RFID & GSM Methods for Automatic Toll Collections Technology

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Abstract:
Most Electronic toll collection systems around the world are implemented using Dedicated Short Range Communication technology. The Automatic toll tax payment system is proposed and the amount transaction information sends to the cell phone of the motorists through the GSM modem technology. It is an innovative technology for expressway network automatic toll collection method. The aim of the project is to design a system, which automatically identifies an approaching vehicles and records vehicles number and time. The vehicle belongs to the authorized person, it automatically opens the toll gate and predetermined amount is automatically deducted from its account. Suppose the illegal entry through gate is observed, then it will be registered and providing the warning sound. Each vehicle will hold an RFID tag and it contain unique identification number assigned. Whenever the vehicle passes the toll booth, the amount will be deducted from his prepaid balance. New balance will be updated. In case if one has insufficient balance, his updated balance will be negative one. The data information is exchanged between the motorists and the toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors.

Keywords: RFID Tag, GSM, Automatic toll gate

I. INTRODUCTION

Design and develop an Automatic toll plaza which is based on microcontroller, RFID technology and load cell to save the time at toll plaza and having cash free operation". As the name suggests "*Automatic Toll Plaza*" the key theme of our project is the automation. So here we will just take the overlook of what is mean by Automation. The term Automation means to replace the human being from the process with the machines. Means what presently the human is doing on the process now onwards the machines are going to do. Before moving further we will just take the overlook of history of the Toll plazas. So before the Toll plazas were fully manual controlled. There are two people for opening & closing of the gate & another two are for reception of the money & data keeping etc. But in 1995 when the Express ways had been developed the semi-automatic toll plazas were launched in which data is stored in computers & gate operation is automatic, only two personals are required for single booth. But here we are going to see the human less plaza.

The requirement of this type of the project in day to day life.

- Avoids fuel loss
- Saves time in collecting toll
- To monitor the traffic

In present system the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just 40 to 42 sec to complete the whole process. There is reduction in time for completion of the process so indirectly there will be no traffic as such & as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

II. LITERATURE SURVEY

[1] Pranoti Salunke1, Poonam Malle2, Kirti Datir3, Jayshree Dukale," Automated Toll Collection System Using RFID", Journal of Computer Engineering, volume 9, no2, PP 61-66 Feb. 2013. ATCS is an Automated Toll Collection System used for collecting tax automatically. The identification is done with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. Reader will be strategically placed at toll collection center. Whenever the vehicle passes the toll, the tax amount will be deducted from his prepaid balance.

[2]J. M. Seguí et al., "Enhancing the shopping experience through RFID in an actual retail store," in Proc. ACM UbiComp Adjunct, Internaional conference on industrial and information system, pp. 1029–1036, Sep. 2013. According to observations regarding real-time shopping where the real experience is acquired, to get a conclusion that should be provided to enhance and speed up the process to save time of busy people and also, provide them with some guidance to do the shopping more effectively and meaningfully. This research based development is focused on real-time shopping and it would guide the customers to quick track the goods to buy in a store.

[3] Zimu Zhou, LongfeiShangguan, Xiaolong Zheng, Lei Yang, and Yunhao Liu,

"Design and Implementation of an RFID-Based Customer Shopping Behavior Mining System", IEEE ON NET WORKING, Volume: 25, no 4, pp. 2405 – 2418, April 2017. Shopping behaviour data is of great importance in understanding the effectiveness of marketing and merchandising campaigns. Online clothing stores are capable of capturing customer

shopping behaviour by analyzing the click streams and customer shopping carts. The intuition is that the phase readings of tags attached to items will demonstrate distinct yet stable patterns in a time-series when customers look at, pick out desired items.

[4]. J. Han et al., "Cbid:

"A customer behaviour identification system using passive tags," IEEE/ACM Trans. Netw., vol. 24, no. 5, pp. 2885–2898, Oct. 2016. Different from online shopping, in-store shopping has few ways to collect the customer behaviours before purchase. The author presents the design and implementation of an on-site Customer Behaviour Identification system based on passive RFID tags, named CBID. The three main objectives of behaviour identification is modelled by concrete problems and solve them using novel protocols and algorithms. The prototype of CBID is implemented in which all components are built by off-the-shelf devices.

