Automatic Toll E-Ticketing for Transportation Systems

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Abstract: *Nowadays all tollgates are operated manually by an operator. It leads to heavy traffic and waste of time. So in order to avoid these consequences we have proposed an electronic tollgate system which operates using RFID technology which collects the toll automatically from the moving vehicle thereby avoiding the need for waiting in a heavy traffic. The vehicle owner has to maintain an account for this purpose. The amount is detected based on the weight of the vehicle which is calculated by using a pressure sensor. If the balance in the vehicle owner's account is not sufficient for the toll, the gate will be remain closed and the payment has to be done manually. A gas sensor is used in case of any explosive gases is being carried by the vehicle crossing the tollgate.*

Keywords: *RFID(Radio Frequency Identification), RFID tags, Pressure sensor , Gas sensor, RFID Reader module, Servo motor, Visual basic*.

I. INTRODUCTION

Fig-1 demonstrates the automatic toll e-ticketing system. As the vehicle reaches the toll plaza, it is detected using the RFID reader module in the receiver. It reads the signals from the RFID tag in the transmitter side of vehicle and send these signals to the microcontroller (ARM LPC 2148) as interrupts. The RFID tags in the vehicle have 16-bit identification numbers which gives the information about the vehicle and the owner. A software program known as Visual Basic running on the computer retrieves vehicle's detail from its vehicle database and is displayed. Based on the weight of the vehicle which is calculated by using a pressure sensor, appropriate toll tax is deducted from the account of the vehicle's owner. If the balance is low in the owner's account or if the vehicle is not equipped with an RF system, the toll gate remains close.

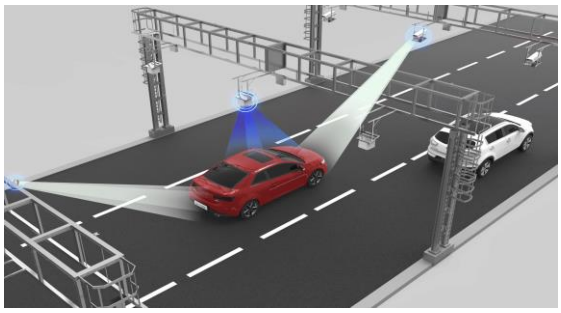

Fig-1: Automatic toll e-ticketing system

II. HARDWARE DESCRIPTION

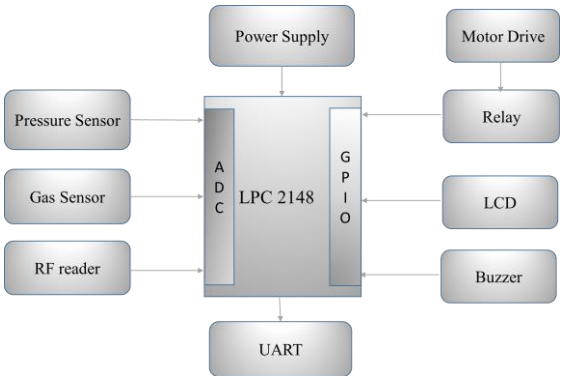

Fig-2: Block diagram of automatic toll E-ticketing system

A.ARM Board:

ARM LPC2148 is a 16-bit/32-bit microcontroller manufactured by Philips semiconductors(NXP). It consists of 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. A 128 bit wide memory interface and unique accelerator enable high speed 60 MHz operation. The ARM architecture is based on Reduced Instruction Set Computer (RISC). LPC2148 contains two analog to digital converters and a digital to analog converter. These ADC converters are single 10-bit successive approximation analog to digital converters. The total number of available ADC inputs for LPC2148 is 14. It contains two UARTs with baud rate of 9600 for the transmission of data.

B. Radio Frequency Identification (RFID):

Radio Frequency Identification deploys electromagnetic fields to automatically identify and track tags attached to objects. The most commonly used frequency range is LF (125-134kHz) and HF (13.56MHz).

1. *RFID Tags*

The RFID tags contain electronically stored information. These are classified as passive and active RFID tags. Passive tags do not contain a battery and draws power from the radio waves from the reader. Active tags have their own power supply and a transmitter and can be read from a distance of hundred feet or more.

Fig-3: Passive RFID tags

2. *Reader module*

RFID reader module reads signal from the antennas in the RFID tags.The EM-18 RFID reader module is operated at a frequency of 125kHz and it can read signals within the range of 10cm.

Fig-4: RFID reader module

C. Sensors:

A Sensor is an electronic device that detects and responds to some physical quantities from the environment.

1. *Pressure sensor*

Pressure sensor is connected to one of the ADC pins in microcontroller. It consists of LM358 which acts as an A/D converter thereby converting the amount of pressure given by the vehicle into a digital signal and detects the amount for toll tax proportional to the weight of the vehicle. When the pressure exceeds an interrupt signal is provided to the controller.

