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Designing an Intelligent Transport Navigation System Using RFID

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ABSTRACT

GPS receivers are used to provide vehicle position and velocity data. But in practice, GPS does not provide sufficient information for navigation due to its low positioning accuracy (5 to 7 meters). Moreover, even combined with map-matching technologies, GPS still cannot achieve lane level positioning and cannot provide information regarding the traffic direction in the current lane. This project is implemented using RFID in order to guide the person who wants to go to certain location but doesn't know the route. The communication is done using RF434 wireless module. RADIO Frequency Identification (RFID) has attracted considerable attentions in recent years for its broad applications in ubiquitous computing. In this paper, we propose a RFID Assisted Navigation System (RFID-ANS). RFID-ANS consists of RFID readers installed on vehicles and passive RFID tags deployed on roads. As the maintenance for a passive tag is easy and its cost is less than a dollar, it is feasible to deploy a large number of passive tags for a relatively low cost over a broad area that is full of roadways.

Keywords: RFID, RF434Mhz, IR sensor

INTRODUCTION

RFID (Radio Frequency Identification) is a technology that uses electromagnetic fields to identify objects in a contactless way. It is also called proximity identification. There are 2 elements in RFID communications: the RFID module (or reader/writer device) and an RFID card (or tag). The RFID module acts as the master and the card acts as the slave. This means the module queries the card and sends instructions to it. An RFID card can be understood as a remote storage unit where we can read and write information without contact. Most of the RFID tags are passive, which implies that the RFID module must create an electromagnetic field in order to power the tag. The RFID card's antenna (in fact it is an inductive coupler) gets the power from this field. Also, an RFID card has a very basic microcontroller which manages the communications and memory access.

Intuitively, RFID-ANS complements to the current GPS navigation system when GPS signals are not available (such as in tunnels) or if the GPS position is ambiguous to a vehicle (such as at cloverleaf intersections). Our RFID-ANS is designed to address such problems. Its convenience and benefits give incentives for users to install RFID readers on their vehicles. Additionally, RFID-ANS can be configured to provide electrical traffic signs. It might be essential to future autonomous vehicle systems as this system can provide more precise real time road information for traffic scheduling. Note that the RFID reader attached at a vehicle is independent of the vehicle model, and it can be easily upgraded to guide driving. Therefore, RFID-ANS could play an important role in the future complex driving environment that contains autonomous, semiautonomous, and man-controlled vehicles. RFID-ANS is a ground navigation system that is designed for the lane level navigation. The issues relevant to a practical RFID-ANS in a complex vehicular environment have never been addressed before. To our knowledge, this is the first work that provides a systematic approach to designing a RFID-ANS. Our multifaceted contributions are stated as follows:

1. We present the design of the RFID readers for RFID- ANS in detail. The ranges of the critical parameters for the RFID readers are derived according to the requirements of the navigation system and the tag deployment.

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2. We jointly consider the design of the RFID reader's read interval and the deployment of the RFID tags, such that the cost and energy consumption can be optimized as long as the requirements of the navigation system are satisfied. The proposed methods for read attempt scheduling and tag deployment are robust and adaptable to dynamic road environments.
3. They propose methods to estimate the vehicle position. The accuracy of the estimated position and the performance of the designed RFID-ANS are analyzed.

PROPOSED PROJECT

This project is implemented using RFID in order to guide the person who wants to go to certain location but doesn't know the route. In this system, the reader units are placed at some distance to each other. Reader unit reads the tag of the vehicle unit and intimates to the central unit about the vehicle unit. Then the central station calculates the Speed of the vehicle unit by using time and distance travelled that is obtained from RTC which is inbuilt in it and also detects the location of the vehicle unit based on readers position and send this information to the Vehicle unit. So the vehicle unit in this system is going to know the location and the speed that it is going, if the speed is higher than predefined then the speed control unit slowly reduce the vehicle speed. The central unit also provides the next location information to vehicle unit so that he can decide the route that he wants to go. Central station also gives Traffic updates and Accident updates to the vehicle unit. Obstacle sensor in the vehicle unit detects the obstacle and intimates the vehicle unit if any obstacle occurs. The communication between them is done using RF434 wireless module.

