AUTOMATIC TOLL COLLECTION AND HAZARD DETECTION SYSTEM USING RFID TECHNOLOGY

Soundarya.R[1] | Soundarya Devi .S[2] | Sridevi.E[3] | Yuvaraj.V[4]

[1](Department of ECE, GKM College of Engineering & Technology, Chennai, India)
[2](Department of ECE, GKM College of Engineering & Technology, Chennai, India)
[3](Department of ECE, GKM College of Engineering & Technology, Chennai, India)
[4](Department of ECE, GKM College of Engineering & Technology, Chennai, India)

Abstract*—Automatic process of toll collection will save time, effort, and man power. In this work propose a low cost and efficient technique called Automatic Toll Collection using RFID modules that automatically collects the toll from moving vehicles when they cross the toll plaza. We also assume that an owner maintains a prepaid account, so that toll tax is deducted automatically from the driver's account at toll plaza. If the balance in the owner's account is low or if the vehicle is not equipped with an RF system, the toll gate remains close. The owner receives an SMS message using GSM module on his/her mobile about the details of the payment and there is no need for him to stop the vehicle. How many vehicles passing through the toll gate stored in a database. We can also find out a vehicle how many times passing through the toll gate in a day. We are using vibration sensor to detect hazards occurring in the toll plazas.*

Keywords—Automatic Toll; RFID(Radio Frequency Identification);Vibration Sensor;GSMModule; ARMLPC2148

1. INTRODUCTION

Smart Toll Collection builds a "Customer Relationship Management", which helps in easy management of Toll Collection. The most obvious advantage of this technology is the opportunity to eliminate congestion in tollbooths, especially during festive seasons when traffic tends to be heavier than normal. Most importantly, the system allows non–stop service to the road users without bothering about toll rates or money change, same tag is read at toll plaza on all the Highways across the country and we save paper as well as fuel. Automatic toll collection utilizes radio frequency identification (RFID) technology. It contains RFID tag and reader. Reader contain antenna to transmit and receive signal from each tag. The tag which is sticked at the front glass of the vehicle is detected by the RFID reader and data is matched with the database provided at every toll booth, toll amount is deducted from his account, immediate gate is opened and message will be sent to registered mobile number.

Fig1: Automatic Toll System using FASTag.

2. BACKGROUND OVERVIEW

In the existing system, there are two toll collection systems and they are, all vehicles has to stop at toll plaza along the highway to pay the toll, one person collect the money and issue a receipt, after which gate is opened either mechanically or electronically for the driver to get through the toll plaza.

Another is smart card system in which driver show a smart card to access the data to the system installed on toll plaza to pass.

There is another facility of detection of stolen vehicle, database contain stolen directory in which stolen vehicle tag number is stored by the authority. When incoming vehicle data is matched then transaction will proceed and immediately message will send to registered police station, it is another advantage of this system. The above system for collecting toll tax is time consuming method; there is long queue of vehicle at toll plaza chances of escaping the payment of toll tax.

3. SYSTEM OVERVIEW

The system is simple in construction; provide automatic toll collection and hazard detection. A RFID tag is mounted on each vehicle with unique ID. This ID is invisible on tag, it contain all the information about the vehicle and owner. When vehicle reach at toll plaza tag will emit the radio wave signal. RFID reader receives the signal from tag, decode that signal and send to ARM controller. The ARM microcontroller used is LPC2148 .The controller will display the vehicle number and amount on LCD.

Microcontroller is interface with computer host to collect the vehicle data through serial port for future use. When access from database it shows all the vehicle details on computer screen such as ID, vehicle number, date, time. Microcontroller check the balance if sufficient balance, deduct predetermined balance from prepaid account and update the balance in that account, message will be sent to vehicle owner by using GSM .If there happens any unfortunate incidents, the vibration sensor placed will enable and the buzzer will be indication following the camera on the lane will capture the number plate of the vehicle and send it to the nearby or registered police station.

4. HARDWARE DESIGN

Block diagram of automatic toll collection using RFID technology is as shown in Fig 2.