[5]. Rafiya Hossain, Moonmoon Ahmed, Md. Mozadded Alfasani, Hasan U. Zaman,"

An Advanced Security System Integrated With RFID Based Automated Toll Collection System", Conference on Defence Technology, vol. 24, no. 5, pp. 28–98 Jan2017. In the developing countries many crimes are happening at the highways and bridges. In this paper, the author introduced a security feature which can resist the occurrence of those crimes. However, this system is based on RFID technology which replaces the traditional manual tolling system.

III. EXISTING METHODS

In the present toll collection process which is in place the money is collected at the toll booths and the user is required to pay the toll at the booth. Though this method is extremely simple, it is highly inefficient.

Disadvantages of existing methods

• In toll booth method, there would be a lot of expenditure in building the toll booth.

• It is inefficient as it delays traffic and wastes time and is relatively expensive.

IV. PROPOSED METHOD

Electronic tolling system using Atmel uses the signals coming from the RFID to check if the vehicle has entered a certain location. In an event where it has, the Arduino uses the GSM module and the SIM slot to send a text message to the user informing them of the amount to be deducted. When the vehicle is going to enter into the toll plaza, the first aim is to detect the type & no. of the vehicle. For that purpose it has to first pass through the IR transmitter - receiver gate then we have here the RFID system. In this system the tag which is stickled at the front glass of the vehicle is detected by the RFID reader & the data is matched with the data base provided at every tollbooth. Then the consumer has to just swap his smart card so that desired amount of toll will be deducted from his account.
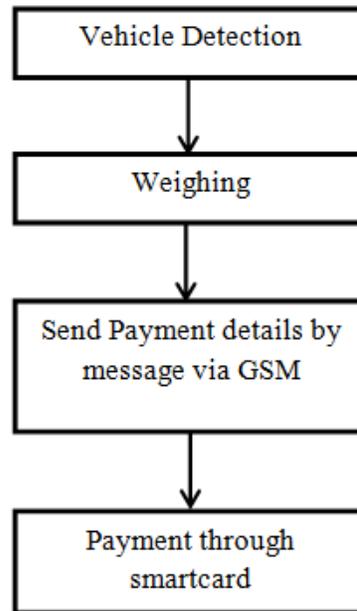
V. FLOW DIAGRAM

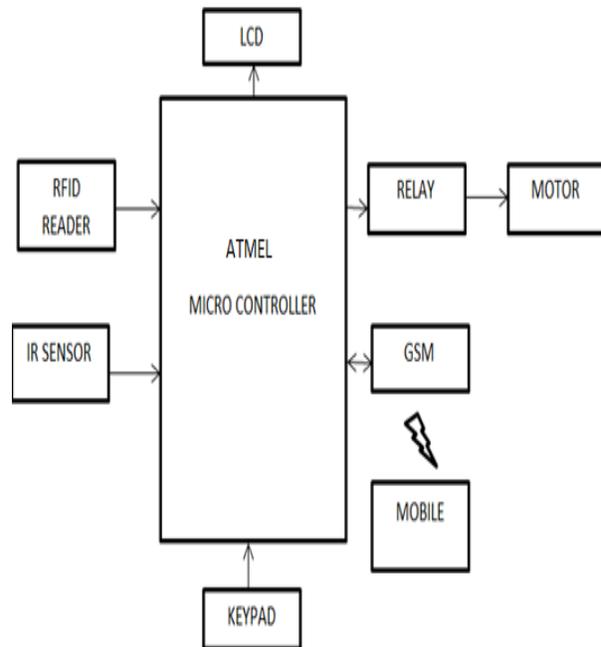**Figure.1. Amount Deduction in Tool System**

VI. BLOCK DIAGRAM

Figure.2. Block Diagram of RFID Toll Gate System

HARDWARE USED
  i. Active RFIDTx-Rx Pair
  ii. 16x2 LCD
  iii. IR Sensor
  iv. Relay Circuit
  v. GSM Sim 900A

MICROCONTROLLER
The AT89S52 is a low-power, high-performance CMOS 8- bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density

non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pinot. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory pro -grammer. By combining a versatile 8-bit CPU with in- system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications

