

# IOT based Toll Collection System using RFID

Dr. Shridevi Soma

Department of Computer Science  
and Engineering  
P.D.A College of Engineering  
Kalaburagi, India

Sneha

Department of Computer Science  
and Engineering  
P.D.A College of Engineering  
Kalaburagi, India

Vijayalaxmi

Department of Computer Science  
and Engineering  
P.D.A College of Engineering  
Kalaburagi, India

**Abstract-** Connecting physical and digital worlds is the goal of Internet of Things (IoT), which is a revolutionary idea. It is shown through interconnectedness of physical world and how it affects lives of people across world. While driving, a driver may make a toll payment with the use of FASTag, which uses RFID technology. When RFID scanners at toll plaza fail to read FASTag, it's a regular problem for many drivers. The main concept of proposed work is to design a toll collection model using RFID based on Internet of things (IOT) concept and to implement proposed work by developing a model to show how the TOLL collection system works. Vehicle detection using IR sensor is the first step to be carried out, it detects vehicle from particular distance by emitting light. Later, speed detection near toll booth results in capturing the vehicle speed by ultrasonic sensors. These ultrasonic sensors uses sound waves at a specific frequency which should be roll backed by calculating distance on the time required. After calculating vehicle speed it validates the condition of the speed as normal and over speed, if the value calculated as over speed then fine must be taken. RFID readers should read RFID tag, which contains the unique ID value for validating card present in database, if the card is valid then payment must be done by just tapping card by the sufficient balance in it. Invalid cards are not accepted as well as card with insufficient balance must recharge the card using keypad. After payment with valid card the servo motor/gate uses automated method for opening the gate. Using Node MCU it is possible to keeps track of all the toll tax transaction that was carried out by the toll tax payer. Deducted and Sufficient balance can be displayed for authorized user by using IOT Server. An optimal performance of the system observed during the experimentation. This solution still keeps open the challenges for finding vehicle at distance from the Tollgate to reduced the congestion and pollution at the Tollgate.

**Keywords -** IOT, RFID, Arduino, Adafruit IO

## I. INTRODUCTION

### A. Introduction For Proposed Domain

The toll collection system using RFID is a fully digitalize system which has no need of any manual operations at the toll stations. To reduce wait times at toll booths and eliminate need for cash, engineers turned to microcontrollers, RFIDs, and sensors to create an automated toll collecting system. Automated toll collection utilizing RFID is primary focus of this project. The word "automation" refers to use of machines to take place of people in a process. In the meanwhile, we'll take a look back at the Toll plazas' history. Toll plazas were manually operated prior. Two persons are responsible for unlocking

and unlocking the gate, while two others are responsible for receiving and storing money and other valuables. Semi-automatic toll plazas began to be used in 1995, after the Expressways had been completed. In this case, only two people are needed to operate a single booth. However, this is human-free plaza that we are about to see. The project's most fundamental need in real life is: It saves time and money by reducing the need for manual operation, avoiding fuel loss, and reducing time spent collecting tolls. Toll collecting procedure for a single car used to take one minute under the old method. Just 40 to 42 seconds will be needed to finish whole procedure using this automated method. Because the process takes less time to complete, there will be less traffic, and less traffic means less fuel waste, which is the whole point of creating roads in the first place: to cut down on travel time and decrease financial losses.

### B. Objective:

The purpose of this study is to Automatic Toll Collection. Safe and fastest payment method Reduces in the number of personnel required for toll collection. Saving time and reducing the Traffic Jams at the toll station. Save fuel and reduction of pollution. Contactless payment terminals. Less expensive to build and operate than traditional toll collection methods.

### C. Existing System

However current technology does not include an automated barrier that may be opened at any given moment, making it less efficient than suggested solution. Toll payments may be made using a prepaid card. Toll also has RFID sensors installed in it. It's also possible to pay tolls using a smartphone app. These toll collecting systems take a long time to complete. Additionally, there are ways to avoid paying toll taxes. As a result, subsequent cars must wait in line for an extended period of time.

Currently, two types of tax collection are being used: It starts with a manual approach, in which a single person receives money and provides a receipt for each payment. In addition, there is Smart Card method, which requires a person to present their smart card at toll tax department in order to access Gate. In current toll collecting system, tax is taken at toll booths and user must pay toll there. This approach, despite its simplicity, is very wasteful.