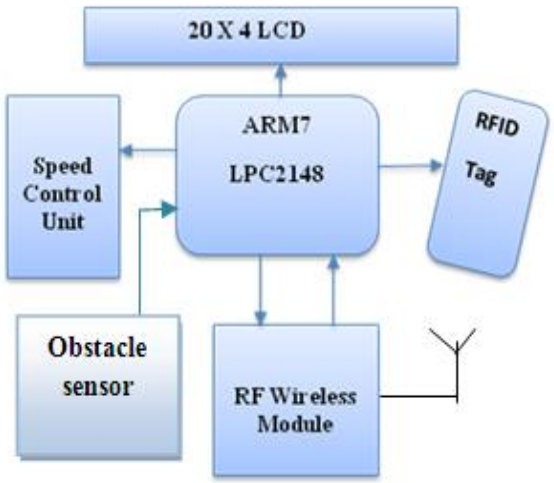


Fig 1. VEHICLE UNIT

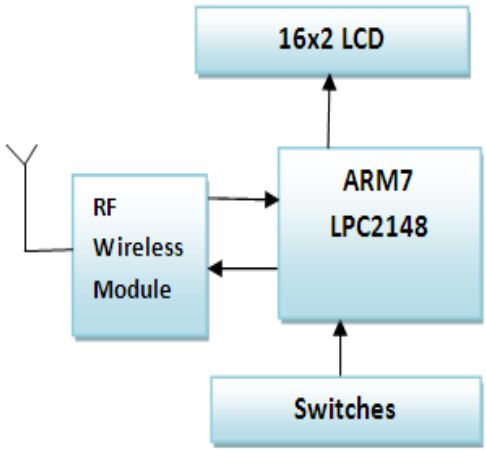


Fig 2. CENTRAL UNIT

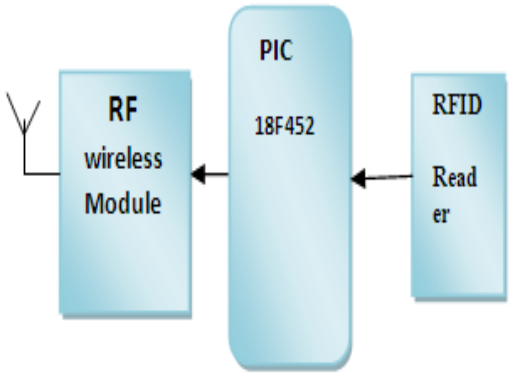


Fig.3 READER UNIT-1

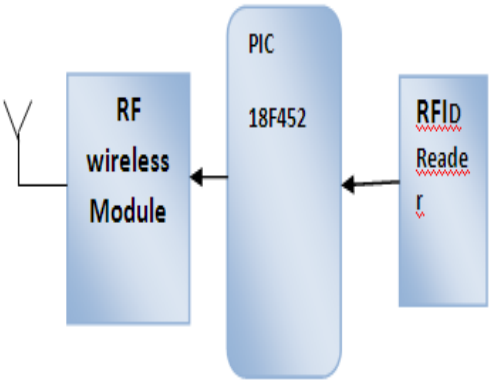


Fig. 4 READER UNIT-2

RF434MHZ WIRELESS MODULE

HM-TR series transparent wireless data link module is developed by Hope microelectronics Co. Ltd, dedicated for applications that needs wireless data transmission. It features high data rate, longer transmission distance. The communication protocol is self controlled and completely transparent to user interface. The module can be embedded to your current design so that wireless communication can be set up easily. Radio Frequency Identification (RFID) systems use radio frequency to identify, locate and track people, assets and animals. Passive RFID systems are composed of three components – a reader (interrogator), passive tag and host computer. The tag is composed of an antenna coil and a silicon chip that includes basic modulation circuitry and non-volatile memory.

