A Minor Project Report

On

**(RFID BASED AUTOMATED TOLL COLLECTIOn system using arduino)**

SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF DEGREE OF

**Bachelor of Technology**

**IN**

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**CERTIFICATE**

This is to certify that the minor project report entitled, “**RFID based automatic Toll collection using Arduino**” submitted by Himanshu Singh (9916102102), Abhishek Gupta (9916102086), Anand (9916102176) in partial fulfillment of the requirements for the award of Bachelor of Technology Degree in **Electronics and Communication Engineering** of the Jaypee Institute of Information Technology, Noida is an authentic work carried out by them under my supervision and guidance. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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**DECLARATION**

We hereby declare that this written submission represents our own ideas in our own words and where others' ideas or words have been included, have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and   have not   misrepresented   or   fabricated   or   falsified   any   idea/data/fact/source   in   our submission.

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**ABSTRACT**

Automatic Toll Tax 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. When the car moves through the toll gate on any road, it is indicated on the RFID reader that it has crossed the clearing. The need for manual toll based systems is completely reduced in this methods and the tolling system works through RFID. The system thus installed is quite expedient reducing the time and cost of travelers since the tag can be deciphered from a distance.

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**CHAPTER 1**

**INTRODUCTION**

**1.1 Toll Collection System**

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

* **Method of toll collection:**
* Manual Toll Collection
* Automatic Toll Collection
* Electronic Toll Collection
  1. **Automatic Toll Collection(ATC)**

Unlike manual collection method, it does not use any human. Instead, machine known as an Automated Coin Machine (ACM) is used. This machine accepts coins or tokens provided by agency operating the booth. ATC 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 ATC system is useful for both the motorists and toll operators; this is the reason of extended use of ATC system throughout the world.

* 1. **Microcontrollers**

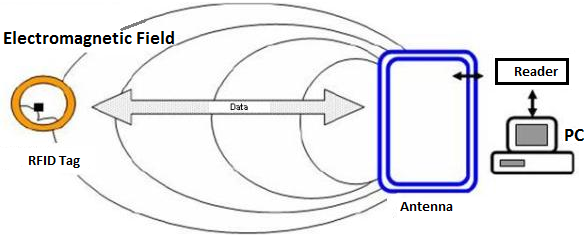
A microcontroller is a computer designed to perform particular tasks which appear to be small or minor but are as important in a system. For e.g.: turning ON an LED. A microcontroller comprise of the processor or the CPU which perform the task for which it is designed. It has the input and the output ports to which any external device can be connected. It also has its memory i.e. RAM and ROM which means that data can be stored in it or processed value can be stored. One of the major uses of microcontrollers is in embedded applications. Thus, it is very useful in ATC system.

1. Reading information and the RFID card number from the RFID card of the person.
2. Sending this data on the LCD screen of the operating person.
3. Sensing and receiving the signal from the IR receiver.
4. Sending the signal to the motor to open the gate it the data is genuine and the card has the balance.
   1. **Radio Frequency Identification(RFID)**

It is a new identification technology that uses radio frequencies for identifying any object or a person. It’s one major advantage is that it is wireless and no one can read the information stored in it accept for the device meant for reading it. Thus, the information is confidential. It is generally done using a RFID tag which is a small card with an electromagnetic chip embedded over it with an antenna. All the information is stored in that chip. Generally, a RFID serial card number is used as the identification number. Each user has its unique ID number stored in that chip. A RFID system comprises of the RFID tag and the reader or the sensor. Both the card and the reader have their antenna for sending and receiving the signal. There is a specific range in which the tag works with the reader. As soon as the tag reaches the range of the reader, it gets induced and sends the information.

**Working of RFID**

When the vehicle arrives at the toll plaza, the RFID tag attached to it is sensed by the sensor. The moment the tag comes within the magnetic field of the RFID reader, the current is induced in it and it gets energized. Then, it sends the information stored in the chip inform of the radio frequency signals through the antenna. When the antenna of the reader receives the signal, it again converts it into digital form thus making it suitable for displaying on the LCD screen of the operating person.



**Fig 1.1: working of RFID**

**CHAPTER 2**

**LITERATURE SURVEY**

We now continue to analyze some of the systems developed. The first discussed a system that was developed to provide with the following features:

i. Reduce time for collecting toll at the toll plaza.

ii. RFID tags can be read at much greater distances; an RFID reader can pull information from a tag at distances up to 300 feet.

iii. As the vehicle approaches the identification site, the computerized control unit placed near toll lane receives the identifier signal and calculates the toll to be debited and electronically debits the toll on the account of the particular vehicle.

iv. This system allows a vehicle to persist past the scan point without stopping, thus offering maximum convenience to motorists, speeding up the flow of traffic, and reducing the number of human resources required at highway toll plazas.

v. Smooth traffic flow at toll gates.

vi. Convenient toll collection without handling cash.

vii. Reduction of management costs.

vii. Convenient and quick service to the vehicle owners.

viii. Stolen vehicles can be detected.

