Cost Efficient Smart Toll Gate Billing System For Intelligent Transport Systems In Metropolitan Cities

Baranidharan V, Samyuktha M M, Nithya Shree N, Vikash Raj U K and Varsha P

Abstract: In India, the existing toll assortment system uses manual money transactions. Exponential growth in traffic is discovered in past years. These electronic booths mechanically collect toll from user account corresponding to the RFID tag glued on the windscreen of the automobile. The toll is subtracted is the amount from the user account on every occasion it passes through a parcel of land. Associate degree RFID reader with high power and high directional property is placed overhead for detection the passive tags glued on the windscreen. On the spot displays details regarding the toll subtracted and remaining account balance. After the prospering dealings, the barricade is opened. Recharge facility for accounts having depleted balance is provided on toll booths. This technique addresses all problems like time wastage, fuel consumption and assortment errors etc. An electronic system will bring transparency in toll tax collection and stop corruption and non-payment problems. Automatic Toll Tax systems have extremely helped a great deal in reducing the serious congestion caused in the metropolitan cities of nowadays. It's one amongst the simplest strategies accustomed organize the serious flow of traffic. Once the automobile moves through the toll gate on any road, it's indicated on the RFID reader that it's crossed the clearing. The requirement for manual toll primarily based systems is totally reduced during his strategies and therefore the tolling system works through RFID. The system so put in is kind of expedient reducing the time and value of travellers since the tag may be deciphered from a distance.

Index Terms: Vehicle traffic, RFID reader, Intelligent transport systems, Billing systems and Metropolitan cities.

1 INTRODUCTION

Our aim is to form a digital toll assortment system which is able to be less time overwhelming and automatic. Moreover, Economical analysis of the automated toll assortment system we conjointly were given and compared with the manual ticketing base system. Additionally, we've got conjointly used a weight sensing element to live the load of the transports to take care of the health of the roads and bridges. Suppose time taken by each vehicle on toll booth is 60 seconds a day(approx.) then time taken in a complete year is 365 x 60 = 21900 sec = 6 hrs. Suppose 10000 vehicles pass through a particular toll booth in a single year, total of 60000 fuel hours are wasted. This is a substantial loss of natural resources. The idea of smart toll booth provides a solution for the control of traffic in highways and to maintain the toll collection in a fully automated manner. The main objective of our paper is to completely automate the highway tolls and to reduce time consumption. This work focuses on electronic toll collection system using RFID (Radio Frequency Identification) technology. The users are provided with unique RFID tags with their details, the amount is being charged when the user scans their tags which reduce human errors and processing time. This system has the ability to pay the tolls by keeping the amount on the card itself; this makes the system faster and efficient.

2 LITERATURE SURVEY

Electronic toll assortment was 1st enforced in 1986. Subsequently, several electronic toll assortment systems square measure enforced with completely different techniques. A number of them square measure as follows: System proposed in [2] uses Wi-Fi for communication with the Smartphone of the user. This phone contains all necessary knowledge associated with the user registration. The user has registered at toll booth automatically as he passes through. But in countries with less Smartphone penetration, the system may not work effectively. System proposed in [3] uses RFID Technology. It is unique technology to transfer the electronic data. The system uses both active and passive RFID’s. System proposed in [4] uses NFC chips for the detection of vehicle identity. The NFC chips are designed to work in the close vicinity of the reader. If the distance between reader and chip is more than the critical limit, the system will not detect the vehicle. System proposed in [5] uses an overhead camera to detect number plate and uses it as the account number of the user. The database is stored on a central server. But deterioration of number plates or duplicate numbers may introduce false positives in the system. System proposed in [5] uses GPS base ETC system. GPS Toll assortment uses contact less automatic vehicle identification technology for identification of car Owner passing through that individual toll assortment centers. This paper aims at developing software to collect toll by providing the top user a postpaid wireless telephoneConsidering the constraints of former systems, RFID stands out with several benefits. RFID tags want no battery as they'll work dead with the ability transmitted by RFID reader. Not like variety plate, physical wear and tear don't have any hurt. the gap of the tag from the reader isn't an issue as high power radio waves will sight the tag up to the comfortable distance. not like Wi-Fi, it doesn't need any authentication thus quicker than system projected in [5]. More to the current the raspberry pi primarily based toll assortment system provides a cheap implementation as parts are fairly cheap.

