Automated Toll Plaza Using RFID and GSM

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Abstract— The aim of this research paper is to illustrate the convenience and versatility of an automatic toll plaza system using RFID technology and its advantages over toll plazas using other techniques. With the number of vehicles increasing every year, the time and fuel wasted on waiting at the toll plazas is ever increasing. Automatic toll plazas can eliminate this wastage of time, fuel and enhance the vehicle security by providing a host of other features such as sending a text message to the registered mobile number of the owner, displaying the information about the vehicle on the display in addition to automatic opening and closing of the barricade. The toll is deducted from the vehicle owner's prepaid account. A 125 KHz RFID reader is used for detecting the passive tags by the reader module. The motor for the barricade, on-site LCD display and GSM modules have been interfaced with the microcontroller (ATMega328). This system will cut down time and fuel wastage at the manually controlled toll plazas, provide a layer of security because the SMS sent and will ensure a smoother travel experience for the travelers.

Index Terms — ATMega328, GSM, LCD, RFID, Toll Plaza

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I. INTRODUCTION

The project mainly focuses on the Automation of the Toll Plazas for smoother movement of the traffic to in turn benefit the people by saving their time and money.

Suppose the manual toll collection system is very efficient, then Time taken by 1 vehicle at the plaza = 60 sec (approx.) Time taken by 1 vehicle/year = 60 X 365 = 21900 sec = 6 hoursSuppose 10000 vehicles are passing through a toll plaza 60000 fuel hours get wasted per year and thus equivalent amount of fuel. By making the toll plaza fully automatic using the RFID technology, the cars can pass through the plaza at around 55 mph i.e. 86 kmph. The time and fuel wastage can be drastically brought under control by this.

We here, are interfacing the RFID receiver to the microcontroller. The receiver is Active and the RFID tags are passive. The receiver will be fixed at the toll plaza constantly trying to search for the tag. As soon as the tag comes in the range of the receiver, the unique code from the tag is identified by the receiver and transmitted serially to the microcontroller.

The controller then matches the unique code to the Central Database and checks if the owner of the tag is in good standing with respect to the balance in his account. Stipulated price of the toll will be deducted from his account. Hence a complete cashless operation is made possible. Then an SMS will be sent to the owner using the GSM module about how much money has been debited from his account OR if there is insufficient balance. Moreover, the owner will be sent the information regarding the location of the toll plaza from where the vehicle has passed. In this way he will get a warning to maintain sufficient balance in his account and also be able to track his vehicle in case of theft. Also as he passes the portal he will be able to see his details on site on the LCD on site. Accordingly, if the toll is paid properly the gate will automatically open for him.

II. LITERATURE SURVEY

In [1], the automation of toll plaza has been done based on image processing. ANPR (Automatic Number Plate Recognition) system has been employed which uses a camera to capture the number plate of the vehicle and deducts the toll by matching it with the owner database.

In [2], the system is based on infrared sensors. In this, the user has to get the IR transmitter from the main toll office. The transmitter will be charged by the store office and the data of the user will be stored in the microcontroller. When the car arrives at the toll plaza the user will have to mount the transmitter on the car and press a button to turn it on. It must be in the line of sight of the receiver. The receiver will confirm the data from the transmitter with the database and the amount of toll will get deducted. It uses a stepper motor for gate control.

In [3] also the system is based on the RFID technology. The controller used is PIC 18F4550 and has been connected with the system using USB. The RFID receiver senses the tag coming in its range and the amount gets deducted from the account of the owner after all the related information is checked from the database. The IR senses the vehicle motion for controlling the opening and closing of the gate. A stepper motor is used to control the gate.

The rest of the references mentioned below have also employed the RFID technology and the working is quite similar to [3] except the database creation methods. The authors have put the GSM interfacing in their future scopes which we have implemented in our project.
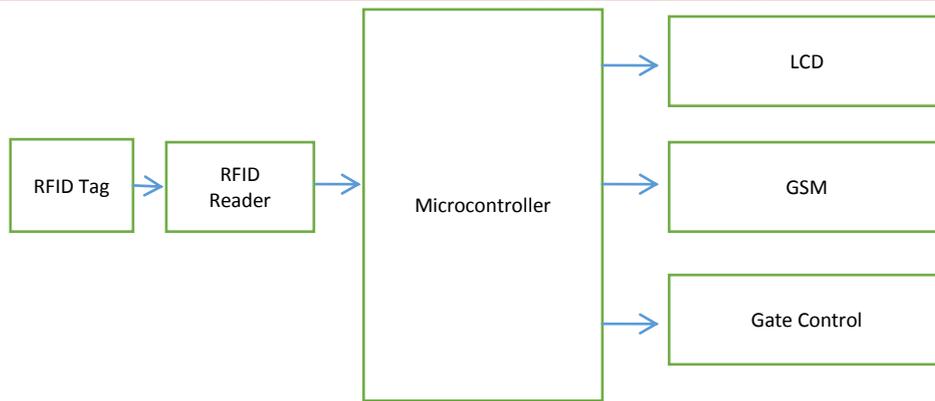System Design And Implementation

