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Automated Toll Gate Collection with Complex Security System

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Abstract

The current system for collecting toll is on the basis of manual transaction which involves stopping each vehicle at the toll plaza for vehicle information and to get the appropriate payment. An Automated Tollgate collection with complex security system with the help of Smart card and RFID technique is used for toll collection without making traffic congestion and waiting in long queue. Here, no need to stop vehicle at toll plaza, the system will detect the RFID tag, which gives the vehicle information. After this, the RFID Reader reads the vehicle information and the balance from the customer's account will be deducted using Prepaid Smart card and display it on LCD the toll plaza will open, after passing the vehicle the gate will be closed. Results are included and discussed herewith.

Keywords: ARM7, RFID, Smart Card and LCD.

Introduction

In our daily life toll gate plays a major role while travelling a vehicles and are going to pay certain amount to the government in the form of tax through this toll gate. This toll gates being placed in some national high ways. In order to pay tax, we pay in form of cash, but instead of that as the technology is growing we can make use of smart card and RFID .The need for manual toll based systems is completely reduced in this method and the tollgate system works through smart card and RFID. A complete RFID system consists of a transponder (tag), reader/writer and antenna. The transponder, also known as the tag. The microchip contains memory and logic circuits to receive and send data back to the reader. The RFID used to store the details of particular person vehicle information.

The main objective of this project is to pay the toll gate tax using smart card, which will be recharged with some amount and whenever a person wants to pay the toll gate tax, the person needs to insert smart card and then the amount will be deducted.

In section 2, related work in ARM7LPC2148, RFID and Smart Card is discussed. System implementation is present in section 3. Result and conclusion is present in section 4. Finally, a reference is present in section 5.

Related Work

ARM7LPC2148

The LPC2148 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. A blend of serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTS, SPI, SSP to I2Cs and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems.

The LPC2148 consists of an ARM7TDMI-S CPU with emulation support, the ARM7 Local Bus for interface to on-chip memory controllers, the AMBA Advanced High-performance Bus (AHB) for interface to the interrupt controller, and the VLSI Peripheral Bus (VPB, a compatible superset of ARM's AMBA Advanced Peripheral Bus) for connection to on-chip peripheral functions. The LPC2148 configures the ARM7TDMI-S processor in little-endian byte order. AHB peripherals are allocated a 2 megabyte range of addresses at the very top of the 4 gigabyte ARM memory space. Each AHB peripheral is allocated a 16 kB address space within the AHB address space. LPC2148 peripheral functions (other than the interrupt controller) are connected to the VPB bus. The AHB to VPB Bridge interfaces the VPB bus to the AHB bus. VPB peripherals are also allocated a 2 megabyte range of addresses, beginning at the 3.5 gigabyte address point. Each VPB peripheral is allocated a 16 kB address space within the VPB address space. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. The ARM7TDMI-S processor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind THUMB is that of a super-reduced instruction set.

Figure1: ARM7 Processor

RFID

RFID is short for Radio Frequency Identification. Generally a RFID system consists of 2 arts. A Reader, and one or more Transponders, also known as Tags. RFID systems evolved from barcode labels as a means to automatically identify and track products and people. You will be generally familiar with RFID systems as seen in

Access Control

RFID Readers placed at entrances that require a person to pass their proximity card (RF tag) to be "read' before the access can be made.

Contactless Payment Systems

RFID tags used to carry vehicle information. RFIDs are particular suited to electronic Toll collection systems. Tags attached to vehicles, or carried by people transmit vehicle information to a fixed reader attached to a Toll station.

Product Tracking and Inventory Control

RFID systems are commonly used to track and record the movement of ordinary items such as library books, clothes, factory pallets, electrical goods and numerous items.

How do RFID WORK?

A typical RFID system. In every RFID system the transponder Tags contain information. This information can be as little as a single binary bit, or be a large array of bits representing such things as an identity code, personal medical information, or literally any type of information that can be stored in digital binary format, that communicates with a passive Tag. Passive tags have no power source of their own and instead derive power from the incident electromagnetic field. Commonly the heart of each tag is a microchip. When the Tag enters the generated RF field it is able to draw enough power from the field to access its internal memory and transmit its stored information. When the transponder Tag draws power in this way the resultant interaction of the RF fields causes the voltage at the transceiver antenna to drop in value. This effect is utilized by the Tag to communicate its information to the reader. The Tag is able to control the amount of power drawn from the field and by doing so it can modulate the voltage sensed at the Transceiver according to the bit pattern it wishes to transmit.

Figure.2 RFID READER

Basic RFID systems consist of three components:The antenna emits radio signals to activate the tag and read and write data to it. An RFID tag is comprised of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader.The RF transceiver is the source of the RF energy used to activate and power the passive

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RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment.

SMART CARD

The smart card is used for the purpose of deducing the exact amount from the vehicle owner who frequently passes from the tollgate. The smart card is same as the ubiquitous bank card with its magnetic stripe that is used as the payment instrument for numerous financial schemes. Integrated Circuit Cards come in two forms, contact and contactless. In this project we are using contact smart card. The Contact Card is the most commonly seen ICC to date largely because of its use in France and now other parts of Europe as a telephone prepayment card.

Figure 3: SMART CARD

The manufacture of a smart card involves a large number of processes of which the embedding of the chip into the plastic card is key in achieving an overall quality product. This latter process is usually referred to as card fabrication. From the requirements individual specifications can be prepared for the chip, card, mask ROM software and the application software.

