

Modern Toll Tax Automation Using R F Technology

¹Neeraj Devi, ²Vinay Kumar Verma, ³Pooja Singh, ⁴Diwakar Tiwari, ⁵Vishesh Pandey

^{1,2,3,4,5}Dept. of ECE, Shri Ram Murti Smarak, College of Engg. & Technology, Unnao, UP, India

Abstract

This paper gives the idea about making Toll Plazas completely automatic. Here RF Technology merges wireless communication with unique identification method, in which every source RF Tag at vehicle emits its unique Identification Code (UIC) and then after receiving it, a receiver (at Toll Plaza) decrypts the signal and identifies the particular transmitter. Then this information about the source (vehicle) is displayed and Toll is deducted and stored for future use. But this system does not make toll collection completely automatic when there is need of recharging the user's account. Hence, in order to make toll collection system completely automatic and to avoid corruption at Toll Plazas some unique methods are suggested in this paper.

Keywords

Microcontroller, R F Tag, Transmitter Receiver, Motor Driver

I. Introduction

This paper is being designed to bring the RF technology (range limited wireless communication) in use that is widely used wireless communication system. It is used in different applications in different forms like security systems, attendance system, wireless control unit etc. In this system we are using this technology to make a wireless remote through which has inbuilt unique identity and can be used notify and define any person, object etc.

Today, we live in an age of wireless revolution where every effort is directed towards getting rid of wires. Removing wires not only makes things easy but also improves speed of operation. For example no one wants to stop at a toll tax and then mechanically deposit money rather there needs to be mechanism through which the car needn't be stopped and still the tax gets deposited. This will help in both achieving customer satisfaction as well as improving the efficiency of whole system.

Similarly identification of different things has also achieved new heights. It is very important to keep track of one's assets and hence unique identification has a major scope of development. This unique identification system will improve the overall efficiency of the system and will bring more social security. Through this technology we can keep track of our pets, clothes, cars and various other things. This technology has application ranging from commercial purposes to even for an individual.

II. Overview and Problem Statement

In existing manual Toll collection system there are several problem such as:

1. Due to corruption at Toll Plaza there is Financial Leakage.
2. Long queues of vehicle at Toll Plaza waste the fuel of vehicles.
3. Inaccuracy and delay in the system due to involvement of human nature.

Hence, this system is proposed in which there are three units:

- **Transmitter Unit:** It consists of RF Tag which continuously emits radio frequency of 434 MHz, which is modulated signal indicating unique identification of user.
- **Receiver Unit:** It consists of radio frequency Receiver which stores receives the transmitted signal, 8051 microcontroller

which is main driving part of this system, and LCD which displays the details of user account balance and unique id.

- **Motor Driving Unit:** It consists of 12V gear motor. It is used to control the gate according to the command of microcontroller.

A. Literature Survey:

1. Present Method

Present method is a manual method in which Toll Tax is collected by manually in form of cash.

But due to several inconveniences and disadvantages we have tried to propose a new method with several advancements.



Fig. 1: Existing Inconvenient Toll Tax Collection Method

III. Proposed Method

In our method we have used RF Technology to automate the Toll Tax Collection System, in which Toll Tax will be deduct from the user account as the vehicle moves from Toll Plaza and the Toll Gate will operate automatically with the command of microcontroller.



Fig. 2: Proposed Automatic System

A. Advantages of Proposed System

- Financial leakage control
- Fuel saving
- Reduced man power
- Reduced time for completion of process
- Cash free operation

