RESEARCH ARTICLE OPEN ACCESS

Zigbee Based Indoor Campus Inventory Tracking Using Rfid Module

M. Gireesh Kumar*, K. Sripath Roy**
*Department of Electronics and Computer Engineering, KL University, Guntur, A.P. India
**Department of Electronics and Communication Engineering, KL University, Guntur, A.P. India
Assistant professor KL University.

ABSTRACT
This is a very useful application of RFID (Radio-frequency identification) and is very commonly used in institutes, offices, homes and so on. An RFID system consists of a reader device and a transponder. A transponder or tag has a unique serial number which is identified by the reader. Here RFID has been interfaced with ARM Processor to provide secured access. The relevant messages are also displayed on a 16x2 LCD.RFID automated access for door controls to buildings, departments, rooms, secured closets (wiring, PBX, etc.) and cabinets is very cost effective and secure to use. Many people do not realize how easy it is to implement card access systems such as card access door or doors using RFID readers and RFID Cards or Key fobs for Secured Access Control Management. You can even use smart readers for computer rooms and securing individual computers. RFID tags are categorized as either active or passive. Active tags are powered by an internal battery and are typically read/write,i.e tag data can be rewritten or modified. Passive tags operate without a separate external power source and obtain operating power generated from the reader.
Keywords – Zigbee, RFID

I. Introduction

RFID is acronym for radio frequency identification. It is one family member in the family of Automatic Identification and Data capture technologies and is a fast and reliable means of identifying just about any object. It can be applied in real time applications such as for tracking .Zig-bee module is used to transfer the details to the central system or server. This system can be used in big companies, industries, colleges etc, where there are many number of candidates available. Radio-frequency identification(RFID) is a technology that uses radio waves to transfer data from an electronic tag called an RFID tag or label, which is attached to an object through a reader for the purpose of identifying and tracking the object. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. RFID systems have been widely used in many different application areas, such as: product tracking through manufacturing and assembly ,control of inventory, parking lot access and control, container tracking, ID badges and access control,Inthis project a connectionlesstracking architecture based on Zigbee RFID sensor network is proposed for inventory management applications. Such architecture features a consistent network structure, low hardwareenergy consumption and accumulated error for localization algorithms with the least additional cost and hardware required on top of the existing Zigbee RFID sensor network systems. A simple demo system is also developed to demonstrate the feasibility of our design.RFID is acronym for radio frequency identification. It is one family member in the family of Automatic Identification and Data capture technologies and is a fast and reliable means of identifying just about any object. It can be applied in real time applications such as for tracking .Zig-bee module is used to transfer the details to the central system or server. This system can be used in big companies, industries, colleges etc, where there are many number of candidates available. Radio-frequency identification(RFID) is a technology that uses radio waves to transfer data from an electronic tag called an RFID tag or label, which is attached to an object through a reader for the purpose of identifying and tracking the object. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. RFID systems have been widely used in many different application areas, such as: product tracking through manufacturing and assembly ,control of inventory, parking lot access and control, container tracking, ID badges and access control , In this project a connectionless tracking architecture based on Zigbee RFID sensor network is proposed for inventory management applications. Such architecture features a consistent network structure, low hardware energy consumption and no accumulated error for localization algorithms with the least additional cost and hardware required on top of the existing Zigbee RFID sensor network systems. A simple demo

system is also developed to demonstrate the feasibility of our design.

II. RFID

RFID technology is based on the concept of magnetic coupling, which is the principle that current flowing in one circuit can induce current flow in another circuit through a magnetic field generated in the space between the circuits. In passive RFID, there are two major components: the reader and the mobile tag. The reader has two main functions: the first is to transmit a carrier signal, and the second is to receive a response from any tags in proximity of the reader. A tag needs to receive the carrier signal, modify it in some way corresponding to the data on the card, and retransmit the modified response back to the reader. In modern passive RFID devices, the tag consists of a small integrated circuit (that performs the modulation) and an antenna. The benefit of passive RFID is that it requires no internal power source; the circuit on the tag is actually powered by the carrier signal. Thus, the carrier signal transmitted from the reader must be considerably large so that the response can be read even from the card. In modern passive RFID devices, the tag consists of a small integrated circuit (that performs the modulation) and an antenna. The benefit of passive RFID is that it requires no internal power source; the circuit on the tag is actually powered by the carrier signal. Thus, the carrier signal transmitted from the reader must be considerably large so that the response can be read even from the card.

