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RFID Based Intelligent Bus Management and Monitoring System

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***Abstract*- This paper summarizes our work on the design and implementation of RFID-based system for tracking the location of buses provided for private transportation. The system consists of three main modules: In-Bus Module, Bus-Stop Module and Base-Station Module. When bus leaves from BASE-Station, the RFID tag at BASE-Station is read by the RFID reader in the In-Bus Module and the tag data is then sent to BASE-Station via GSM. By using the signals from ATmega328 microcontroller, GSM modem is used to send appropriate RFID tag data to the BASE-Station. An entry corresponding to the bus is created and entered into the database at BASE-Station. BASE-Station Module sends the data about bus, its current location and remaining time for arriving particular bus stop to the Bus-Stop modules via GSM. Bus-Stop Module is installed at every bus stop and consists of GSM, RFID tag and LCD display all interfaced to a microcontroller. This module then display the data received form BASE-Station on LCD displays. ATmega328 microcontroller is the main controlling device which controls and synchronizes all the operations by receiving the data from RFID tag. This paper is embedded based, embedded means dumping of software in to the hardware. Here software code is written and debugged with the help of micro version Keil. Keil converts the asm file into hex file and this software code is dumped into the microcontroller ATmega328 using dumping kit.**

INTRODUCTION

Radio Frequency Identification (RFID) has attractedconsiderable attentions in recent years for its broadapplications in ubiquitous computing. In this paper, wepropose a RFID Assisted Navigation System (RFID-ANS)with GSM for bus position identification. RFID-ANS consists of RFIDreaders installed on vehicles and passive RFID tagsdeployed on bus station. As the maintenance for a passive tag iseasy and its cost is less than a dollar, it is feasible to deploy alarge number of passive tags for a relatively low cost overa broad area that is full of roadways.GPS cannot achievelane level positioning and can provide information regardingthe traffic direction in the current lane. By using RFID-ANSwith GSM, it is achievable.

Intuitively,RFID-ANS complements to the currentGPSnavigation system when GPS signals are notavailable (such as in tunnels) or if the GPS position isambiguous to a vehicle. Moreover, even combined withmap-matching technologies, nevertheless, thisinformation are necessary to prevent vehicles fromentering a wrong way when roads are underconstruction or lanes are temporarily borrowed by thetraffic along a different direction. Our RFID-ANS withGSM is designed to address the position of bus. Itsconvenience and benefits give incentives for users toinstall RFID readers on theirvehicles.

Additionally, RFID-ANS can be configuredto provide electrical traffic signals.Itmight be essential tofuture autonomous vehicle systems as this system canprovide more precise real time road information fortraffic scheduling. Note that the RFID reader attachedat a vehicle is independent of the vehicle model, and itcan be easily upgraded to guide driving. Therefore,RFID-ANS could play an important role in the futurecomplex driving environment that containsautonomous, semiautonomous, and man-controlledvehicles.RFID-ANS is a ground navigation system that isdesigned for the lane level navigation. The issues relevant toa practical RFID-ANS in a complex vehicular environmenthave never been addressed before. To our knowledge, thisis the first work that provides a systematic approach todesigning a RFID-ANS.

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Our RFID-ANS with GSM providesefficient navigation for autonomous vehicles system. Ourmultifaceted contributions are stated as follows. We provide an analysis on the design criteria ofRFID-ANS. These criteria serve as guidelines for thedesign of the RFID readers and the deployment ofthe RFID tags. We present the relationships amongthese design criteria, and investigate how they shouldbe used cooperatively to achieve the objectives of thenavigation system. Based on these criteria, weidentify the parameters that are important for theRFID-ANS design. We present the design of the RFID readers forRFID-ANS in detail. The ranges of the criticalparameters for the RFID readers are derivedaccording to the requirements of the navigationsystem and the tag deployment. We jointly consider the design of the RFID reader'sread interval and the deployment of the RFID tags,such that the cost and energy consumption can beoptimized as long as the requirements of thenavigation system are satisfied. The proposedmethods for read attempt scheduling and tagdeployment are robust and adaptable to dynamic roadenvironments.We propose methods to estimate the vehicle position.The accuracy of the estimated position and thePerformance of the designed RFID-ANS is analyzed.

EXISTING SYSTEM

Traditionally, RFID tags were designed forcommercial applications to replace the bar codes for assetcounting and identification. One importantchallenge in such applications is how to handle the readcollision problem that occurs when one or more RFIDreaders query multiple RFID tags roughly a small area. As a result, most existing research focuses on anti-collision protocol design to schedule the reader's read requests and the tag's responses. In RFIDANS,read collision is not possible as our design guarantees the one-to-one coupling of a RFID reader and a tag in a restricted area. RFID systems have been deployed for VANETs, in which RFID tags are installed on vehicles while RFID readers are deployed on stationary infrastructures. For example, in a typical Electronic Toll Collection (ETC) system, automatic toll RFID readers are installed at the gate.