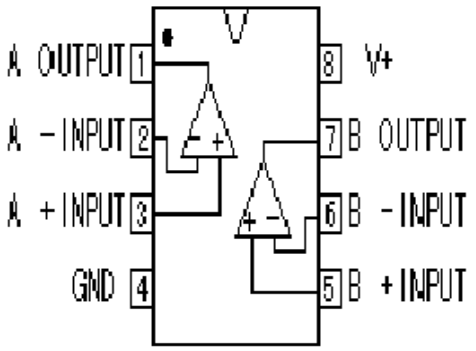

Fig-5:Pin diagram of LM358

2. *Gas sensor*

Gas sensors are used to detect the presence of dangerous LPG leak in vehicles. MQ-6 gas sensor can detect gas concentrations anywhere from 200 to 10000ppm. The sensor has excellent sensitivity combined with a quick repsonse time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

Fig-6:MQ-6 Gas sensors

D. Buzzer:

Buzzer is an audio signalling device. Here the buzzer is combined with the gas sensor to provide an alarm signal when explosive gases are detected.

E. Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. When the explosive gas is detected, the relay circuit is closed thereby driving the motor to close the gate.

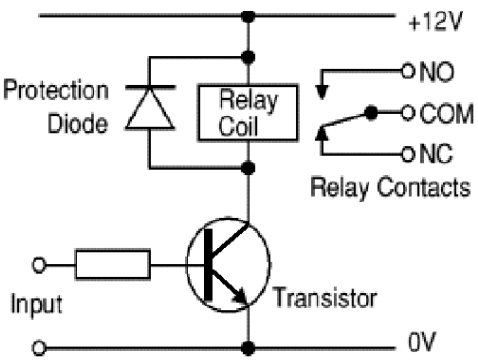

Fig-7:Relay circuit

F. Motor drive

The motor drive is used to control the opening and closing of the gate which is assisted with the relay circuit. we can vary the speed of motor by changing the voltage across the motor terminals

Fig-8:DC motor

G.LCD:

Dot matrix LCD modules is used for display the parameters and fault condition.16 characters 2 lines display is used. An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes to display character, symbols or patterns.

Fig-9: LCD display

III. SOFTWARE DESCRIPTION

***A. Visual Basic*:**

Visual Basic 6.0 is used to interface the microcontroller with the PC. The inputs from the microcontroller are given to the PC's parallel port through UART and this data is retrieved by VB 6.0 software program, which manages the vehicle's database. On receiving the signal from the ARM LPC2148 microcontroller, the toll amount is deducted from the vehicler's account .

B. Keil IDE's:

Keil is used to develop the source code needed for the design. The tool helps us not only to develop but also compile and simulate the code. It is also used to convert the compiled Embedded C code to its equivalent hex code.

IV. WORKING OF PROPOSED SYSTEM

The automatic toll e-ticketing system consists of the RFID transmitter and receiver section for detection of the vehicle crossing the tollgate automatically. The RFID reader module in the toll plaza reads the radio waves from the RFID tag present in the vehicle and the information on the tag is retrieved using the software program running in the PC. The pressure sensor placed on the path calculates weight of the vehicle and the appropriate toll tax is deducted from the vehicle owner's account. The gas sensor present in the toll plaza gives signal to the buzzer in case of any explosives detected which causes the closing of relay circuit. Hence the gate will be closed.

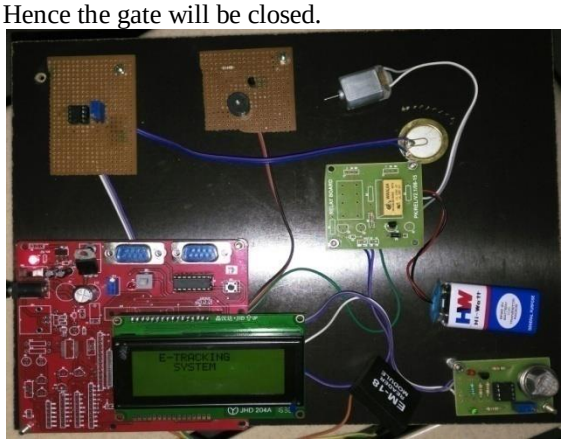

Fig-10: Experimental setup

V. RESULTS

VI. CONCLUSION

In this paper, the automatic toll e-ticketing systems significantly contribute to improve travel conditions by addressing delay caused by congestion. People hate the delay at tollbooths. This system collects toll from the vehicles driving on toll roads without making the vehicle stop at Tollbooths. These systems include benefits to both toll authorities and facility users, in terms of time and cost saving, improved security, increased capacity and greater convenience.

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