WORK FLOW OF RFID

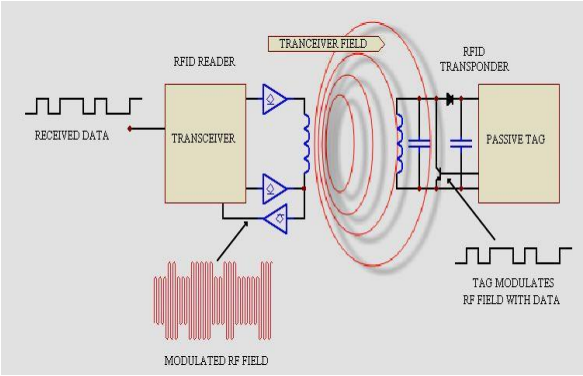

Fig 3: Work flow of RFID

In modern passive RFID devices, the tag consists of a small integrated circuit (that performs the modulation) and an antenna. The benefit of passive RFID is that it requires no internal power source; the circuit on the tag is actually powered by the carrier signal. Thus, the carrier signal transmitted from the reader must be considerably large so that the response can be read even from the card.A basic RFID system consists of three components: · An antenna or coil

· A transceiver (with decoder)

·Atransponder (RF tag) electronically programmed with unique information

2.1 ANTENNA

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate tollbooth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, a sensor device can activate the field. Often the antenna is packaged with the transceiver and decoder to become a reader (a.k.a.interrogator), which can be configured either as a handheld or a fixed-mount device. 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.

2.2 TAGS(Transponders)

An RFID tag is comprised of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader. At its most basic, the chip will contain a serialized identifier, or license plate number, that uniquely identifies that item, similar to the way many bar codes are used today. A key difference, however is that RFID tags have a higher data capacity than their bar code counterparts. This increases the options for the type of information that can be encoded on the tag, including the manufacturer, batch or lot number, weight, ownership, destination and history (such as the temperature range to which an item has been exposed). In fact, an unlimited list of other types of information can be stored on RFID

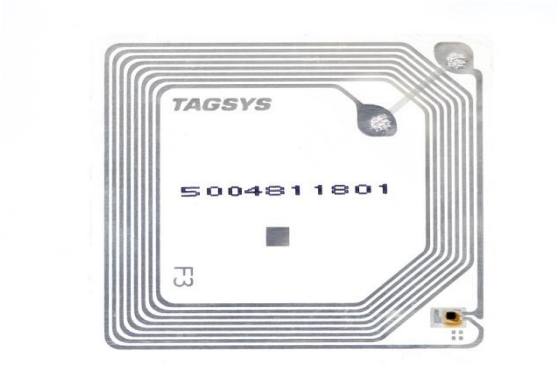

Fig: RFID Tag

tags, depending on application needs. An RFID tag can be placed on individual items, cases or pallets for identification purposes, as well as on fixed assets suchas trailers, containers, etc. The amount of data storage on a tag can vary, ranging from 16 bits on the low end to as much as several thousand bits on the high end. Of course, the greater the storage capacity the higher the price per tag.. The amount of data storage on a tag can vary, ranging from 16 bits on the low end to as much as several thousand bits on the high end. Of course, the greater the storage capacity the higher the price per tag.

2.3 RF TRANSCEIVER

The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives.

III. ZIGBEE

ZigBee is the only standards-based wireless technology designed to address the unique needs of low-cost, low-power wireless sensor and control networks. Using the networking system Zigbee Technology can connect machines and control through one connection whiles consuming less power. So Zigbee is the cost-effective wireless technology for controlling and monitoring. Applications of Zigbee Technology is not limited to a certain level but because of being cost effective, low-power battery and wireless connectivity, this Zigbee technology is used in almost every appliance.No new wires, Easy to install and maintain (mesh, self-organizing), Reliability (self-healing), Ability to scale to thousands of devices (nodes), Long battery life (years on a AA battery), Low cost (open standard, multi-vendor availability). ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. For the first time, companies will have a standards-based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, low-cost and low-power.ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. The technology is intended to be simpler and less expensive than other WPANs such as Bluetooth.ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60K and 128K flash memory.

3.1ZIGBEE DEVICE TYPES

There are three different types of ZigBee devices:

- ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys.
- ZigBee Router (ZR): As well as running an application function, a router can act as an intermediate router, passing on data from other devices.
- ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

3.1 ZIGBEE ARCHITECTURE

The LR-WPAN Architecture is defined in terms of a number of blocks in order to simplify the standard. These blocks are called layers. Each layer is responsible for one part of the standard and offers services to the higher layers. The layout of the blocks is based on the Open Systems Interconnection (OSI) Seven-Layer Model. The Interfaces between the layers serve to define the Logical Links between Layers. The LR-WPAN architecture can be implemented either as Embedded Devices or as devices requiring the support of an external device such as a PC.An LR-WPAN device comprises a PHY, which contains the radio frequency (RF) transceiver along with its Low-Level Control Mechanism, and a MAC sub layer that provides access to the physical channel for all types of transfer. The first stack release is now called ZigBee 2004. The second stack release is called ZigBee

2006, and mainly replaces the MSG/KVP structure used in 2004 with a "cluster library". The 2004 stack is now more or less obsolete. The relationship between IEEE 802.15.4 and ZigBee is similar to that between IEEE 802.11 and the Wi-Fi Alliance. The ZigBee 1.0 specification was ratified on 14 December 2004 and is available to members of the ZigBee Alliance. Most recently, the ZigBee 2007 specification was posted on 30 October 2007. The first ZigBee Application Profile, Home Automation, was announced 2 November 2007.