It is possible to pay for a toll using Radio Frequency Identification (RFID) technology while vehicle is in motion

using FASTag. Customers may pay tolls directly from their bank accounts using FASTag (RFID Tag) which is mounted on their windshield. Customers may save money and time by not having to stop at toll booth with use of FASTag's cashless payment system.

#### D. Proposed Method

An IOT-based Toll booth system has been devised in which a person may pay Toll fee using an RFID. Fig 1 describes the data flow of the proposed work. At toll collection facility, an RFID reader will be properly positioned. When a vehicle passes through a toll collecting facility, tax amount will be withdrawn from prepaid balance of car. It will be updated with new balance. One's updated balance will be negative if he or she does not have enough money. To deal with this issue, a warning sound that will notify the appropriate authorities that vehicle in question lacks adequate balance and may get stuck. As cars don't have to wait in a line, it saves time, fuel, and money, all of which contribute to a more efficient transportation system. Payment is also done automatically. Using an RFID reader, tag can be scanned and its data may be read. Vehicles RFID tag is validated by an RFID reader, which scans tag and compares data to a database to determine if vehicle may proceed. Other than that, it's business as usual at toll gate. Then it checks if the RFID tag is valid or not, if valid then further process is taken place. the valid tag sufficient balance is checked. If sufficient balance, the amount will be deducted and vehicle will be permissible to pass from toll booth. Amount that has been deducted is shown on LCD screen, and a message with the remaining balance in tag is delivered to vehicle owner. Ultrasonic sensors are used to recognize the speed of vehicle and if speed exceeds then vehicle owner must pay the fine along with toll tax.

#### E Flow chart diagram

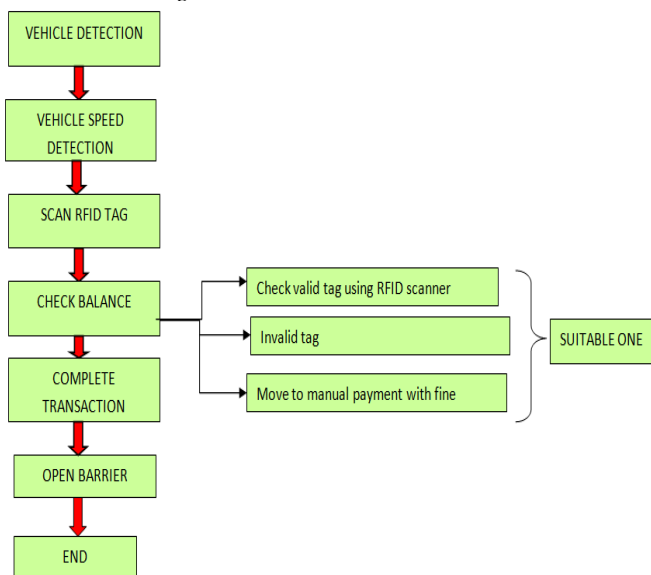


Fig 1. Flowchart Of the Proposed Work

## II. RELATED WORK

PranotiSalunke et al. Toll Collection System (ATCS) is a tax collection tool that utilises a computerised system. Radio frequency is used to identify object. An RFID tag will be attached to a vehicle. This label is nothing more than a randomly generated identifying number. Reader will be installed in a prime location at toll plaza. Tax amount is taken from prepaid balance whenever vehicle passes toll. J. M. Seguí et al. To reach a conclusion that should be offered to upgrade and speed up the process to save time for busy people and also, present them with some recommendations to complete shopping more effectively and meaningfully, based on observations made in real-time shopping where genuine experience is gained. Real-time shopping is subject of this research-based initiative, which will help shoppers find items they want to purchase more quickly in a store. Zimu Zhou et al. Marketing and merchandising initiatives are more successful when they are based on data on consumer shopping habits. Customers' buying habits may be tracked by online apparel companies by examining their click streams and shopping carts. According to theory, when buyers examine and choose desirable things, a time series using phase readings from tags affixed to those items would reveal different but consistent patterns in terms of trends over time. J. Han et al. There are fewer methods for tracking consumer behaviour during in-store purchases than there are when buying online. CBID, a Customer Behaviour Identification system based on passive RFID tags, was designed and implemented by the author. In order to achieve three basic goals of behaviour identification, new protocols and algorithms are used to represent real-world situations. CBID prototype uses off-the-shelf technology to construct all of its components. RafiyaHossain, et al. crimes occur on roads and bridges in underdeveloped nations. Author of this research proposes a security mechanism that may prevent such crimes from occurring. Instead of relying on a human tolling system, this system uses RFID technology.

