Volume: 02, Issue: 06, Pages: 923-926 (2011)

Design and Implementation Of Hardware And Software Systems For Object Tracking Using RFID Technology

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ABSTRACT

Now a day's mobile technology plays key role, in various environments identification of objects can be done manually, to improve the efficiency of an identification of objects we are using RFID tags. RFID tags track objects in supply chains, and are working their way into the pockets, belongings and even the bodies of consumers. Tag collision occurs while two or more than two tags deliver their unique identification (UID) to the reader. Since collision, which would significantly affect the efficacy of RFID, has been one of the major study issues for RFID technology, we have developed a solution, bit competed algorithm (BCA), to solve the collision problem occurred in RFID system and consequently improve the efficacy of RFID .This paper briefly presents what are the components in RFID system, Architecture of a RFID system, what are the frequency ranges used in the RFID system and what are the problems occurred in the RFID system. Here we develop a system as a prototype for object identification. By using this technology objects can be tracks more efficiently, it provides more security, it save time and money.

Keywords: RFID, Sensors, BCA, UID

Date of Submission: 30 March 2011 Date of Acceptance: 01 May 2011

I. INTRODUCTION

Nowadays, low-cost radio frequency identification (RFID) has been attracting more and more interests from both industry and academic institutes [1]. It has gained wide range adaptation for low-cost and ubiquitous computing applications, such as location tracking, access control and environmental conditions monitoring. An RFID system consists of three parts: radio frequency (RF) tags, RF tag readers and the back-end database that associates records with tag data collected by readers. Tags are composed of a microchip for memory and logical operations, and an antenna coil for receiving and transmitting wireless signals. Readers interrogate tags for their contents through RF antenna and interface to back-end databases for more functionality [2], [3].

A typical scenario of exploiting RFID is supply chain management [4]. It aims at reducing supply chain inefficiencies and improved inventory flow whilst considering the returns process. RFID based supply chain management achieves has many beneficial features over traditionally used bar code. 1) It doesn't require line-of-sight access to read. 2) The reading range of RFID is larger than bar code, though it's still short range. 3) Tags can be read simultaneously. Inventory can be obtained in a very short time without line of sight at the entrance, because multiple tags can be read at the same time. 4) Tags can store more data, such as the unique ID for a certain things and data from the readers and the environment. Hence they can be tracked from producers to distributors and to retailers.

This paper is organized as follows. The components and architecture of a RFID system are firstly introduced in section II. Frequency ranges used for RFID system is proposed in section III. Problems occurred in the RFID system is proposed in section IV and using above concepts prototype can be implemented successfully.

II. COMPONENTS AND ARCHITECTURE OF A RFID SYSTEM

RFID system mainly consists three components. Those are tags, readers and antennas and middleware software.

Tags: Tags are the heart of an RFID system, because they store the information that describes the object being tracked. Specific object information is stored in the memory of tags and is accessed via the radio signal of rfid readers

Data is transferred between a tag and a reader via low-power radio waves which are tuned to the same frequency. To obtain information from a tag, at transceiver must send a signal to the RFID tag, causing the tag to transmit its information to the transceiver. The transceiver then reads the signal, converts it to a digital format, and transmits it to a designated application such as an inventory management system.

Tags may be active or passive and read-only, write-once, or read-write. Below is a description of each:

- ❖ Active tags have a battery, which runs the microchip's circuitry and enables the tags to send a stronger signal to the reader, and have a read range of approximately 100 feet.
- ❖ Passive tags have no battery. Instead, they draw power from a reader, which sends electromagnetic waves that induce a current in the tag's antenna and powers the microchip's circuits. The chip then modulates the waves the tag sends back to the reader. Passive tags have a read range of approximately 30 feet.
- ❖ Read-only tags contain data, such as a serialized tracking numbers, which are pre-written onto them by the tag manufacturer or distributor. Read-only tags are generally the least expensive, because they cannot have any additional information included as they move throughout the supply chain. Any updates to that information have to be maintained in the application software that tracks the stock unit's movement and activity.
- ❖ Write-once tags enable a user to write data to the tag one time during production or distribution. This information can be a serial number or other data, such as a lot or batch number.
- ❖ Full read-write tags allow new data to be written to the tag as needed and written over the original data.

Readers and Antennas: RFID readers are devices that convert radio waves from RFID tags into a form that can be passed to middleware software. An RFID tag reader uses antennas to communicate with the RFID chip. Reader requirements vary depending on the type of task and application, and almost all applications will require multiple forms of readers to make a successful system.

