Smart Toll Gate Collection on Highways

S. Revathi, M. Shanthalakshmi, S. Viji, S. Thillaikkarasi

Department of Electronics and Communication Engineering, Sri Eshwar College of Engineering, Kinathukadavu, Coimbatore, Tamilnadu, India

ABSTRACT

Even from the earlier days, traffic jams mainly occurs on highways due to toll collection. In order to reduce the long queue and human billing time delay on highways, a smart toll gate collection mechanism is introduced, which would be helpful to make the city smarter and go cashless. Digital scheme adaption technique makes the highways independent of man power. Anyhow, the tax payment compensates the expenses of society. Toll collection could be made smarter only through wireless technologies. The very recent advancement technique in wireless communication is RFID cards and GSM. In the current system, several technologies are used through wireless networks. GSM modem technology helps to send information about the toll tax payment on highways. The whole smart toll gate collection mechanism works with electromagnetic waves.

Keywords : Radio Frequency Identification (RFID), Global System for Mobile communication (GSM).

I. INTRODUCTION

When the smart toll gate collection mechanism is introduced on the highways, then when a vehicle enters into the toll gate, it is automatically deducted by the IR sensor, and then the toll gate gets opened. Usually all the objects radiates some form of thermal radiation, which are invisible to our eyes, but that can be easily detected by IR sensor, IR sensor is user friendly, since it fits in small spaces and no external circuit connection is required. RFID tags are used to read each vehicle with the help of RFID reader. Toll collection is made directly by scanning the RFID card in the RFID reader. As we all think that scanning the RFID card is difficult as like we face the problems of bar codes in shops but obviously, RFID device can be used few feet away from the RFID reader, where information stored on the microchip can be read. RFID card could be easily recharged through online hence the toll amount is automatically deducted from the owner's account. The IR Receiver gets the details and sent it to the controller, which then transmits the vehicle number through RF transmitter located in the vehicle. The advancement in this technique is usage of GSM, which can be either a mobile phone or a modem used to communicate over a network through any of the processor. The GSM is interfaced with the UART which is a programmed microchip that controls the system interface to its attached serial devices. The toll tax payment details are sent as an SMS to the owner's account and there is no necessary to stop the vehicle to check for the payment details. To the added advantage the number of times vehicle passing through the toll gate could also be stored in the database.

II. METHODS AND MATERIAL

In the present system, for each vehicle tax payment time is 60 seconds per day. For a month: 60x30=1800 sec, and for a year it takes approximately 6 hours. On an average yearly, in an engine start condition each vehicle waits for 6 hours which aids to pollution and wastage of fuel.

PROPOSED SYSTEM

1. Power Supply Unit

The input 230V electrical AC power is stepped down to 12V AC by using step down transformer. Bridge rectifier is used to convert 12V AC to 12V DC. During conversion noise may get added, hence filter is used to remove the noise. Voltage regulator is used vary the voltage according to the requirement of the components.

2. Microcontroller

PIC (Programmable Interface Controller) is a smallest controller that can be used to carry out huge number of tasks. It is easy to interface with other peripherals, hence mostly preferred. PIC16F877A is used here for its inbuilt ADC. Every PIC controller architecture consists of some registers and stack where registers function as Random Access Memory (RAM) and stack saves the return addresses. The main features of PIC microcontrollers are RAM, flash memory, Timers/Counters, EEPROM, I/O Ports, USART, CCP (Capture/Compare/PWM module), SSP, Comparator, ADC (analog to digital converter), PSP (parallel slave port), LCD and ICSP. PIC16F877 has 5 basic input/output ports. They are usually denoted by PORT A (R A), PORT B (RB), PORT C (RC), PORT D (RD), and PORT E (RE). These ports are used for input/ output interfacing. In this controller, PORT A is only 6 bits wide (RA-0 to RA-7), PORT B, PORT C, PORT D is only 8 bits wide (RB-0 to RB-7, RC-0 to RC-7),RD-0 to RD-7), PORT E has only 3 bit wide (RE-0 to RE-7). The added advantage of this series is having TRIS register.
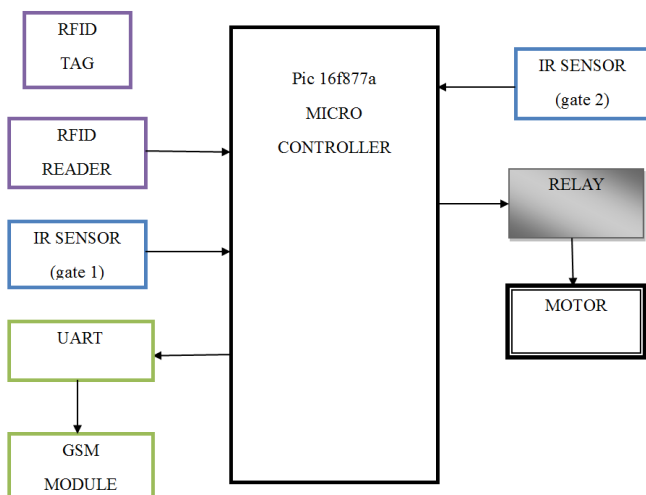
Overview:

Figure 1. Power Supply Unit

Figure 2. Block Diagram

3. RFID Tag And Reader

RFID (radio frequency identification) is a technique facilitating identification of any product or item without the requirement of any line of sight amid transponder and reader. RFID Structure is continuously composed of 2 main hardware components. The transponder which is located on the product to be scanned and the reader which can be either just a reader or a read & write device, depending upon the system design, technology employed and the requirement. The RFID reader characteristically comprise of a radio frequency module, a controlling unit for configurations, a monitor and an antenna investigate the RFID tags. In addition, a number of RFID readers are in-built with an extra interface allowing them to forward the data received to another system (control system or PC). RFID Tag – The actual data carrying tool of an RFID structure, in general comprise of an antenna (coupling element) and an electronic micro-chip.
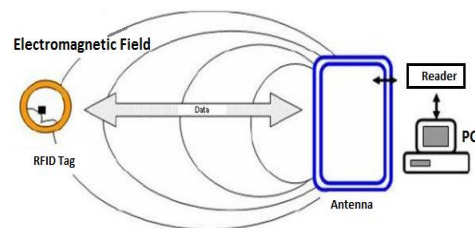

Figure 3. RFID tag and reader

Figure 4. Clamshell Card

4. IR Sensor

An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. Infrared sensors are in the form of diodes with 2 terminals. You can buy a pair of such diode (one transmitter and one receiver) at a very low cost of about 5 - 7 rupees only.
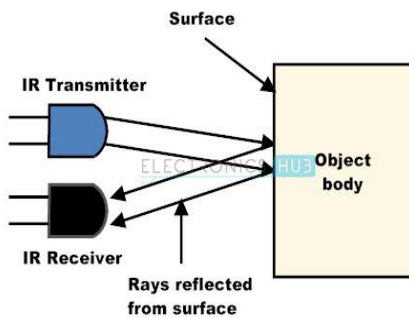
Figure 5. Working of IR sensor

5. GSM and UART:

A UART (Universal Asynchronous Receiver / Transmitter) is the microchip with programming that controls a computer's interface to its attached serial devices. The UART takes bytes of data and transmits the individual bits in a sequential fashion. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires.
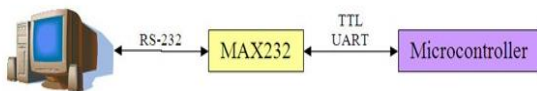

Figure 6. UART

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

6. Relay

An iron core is surrounded by a control coil. The power source is given to the electromagnet through a control switch and through contacts to the load. When current

starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus the upper contact arm starts to be attracted to the lower fixed arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed, then the contact move oppositely and make an open circuit. As soon as the coil current is off, the movable armature will be returned by a force back to its initial position. This force will be almost equal to half the strength of the magnetic force. This force factors are spring and gravity. Relays are mainly made for two basic operations. One is low voltage application and the other is high voltage.
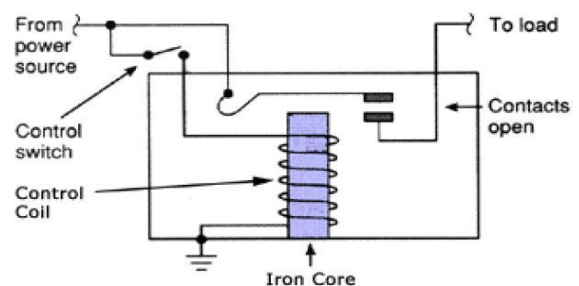

Figure 7. Relay diagram

III. RESULTS AND DISCUSSION

This mechanism results in time consumption and decreases the wastage of fuel. Before converting this project into a commercial product, MP LAB IDE and Proteus software are to be used to execute this process.
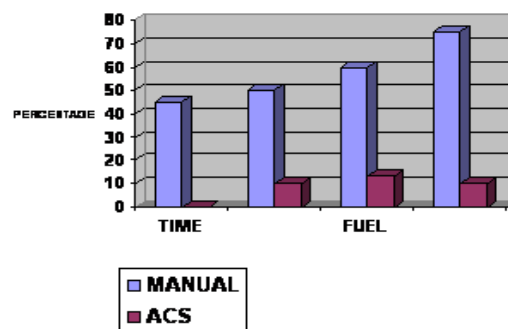

Figure 8. Analysis graph

IV. CONCLUSION

Toll tax payment is made more convenient through smart toll gate collection mechanism. It would reduce the heavy traffic jams due to human billing time delay and reduces the wastage of fuel along with pollution. It replaces the current method with an advancement of

wireless technologies. Travelers on the bypass road will save time and no need to drive so fast to reach their destination. Finally it leads to the development of the country through a digitalized form.

V. REFERENCES

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