## III. SYSTEM DESIGN

### A Module Description-

#### INPUT MODULE:

When vehicle arrives IR sensors senses the vehicle at toll booth. The IR sensor in proposed system acts as an object detecting equipment which detects the vehicle passing from it or vehicle entering toll plaza.

#### PROCESSING MODULE:

In processing module actuators or components which are used for Implementation can be classified into 4 phases: Sensors technology: Speed will be calculated by the distance between the two ultrasonic sensors divided by the time for the object to reach the second sensor. If the speed of the vehicle exceeds then vehicle must pay the fine along with toll tax. An ultrasonic sensor emits sound waves that are too high in frequency for humans to hear. When they hear sound bounce back, they may use that time to figure out how far they are from each other.

RFID technology: RFID tags are made out of three pieces: a micro chip, an antenna, a substrate. RFID tag is scanned by RFID sensors in which the transaction is done. RFID tag is scanned through RFID reader, by Radio frequency in the form of waves within a particular distance. The Automatic Identification and Data Capture (AIDC) technology family includes RFID. Computer systems may be programmed to recognise and gather data about items using AIDC technologies without need for human participation. After that, reader does work of converting the radio waves into something that can be used. Using a communications interface, data from tags is sent to a host computer system, where it may be accessed and stored in a database.

Processing of data using IOT: The data which has been processed during whole process is carried out by automated toll tax collection is stored in cloud by using Adafruit IO platform which helps in continues monitoring the process, transaction and the data can be stored unlimitedly.

Message sending technology: To report the amount deducted, the work utilizes the Node MCU to send message through Internet of Things (IoT) server. To report the Total amount with or without fine deducted to authorities, IoT is best possible solution. The normal criteria is to make a payment using RFID reader. If there is no balance in RFID tag then it should make a recharge to it by using the keypad.

#### OUTPUT MODULE :

Message Of Transaction- the message of successful payment and amount detection should be shown in the given Node MCU module device through which payment is done. The transaction details is shown through adafruitio.

Opens Gate- When the whole procedure of payment is done successfully with all the requirements then toll barriers must be opened using servo motor. The below figure 6 refers the output module.

### IV. IMPLEMENTATION

#### A Methodology Used For Implementation

Sensor technology- It is used to detect vehicle arrived and The speed is also detected using ultrasonic sensor. If the speed of vehicle and if the speed exceeds then vehicle must pay the fine along with toll tax.

RFID technology- It mainly aims for identifying the card sensed on the toll plazas. RFID tag is scanned through RFID reader, by Radio frequency in form of waves within a particular distance. RFID tag is linked with owner account, each RFID tag has a wallet to which the owner has to top-up with prepaid amount.

IOT technology-Node MCU is used in this study to send a message to an IoT server, which has global coverage, in

order to report amount deducted. It is presently most effective means of communication. Using IoT to submit whole amount, with or without a fee, to authorities is best option.

Node MCU technology: To report the amount deducted, the work utilizes the Node MCU to send message through Internet of Things (IoT) server. To report the Total amount with or without fine deducted to experts, IoT is best possible solution. The normal criteria is to make a payment using RFID reader. If there is no balance in RFID tag then should make a recharge to it by using the keypad.

