# IoT based Smart Toll Collection System

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***Abstract:*** *With the emerging technologies, there is an innovation in various sectors. However, if we consider about the Toll collection Booths, there is still an Old and Ineffective Process used. To overcome the long process and queues, an effective way can be implemented using IoT. A smart card-based toll booth system is designed, which can identify the vehicle arriving at toll plaza. In addition to this it also records its registered RFID number and verify the same data with the information stored in the cloud. To implement this proposed system, every vehicle owner should possess an RFID (Radio Frequency Identification) based card. The Toll Management System monitors the authorized vehicle, it opens the toll gate with a fix toll amount to be transected from its account. The Internet servers will maintain all the data of the user with their transactions and balance. To make it possible, here the combination of microcontroller and RFID using IoT is been automated. Activities like Trespassing on borders and the Surveillance system can be extended using this type of Toll payments system. The proposed system thus automates the one step ahead to the Digital India Scheme for the citizens residing in this country.*

***Index Terms - RFID and RFID Module, Arduino MEGA, GSM Module, Internet of Things (IoT), Toll Plaza, Digital India.***

## I. INTRODUCTION

### 1.1 Basic Principle

With the increase in the number of vehicles the need for expansive roads catering to thousands of vehicles moving across India has become ineluctable. However, considering the current situation the current toll system has several drawbacks. Due to the insufficient number of toll booths and slow collection process, the average waiting time per vehicle is 10 minutes, which results in losses worth thousands of cores of Rupees in terms of fuel wastage. This type of situation of long wait time often results in drivers getting irritated resulting in verbal spats and physical fights among people and the toll attendants. Well some of the incidents have been reported in the press with some of these fights even resulting in the death of the toll plaza attendants.

In addition, there are number of cases of toll plaza accidents which happen due to the sudden lane changing by drivers for faster clearance. The major reason behind this is, the security at the tolls is insufficient and it is beyond the traffic polices control to manage the vast number of vehicles. We keep listening of many such incidents at toll plazas which mostly occur due to negligence either on the people's side or due to lack of control from the government agencies including the police.

To install an automated e-toll collection system with motivating the cashless transaction is the sole purpose of this paper. This system will be capable of saving time as well as fuel conservation which can save a lot of individual's economy. This proposed system is far much better and very efficient towards people as they will not stay in a long and lengthy queue thus automated e-toll system will eliminate the hardships of people parking vehicles in a long queue. RFID has the potential of eliminating corruption at certain levels and also reduce operational costs as well as errors in human operations.

#### 1.1.1 Concept of Automatic System

- Improving the speed and the efficiency of Traffic flow.
- One Step Towards Digital India.
- Reduces loss of Fuel.
- Transparency to the whole system.

### 1.2 History

**II.** There are various kinds of existing gates like slide gates, swing gates, barrier gates etc. These are the commonly used types apart from these there are hydraulic gates etc. They are controlled mostly manually. The present methodology is the most common

approach for collecting tolls that is to have the driver stop and pay a toll collector sitting in a tollbooth. The amount to be paid is based upon the characteristics and classification of the each vehicle which is determined by the toll collector.

## III. DESIGN AND IMPLEMENTATION OF PROPOSED SYSTEM

### 2.1 Algorithm

1) Wait for signal from RFID reader.
2) Store the 12-digit number from RFID into microcontroller memory.
3) Check if the received RFID card number is valid.
4) If card id not valid then turn on buzzer and go to step1.
5) If card is valid then read the balance for the respective card.
6) If balance is less than 50 then turn on buzzer and display "Insufficient Balance".
7) If balance is greater than 50, then reduce 50 from the existing balance.
8) Open the gate (turn on DC motor clockwise).
9) Wait for signal from IR Receiver.
10) If signal received from IR receiver then close the gate (Turn DC motor anticlockwise).
11) Exit from the RFID mode.