* Mr. Baranidharan V is currently working as an Assistant professor in Department of Electronics and Communication Engineering, Bannari Amman Institute of Technology, Sathy, India. His areas of interest are Wireless Communication and Networks, Wireless Body Area Networks & Image processing. E-mail: baranidhar@hotmail.com
* Ms. Samyuktha M M, Ms. Nithya Shree N, Mr. Vikash Raj U K & Ms. Varsha P are currently pursuing Bachelor Degree in Electronics and Communication Engineering, Bannari Amman Institute of Technology, Sathy, India. Email samyuktha.ec16@bitsathy.ac.in, nithyashree.ec16@bitsathy.ac.in, vikashraj.ec16@bitsathy.ac.in and varshaap.ec16@bitsathy.ac.in
3 SYSTEM DESIGN
As demonstrated in this document, the numbering for sections upper case Arabic numerals, then upper case Arabic numerals, separated by periods. Initial paragraphs after the section title are not indented. Only the initial, introductory paragraph has a drop cap. The base idea behind implementing RFID Based Toll System is to automate the toll collection process and thereby reducing manual operation in toll booths and the long queues at toll booths using RFID tags. In addition to this, we can not only help the vehicle owners and system administrators from vehicle theft detection but also can track over speeding vehicles, and crossing the signals. Here we are going to see some points regarding the purpose of choosing this topic & what is the requirement of this type of the project in our day to day life. The user enters the toll, the red LED indicates that the system is working. Then the system asks the user for his/her preference. The user will select either one way(single) or Two way (double) with the use of push buttons, and then will scan the RFID tag. The amount will be deducted from the tag, and the display will show the user details. If there is sufficient balance and the amount was deducted successfully then a green LED indicates that the person can continue with his/her journey. If not, yellow LED indicates that there is insufficient balance in the card and to proceed to the recharge area located near the toll. The system is implemented with the following major components: Raspberry Pi 3 Model B+, RFID Reader, RFID Tags, Display, Push Button, LED, Jumper Wires

![Fig-1: System Block Diagram](image1)

3.1 RASPBERRY PI 3 MODEL B+
The Raspberry Pi three is that the third generation Raspberry Pi single-board laptop. it’s supported a one.2GHz 64-bit quad-core ARMv6 C.P.U. it’s intrinsical 802.11n Wireless LAN and Bluetooth four.1. Bluetooth Low Energy (BLE) makes it economical to use with battery operated devices. It has1 GB RAM. four USB ports make it economical to attach external hardware, forty GPIO pins with TTL output. they need a current supply or sinking ability up to 16mA. LAN port makes it simple to attach with the network. Video Core four three graphics core support Full HDMI output at the side of Combined 3.5mm audio jack and composite video. This makes it back compatible with older TV systems. Camera interface (CSI) and show interface (DSI) ports square measure provided to direct interfacing of camera and camera and show.

![Fig-2: Raspberry pi Model B+](image2)

3.2 RFID
RFID (radio frequency identifications) is used for the system of identification where it identifies the objects with the use of tag joined with them. While identifying they no need any light of sight between tag and tag reader. But they need radio communication between them. Generally, it contains a silicon microchip attached with a small antenna.A module which is reader cum writer that have one RC522 IC and two S50 RFID cards. RFID Reader has an exceptional modulation and demodulation algorithm to provide easy RF communication at 13.56 MHz. The S50 RFID Cards will relieve up the process serving you to learn and add the 13.56 MHz RF conversion to the project.

![Fig-3: RFID Reader (RC522)](image3)

**Features**
- A chip-based board.
- Contactless communication chip with frequency 13.56 MHz.
- It has a supply voltage of 3.3V and current 13-26 mA.
- It transfers data at the rate of 10 Mbit/s.
- It is ideal for user equipment development.

An RFID tag, or electrical device, consists of a chip ANd an antenna. A chip will store a novel serial range or different info supported the tag’s form of memory, which may be read-only,
read-write, or write-once-read-many (WORM). The antenna, that is hooked up to the semiconductor, transmits info from the chip to the reader.

Typically, a bigger antenna indicates an extended scan vary. The tag is hooked up to or embedded in an object to be known, like a product, case, or pallet, and may be scanned by mobile or stationary readers exploitation radio waves.

3.3. DISPLAY
A show monitor is an associate device accustomed to showing video output from computers. show monitors are employed in several computing devices, starting from personal computers (PC) and laptops to little hand-held mobile devices, like cell phones and MP3 players. A show monitor is additionally called a visual display unit or computer screen

Monitor performance is measured in line with the subsequent main factors:
- Luminance: Brightness in candelas per centare (cd/m² or Nits)
- Aspect ratio: quantitative relation of vertical and horizontal length as in 4:3, 16:9, 16:10
- Display resolution: range of pixels per sq in.
- Response time: The time it takes for an element to move (on) to inactive (off) and the other way around. Measured in milliseconds.
- Contrast ratio: quantitative relation of the luminance of the brightest (white) to darkest color (black) which will be created by the monitor
- Power consumption: Measured in Watts

3.4. PUSH BUTTONS
A push-button is a simple button which is used for switch mechanism for controlling some portion of a machine or a process. Buttons are made out of hard material, usually plastic or metal. The surface is generally flat or shaped to hold the human finger or hand, so it can be easily depressed or pushed.