GSM

GSM (Global System for Mobile Communications, originally Group Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second-generation (2G) digital cellular networks used by mobile phones. GSM supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service).GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band. Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their mobile phones when they travel to other countries. SIM cards (Subscriber Identity Module) holding home network access configurations may be switched to those will metered local access, significantly reducing roaming costs while experiencing no reductions in service
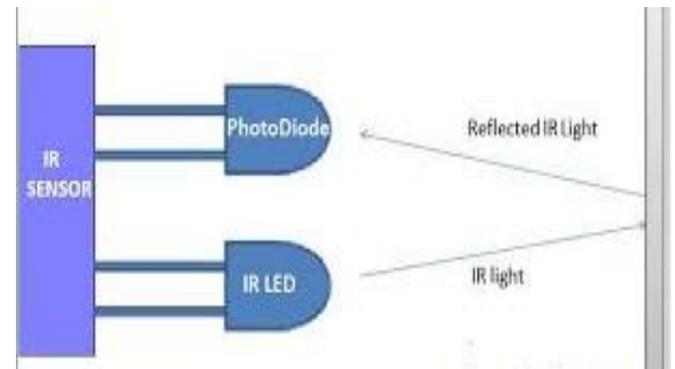

Figure.3. Shows the 2x16 Line LCD Display

IR Sensor

Figure.4. Shows the IR Transmitter

This IR sensor is used to sense the car passing through the toll booth. Accordingly the motor will work. Transmitter emit infrared radiation if obstacles is present it get reflected back to sensor which is receive through the receiver. It is connected to

the microcontroller.

Figure.5. Shows the IR Sensor

RFID Module

RFID stands for Radio-Frequency Identification. The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. And, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information. An RFID reader's function is to interrogate RFID tags. The means of interrogation is wireless and because the distance is relatively short; line of sight between the reader and tags is not necessary. A reader contains an RF module, which acts as both a transmitter and receiver of radio frequency signals. The transmitter consists of an oscillator to create the carrier frequency; a modulator to impinge data commands upon this carrier signal and an amplifier to boost the signal enough to awaken the tag. The receiver has a demodulator to extract the returned data and also contains an amplifier to strengthen the signal for processing. An RFID reader, also known as an interrogator, is a device that provides the connection between the tag data and the enterprise system software that needs the information. The reader communicates with tags that are within its field of operation, performing any number of tasks including simple continuous inventorying, filtering (searching for tags that meet certain criteria), writing (or encoding) to select tags, etc. The reader uses an attached antenna to capture data from tags. It then passes the data to a computer for processing. Just like RFID tags, there are many different sizes and types of RFID readers. Readers can be affixed in a stationary position in a store or factory, or integrated into a mobile device such as a portable, handheld scanner. Readers can also be embedded in electronic equipment or devices, and in vehicles.

EM18 RFID Reader

This module directly connects to any microcontroller UART or through a RS232 converter to PC. It gives UART/Wiegand26 output. This RFID Reader Module works with any 125 KHz RFID tags.

Specifications:

- 5VDC through USB (External 5V supply will boost range of the module)
- Current:<50mA
- Operating Frequency:125Khz
- Read Distance:10cm
- Size of RFID reader module: 32mm (length)* 32mm

(width) *8mm(height)

LCD

It is called Liquid Crystal Display. We are going to use 16x2 character LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LCD will provide interactive user interface. This unit requires +5VDC for it proper operation. This module is used for display the present status of the system.
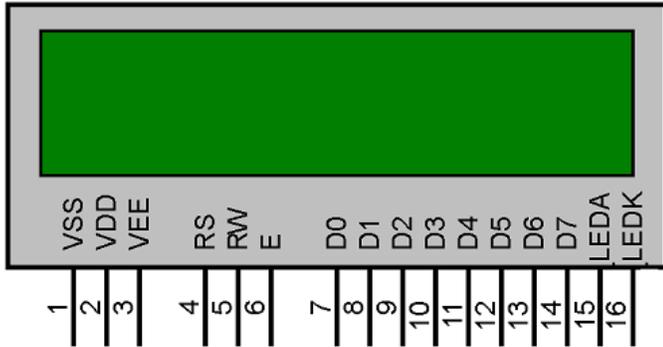

Figure.6. shows the 2x16 line LCD display

Relay Circuit

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The output of micro-controller is given to relay driving circuit. The relay switches based on signal given by microcontroller.