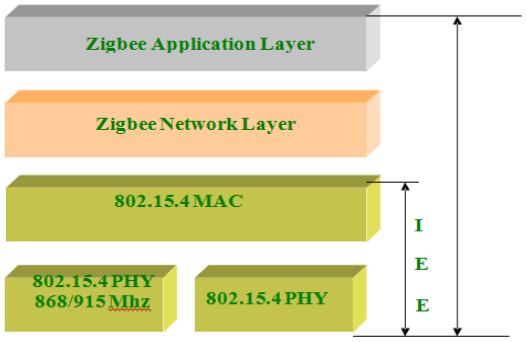

Fig:Zigbee Architecture

IV. IMPLEMENTATION OF SYSTEM

In this project, A step down transformer is used to convert the 230v power supply into 5v to the circuit. Step down transformer is connected to the power supply unit. To that supply unit transmitter zigbee, RFID reader module, ARM controller and relay circuits are connected. In this project, RFID and Zigbee are the main components. RFID is a methodology of identification using radio waves, RFID module consists of reader and tag. The reader sometimes called as interrogator/it sends and receives RF data to and from the tag via antenna. Reader may have multiple antennas that are responsible for sending and receiving radio waves. Tags or transponder is made up of the microchip that stores the data. Basically RFID tags are two categories Active RFID and Passive RFID. In this project passive tags are used they do not contain battery Instead; they draw their power from the reader. The reader transmits a low power radio signal through its antenna to the tag. Passive tags transmit information over shorter distances then active tags. Whenever the tag kept near the RFID reader module automatically the information regarding the person will be displayed and it also stores in the central system using Zigbee module.Zigbee is a low cost, low power, mesh networking proprietary standard. In this project two zigbee modules are used one is from the transmitter side and the other one is used at the receiver side. Transmitter side Zigbee transmits the information to the receiver side zigbee.Receiver zigbee is connected to the central system so the information of an every individual can be stored in central system wirelessly using Zigbee.

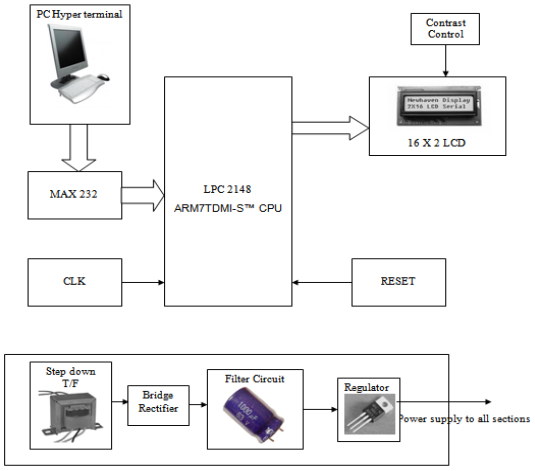

Fig:Block diagram representation

V. SOFTWARE EXPLANATION

Software's used are:

*Keil software for c programming µVision3 is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors. I.E the programs written in one of the HLL like 'C' will compile the code to run on the system for a particular processor like x86 (underlying microprocessor in the computer). For example compilers for Dos platform is different from the Compilers for Unix platform It encapsulates the following components:

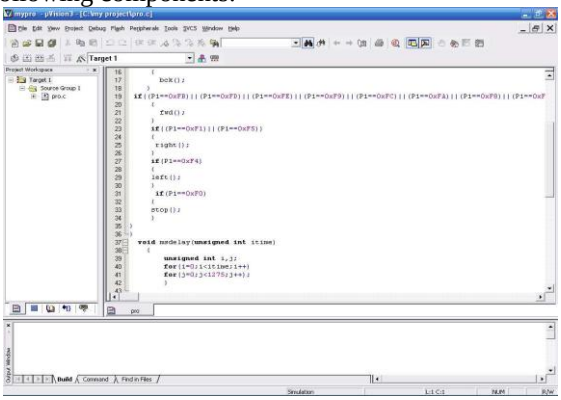

Fig: A view of Keil uVision 3

- A project manager.
- A make facility.
- Tool configuration.
- Editor.