### 2.2 Design (Flow Chart)

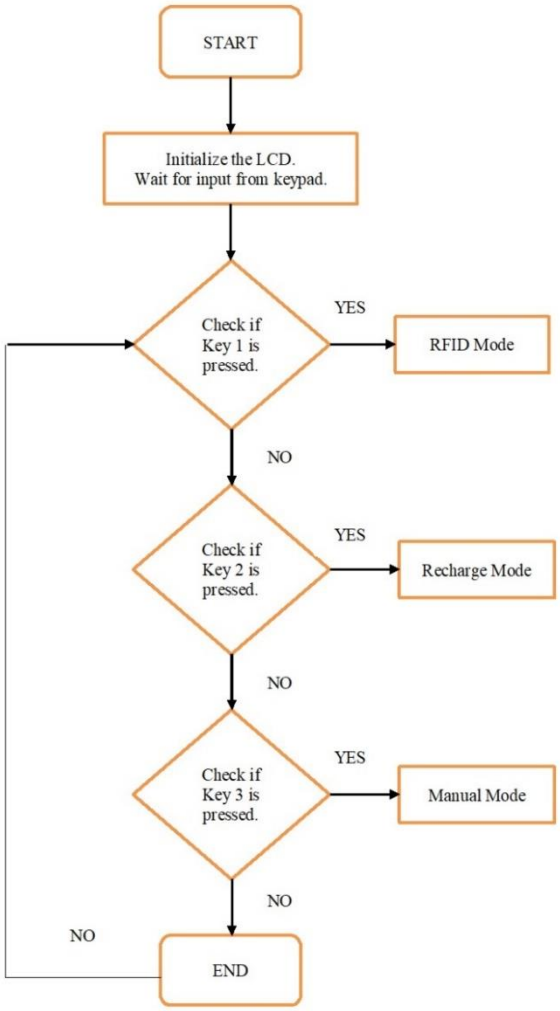


**Figure 1** Flow Chart of Proposed System

## 2.3 Implementation

### 2.3.1 Hardware Modules

**1) Arduino**

Arduino is used as a microcontroller playing an important part of the project. This controller is known for the detection and connecting peripheral's with other hardware modules. It is responsible for making decisions for the connected devices.

**2) Liquid Crystal Display (LCD)**:

16x2 LCD is used to display information about the mode selected, process done after selecting modes and the mentioning of details of the system going on, when RFID is read by the RFID Reader Module.

**3) RFID card reader**

Here RFID card reader is used for the detection process, to analyze and indicate the card used, and sending the code to respective card. This code is sent through serial communication.

**4) Keypad:**

Keypad is used to recharge the RFID cards. We have to enter the recharge amount through Keypad. For this purpose, we have used a 4x1 keypad. Keypad is used to set the time. It has mainly four keys which are Enter, Increment, Decrement, and Escape.

**5) IR Receiver**

It receives the IR rays transmitted from IR Transmitter. Here we have used 38 kHz infrared IR receiver for detecting if a vehicle has passed the toll collection booth. The connections for detection method of 38 kHz is given through the IR LEDs via a 555 timer.

**6) IR Transmitter**

It transmits the IR rays to the IR receiver. IR Transmitter is transmitting the rays at 38 KHz frequency. IR LED (Transmitter) Light Emitting Diode which is commonly known as LED is used as IR transmitter. It indicates that the object is been passed over.

**7) DC Motor**

A DC Motor is used to open the gate when the signal is given from microcontroller.

**8) Buzzer**

A buzzer is used for indication of Invalid card used at the toll booth.Alarm devices, timers and confirmation of user inputs are the uses of buzzers included in it.

**9) GSM Module**

This module accepts the "AT" command as it supports the user to develop application quickly.The power is supplied from UPS for uninterrupted operation. This product has inbuilt SIM card holder which activates when SIM card is inserted for normal use.This product provides great feasibility for devices in remote location to stay connected which otherwise would not have been possible where telephone line does not exist.

**2.3.2 Software Description**

**1)EAGLE PCB Design Software**

Eagle is the most used software in the field of drawing Electronic schematics. The name EAGLE is a short form, which stands for Easily Applicable Graphical Layout Editor. This software offers user friendly and powerful solutions for PCB design, including Schematic Capture, Board Layout and Autorouter. This software is developed by Cadsoft. Because of its freeware licence and rich availability of components libraries on the web make EAGLE popular amongst all.

**2)Arduino IDE**

The Arduino integrated development environment (IDE) is a cross-platform application used to write and upload programs to Arduino compatible boardswith the help of 3rd party cores and other vendor development boards.

Arduino Integrated Development Environment (IDE) is used for connecting the Arduino hardware for uploading programs and communicating with the outside world, due to its software libraries. The programming for the proposed system is done in Arduino IDE so as to interface the components like RFID, LCD etc.

**3) Ubidots**

It is an IoT Development Dashboard used to make this project as Real Time Specified with the help of the cloud server.