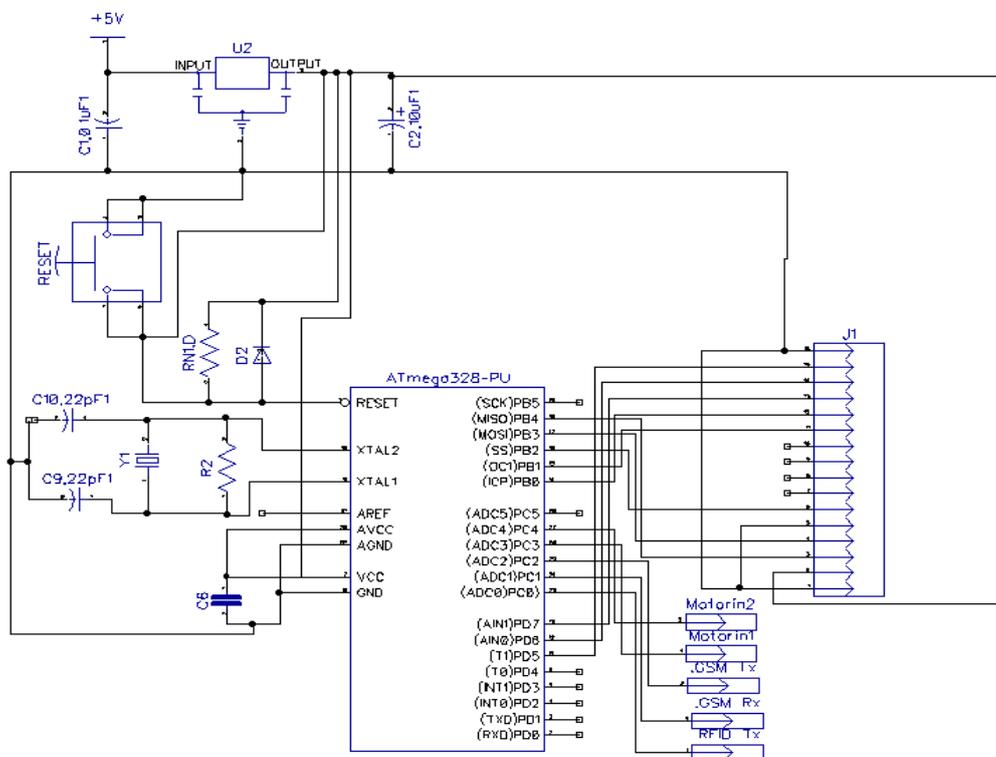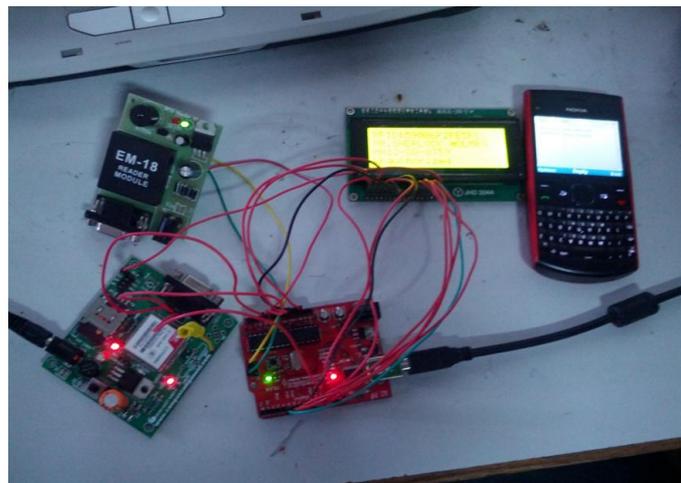*Figure 1: Block Diagram of the system*

Figure 2: Circuit Diagram

The major components of the gate control system are as follows:

- ATMega328PU microcontroller
- EM-18 (RFID reader module)
- SIM900 (GSM module)
- DC Motor with driver(L293D)
- LCD display
- Power supply unit

1. **ATmega328-PU μC:**
   Features:
   28 Pin I/O
   RESET Pin NO. 1 (ACTIVE LOW)
   Crystal Pins at 9-10 PIN
   Software Declarable Serial Ports

   We have selected this controller because it has programmable UARTs required for both RFID and GSM modules.

2. **EM-18 (RFID reader module):**
   Features:
   Operating Distance – 10cm
   Operating Voltage – 5V
   Operating Frequency – 125 KHz
   Current Consumption - <50 mA

   This is the stationary Active RFID receiver module situated at the toll plaza. It continuously keeps monitoring for the RFID tags. As soon as the tag comes in the range of the receiver, the buzzer on the module gives an indicative beep and sends the data serially to the microcontroller.