There are a variety of different reading systems and technologies. These include:

- ❖ Handheld readers that act like a handheld bar code scanner.
- ❖ RFID readers embedded into mobile data collection devices
- ❖ Fixed readers, which are mounted to read tags automatically as items pass by or near them

Middleware: Both middleware and software applications are required in an RFID environment. A major issue for companies seeking to implement an RFID solution is the lack of sufficient middleware to link RFID systems and enterprise applications. Middleware software or applications are needed to manage the flow of data from readers and send the data to back-end management systems. RFID middleware assist with the following:

- ❖ Retrieving data from readers.
- ❖ Filtering data feeds to application software.
- ❖ Generating inventory movement notifications.
- ❖ Monitoring tag and reader network performance.
- ❖ Capturing history.
- ❖ Analyzing tag-read events for application tuning and optimization

An RFID tag is composed of an antenna, a wireless transducer and an encapsulating material. These tags can be either active or passive. While the active tags have on-chip power, passive tags use the power induced by the magnetic field of the RFID reader. Thus passive tags are cheaper but with lower range (<10mts) and more sensitive to regulatory and environmental constraints, as compared to active tags.

An RFID reader consists of an antenna, transceiver and decoder, which sends periodic signals to inquire about any tag in vicinity. On receiving any signal from a tag it passes on that information to the data processor.

The data processing subsystem provides the means of processing and storing the data

Architecture of a RFID system is shown in fig.1

III.FREQUENCY RANGES USED FOR RFID SYSTEM

Radio-frequency (RF) signals are typically sinusoidal or nearly so - that is, the voltage or field is a smooth, periodic function of time. The number of times the signal repeats itself per second, the frequency, varies widely in differing RFID systems [5]. Frequency is measured in Hertz(Hz).

The figure.2 shows some of the common and less-common frequency bands in which RFID systems operate. Also shown is the corresponding ***wavelength*** - the distance between points at which the field has a fixed value when the signal moves at the velocity of light.

Several issues are involved in choosing a frequency of operation. The most fundamental, as indicated in the diagram, is whether ***inductive*** or ***radiative*** coupling will be employed. The distinction is closely related to the side of the antennas to be used relative to the wavelength. When the antennas are very small compared to the wavelength, the effects of the currents flowing in the antenna cancel when viewed from a great distance, so there is no radiation. Only objects so close to the antenna that one part of the antenna appears significantly closer than another part can feel the presence of the current. Thus, these systems, which are known as inductively-coupled systems, are limited to short ranges comparable to the size of the antenna. In practice, inductive RFID systems usually use antenna sizes from a few cm to a meter or so, and frequencies of 125/134 KHz (***LF***) or 13.56 MHz (***HF***). Thus the wavelength (respectively about 2000 or 20 meters) is much longer than the antenna. Radio active systems use antennas comparable in size to the wavelength. The very common 900 MHz range has wavelengths around 33 cm. Reader antennas vary in size from around 10 to >30 cm and tags are typically 10-18 cm long. These systems use radiative coupling, and are not

Volume: 02, Issue: 06, Pages: 923-926 (2011)

limited by reader antenna size but by signal propagation issues.

Finally, changes in operating frequency affect the propagation characteristics of the resulting radiated fields. Lower frequencies diffract more readily around obstacles, but couple less well to small antennas. Radiated fields are absorbed by many common materials in buildings and the environment, particularly those containing water. The degree of absorption due to water increases gradually with increasing frequency. Tags immersed in water-containing materials (i.e. injected into or swallowed by animals or people) must use very low frequencies to minimize absorption: this is a typical 125 KHz application. For locating large objects or people outdoors, a relatively low frequency (e.g. 433 MHz) may be desirable to avoid obstacle blockage; when a clear line of sight from the antenna to the tag can be assured, a higher frequency may be useful to reduce the size of the antennas.

Various frequency ranges are shown in table.1

IV.PROBLEMS OCCURRED IN THE RFID SYSTEMS AND THEIR SOLUTION

Main problem occurs in the RFID system is Tag collision. In this problem, two or more than two tags deliver their unique identification (UID) to the reader. Since collision, which would significantly affect the efficacy of RFID, has been one of the major study issues for RFID technology, we have developed a solution, bit competed algorithm (BCA), to solve the collision problem occurred in RFID system and consequently improve the efficacy of RFID. While receiving the UIDs, our reader will identify the tags through Boolean OR operation for bit-by-bit priority competition. The massive computer simulation results and the comparison with other algorithms for collision prevention proved our solution can effectively solve the collision problem and improve the efficiency of RFID system [6],[7].

There are two types of collision in RFID, tag Collision and reader Collision, which were described in Figure 3.

Tag collision is occurred when more than one tag was responding the message to the same reader at the same time and causing tags competition, as in Figure 3(a).

Reader collision is occurred when more than one reader in a certain area delivered the request message to the same tag, as in Figure 3(b).