B. Block Diagram

1. Transmitter Remote (or tag)

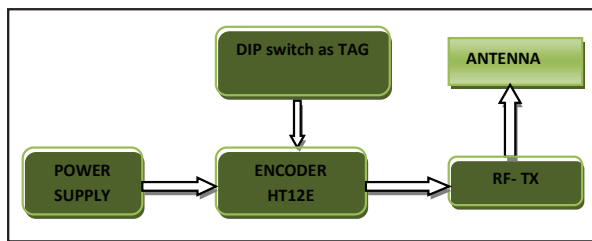


Fig. 3: Block Diagram of Transmitter

2. PCB Implementation

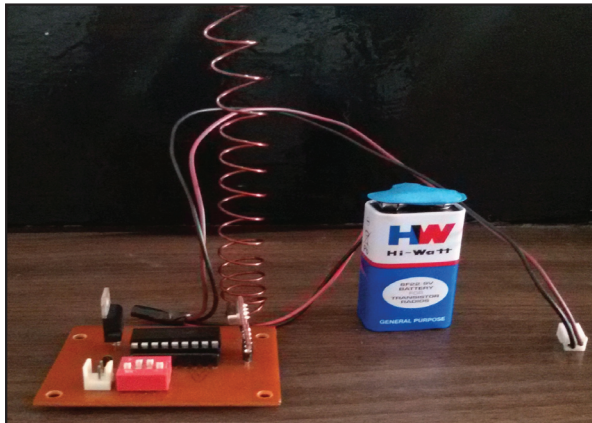


Fig. 4: Transmitter Module

3. PCB Implementation

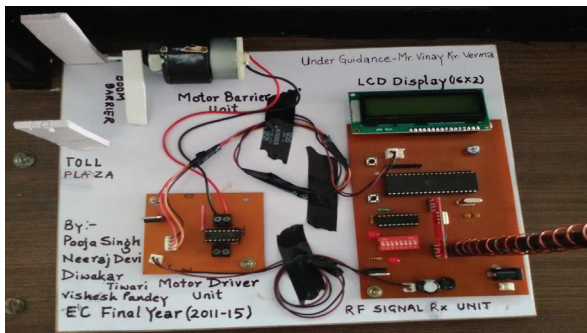


Fig. 5: Receiver Module

4. Toll control Device

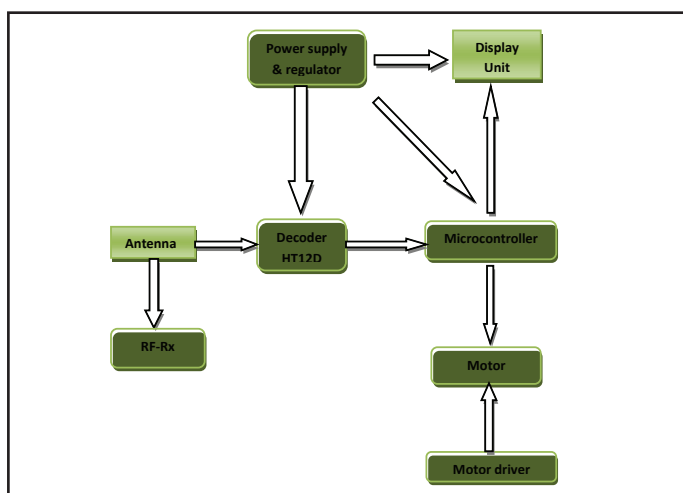


Fig. 6: Block Diagram of Toll Control Device

5. Schematic Diagram

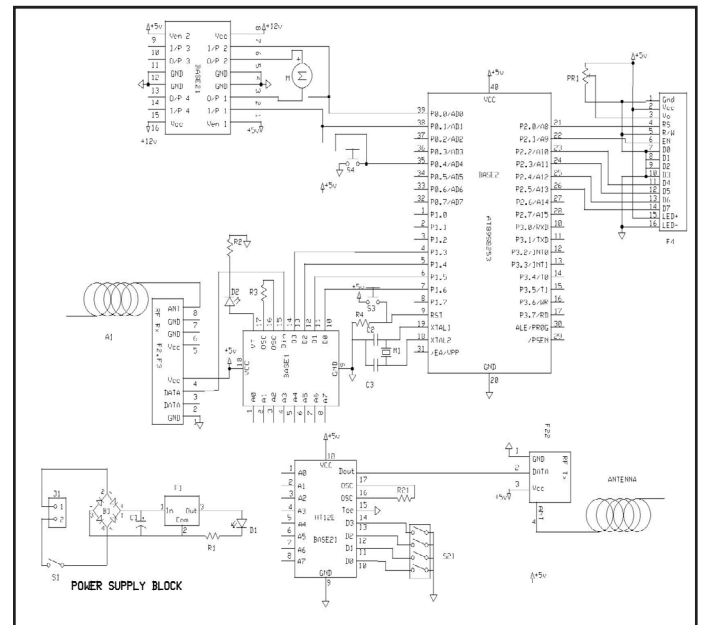


Fig. 7: Schematic Diagram of Toll Tax Automation System

6. Working of Toll Plaza

- In this system we have used RF technology to store the balance of each user.
- When a user comes with his/her vehicle he will have a RF tag inbuilt in his vehicle.
- Whenever the user comes with his vehicle the RF receiver connected to the toll tax station, reads the RF tag which stores the vehicle number.
- The micro controller processes this code and checks the balance of that particular user
- If there is enough balance which is Rs50 over here he can go through the toll gate.
- The micro controller gives the command to the motor driver to rotate the motor in forward and backward direction to signify the opening and closing of the gate.
- If he does not have enough balance then the micro controller waits for the recharge button to be pressed.
- Thus the toll tax Automation system works.