3. **SIM900 (GSM module):**
   Features:
   - Quad-Band GSM/GPRS 850/ 900/ 1800/ 1900 MHz
   - Built in RS232 Level Converter MAX3232)
   - Configurable baud rate
   - SMA connector with GSM L Type Antenna.
   - Built in SIM Card holder.
   - Built in Network Status LED
   - Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
   - Normal operation temperature: -20 °C to +55 °C
   - Input Voltage: 5V-12V DC

4. **DC Motor with driver(L293D):**
   L293D contains two inbuilt H-bridge driver circuits.
   In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.
   The L293D is a Dual Full Bridge driver that can drive up to 1 Amp per bridge with supply voltage up to 24V

Two H bridges of L293D can be connected in parallel to increase its current capacity to 2 Amp.
Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal

Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Technical Specification:
Power Supply: Over FRC connector 5V DC
External Power 9V to 24V DC
Temperature Range: 0°C to +70 °C
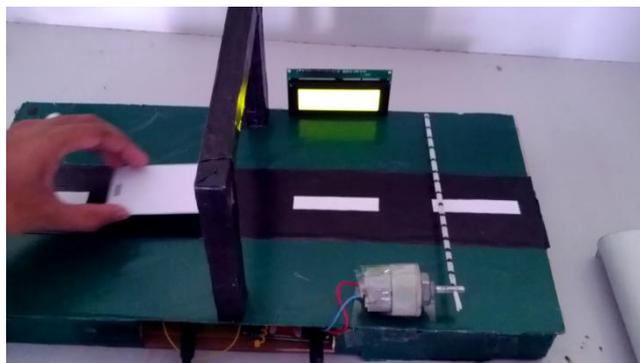
5. **LCD display:**
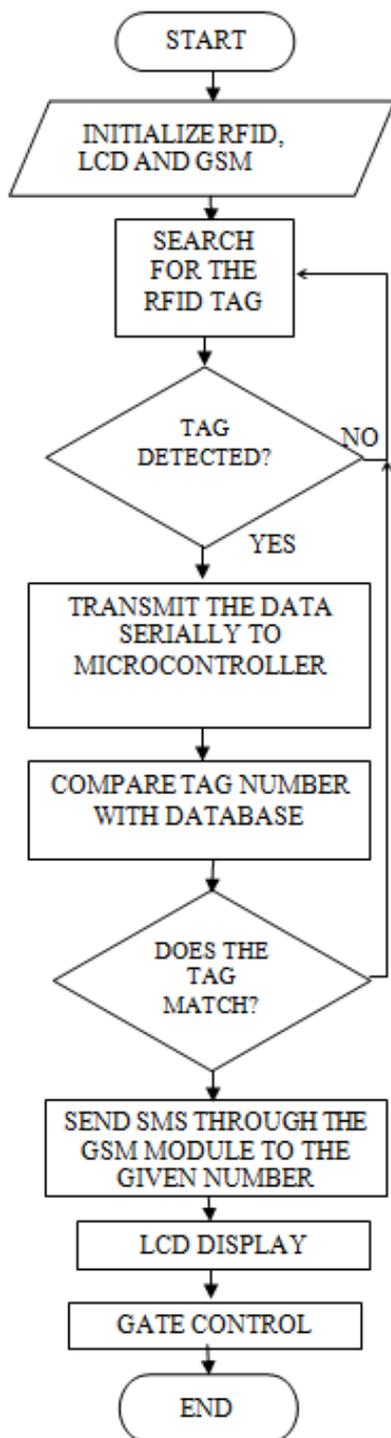   20X4 lines display
   5X7 dot matrix display
   4 bit data interface

6. **Power supply unit:**
   Specifications:
   12 V, 2A

Flow Chart

III. ADVANTAGES

- RFID system does not need Line Of Sight (LOS) unlike bar-codes or image processing based system. Thus it can be installed inside the car from where it is not visible, which saves tampering with the process in case of theft.
- As in [1], the cars need to be at a specified position for the system to scan the number plate which is not required in RFID based system. Also, the number

plates can easily be exchanged which has no way to get detected.

- High speed passage of car is possible (55 mph or 86 kmph).
- Wastage of fuel is substantially reduced.
- Traffic jams are avoided to a great extent.
- Security is an added advantage - The location of a stolen car can be notified to the concerned owner through the GSM module.
- The owner will also be informed about the amount deducted and the remaining balance which will help him to maintain a sufficient balance in his account.

IV. CONCLUSION

We can reduce the prevalent problem of skipping the payment of toll at toll plazas because of automatic deduction and enhance the security of the vehicle due to GSM interfacing. The long queues at the toll plaza and need for human intervention is reduced greatly. This system will ensure a smoother and safer journey for the passengers.

V. FUTURE SCOPE

In addition to the current work, image processing can be combined with the RFID system to make the system more reliable and secure. By combining the positives of the two we can eliminate any possible discrepancies in the system. Internet banking as well as SMS banking can be used for recharging the account of the user to make it convenient.

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