## IV. EXPERIMENTAL SETUP

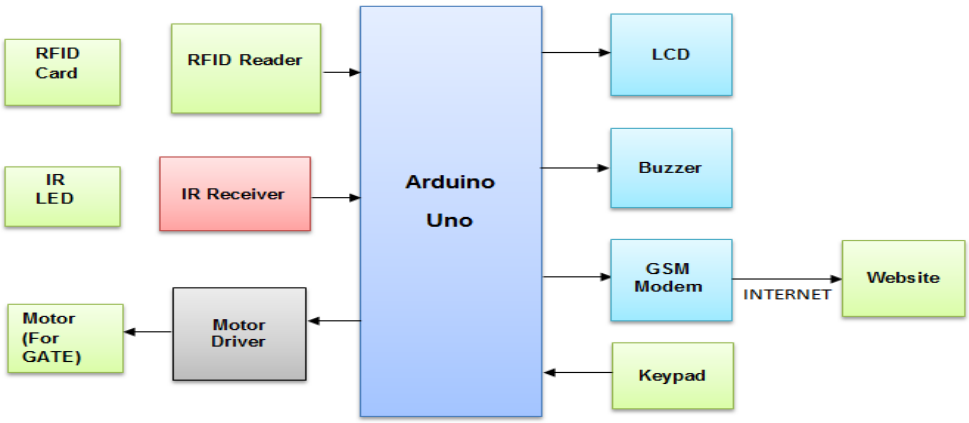


**Figure 2** Block Diagram

## V. WORKING

First of all, we need to have a valid IoT Platform using Ubidots for the data entry and to initiate the user profile. From there, we can visualize the toll activity throughout the system from anywhere and anytime.

When the person with RFID tag enter the toll plaza, the person has to select the mode of payment. And when the RFID mode is pressed on the keypad, the payment will be done through the RFID mode. Now the RFID card needs to been shown on the RFID Reader Module, so it can detect the user ID. RFID Reader reads the tag and verifies it with the microcontroller. If the card is not valid or with insufficient balance the buzzer will turn ON. If its valid, the microcontroller gives command to the DC Motor to open the gate and the Wi-Fi Module sends a message displaying 'Your RFID Card is used at Toll Booth'. The IR Sensor verifies the car which has passed and the gate is closed again back to its position.

For the Toll Booth Management System, we can see the all data including time, place, and the user with its existing amount on the IoT Platform. The details of each User ID can be accessed at Toll Booth Management System.

Additionally, the user account can be recharged using RFID at Toll Booth. For that a user need to select a recharge Mode where they can increment the recharge amount, they needed, and a message is sent to the user stating 'recharge Mode has been selected,recharge done successfully'.


**Figure 3** RFID Mode ON


**Figure 4** RFID Card Valid


**Figure 5** Payment Accepted


**Figure 6** Gate Opens

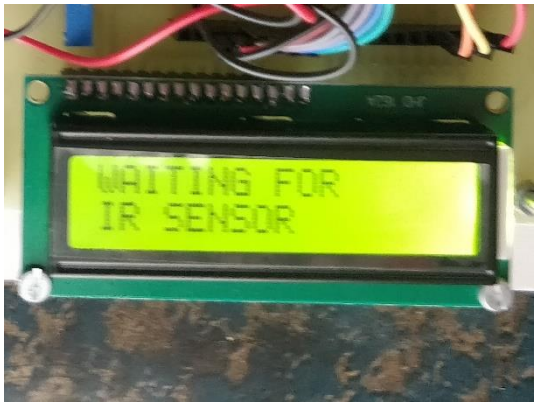


**Figure 7** Vechilce crosses the gate


**Figure 8** Gate Closed


**Figure 9** Data Sent to the IoT Server


**Figure 10** Recharge Mode Selected


**Figure 11** Invalid RFID Card

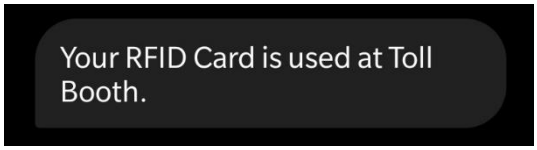


**Figure 12** SMS sent to the User when the Card is used

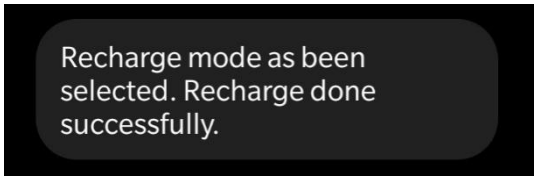


**Figure 13** SMS sent to the User wen Recharge is done

## VI. Future Scope and Conclusion

In this paper, we have presented the implementation of IoT technology in the application of Toll Tax Collection. This method at toll collection stations allow the traffic to flow continuously and vehicle having been avoided stopping and starting again. The reduced fuel consumption has positive effect on environment which means pollution created will be minimum. Furthermore, the system also increases safety, as bottlenecks and long queues are avoided. Society and business community also benefits from the system because of its results in faster transportation. This system is cost-effective, time saving and easy to install which benefits the operator as well as user. IoT based toll booth monitoring system is a Arduino based toll collection system. The results obtained from working have shown that the system performance is quite reliable. The system has successfully overcome the shortcomings of the existing system by reducing the manpower at the toll booth. It provides easy way of toll collection and maintenance of the information.

The sole purpose of this paper is to the scheme Digital India initialized by Hon. Prime Minister Shri Narendra Modi. Stagnant of long queue traffic and corruption less transaction with smooth trafficking is been promoted by this means.

**FUTURE ENHANCEMENT:**

- Improvised travel patterns.
- Improvements in Public transport System.
- Traffic flow improvements.
- Ecofriendly.
- Increased Safety.

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