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RFID Based Automatic Toll Collection System using GSM

Prof. Amit Hatekar[1], Nikita Kokal[2], Tarun Jeswani[2], Pratik Lalwani[2]

[1]*Department of Electronics and Telecommunication, Thadomal Shahani Engineering College, Mumbai-50*

[2]*Department of Electronics and Telecommunication, Thadomal Shahani Engineering College, Mumbai-50*

Abstract - *This paper describes the RFID based automatic toll collection system for toll gate. Most of the toll collection systems commonly used in India consists of manual transaction. Now a day's traffic has increased on a large scale resulting in congestion at the toll plazas. It causes traffic jam and wastage of time as well as fuel. The objective of this project is to transform manual transaction to automated toll collection with the help of RFID technology. Automatic toll plazas eliminate wastage of time, as well as it can keep the user updated about its balance by sending a message each time it passes through the toll plaza. The toll is deducted from the vehicle owner's prepaid account each time it passes through it. A 125 KHz RFID reader is used for detecting the passive tags used by the user. The motor used for the barricade, on-site LCD display , which displays all the details about the transaction, and GSM modules have been interfaced with the microcontroller (ATMega8). This system will cut down time and fuel wastage at the toll plazas, provide information to the user about his/her balance as the SMS is sent and will ensure a smoother travel experience for the travelers. Also switches have been provided for recharge option in case of insufficient balance.*

Key Words: **ATMega8, Automated toll collection, GSM, LCD, RFID, GSM SIM900.**

1. INTRODUCTION

The project is based on making the toll plazas automatic and reducing the wastage of time as well as fuel. 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 hours. Suppose 10000 vehicles are passing through a toll plaza 60000 fuel hours get wasted per year and thus equivalent amount of fuel which results in a great loss. The time and fuel wastage can be drastically brought under control by using this technique of automated toll plazas.

We here, are interfacing the RFID receiver to the microcontroller. The receiver is Active and the RFID tags are passive. As soon as the RFID tag comes within the range of the receiver it will be detected by the reader. The reader will serially communicate the information to the microcontroller. The stipulated amount will be deducted from the account of the user and same will be displayed on the LCD screen. After the amount is deducted the motor driver, which is driven by the microcontroller, will open the gate and allow the vehicle to pass through it. A message will be sent to the user which will give him/her the information about the toll amount and current balance using GSM module. If the balance in the account is insufficient switches are provided to recharge the card and information about the recharge is also sent to the user via SMS.

2. LITERATURE SURVEY

There are different methods that can be used to implement automated toll collection. By doing survey, different methods that were found out are as follows:

- In [1] the automated toll plaza is implemented based on image processing. Here the number plate of the vehicle is captured using a camera and the toll is deducted by matching the number plate with the database.
- In [2] system is based on infrared sensors. Initially the user has to get a transmitter from the office which will consist of all the details of the user. As the user arrives at the toll plaza, the transmitter needs to be positioned in such a way that it comes in line of sight of with the receiver. Once this is achieved the switch is pressed and the receiver will search for a match in the database and the desired amount will be deducted.
- In [3] the system is entirely based on RFID Technology. As the RFID tag comes in the range of the reader stipulated amount is deducted after matching the information from the database and the gate that is controlled by the motor allows the vehicle to pass through it.

The remaining references are quite similar to [3].Our project is based on RFID technology similar to [3] but we haven't included the database. We have also included GSM module in our project which is considered to be future scope in most of the papers.

3. SYSTEM DESIGN AND IMPLEMENTATION

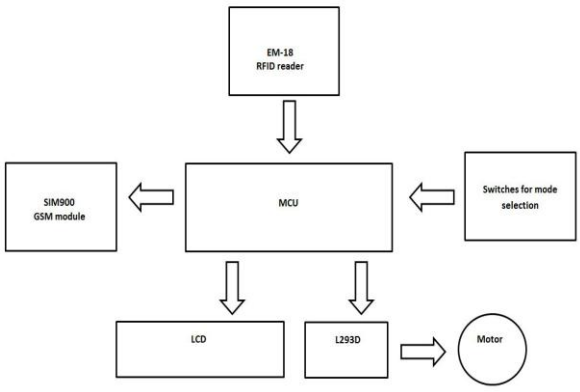

Fig-1: Block Diagram

The major components of the system as seen in the block diagram are as follows:

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

3.1 ATmega328-PU µC

ATmega8 is an 8-bit microcontroller which delivers high performance at a low power consumption rate. It has an advanced RISC (Reduced Instruction Set Computing) architecture with 130 instructions that mostly execute in one machine cycle. The maximum frequency of operation is 16MHz at 4.5V. It has 16KB of in-system self-programmable flash program memory, 1KB of internal static RAM and 512 bytes of internal EEPROM. It has a data retention capacity of 20 years at 85ºC and 100 years at 25 ºC.

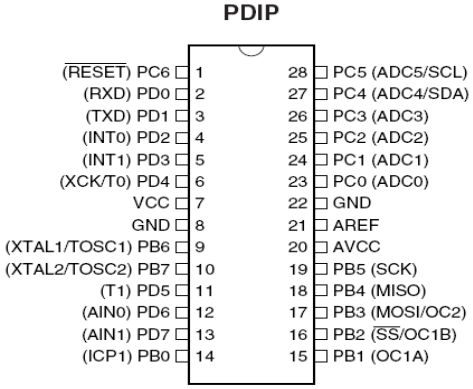

Fig-2: Pin configuration of ATMega8

The microcontroller is a 28 pin IC out of which 23 pins are programmable I/O ports. The IC and its pin configuration are shown in Figure 2.

3.2 EM-18 (RFID reader module):

Operating distance of the reader is 10cm and operating voltage is 5V.
It is an active RFID receiver module which is situated at the toll plaza. It constantly keeps on searching for the RFID tag. As soon as the tag arrives wi9thin the range of the receiver it informs the microcontroller and serially communicates with it. The operating frequency is 125 KHz and current consumption less than 50mA.

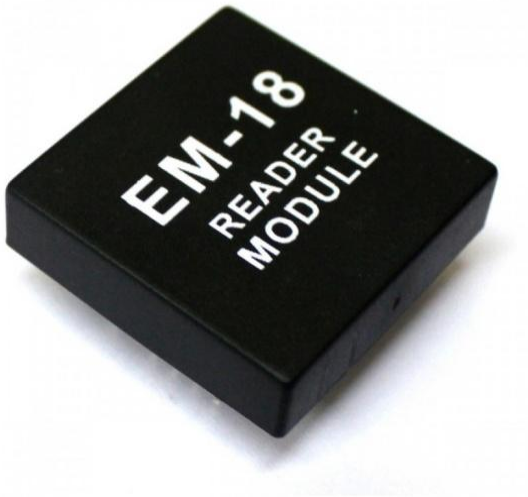

Fig-3: EM-18 Reader Module

3.3 SIM900 (GSM module):

SIM900 is a complete Quad band GSM/GPRS solution in a SMT module which can be embedded in customer applications. It delivers GSM/GPRS 850/900/1800/1900 MHz performance for voice, SMS, data and fax in a small form factor and low power consumption. With tiny configuration it can fit in almost all space requirements.

Features:

- Quad-Band 850/900/1800/1900 MHz
- Dual-Band 900/1900 MHz
- GPRS multi-slot class 10/8
- Compliant to GSM phase 2/2+ Class 4(2W) Class 1 (1W)
- Control via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands)
- Low power consumption: 1.5mA(sleep mode)
- Operation temperature: -40°C to +85 °C

- SIM application tool

Fig-4: GSM modem using SIM900 module

3.4 DC Motor with driver (L293D):

This is a motor driver that can drive two motor simultaneous ly. L293D IC is a dual H-bridge motor driver IC. One H-bridge is capable to drive a dc motor in bidirectional. L293D IC is a current enhancing IC as the output from the sensor is not able to drive motors itself so L293D is used for this purpose. L293D is a 16 pin IC having two enables pins which should always be high to enable both the H-bridges.