3.5. LEDs
LED (light-emitting diode) is a semiconductor device that emits light when an electric current is passed in it. When the particles carry current light is produced combine together within the semiconductor material.

Jumpers are simple wires. Connector pins are present at each end. They are used to connecting two points to each other without soldering. Jumper wires are generally used with breadboards and other tools in order to make it easy to change a circuit as needed.

4 SYSTEM DESIGN
The functioning of the Digital toll collection system is completely automated with the use of Raspberry Pi microprocessor. Raspberry Pi is the heart of the system which controls the overall operation of the system. A red LED will indicate the working of the system. First, when the user enters the toll the display will display to select the preferences between one way (single) or two way (double). The fair will be different for both the differences and also it differs based on the vehicle type eg: for a car, the fair will be ₹60 for one way and ₹120 for two way. For a district highway. The fair will raise or fall also based on the highway the toll is being located. With the help of the push buttons situated in the machine, the user can select his preferences. Then the display will ask for the user to scan the RFID tag. The RFID reader will be located on the machine. When the user scans the RFID tag, the reader will scan the unique RFID number and transfer the number to the Raspberry Pi. Then the Pi will access the database and gathers the information of the user. Then the amount will be deducted from the user tag, and a green led indicates that the amount is deducted and the user is ready to go. Then the display will show the user details like owner name, vehicle registration number, vehicle model, the amount deducted and the balance amount. The servo motor will be activated by Raspberry Pi and the Tollgate opens.
In case if the user’s tag does not have the desired amount and the machine is unable to process, then a yellow LED indicates that there is insufficient balance in the tag. Then the display will direct the user to proceed to the recharge area. The toll gate opens and the user’s tag will be marked as waiting with a wait time of 5 minutes. The user has to recharge the card and again needs to scan in the same machine to ensure the payment if not then the user details will be marked as criminal and the details will be forwarded to the desired officials.

The Digital Toll Collection System has been designed using the above-mentioned components and Fabricated Successfully. All the necessary functions are implemented in this application. The functioning of the Digital toll collection system is completely automated with the use of Raspberry Pi microprocessor. Raspberry Pi is the heart of the system, which controls the overall operation of the system. The base idea behind implementing RFID Based Toll System is to automate the toll collection process and thereby reducing manual operation in toll booths and the long queues at toll booths using RFID tags.

The user enters the toll, the red LED indicates that the system is working. Then the system asks the user for his/her preference. The user will select either one way (single) or Two way (double) with the use of push buttons. A red LED will indicate the working of the system. First, when the user enters the toll the display will display to select the preferences between one way (single) or two way (double). The display will ask the user to scan the RFID tag. The RFID reader will be located on the machine. When the user scans the RFID tag, the reader will scan the unique RFID number and transfer the number to the Raspberry Pi. Then the Pi will access the database and gathers the information of the user.

After scanning RFID, the amount will be deducted from the user tag, and a green led indicates that the amount is deducted and the user is ready to go. It indicates for successful transaction.

The display will show the user details like owner name, vehicle registration number, vehicle model, the amount deducted and the balance amount. Raspberry Pi will activate the servomotor and the Tollgate opens.

5 Conclusion and future scope
Issues like long queues square measure fully eliminated by implementation of the system. This technique saves time and fuel. Transparency in toll assortment is accumulated as reports square measure hold on digitally. Want for the workforce is reduced on an oversized scale. The user can get correct info of his account on the toll booth show. Skipping of the toll is avoided. This technique can guarantee quicker commutation on highways. By doing, therefore, exaggerated potency is bonded since RFID is thought as an extremely stable
technology. With the elimination of human interaction within the entire toll assortment method, we will produce a more robust ETC system to be enforced in India. It can even considerably improve the potency of toll stations and also the traffic skills of the road. In our country road accidents are too common now a day. This accidents one of the main reason is high speed. If people would limit their speed according to by the speed meter than 90% of accident can be reduced. So in high ways, this speed meter can give all the vehicles users a proper guideline of speed limiting. Moreover, it can also have an extra application like if any vehicle goes beyond the speed limit which it is not supposed to then this speed meter will trace that vehicle.

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REFERENCES