RFID is the acronym for Radio Frequency Identification. The components of the RFID System basically include RFID transmitter, a RFID receiver and some processing machine (a computer). Then we goes on to discuss about the types of RFID tags(RFID transmitters). Types of RFID tags include Active Tags and Passive Tags. Active tags are used to transmit information that includes the RFID tag’s ID, as well as some other information that can be soft-coded into it. Soft coded information means that it can re-writable and can also be dynamic in nature. In this problem statement, the soft-coded information could include the Global Position Coordinates of the vehicle on which the RFID tag is attached. Then we goes on to discuss a micro-simulation model of the actual toll collection system by providing an architecture for the system.



**Fig 2: toll collection system**

**CHAPTER 3**

**HARDWARE USED**

**3.1 ARDUINO UNO**

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**Figure 3.1 Arduino UNO**

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing and MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

**Why arduino?**

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

* Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
* Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
* Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.

**3.2 LIQUID CRYSTAL DISPLAYS (LCD)**

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**Figure 3.2 LCD**

Certain organic large size molecule types of liquids possess properties, which cause them to interfere with light passage in them. One type, called the twisted nematic type, is becoming more useful in today’s LCDs. In this, the liquid crystals have thread-like shapes: the units join head to tail for million molecules to form lengthy chains. Moreover each plane is twisted a few degrees from the next. Some of the recent chemicals of this variety are made of pyrimidines, phenyl cyclohexanes, bicyclohexane and 4-(4’ methoxy benzylidine) -n-butylaniline. They exhibit a crystalline structure even in liquid form at ordinary temperatures.

The property of the liquid is anisotropic in the two perpendicular directions. The cell thickness is so designed that there is a 900 turn of the molecules between the top and the bottom faces. The twisted nematic has the property that twists light, which passes through it. Polaroid filters are fitted above and below the cell so that light is polarized as it enters, and is twisted through 900, exiting through a filter kept at 900 to the one at top. The light is then reflected via a mirror at the back and returns via the same pathway.

**3.3 Motor driver:**

Motor driver is an IC which is used to drive the motor.

**3.4** **DC Motor:**

Motor is used to open the gate.

**3.5 EM-18 RFID Reader**

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**Fig 3.3 RFID Reader**

RFID reader is an active device with is powered through the Arduino board. It has an inbuilt small antenna in it, which emits radio waves continuously when it is an active mode, and the RFID tag responds to the radio waves by sending its data to the reader. In the project the use of RFID reader is to detect the tag on yhe vehicle arriving at the toll plaza and providing the tag’s ID to the microcontroller.

EM-18 RFID Reader has some specifications such as:  
 1. Operating distance - 10 cm

2. Operating voltage - 5 volts

3. Operating frequency- 125 kHz

4. Current consumption- <50ma

In this project it is used as stationary reader which is always looking for the RFID tags in its range. If any vehicle with RFID tag comes in its range it receives its data and transfers its unique ID to the Arduino.

**3.6 RFID Tags**

A Radio Frequency Identification tag usually known as RFID tags are electronic gadgets that can be attached with a product, person, anima or many more for their identification or tracking using radio waves. Every tagits own identity or tag number.



**Fig 3.4 RFID Tag**

There are basically three types of RFID tags:

1. Passive tags, with no power supply
2. Active tags, with power supply
3. Beacon tags

The RFID tags use in this project are passive type this helps in saving power has no problem of providing power supply to the tags all the time to make them work. Passive tags work with the help of small amount of current induced in tag’s antenna from RF signal of reader, this current generated enough power for circuitry in tag to start up and give response to the reader.

**CHAPTER 4**

**SOFTWARE USED**

* **Arduino**

Arduino can be used for the manufacturing of single board microcontroller and microcontroller kits. A digital devices and interactive objects built by arduino are used for sensing the control objects in the physical world. The CPU models in the arduino are Atmel AVR (8-bit) , ARM cortex –M0+(32-bit), ARM cortex-M3(32-bit) and Intel Quark(X86)(32-bit). The built in memory for the arduino is SRAM.A arduino board is pre-assembled and the Arduino programming simplified from the c/c++ languages is called as “sketches” by the arduino.

* **Arduino compiler –** version 1.5.7for windows

Source: [www.arduino.cc](http://www.arduino.cc)

* **Language used –** Embedded C

Embedded C is very similar language to C and C++ with few of its libraries and function name being different it serves as an easy and simple language to make embedded system work according to coders need.

