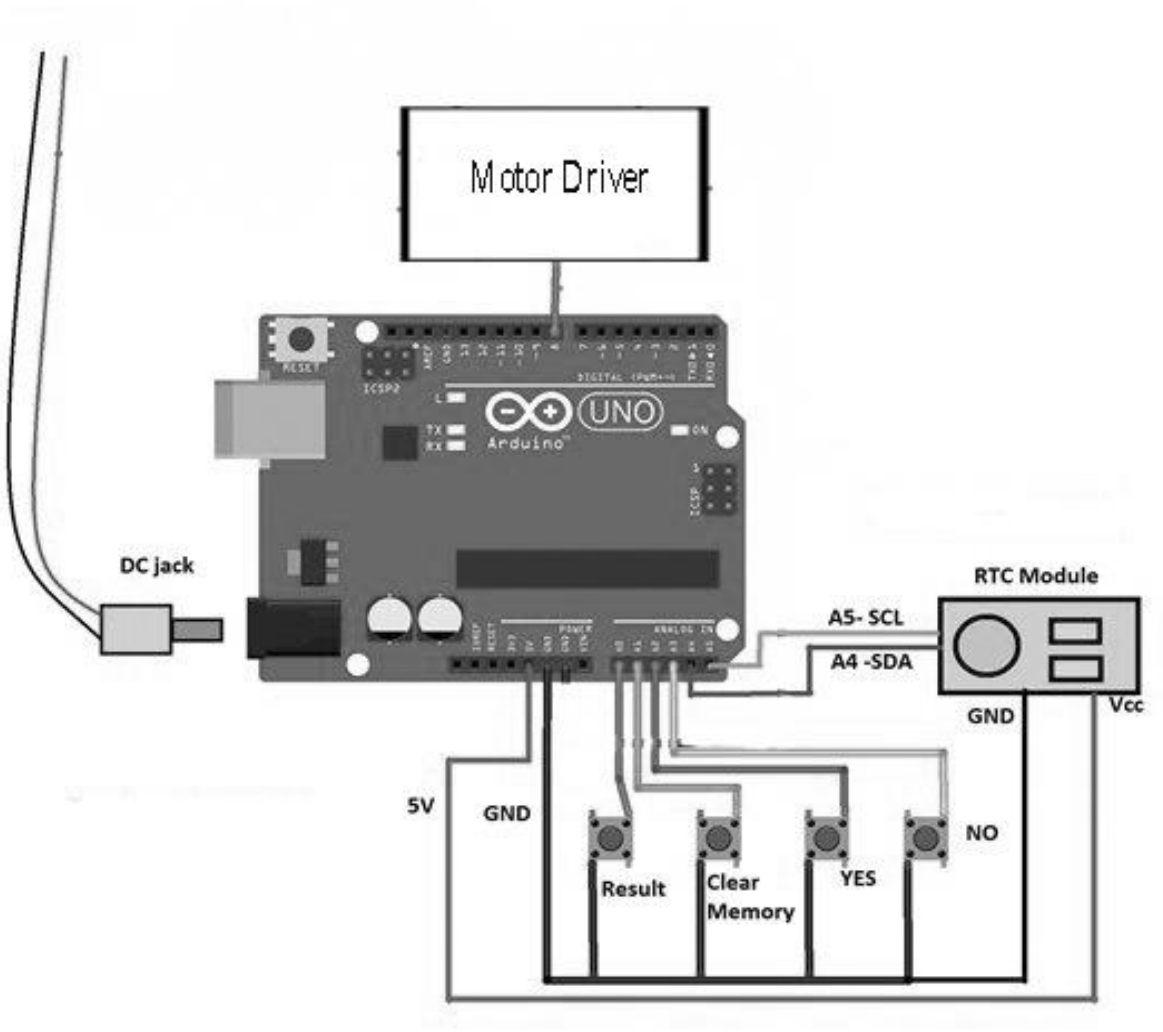
Arduino to RFID module connection:



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.

We have to place the UID codes here (our RFID tag's UID):

```
// ---------------- SET UIDs ----------------- //
char UID1[] = "F6:97:ED:70";
char UID2[] = "45:B8:AF:C0";
char UID3[] = "15:9F:A5:C0";
char UID4[] = "C5:E4:AD:C0";
char UID5[] = "65:1D:AF:C0";
char UID6[] = "45:8A:AF:C0";
char UID7[] = "15:9F:A4:C0";
char UID8[] = "55:CB:AF:C0";
char UID9[] = "65:7D:AF:C0";
char UID10[] = "05:2C:AA:04";
char UID11[] = "55:7D:AA:04";
char UID12[] = "BD:8A:16:0B";
//--------------------------------------------//
```

You have place names here:

```
// -------------- NAMES ----------------------//
char Name1[] = "Vehicle1";
char Name2[] = " Vehicle2";
char Name3[] = " Vehicle3";
char Name4[] = " Vehicle4";
char Name5[] = " Vehicle5";
char Name6[] = " Vehicle6";
char Name7[] = " Vehicle7";
char Name8[] = " Vehicle8";
char Name9[] = " Vehicle9";
char Name10[] = " Vehicle10";
char Name11[] = " Vehicle11";
char Name12[] = " Vehicle12";
//--------------------------------------------//
```

Replace student1, student2 with any name you wish or leave it as it is.

You have to set the time from when to when the attendance system should be active, rest of the time the system won't register the attendance when we scan RFID tag/card:

```
// ------ From -------- //
int h = 21; // Hrs
int m = 00; // Min
// ------- To ------- //
int h1 = 21; // Hrs
int m1 = 50; //Min
//-------------------------//
```

The upper part is starting time and the lower part is ending time. You have to enter time in hours from 0 to 23 and minutes from 00 to 59.

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

The Electronic Toll Collection system in expressway based on RFID, a design scheme was put forward. It is low cost, high security, far communication and efficiency, etc. It not only improves the passage ability of expressway but also improves the technology level of charge. Electronic toll collection system using RFID is an effective measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station. In the design of the proposed Electronic toll collection (ETC) system, real time toll collection and anti-theft solution system have been designed. This reduces the manual labour and delays that often occur on roads. This system of collecting tolls is eco friendly and also results in increased toll lane capacity. Also an anti-theft solution system module which prevents passing of any defaulter vehicle is implemented, thus assuring security on the roadways.

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