This keil is a cross compiler as this code can be executed in any other systems also. If we write a code in one system and execute that code can be

executed on another system also. Thus it is a cross compiler.In this we write a code in Embedded C language then it is converted into .asm when we start debugging, then it is converted to .hex file which is used for execution. This HEX file is loaded to simulator then we can observe the output from simulator.

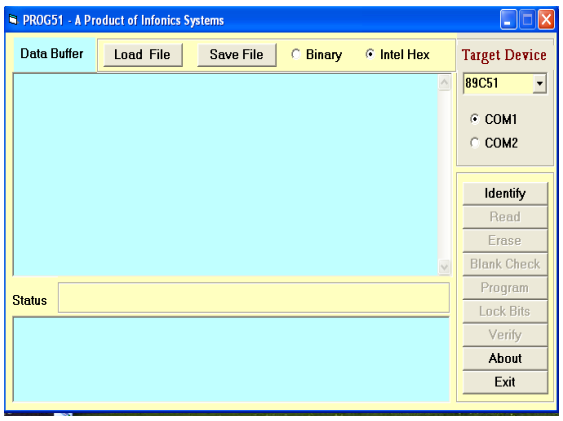

Fig:Pr051 Burner Software

In-System Programming (abbreviated ISP) is the ability of some programmable logic devices, microcontrollers, and other programmable electronic chips to be programmed while installed in a complete system, rather than requiring the chip to be programmed prior to installing it into the system. Otherwise, In-system programming means that the program and/or data memory can be modified without disassembling the embedded system to physically replace memory. The primary advantage of this feature is that it allows manufacturers of electronic devices to integrate programming and testing into a single production phase, rather than requiring a separate programming stage prior to assembling the system.

ISP (In System Programming) will provide a simple and affordable home made solution to program and debug your microcontroller based project. Normally, the flash memory of an ATMEL microcontroller is programmed using a parallel interface, which consists of sending the data byte by byte (using 8 independent lines for the data, and another bunch of lines for the address, the control word and clock input).The memory buffer contains both the code data and the EEPROM data for the devices which have EEPROM memory. The EEPROM memory address in buffer is started after the code memory, so it is necessary the hex file should contains the EEPROM start address after the end of code memory last address.The software does not provide the erase command because this function is performed automatically during device programming. If you are required to erase the controller, first use the clear buffer command then program the controller, this will erase the controller and also set the device to default setting.

VI. Conclusion

As the RFID technology evolves, more sophisticated applications will use the capability of RFID to receive, store and forward data to a remote sink source. RFID has many applications in this paper we have utilized versatility of RFID in implementing the Zigbee based indoor campus inventory tracking using RFID module system allows us to track the student simply by swiping or moving their ID cards over the RFID reader which are located at the every entrance of the campus. By using databases the data is more organized. By knowing the problems and requirement required by the organization, a system was successfully developed. Development of the system will be based on problems be addressed and which can meet the needs of organization. Apart from the analysis of the problems and research needs, objectives and scope project was set to give a preliminary and a more functional clearly to ensure the smooth running of the system has been developed.

References

[1] Victor S, Jonathan M, Reece J, and Lemire J(2003),"*Student Wolfpack Club Tracking System*", North Carolina State University. USA.

[2] Longe O.O.(2009),"*Implementation of Student Attendance System using RFID Technology*", B. Tech Project Report, Ladoke Akintola University of Technology,Ogbomoso, Nigeria.

[3] Liu C.M and Chen L.S (2009), "*Applications of RFID technology for improving production efficiency in an Integrated-circuit packaging house*," International Journal of Production Research, vol 47, no. 8, pp. 2203-2216,.

[4] RFIDSensNet Lab (2005), *A white paper on Automatic Attendance System.* Texas A & M University, Texas,USA.

[5] Bardaki,C., Kourouthanassis, P. and Pramatari, K., (2012),*Deploying RFID-Enabled Services in the Retail Supply Chain: Lessons Learned toward the Internet of Things, Information Systems Management*, Vol. 29: no.3, pp. 233-245..

[6] Sun, T., et al., *Evaluating Mobility Support in Zigbee Networks, IFIP International Conference on Embedded and Ubiquitous Computing*, UK, 2007

[7] Alhmiedat, T., Yang, S., *A Zigbee-based Mobile Tracking System through Wireless Sensor Networks, International Journal of Advanced Mechatronic Systems*, Volume 1, Number 1, pp. 63-70, 2008.

[8] Yang, H. et al , *Zigbee Enabled RFID System, Proceedings of the IASTED International Conference on Communication Systems*, Networks and Applications, pp. 163-168, Beijing, 8-10 Oct, 2007