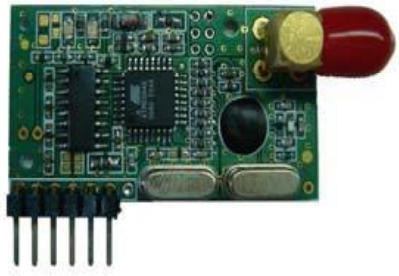


Fig. *HM-TRXXX-232 RF Wireless module*

The tag is energized by a time-varying electromagnetic radio frequency (RF) wave that is transmitted by the reader. This RF signal is called a carrier signal. When the RF field passes through an antenna coil, there is an AC voltage generated across the coil. This voltage is rectified to result in a DC voltage for the device operation. The device becomes functional when the DC voltage reaches a certain level. The information stored in the device is transmitted back to the reader. This is often called backscattering. By detecting the backscattering signal, the information stored in the device can be fully identified.

In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs. Radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs. Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E. Transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver. The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data.

RFID

Short for **r**adio **f**requency **id**entification, RFID is a **d**edicated **s**hort **r**ange **c**ommunication (DSRC) technology. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID technology is similar to the bar code identification systems we see in retail stores everyday; however one big difference between RFID and bar code technology is that RFID does not rely on the line-of-sight reading that bar code scanning requires to work.

A basic RFID system consists of three components:

- An antenna or coil
- A transceiver (with decoder)
- A transponder (RF tag) electronically programmed with unique information
- The antenna emits radio signals to activate the tag and to read and write data to it.
- The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal.
- The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

RFID reader is used to activate passive tag with RF energy and to extract information from the tag. For this function, the reader includes RF transmission, receiving and data decoding sections. In addition, the reader includes a serial communication (RS-232) capability to communicate with the host computer. Depending on the complexity and purpose of applications, the reader's price range can vary from ten dollars to a few thousand dollar worth of components and packaging.

The RF transmission section includes an RF carrier generator, antenna and a tuning circuit. The antenna and its tuning circuit must be properly designed and tuned for the best performance. Data decoding for the received signal is accomplished using a microcontroller. The firmware algorithm in the microcontroller is written in such a way to transmit the RF signal, decode the incoming data and communicate with the host computer. Typically, reader is a read only device, while the reader for read and write device is often called interrogator. Unlike the reader for read only device, the interrogator uses command pulses to communicate with tag for reading and writing data.

SPEED CONTROL UNIT

PWM is a technique used to control the speed. PWM stands for Pulse Width Modulation, and is a signal that stays not at a constant level but is rapidly being turned on and off. The ratio of the on time to the off time determines how much power you are driving into the load and hence how fast it goes. Waveform A is off most of the time and so will result in a slow speed, where as waveform B is on most of the time and so the motor will run faster. If this causes the motor to buzz then place a capacitor across the motor to smooth it out. Some of the Arduino outputs can be used as PWM outputs, this varies with the different model of Arduino so look to see what pins are supported by yours.

BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

INFRARED SENSORS

An Infrared (IR) sensor is used to detect obstacles in front of the robot or to differentiate between colors depending on the configuration of the sensor. Infrared radiation was first discovered by the astronomer William Herschel. He conducted an experiment in which he used a prism to refract light from the sun. Herschel was able to detect the presence of infrared radiation beyond the red part of the visible spectrum using a thermometer to measure an increase in temperature. In 1800 Herschel published his findings to the Royal Society of London. 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 waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000µm. The wavelength region which ranges from 0.75 to 3µm is known as the near infrared regions. The region between 3 and 6µm is known as the mid-infrared and infrared radiation which has a wavelength greater higher than 6µm is known as far infrared. Infrared technology finds applications in many everyday products. Televisions use an infrared detector to interpret the signals sent from a remote control. The key benefits of infrared sensors include their low power requirements, their simple circuitry and their portable features. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, its resistance and correspondingly, its output voltage, change in proportion to the magnitude of the IR light received. This is the underlying principle of working of the IR sensor.