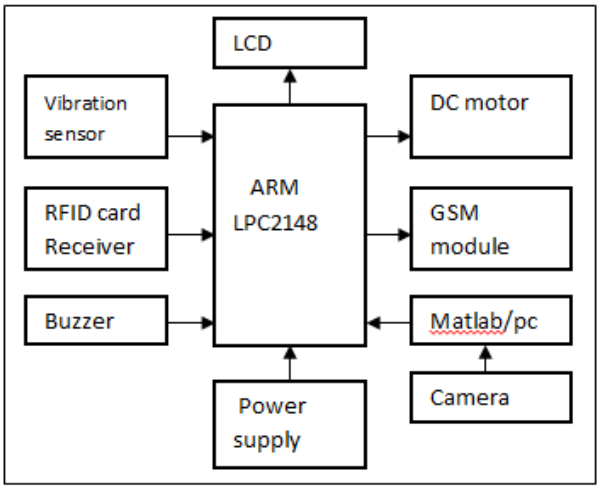

Fig 2: Block diagram of ATC.

A GSM module is interfaced with ARM controller which will send message to car owner regarding less balance or deduction balance. RFID reader decodes the data and sends to controller, PC is act as a database and LCD display the status of transaction.

4.1 ARM LPC2148 Microcontroller:

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.

LPC2148 need minimum below listed hardware to work properly.

- power Supply
- Crystal Oscillator
- Reset circuit
- RTC Crystal Oscillator (This is not necessary if you are not using RTC. However this is considered as necessary requirement)
- UART

4.2 *Features of LPC2148 series controllers*

- 8 to 40 KB of on-chip static RAM and 32 to 512KB of on-chip flash program memory,128 bit wide interface/accelerator enables high speed 60 MHZ operation.
- In –System/In-Application programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1ms.
- Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities.

Fig 3: ARM LPC 2148 Microcontroller.

4.3 RFID TECHNOLOGY

Fig 4 : RFID tag and Reader.

RFID (Radio frequency identification technology) used for automatic identification and tracking of the people or object, it contain tag and reader. Data contained on a tag is scan by reader and send to controller.

RFID Tag

RFID tag has two types: passive and active tag. Passive tags require no internal power source; they are active only when a reader gives power to them, the small electrical current induced in the antenna by incoming radio frequency signal provides enough power for the tag to send the signal. Whereas active tags use a power source in terms of small battery, which is used to power the integrated circuits and broadcast the signal to the reader. Active tags are typically much more reliable because it is used for longer distance than passive tag.

Fig 5: RFID tag showing microchip

Fig 6: RFID reader module.

The tag is attached or embedded in an object to be identified, RFID tag or transponder consist chip and antenna. A unique serial number that identifies a person or object store on a microchip that is attached to an antenna. The combined antenna and microchip are called as "RFID transponder" or "RFID tag" and work in combination with an "RFID reader". Antenna attached to chip transmits the information from chip to the reader using radio frequency.

RFID Reader

Reader is the device that scans the tag and decodes the received data, which is used to convert the received radio signals of a particular frequency into the digital form usage by the controller and data passed to host computer. This reader has on-chip power supply. It incorporates energy transfer circuit to supply the transponder. Readers can process multiple items at once, allowing for increased read processing times. The RFID tag can be affixed to an object and used to track and manage inventory, assets, people etc .The tag can be read inside a case, carton, box or other container.

4.4 VIBRATION SENSOR

The vibration sensor used is a type of piezoelectric transducer. The piezoelectric transducer are a type of electroacoustic transducer that convert the electrical charges produced by some form of solid material into energy.

Description:

The basic piezo sensor from measurement specialties is often used for flex, touch,vibration and shock measurement. A small AC and large voltage(upto +/- 90 v) is created when the film moves back and forth. A simple resistor should get the voltage down to ADC levels.

Fig 7: piezoelectric vibration sensor.

5. CONCLUSION

In this article, we have discussed about Automatic toll collection using RFID technology. RFID is a highly stable and reliable technology. The RFID automatically detect the identities of the vehicles, reading items in motion and tracking of the vehicles can be done accurate. With the elimination of human interaction in the entire toll collection process and also reduction of time at toll plaza, we can create a better ATC system to be implemented. It can also significantly improve the efficiency of toll stations and the traffic solution of the toll road. RFID technology can provide new capabilities as well as an efficient method to collect, manage, disseminate, store, and analyze information. The proposed system detects the hazards such as accidents and providing the way for sudden rescue action.

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