**CHAPTER 5**

**METHODOLOGY OF THE PROJECT**

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**Fig 5. The generalized block diagram of our project**

* **Description in detail:**

Description in detail: It mainly consist of following blocks

* Receiver: We are going to use a Infrared receiver. It is used to detect that vehicle has passed away from the electronic toll collection plaza.
* 2. Transmitter: Infra-Red transmitters used are IR LEDs. IR rays from transmitters are reflected from the vehicle and are received by the receiver.
* Microcontroller: This is the CPU (central processing unit) of our project. We are going to use a microcontroller of 8051 family. The various functions of microcontroller are like

1. Reading the RFID card number from the RFID reader.
2. Sending this data to LCD so that the person operating this project should read various informative messages.
3. Sensing the command given using keypad and receiving singnal from the IR receiver.
4. Sending the data to the motor or buzzer depending upon the RFID card number and balance inside the card.

* LCD: We are going to use 16×2 alphanumeric Liquid Crystal Display (LCD) which means it can display alphabets along with numbers on 2 lines each containing 16 characters.
* DC motor and Motor Driver: We are going to use a DC motor to open the gate. A motor driver IC is required to drive the motor.
* RFID card reader: This is one of the most important part of the project. It reads the unique number from the RFID cards and sends it to the microcontroller.

**CHAPTER 6**

**SYSTEM IMPLEMENTATION**

* **Programming in Arduino**
* We need to install Arduino Programmer.
* Connect your Arduino to the USB port of your computer. This may require a specific USB cable. Every Arduino has a different virtual serial-port address, so we need to reconfigure the port if you're using different Arduino.
* Set the board type and the serial port in the Arduino Programmer.
* Test the microcontroller by using one of the preloaded programs, called sketches, in the Arduino Programmer. Open one of the example sketches, and press the upload button to load it. The Arduino should begin responding to the program: If we've set it to blink an LED light, for example, the light should start blinking.
* To upload new code to the Arduino, either we'll need to have access to code you can paste into the programmer, or we'll have to write it yourself, using the Arduino programming language to create your own sketch. An Arduino sketch usually has five parts: a header describing the sketch and its author; a section defining variables; a setup routine that sets the initial conditions of variables and runs preliminary code; a loop routine, which is where you add the main code that will execute repeatedly until you stop running the sketch; and a section where you can list other functions that activate during the setup and loop routines. All sketches must include the setup and loop routines.
* Once you've uploaded the new sketch to your Arduino, disconnect it from your computer and integrate it into your project as directed.



**Fig 6.1 Hardware assembly**

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**Fig 6.2 Arduino’s coding for Add and delete card at Toll Plaza**

**CHAPTER 7**

**CONCLUSION**

At the end of the report, the conclusion that come out that, to implement modern system of toll collection i.e. ATCS embedded system were used and a new technique RFID come into light. The RFID safety is a key important thing about this project. Strong and verified design were kept in the project, and good, reliable RFID technique was used for authentication and authorization of vehicles. The project is reliable and easy way to collect toll comparing to manual one. ATCS proposed will significantly improve travelling through highways by reducing wastage of time and fuel. This system can easily collect toll from people without even making them stay at the toll booths. This is achieved by using wireless technique of data transfer from vehicle to microcontroller and from microcontroller to vehicle.

This system bill definitely help booth the ends i.e. toll authorities and the people in form of cost, time, increased capacity and better convenience and security. Due to implementation of this technique at all toll plaza of India, the problem of long queues and need for human intervention will be reduced. In ATCS basically a RFID tag is the gate pass for the vehicle if its valid one can go through of its invalid the owner has to wait. This idea of toll collection also reduces fuel consumption and pollution.

So, it is clear from this report that RFID base toll collection system is not only better than manual system but is the best automated toll collection system technique by far because it also helps the owner of the vehicle to know the current location of his/her vehicle through the SMS received from toll plaza after successful transaction, carrying information about the toll plaza where transaction took place.

**FUTURE SCOPE**

**1. Implementation of automatic money debit system**

In our project now we are implementing the smart card mechanism for the payment of the toll amount paid by the vehicle owner. When the vehicle comes at toll plaza the vehicle owner has to swap his smart card in the debit machine. So, desired amount of toll amount will be deducted from the account of owner.

Here we can also implement the automatic debit system. In this system we have to treat the RFID card also as the smart card. In the RFID card we have now vehicle number in the code format. So ,we can combine the RFID card with smart card as both are the different forms of basic principle of Bar code.

**2. Implementation of image processing for centralize data recording**

In our present concept we are only using the RFID system for vehicle detection. So we can extend the scope of this concept in other way for centralize data recording. For that purpose we can use the IR courten at the entry gate which is followed by the Camera which will be continuously capturing the images of the vehicles entering into the toll plaza. And the third step the RFID is collecting the vehicle number.

Now when the vehicle passes through the IR courten it tresses the outline of the vehicle, in the next step the camera will take the image of the vehicle & followed by the RFID to record the data related to the vehicle. The load cell weighs the vehicle & classifies it into two categories as light & heavy vehicle respectively. The whole data collected together & sent to the centralize server which will store it for stipulated time. This application will help in detecting the vehicles in the crime cases like terrorisms & smuggling of goods & it will also reduce the load on check posts.

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