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# RFID BASED VIRTUAL TOLL COLLECTION SYSTEM USING IOT

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

## I. 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.

**Keywords**

IoT, LCD Display, Water level Sensor, ANPR Camera, RFID Tag, RFID Antenna, GPS.

**Related Work**

Sunidhi Vashisth, Sunil Kumar Chawla, Bharti Mahjan and Himani Chugh et al, presented an Internet of Things for Smart Environment Applications. Internet of Things (IOT) is becoming an emerging technology due to the rapid use of internet. IOT is a kind of "universal global network" that combines different things such as mobile, laptop, notepad etc. IOT is a smartly integrated system that interacts with other machines, environments, objects and infrastructure that comprises intelligent machines including radio frequency identification (RFID) and sensor network technologies. In every company, the people send email and access websites, or other online means, but in most countries, the internet is available to transmit data across mobile devices and the Internet through easier, faster, and less costly systems. The main purpose of this object is to provide the detailed study about IOT along with its applications in different field such as health, urban city, industry, transportation and smart building.

Muhammad Irsyad Haziq, Ilanur Muhaini Binti Mohd Noor and Raed Abdulla et al, presented a Smart IoT-based security system for residence The main aim is to develop an IoT based security system for resident which include biometric authentication, plate recognition, and movement detection system. In this proposed method, the programming platforms such as the Python, and the Arduino, were used to develop to demonstrate the proposed system. The performance of the developed proposed system is evaluated by testing the system with several sample tests and from there, the performance was examined. The system performed well in recognizing the different person and capable of returning the correct output in almost all the face samples as well as the plate number detection which can successfully extract the string information from the pictures. It is observed that the system has an overall accuracy of 77% after considering several important factors that may affect the system's performance. The proposed systems used off the shelf components as a proof of concept. The proposed systems were validated based on: a) the range of the temperature found beneath a manhole cover, and b) the signal reconstruction under the presence and the absence of noise. The results show

decent performance of the proposed system from the power consumption point of view, as it can exceed the lifetime of similar two pumps based Jerk chaotic oscillators by almost one year for long lifetime applications such as using LiIon battery. Furthermore, in comparison to PRNG output sequence monitoring MC e generated by a software algorithm used in AIC framework in the presence of the noise, the first proposed system output sequence improved the signal reconstruction by 6.94%, while the second system improved the signal reconstruction by 17.83 %.

**Existing System**

Use of fastag.

FASTag is a prepaid tag, affixed on the vehicle's windscreen, that enables automatic deduction of toll charges and lets the vehicle pass through the toll plaza without stopping for cash transaction.

Toll construction and maintenance

Need of Toll Gate for the reader to sense the tag for some seconds. Electronic Toll Collection (ETC) through FASTag was implemented with a view to save fuel, time and curb pollution as well as ensure seamless movement of traffic. The move also encourages digital payments.

**Drawbacks**

- ✓ If the server fails, it will result in the failure of the automated electronic deduction system.
- ✓ Toll plazas had hired many people for deducting toll. They will become unemployed as there will no need for them.
- ✓ There were many instances of charging the double amount of the original amount due to some technical issues.

**Proposed System**

- ✓ Use of Ultra High frequency Passive RFID tag and reader to detect the vehicles using IOT.
- ✓ Toll amount is detected according to the distance travelled
- ✓ Distance travelled by the vehicle is also Calculated.
- ✓ Removal of toll gate and placing the RFID readers between the service roads and NH.
- ✓ Reduction of Man power

**Merits**

- ✓ Saves Manpower Cost.
- ✓ Cheating of Toll is impossible.
- ✓ All-round Savings.
- ✓ Helps in Emergency situations.
- ✓ SMS alerts.
- ✓ Lower fuel consumption.
- ✓ No stoppage of vehicles and time in the toll gates
- ✓ Ease of payment

**Module Description**

A module is a Hardware and software component or part of a program that contain one or more routines.

Arduino Uno (Atmega 328P Microcontroller)

The Microcontroller used here is an Arduino UNO. The UNO is a Microcontroller board based on ATMEGA 328P. The ATMEGA 328P has 32kB of flash memory for storing code. The board has 14 digital input and output pins, 6 analog inputs, 16 MHz quartz crystal, USB, an ICSP circuit and a reset button. The UNO can be programmed with the Arduino software.