***Chip specification*:** There are a number of factors to be decided in the specification of the integrated circuit for the smart card. For the purpose of this discussion we will consider a CPU based card although the manufacture of a memory card is substantially a subset of that described here. The key parameters for the chip specification are as follows, Microcontroller type, Mask ROM size, RAM size, Nonvolatile memory type (e.g.; EPROM, EEPROM), Nonvolatile memory size, Clock speed (external, and optionally internal)The specification of a card involves parameters that are common to many existing applications using the ISO ID-1 card. The following list defines the main parameters that should be defined: Card dimensions, Chip location (contact card), Card material (e.g. PVC, ABS), Printing requirements, Magnetic stripe (optional). The characteristics of the smart card are part of the ISO 7816 part 1 (physical) and 2 (contact location) standards.

STEPPER MOTOR

A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The motors rotation has several direct relationships to these applied input pulses. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied. Stepper motors operate differently from DC brush motors, which rotate when voltage is applied to their terminals. Stepper motors, on the other hand, effectively have multiple "toothed" electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, such as a microcontroller. Each of those slight rotations is called a "step", with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

System Implementation

The Automated Toll Gate Collection With Complex Security System Block Diagram shown in Fig.4

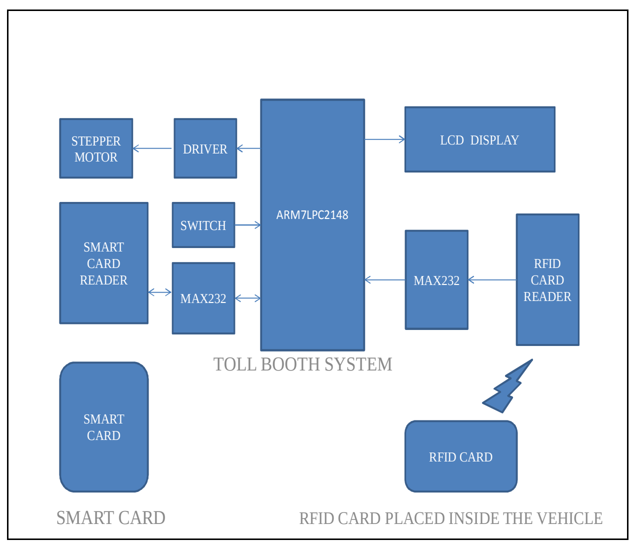

Figure 4: Block Diagram

Flow of Operation

In this paper ARM7 LPC2148, RFID, and smart card are used. The RFID Passive tags are used rather than active tags; however, the RFID tags used a maximum detection distance of 15cm. Thus in our project, we have to put all the object tags close to the reader one by one. The reader will read the tags information and sends the data to the ARM7 and the amount is deduced from the Smart Card and the amount is display it on LCD. After deducing the amount from the Smart card using stepper motor the toll gate will be automatically open and closed. In this project we are using prepaid Smart card, when there is no amount in the Smart card the vehicle owner have to recharge the Smart card and then the vehicle will pass from the toll gate, the gate will be open. The Smart card and the RFID should have the same password then only the RFID and Smart card will be detected.

Algorithm

Algorithm for automated tollgate collection with complex security system:

Step1: Initialize ARM7, RFID, and Smart card.
Step2: Inset the Smart card.
Step3: Show the RFID tag near the RFID Reader at a distance of 0 to 15cm.
Step4: The vehicle information and the amount is display on LCD.
Step5: After deducing the exact amount from Smart card, using stepper motor the toll gate will be open and then closed.
Step7: If the Smart card is empty, the tollgate will not be opened.
Step8: Recharge the Smart card.
Step9: This process should be done one by one, by using RFID and the Smart card.

Figure5: RFID READER & RFID TAG

Result and Conclusion

This paper mainly researches the development Work on the toll gate system. Using RFID communication realized the technology of automated toll collection system for vehicle information and the SMART CARD for automatically amount reduction. The project "Automatic toll collection with complex security system" has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

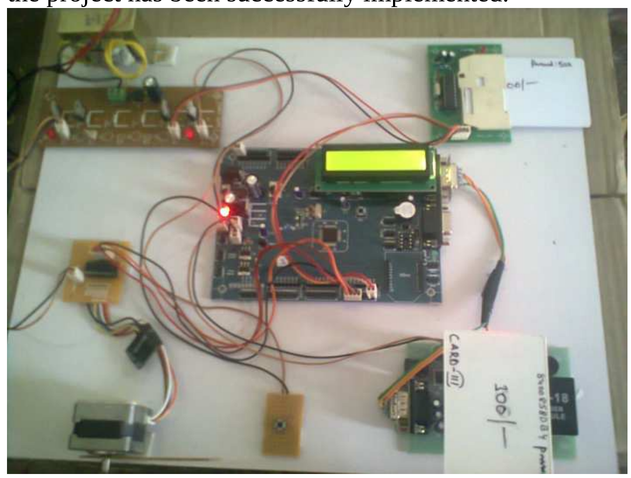

Figure.6:Automated tollgate collection with complex security system

The result is shown from the Fig.6 which is given below. The amount will be automatically debited from the user account. By using this traffic at the toll gates can be avoided and the users can pass the toll gates without stopping.

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