A RFID tag (attached to the E-ZPass on a vehicle) is read by the reader when a vehicle passes by the gateway.The toll system identifies the vehicle through the data obtained from the RFID tag, and automatically charges to the vehicle's or the driver's account. A similar system is established for parking fee collection. Compared to these systems, RFID-ANS contains stationary tags onroads while readers move with vehicles at high speeds.The most related work to RFID-ANS are reported and propose the idea of usingstationary RFID tags deployed on roads to localize vehicleswhen passing by. The feasibility of utilizing RFID tags fornavigation when vehicles move at high speeds is investigatedthrough an experiment in which a RFID reader reads the datain a tag when the tag is dropped down to the ground. Lee etalstudy therelationship between the tag read latencyand the vehicle's speed, and evaluates their results on a testroad. These two works demonstrate the feasibility andpracticality of applying commercial RFID tags and readers inthe vehicular environment. But none of them considerscritical issues such as tag deployment and read scheduling,which are important to the design of a practical RFID-ANS as they mainly focus on the concept and feasibility study.

Inthe Road Beacon System proposed in, RFID tags servingas traffic signs are deployed in the pavement and vehicles getthe road information through reading the tags. The technicaldetails of this work are unavailable to our best knowledge.

PROPOSING SYSTEM

Our paper is a real-time bus position monitoring and broadcasting system. This paper has a RFID Tag on the bus station and the reader on the bus. When the bus is crossing the bus station, the RFID reader identifies the tag which is installedonbus stand the same is intimate to the server system. The server system contains all the passenger’s information database. Once the server is triggered with the bus position information and station information an auto query will be get generated and executed, which results the passenger who are going to board in the next station. These passengers will be intimated about the bus position information before that bus reaches that stop through SMS. The Server which is connected to a microcontroller through a serial communication receives the passenger’s mobile data and the same is sent to GSM modem which is connected to another port of the microcontroller.

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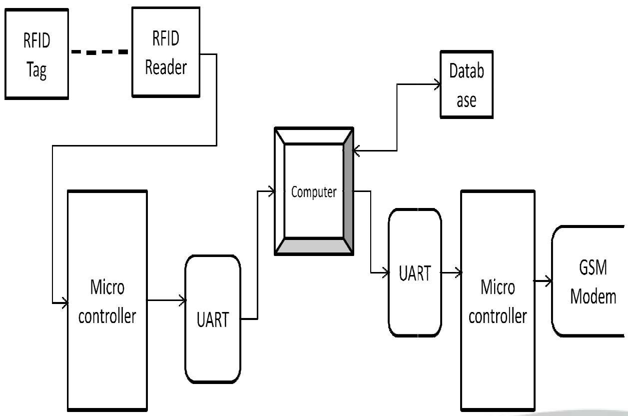

Figure 1: Block Diagram of bus monitoring system using RFID

OVERVIEW OF RFID TECHNOLOGY

RFID system consists of three components namelytransponder (tag), interrogator (reader) and computercontaining the database, as shown in Fig. 2. The interrogatorreads the tag data and transmits it to the computer forauthentication. The information is processed and uponverification, access is granted. The system offers diversefrequency band ranging from low frequencies to microwave frequencies

- Low Frequency: 125-134 KHz
- High Frequency: 13.56 MHz
- Ultra High Frequency: 902-928 MHz
- Microwave Frequency: 2.4 GHz

Depending upon the source of electrical energy, RFID tagsare classified as either active or passive. The active tags use abattery for powering the circuit on the tag and transmit the taginformation upon the reader request. However, these tags arevery expensive and seldom used. On the other hands, passivetags get energy from the reader to power their circuit. Thesetags are very cost-effective and hence most of the applicationsuse them. A comparison of these tags highlighting importantfeatures is shown in Table 1.

Table I. Comparison of Active & Passive RFID Tags

Attribute	Active Tags	Passive Tags
Source of Power	Built-in Battery	Electromagnetic Induction
Reading Distance	High (20 to 100 m)	Low (Up to 3m)
Required Signal Strength	Low	High
Tag Cost	High ($15 to $100)	Low ($0.15 to $5)
Data Storage	Large read/write data (128kb)	Small read/write (128b)
Size	Large	Small
Weight	Large	Small
Tag Life	Small (3 to 8 years depending upon tag broadcast rate)	Large (Up to 10 years depending upon the environment the tag is in)
Tag Readers	Typically lower in cost	Typically higher in cost
Industries/ Applications	Auto dealership Auto Manufacturing Hospitals Construction Mining Laboratories Remote monitoring	Supply Chain High vol. Manufacturing Libraries/book stores Pharmaceuticals Passport Electronic tolls Item level tracking

In the present work, passive RFID tags have been used. Apassive RFID tag transmits information to the reader when itcomes in the vicinity of electromagnetic field generated by thereader. The phenomenon is based on Faraday's law ofelectromagnetic induction. The current flowing through the coilof interrogator produces a magnetic field which links to thetransponder coil thereby producing a current in the transpondercoil. The transponder coil then varies this current by changingthe load on its antenna. This variation is actually the modulatedsignal (scheme is known as load modulation) which is receivedby the interrogator coil through mutual induction between thecoils. The interrogator coil decodes this signal and passes to the computer for further processing.