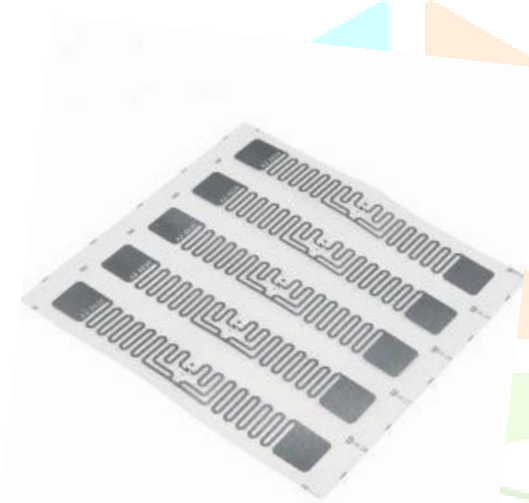
SENSORS

A sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes depends upon transducer in its environment and send the information to other electronics,

frequently a microcontroller. A sensor is always used with other electronics.

MFRC522 RFID Module:

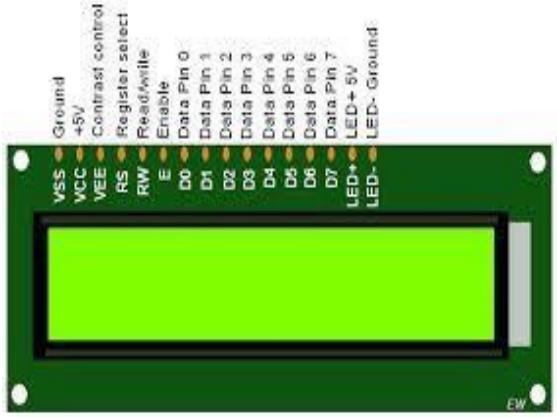
Mifare RC522 is the high integrated RFID card reader which works on non-contact 13.56 MHz communication, is designed by NXP as low power consumption, low cost and compact size read and write chip, is the best choice in the development of smart meters and portable hand-held devices. MF RC522 use the advanced modulation system, fully integrated at 13.56MHz with all kinds of positive non-contact communication protocols. Support 14443A compatible answer signal.



## Results and Discussion

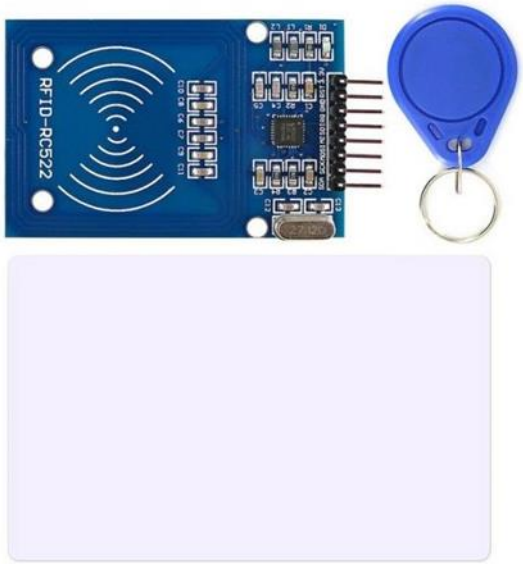
### LCD Display

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.



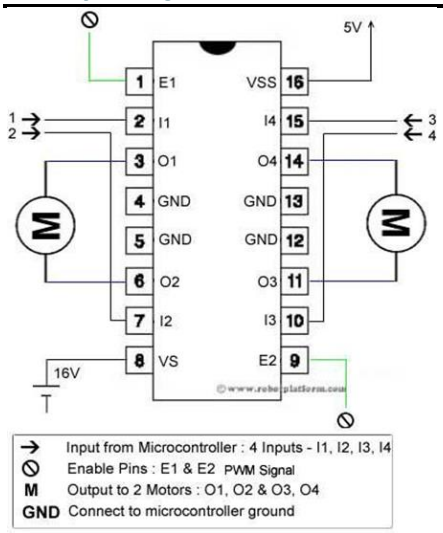

### RFID Technology

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.