IMPLEMENTATION & WORKING

This project is implemented using ARM7 based LPC2148 and an 8 – bit Pic Micro controller. It contains mainly four nodes Vehicle unit, two reader Units, one central unit. Vehicle unit is implemented on ARM7, interfaced with Vehicle speed controlling unit, Obstacle sensor, RF434Mhz wireless module and RFID tag. The central Unit is implemented on ARM7 and is interfaced with RF434 wireless module, RTC (Real Time clock) and database related to each located points of reader Units so as to locate vehicle location. The reader units are interfaced with RFID readers and

RF434Mhz Wireless module. Two Readers are placed at some distance to each other. When a vehicle crosses first reader unit the tag attached to vehicle read by the reader unit and it starts timer send intimation to central station. When the vehicle reaches the second Reader unit there also the Tag is read by reader unit and it also sends the intimation to central station. By taking these details the central station calculates the Speed of the vehicle and also detects the location of vehicle based on readers position and send this information to Vehicle. So the vehicle in this system is going to know the location and the speed that it is going, if the vehicle is going with high speed than predefined then the speed control unit slowly reduce the vehicle speed. Central station also gives Traffic updates and Accident updates using switches to the vehicle unit. Obstacle sensor in the vehicle unit detects the obstacle and intimates the vehicle unit if any obstacle occurs.