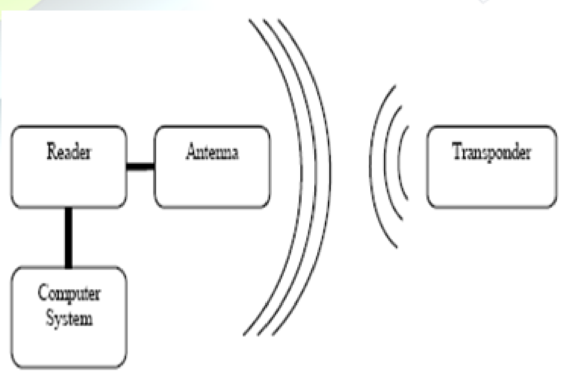

Figure 2: Basic RFID System

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FEATURES OF MICROCONTROLLER

It is aHigh Performance, Low Power Atmel®AVR® 8-Bit Microcontroller and has Advanced RISC Architecture.This controller has 131 Powerful Instructions , Most Single Clock Cycle Execution,32 x 8 General Purpose Working Registers,Fully Static Operation,Up to 20 MIPS Throughput at 20MHz,On-chip 2-cycle Multiplier,High Endurance Non-volatile Memory Segments ,4/8/16/32KBytes of In-System Self-Programmable Flash program memory, 256/512/512/1Kbytes EEPROM,512/1K/1K/2KBytes Internal SRAM,Write/Erase Cycles: 10,000 Flash/100,000 EEPROM,Data retention: 20 years,Optional Boot Code Section with Independent Lock Bits,In-System Programming by On-chip Boot Program,TrueRead-While-writeoperation,Programming Lock for Software Security. This supports Capacitive touch buttons, sliders and wheels,QTouch and QMatrix acquisition,Up to 64 sense channels.Its Peripheral Features are Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode,One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and capture Mode,Real Time Counter with Separate Oscillator,Six PWM Channels,8-channel 10-bit ADC in TQFP and QFN/MLF package,Temperature Measurement, 6-channel 10-bit ADC in PDIP Package, Programmable Serial USART,Master/Slave SPI Serial Interface,Byte-oriented 2-wire Serial Interface (Philips I2C compatible),Programmable Watchdog Timer with Separate On-chip Oscillator,On-chip Analog Comparator,Interrupt and Wake-up on Pin Change.

The Special Microcontroller Features of microcontroller arePower-on Reset and Programmable Brown-out Detection, Internal Calibrated Oscillator, External and Internal Interrupt Sources,Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby, I/O and Packages,23 Programmable I/O Lines, 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF.The Operating Voltage is 1.8 - 5.5V andTemperature Range is -40degree C to 85degree C.

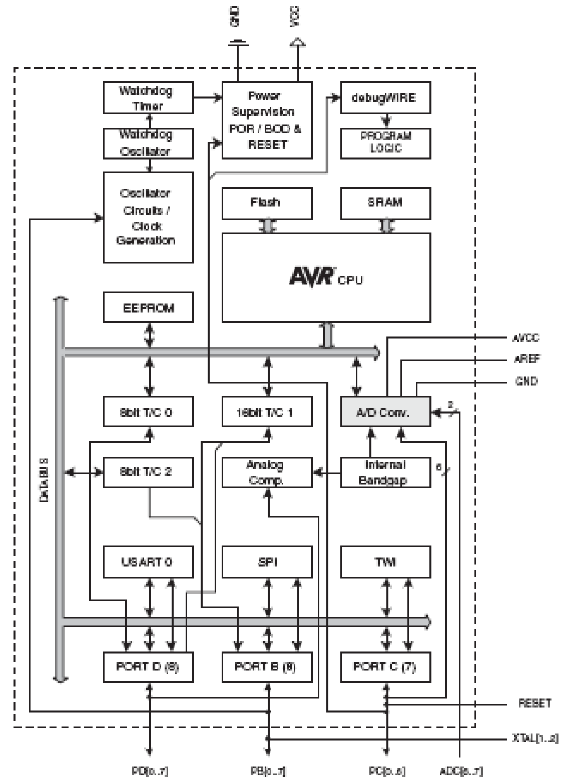

Figure 2: Block Diagram of Microcontroller

CONCLUSION

In this paper, GSM (Global System for Mobiles) is used along with RFID reader and passive RFID tag for vehicle navigation and tracking. It provides lane level and overall navigation even when the vehicle is on the road and also provides vehicular tracking when the vehicle comes out ofthe road. Navigation of vehicular position using LCD display tracking of vehicle by the authorized person using VB coding is possible in this project. Thus using RFID-ANS and GSM is a unique and stand alone navigation and tracking system for future autonomous vehicular systems. This system has more advantage and can be implemented perfectly using suitable hardware circuits.

FUTURE WORK

At present, this can be implemented in college buses, school buses, company buses etc., where the passengers travel in regular buses from the same bus stop. In future this can be extended towards the finding position of various buses for the regular customers in the public transports and etc.,

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