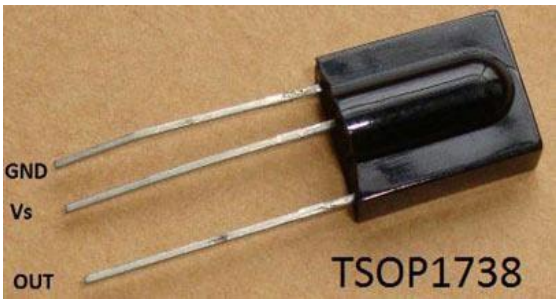

### DC Motor Driver

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.




**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.




**ANPR Camera**

The camera that is used in the vehicle number rechecking in the virtual toll collection system.

The main advantage of this camera is that, it has clear vision even at the nights.

This can be work at all weather Conditions.

It can read in vehicle speed 0-120km/h.

The number plate reading (ANPR) function is send the plate number text, related image and timestamp to the server

**GPS**

GPS (Global Positioning System) is a satellite-based navigation system. It provides time and location-based information to a GPS receiver, located anywhere on or near the earth surface. GPS works in all weather conditions, provided there is an unobstructed line of sight communication with 4 or more GPS satellites.

**Working Flow**

Flow of RFID based toll tax are:

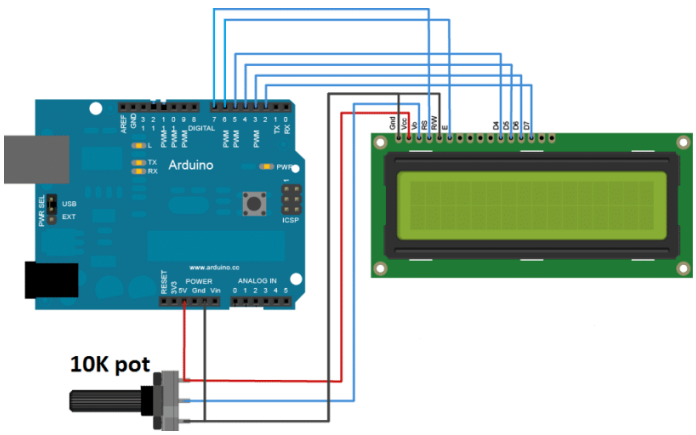
• Detection of vehicle

• 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.

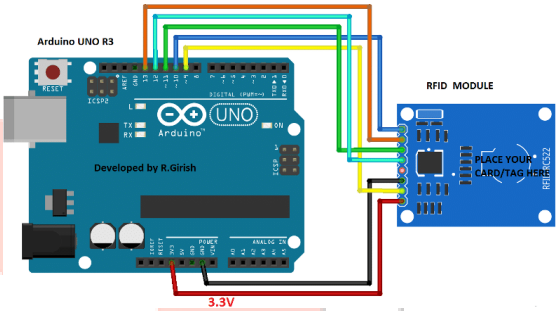
RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for that particular smart card and maintain transaction history in database. Owner of the vehicle needs 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.




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.

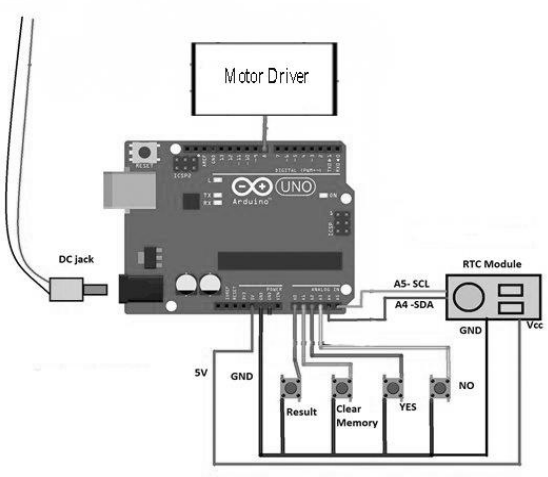
Now we have to find UID or unique identification number of all 12 RFID cards/tags. To find UID, upload the below code and open the serial monitor.

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 program.




**Conclusion and Future Work**

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.

The proposed system can be used to develop a completely digital and virtual smart toll collection system. In our country, manual toll plaza causes a lot of traffic. Besides, corruption in the toll plaza is an open secret. The proposed toll collection system can solve these problems efficiently.

As most of the number plate of vehicles in has already been digitalized by government.

As a result, it will not only save the valuable time and extra payment but also eliminate the corruption in the toll plaza.

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.

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

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.

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