Features

- Featuring Unitrode L293 and L293D Products Now From Texas Instruments
- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs

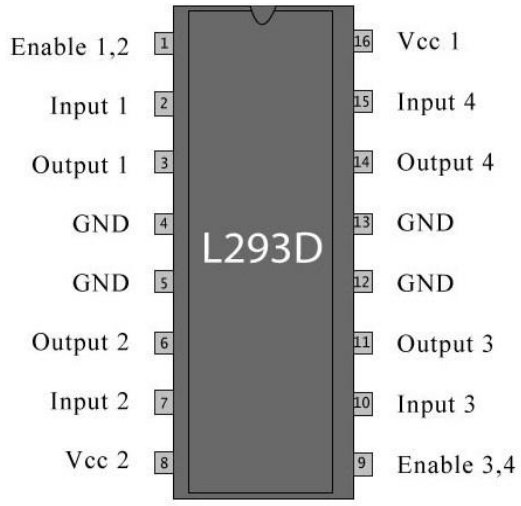

Fig-5: Pin configuration of L293D

- Functional Replacements for SGS L293 and SGS L293D
- Output Current 1 A Per Channel (600mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D)

Fig-6: DC Motor

3.5. LCD Module

Fig-7: LCD Display

The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). It also contains a user-programmed RAM area (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix. To distinguish between these two data areas, the hex command byte 80 will be used to signify that the display RAM address 00h will be chosen.Port1 is used to furnish the command or data type, and ports 3.2 to 3.4 furnish register select and read/write levels.

The display takes varying amounts of time to accomplish the functions as listed. LCD bit 7 is monitored for logic high (busy) to ensure the display is overwritten.

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most common type of LCD controller is HITACHI 44780 which provides a simple interface between the controller & an LCD. These LCD's are very simple to interface with the controller as well as are cost effective.

4. SYSTEM WORKING

When the vehicle passes through the toll initially the RFID tag is detected by the RFID receiver. As soon as the tag is detected the LCD will display 2 modes of operation, namely, transaction mode and recharge mode. If sufficient balance is present in the vehicle stipulated amount will be deducted, motor driver will open the gate and the vehicle will pass through the toll. In case of insufficient balance the user will have to choose recharge mode wherein 3 switches are provided for recharge. Each switch has a specific amount to recharge such as 50, 100 and 150. The user can press a switch according to the amount he/she wishes to recharge. The maximum balance in an account is 250. It cannot exceed this amount.

In both the cases a SMS will be sent to the user using a GSM modem. When the vehicle passes through the toll using the transaction mode a SMS is sent to the user which specifies the toll amount as well as the remaining balance. When the user selects the recharge mode and recharges the card, SMS regarding the recharge details such as amount debited, new balance is sent to the user.

5. ADVANTAGES

- RFID system is better than bar-codes and systems based on image processing. RFID tag can be installed inside the car from where it is not visible and it is much faster than any of them.
- Wastage of fuel is reduced to a great extent.
- Traffic jams are avoided.
- The owner will always be aware of his balance because of the SMS being sent during each transaction. It will also help the user to keep minimum balance.
- RFID Technology is stable and evolving with open architecture and is becoming increasingly available.

6. CONCLUSION

The problem of skipping the payment at the toll plazas as well as the problem of long queues can be solved by automation. By using this system time and fuel are saved. Need for human intervention is reduced on a large scale. User is also always updated about his/her prepaid account in order to avoid insufficient balance. Therefore, the RFID based Automatic Toll Collection System using GSM is the best way for toll collection at the toll plaza. This system will ensure a smooth and safe journey for the passengers and will also keep the passengers aware about their balance by using GSM.

7. FUTURE SCOPE

Since all the payments are done in prepaid mode, a single person is always required at the toll plaza. If a postpaid mechanism is established wherein the user need not recharge at the toll plaza but can recharge his/her account on the internet no person will be required at the toll plaza. In the postpaid technique the user can pass through as many toll plazas without paying and at the end of the month the user will have to pay the entire payment via internet. At the toll plaza's cameras as well as software's are used to keep a track of all users and the amount paid by them. This would make the toll plazas completely automatic and no person would be required at the toll plaza.

8. ACKNOWLEDGEMENT

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