Figure.7. Shows Relay

DC Motor

An electric motor is a machine which converts electrical energy into mechanical energy. DC motor works on the principle, when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force. DC shunt motors can be used where almost constant speed is required and very high starting torque is not required as lathe, machine tools, centrifugal pump and etc. Series motors are used when very high starting torque is required such as electric traction, trolley car, crane, etc. cumulative compound motors are suitable for applications where the load fluctuates such as rolling mills, printing press, reciprocating type compressors, crusher units, etc. Differential compound motors are rarely used because of their poor torque characteristics.

Figure.8. Shows the Dc Motor used for tool Gate system to open / close

ADVANTAGES OF PROPOSED SYSTEM

• It is much cheaper as the hardware is available for low price and the software is available free of cost as it is open source
• There is also no need for construction of toll booths
• It will not delay or slow the traffic in any way.
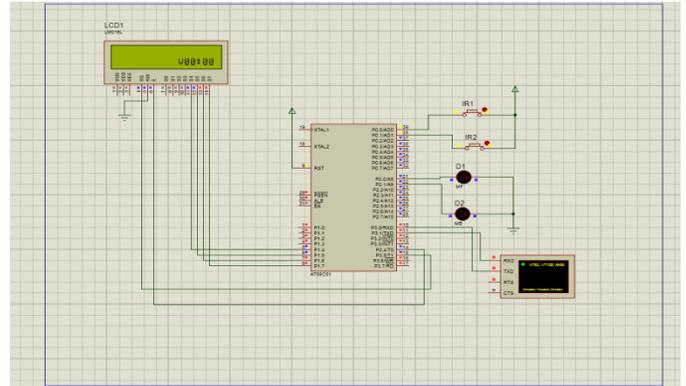
SIMULATION RESULTS

Figure. 9. Illustrates the Virtual terminal

When a vehicle comes the IR sensor gives the information to the microcontroller and the RFID reader reads the information on the tag in the vehicle. Microcontroller processes it and the transaction takes place. The details will be displayed on the LCD as well as it is send to the user's mobile. When a car enters into toll gate, the IR sensor gives the information to the microcontroller and the RFID reader reads the information on the tag in the vehicle.
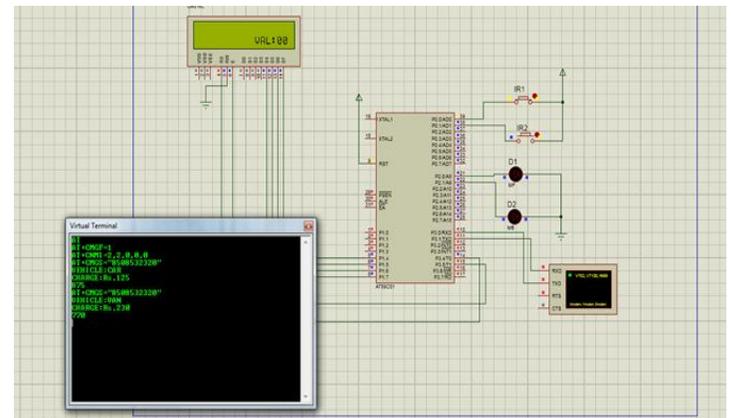

Figure.10. Illustrates the Amount Detection in Car

VII. CONCLUSION

The electronic toll collection system in expressway based on RFID, a design scheme was put forward. It has characteristics of low cost, high security, far communication distance and high efficiency, etc. It not only can improve technology level of charge, but also improve passage ability of expressway.

Electronic toll collection system is an effective measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station. In the design of the proposed Electronic toll collection (ETC) system, real time toll collection and anti-theft solution system have been designed. This reduces the manual labor and delays that often occur on roads. This system of collecting tolls is eco-friendly and also results in increased toll lane capacity. Also an anti-theft solution system module which prevents passing of any defaulter vehicle is implemented, thus assuring security on the roadways.

VIII. REFERENCE

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