### VI. RESULTS AND DISCUSSION

#### A. Implementation

##### Continous Monitoring Through Node MCU

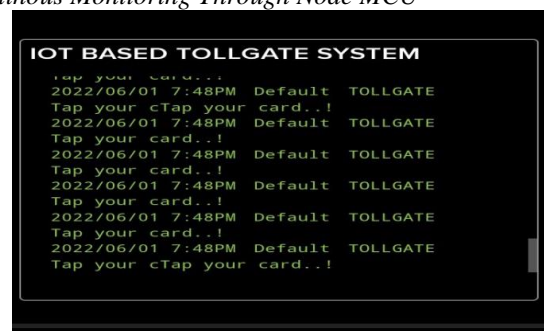


Fig 2: The serial monitoring done using Adafruit IO

Above fig 2 shows the serial monitoring done every fractions of second. The every action took, is shown through adafruit IO software. To begin, users must sign up for an adafruit IO account by entering their email address. Adafruit.io is a cloud service, which simply means that it will operate on your behalf and you won't have to worry about it yourself. It's accessible over Internet. Storage and retrieval are its primary functions. An Arduino board may be connected to Adafruit IO, which is a cloud service that is accessible on Internet. Adafruit IO utilizes NODE MCU for serial monitoring and continuous reporting to authorized users/admin. All that required is creating an account by email id.

#### Model Of Proposed Model

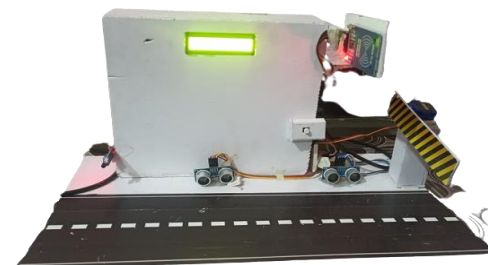


Fig 3: Model For IOT Based Model of TOLL collection system

Fig 3 shows the model developed for IOT based Toll collection system using RFID. This is complete over look of the model developed using IOT.

## VII CONCLUSION AND FUTURE ENHANCEMENT

There is a design proposal for an IOT-based toll collecting system that uses RFID. It has minimal costs, excellent security, long communication distances, and great efficiency. This toll collection method is environmentally sustainable, and it also increases capacity of toll lanes. Till now there is the average of 58.9% of total accidents caused, in that 31.8 % is because of speed of vehicle near toll plaza. Recent survey demonstrate that maximum accidents near/in toll plaza happens due over speed of the vehicle. To, overcome with such situation or to make people aware of the speed, speed recognition is done in the proposed work which takes fine if the speed exceeds near toll plaza. Through speed calculation there will be reduction in accidental cases which happens near/in toll plaza. Wide Range RFID Readers: Using wide range RFID readers the Toll plazas will be more advanced as the RFID tag can be scanned far away. By this technology , the vehicle owners does not need to stop at toll plaza for scanning his RFID. These technologies are used to identify owner of a particular vehicle and bill them

appropriately for the toll. They are collectively known as Automatic Vehicle Identification (AVI)

## REFERENCES

- [1] RakhiKalantri, AnandParekar, AkshayMohite, RohanKankapurkar, "RFID Based Toll Collection System", 2014 Vol. 5 (2) , 2014, (IJCSIT) International Journal of Computer Science and Information Technologies.
- [2] T. Wei and X. Zhang, "Gyro in the air: Tracking 3D orientation of batteryless Internet-of-Things," in Proc. ACM mobiCom, Oct. 2016,pp. 55–68.
- [3] S.Basagni, "Finding a maximal weighted independent set in wireless networks," Telecommun. Syst., vol. 18, no. 1, pp. 155–168, Sep. 2001.
- [4] Q. Pu, S. Gupta, S. Gollakota, and S. Patel, "Whole-home gesture in using recognition wireless signals," in Proc. ACM MobiCom, Sep. 2013,pp. 27–38.
- [5] D. R. Bell and J. M. Lattin,"Shopping behavior and consumer preference for store price format:Why „large basket” shopper prefer EDLP,"Marketing Sci., vol. 17, no. 1, pp. 66–88, Feb. 1998.
- [6] W.Wang, A. X. Liu, M. Shahzad, K. Ling, and S. Lu, "Understanding and modeling of WiFi signal based human activity recognition," in Proc.ACMmobi Com, Sep. 2015, pp. 65–76.
- [7] X. Zheng, J. Wang, L. Shangguan, Z. Zhou, and Y. Liu , " Smokey and Ubiquitous smoking detection with commercial wifi infrastructures," in Proc INFOCOM, Apr. 2016, pp. 1–9.
- [8] D. Zhang, H. Wang, and D. Wu, "Toward centimeter-scale human activity sensing with Wi-Fi signals," Computer, vol. 50, no. 1, pp. 48–57,Jan.2017.