7. Features

- RFID Tag cannot be cloned so cannot be cheated.
- Very efficient saving of time.
- Wastage of money reduced.
- Consumption of oil is reduced.
- Population is reduced to a large extent.
- Speedy Transport.
- Less congestion on roadways.
- Comparatively less maintenance cost.

8. Some Possible Future Enhancements to make system fully automatic

(i). Account Number at Display

Inclusion of bank account Number of user at display of LCD will facilitate activation of Net Banking in case of less balance in user's account. Where Registration number and Balance is already displayed on LCD screen.

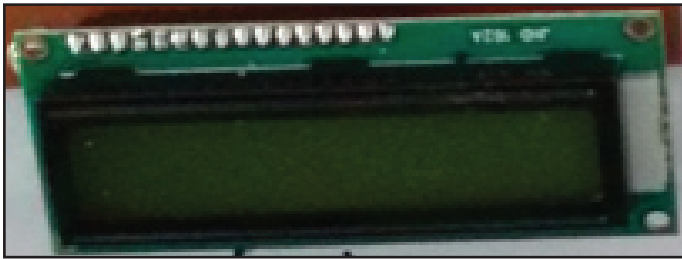


Fig. 8: Toll display on LCD

- Registration Number:
- Balance:
- Account Number:

(ii). Switching system in Tag

Since Tag transmits RF Waves continuously. Hence, Switching system at tag will reduce the power loss in Tag, and it will start transmit RF waves when user will switch it on at Toll Plaza.

(iii). Variation in Toll Tax according to the size of Vehicle

Arrangement can be made such that less Toll Tax will be deducted for the smaller and two wheeler vehicles and more Toll Tax will be deducted for larger four and multi wheeler vehicle by using two different sensors at Toll.

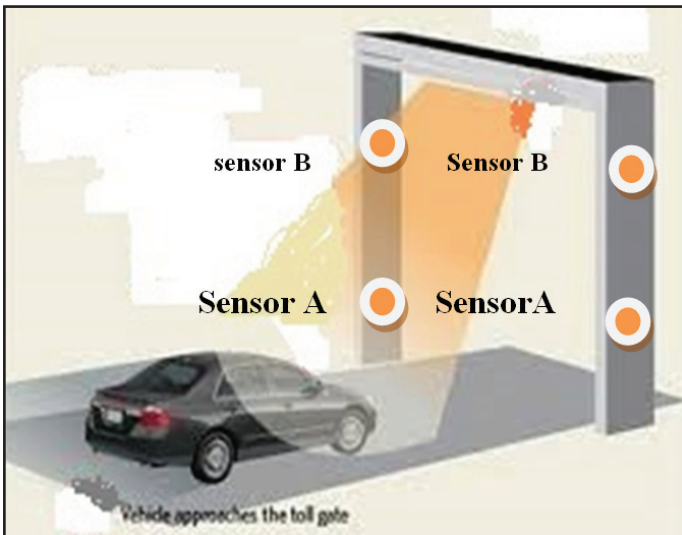


Fig. 9: Toll for Different Vehicles

For arrangement of sensors so that large and small vehicle can be identified is explained below:

Table 1: Truth Table for Gate vehicle detection

Output of Sensor 'A'	Output of Sensor 'B'	Detection through Toll Gate
0	0	0
0	1	x
1	0	S (Small vehicle is detected)
1	1	L (Large vehicle is detected)

On reducing above truth table using 2x2 k-map we get,

Reduced expression for detection through Gate = A (S+BL)

(iv). Integration of whole Toll Collection System

Here, All RFID Tag contains the identification no. of vehicle, which are placed on moving vehicles have their unique identification

number work as mobile system and they continuously transmit R F frequency By the time vehicle reaches the Toll Plaza transmitted signal by Tag is received by Receiver.

Receiver is located at Toll Plaza, which is connected to BTS, each Toll Plaza have its unique ID so, Toll Plaza transmits R F I D id no. of vehicle tag along with its unique id no. to BTS and every BTS transmits RFID no. of vehicle, Toll Plaza id no. and its own identification no. to BSC and finally BSC transmits RFID no. of vehicle, Toll PLAZA id no., BSC id and its own id to main server i.e. MSC.

MSC stores the datasheets of all the vehicle users which contains vehicle RFID Tag no., its balance in account, and its account no. for automatic recharge of account, after receiving signal from BSC, MSC identifies vehicle, Toll Plaza, BTS ,BSC and type of vehicle by using above stated logic of small and large vehicle and after identification MSC deducts the amount of Toll Tax according to the size of vehicle and finally transmits updated balance of user account command to open the gate along with all the ids of BSC, BTS and Toll Plaza.