HARDWARE & RESULTS

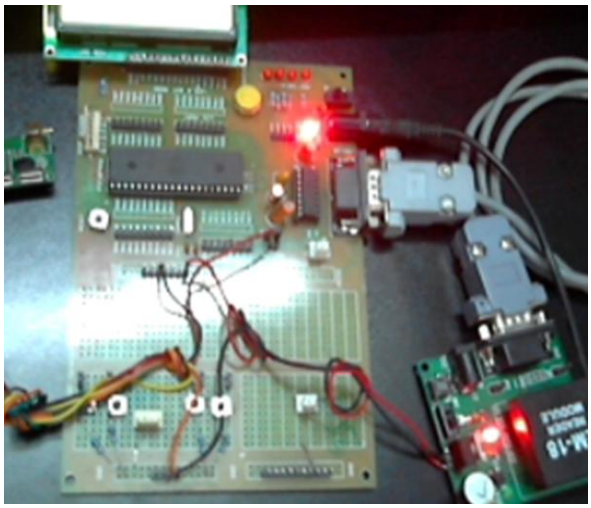


Fig. *READER UNIT*

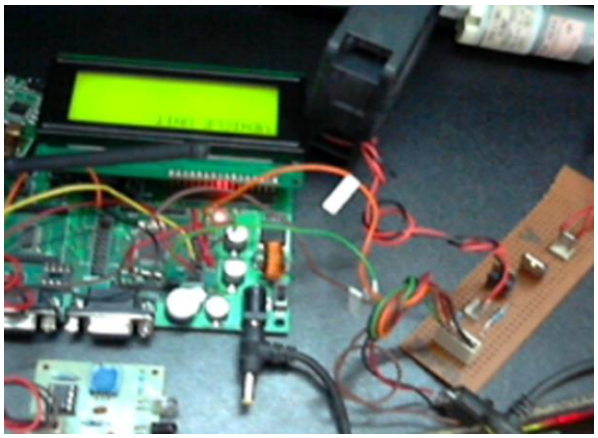


Fig. *VEHICLE UNIT*

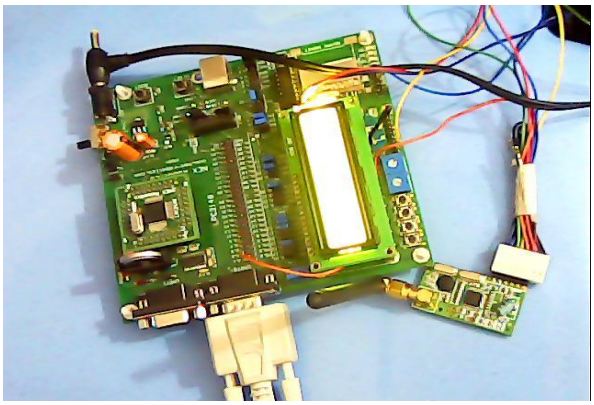
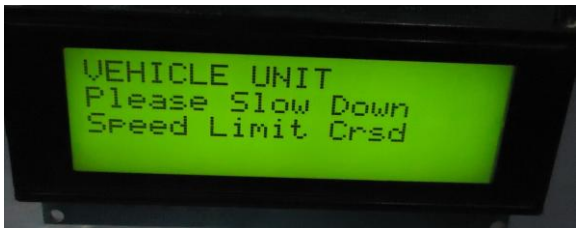


Fig. *CENTRAL UNIT*

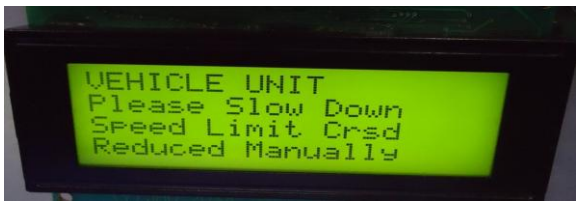
OUTPUT RESULT

The central unit provides the location information to vehicle so that he can decide the route that he wants to go.

If the vehicle is going with high speed than predefined speed then the central unit will send a message to the vehicle unit to slow down the speed.



If the driver doesn't slow down the speed of the vehicle then the speed control unit in the vehicle unit will manually reduces the vehicle speed.



Central unit will also give the information about traffic.

Accident updates given by central unit.

Vehicle unit has an obstacle sensor (IR sensor) which detects the obstacle and gives the information to the vehicle unit.

ADVANTAGES

1. Used for the purpose of detecting the vehicle: If any vehicle will be missing in the remote areas this project is used to detect the vehicle.

2. Used to know the present location of the vehicle: if the owner of the vehicle does not know the location of the vehicle this project is used to find out that location name.
3. Easily we can control the speed of the vehicle: if any vehicle is going with very high speed or low speed easily owner of the vehicle can control the speed of the vehicle so this project is used to reduce the accidents. Used to display the next location from the junction point: if the user of the vehicle does not know that which location goes to which way at junction point this project is used to display the locations of each way at junction point so the user may not be entered in the wrong location.

APPLICATIONS

1. Remote areas: This project will be mainly used in remote areas. Due to the low positioning accuracy of GPS does not provide sufficient information in all the areas. If any vehicle or school van will be entered in that region we cannot detect the vehicle. This project will be used to detect that vehicle and also display the vehicle location name.
2. Security required systems: This project will also be useful in security requiring systems. If anyone wants to send the costly items in the vehicle. Easily we can observe the status of the vehicle at each Reader unit from the central station.
3. Accident areas: This project can be used to reduce the accidents also. Because of very high speed there may be a chance to the occurrence of accidents. If any vehicle is going with very high speed the user of the vehicle can control the speed of the vehicle from central station. So that there may be a chance to avoid the accidents.
4. School zones: This project can be used near school zones. If the vehicle is going with very high speed near school zones central unit observer can send a message to the user of the vehicle. That message is reduce the speed of the vehicle because vehicle reaches the school zone. Based on this command user of the vehicle can reduce the speed of the vehicle.

CONCLUSION

The project "**DESIGNING AN INTELLIGENT TRANSPORT NAVIGATION SYSTEM USING RFID"** has been successfully designed and tested. It has been developed by integrating features of the entire hardware and software components. Presence of every module has been reasoned out and placed carefully.

The main aim of the project is to design a system that guide the route to the person. Hence this project plays a very important role in the remote areas. If any vehicle is entered in GPS signals insufficient areas, owner of the vehicle will come to know the location details of the vehicle. Speed of the vehicle is also controlled by the user from the central station only. Traffic updates and accident updates are also sent by the central unit to vehicle unit. An obstacle sensor is present in a Vehicle unit which detects the obstacle and intimates to the vehicle unit.

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