Information from the MSC is broadcasted to all the BSC but is received by the BSC whose id no. is matches with transmitted one, after receiving information from MSC, BCS broadcasts the user's information, to all the BTS but is received by that BTS whose id is matched with transmitted one.

Now BTS transmits user's information to associated Toll Plaza & Toll Plaza transmits updated balance to vehicle and it is saved on tag and command to open the gate at gate module and finally gate opens, vehicle passes from Toll Gate and Gate closes.

In case of inefficient balance in user account then until it is not recharged gate will not open, user's account is recharged by user's account no. automatically and further Toll deduction process continuous.

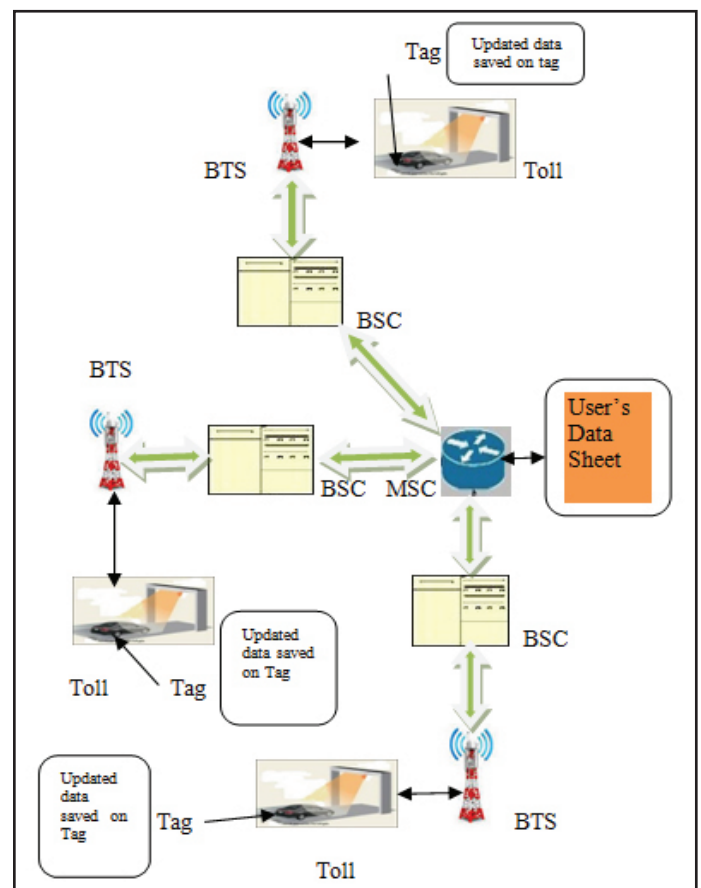


Fig. 10: Integrated Fully Automated Toll System

IV. Conclusion

By doing automation of toll plaza we can have the best solution over money loss at toll plaza by reducing the man power required for collection of money and also can reduce the traffic indirectly resulting in reduction of time at toll plaza.

In our project we have introduced the techniques such as Radio Frequency Identification. This technique will include the RFID tag & reader which in coordination with each other can be used to detect the vehicle identity.

By effectively utilizing above three techniques at different stages of our system we are able to represent the automation in toll plaza which will reduce the complete processing time by few seconds which is very important as well as helps to reduce money leakage in a very cost effective manner.

V. Future Scope

1. Vehicle theft detection
2. Signal breaking Avoidance
3. Tracking over Speedy Vehicle
4. Possible to keep track of our pets, cloths & cars

References

- [1] Customizing and programming microcontroller- Myke Predcko-TMH publication -2000
- [2] FIM30 user manual.
- [3] C programming for embedded systems- Kirk Zurell
- [4] "8051 and embedded system" by Mazidi and Mazidi
- [5] Embedded Microcomputer system- Onathanw. Valvano PHI publication-2000
- [6] Microcontroller inter facing- Douglas V. Hall TMH publication-2000
- [7] [Online] Available: <http://www.ijserp.org/research-paper-0614/ijserp-p3009.pdf>
- [8] [Online] Available: http://www.academia.edu/3425103/Automatic_Toll_Tax_Using_RFID
- [9] [Online] Available: <http://www.engpaper.net/rfid-based-toll-tax-collection-system.htm>
- [10] [Online] Available: <http://www.jatit.org/volumes/researchpapers/Vol22No2/1Vol22No2.pdf>
- [11] [Online] Available: <http://www.slideshare.net/shafeek070/tollgate-automation>