Bit Competed Algorithm: To solve the collision problem through decrease collision occurrence and consequently improve the system efficacy. BCA is working through the Boolean OR operation in reader to prioritize the UIDs according to the results of bit-by-bit priority competition [8]. The reader would periodically broadcast Request Null message to all the tags, and all the tags would deliver their UIDs at the same time. Collision occurred when the tag response is more than 1; then the reader would go through Boolean OR operation of UIDs bit-by-bit, from the highest bit to the lowest bit, to identify the UID with the highest priority.

The procedure of Boolean OR operation is described as follows. Reader would analysis the bit values of all UIDs received, if the Boolean OR algorithm result is 1, all the tags with bit value 0 would give up the competition and only tags with bit value 1 would remain for next bit competition. If the algorithm result is 0, the reader would precede the next bit competition. This bit-by-bit competition would identify only one tag finally. Taking a 3-bits UID tag as an example, the reader would precede the Boolean OR algorithm in the sequence of bit 2, bit 1, and bit 0, from the highest bit to the lowest bit. Our BCA algorithm, using Boolean OR operation bit-by-bit, would effectively decrease the collisions and requests-responses between reader and tag. The procedure of BCA is as Follows

Step 1. The reader periodically sends Request Null message to the tags in the effective range and waiting for the tags' response.

Step 2. Is there a tag collision? If a tag collision occurs, go to step 3; otherwise, go to step 6.

Step 3. Boolean OR ed the highest UID bit of all competed tags.

Step 4. If the value of Boolean OR ed operation equal to 0, go to step 5. If the Boolean OR ed value equal to 1, all tags with the competing bit equal to 0 will stop to compete and waiting for a new request message. If the number of tag with the competing bit value 1 greater than 1, go to step 5; otherwise, go to step 6.

Step 5. Boolean OR ed the next UID bit of all competed tags, go to step 4.

Step 6. Tag identification succeeded.

Objectives: 1.The main objective is to track the object information continuously.

2. To design hard ware and software systems.

3. To enable that object can be protected for external entities and object can monitor continuously.

To test the hard ware and software system as a prototype for hospital management system for various stakeholders to achieve the above objectives successfully

V.FIGURES AND TABLES

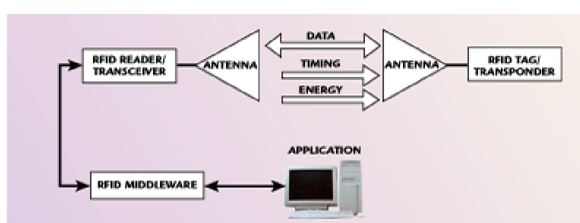

Fig.1 Achitecture of a RFID system

RFID system Architecture mainly consists three components. Those are tags, readers and antennas and middleware software.

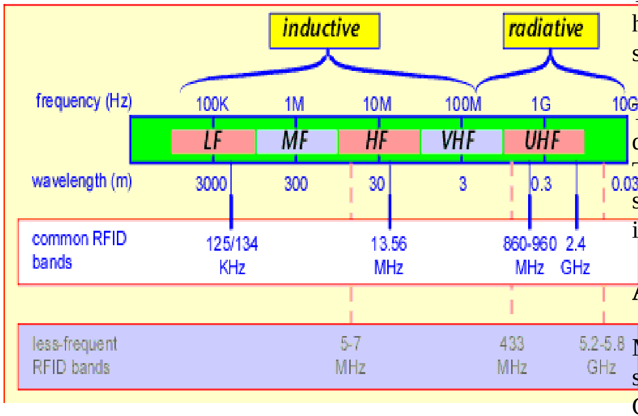

Fig.2 frequency bands in which RFID systems operate

This Diagram represents the various frequency levels used in the RFID system

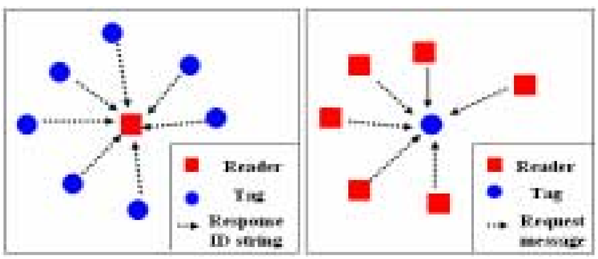

Fig. 3 RFID Collision: (a) Tag Collision (b) Reader Collision

There Exists a two types of collisions in the RFID system and those are diagrammatically represented in the above figures.

Band	Unlicensd Frequency	Wave length	Classical Use
LF	**125–134.2KHz**	**2,400 meters**	**Animal tagging and keyless**
HF	**13.56MHz**	**22 meters**	**entry**
UHF	**865.5-867.6MHz(Europe)915MHZ (U.S.)**	**32.8 cm**	**Smart cards, logistics and item management**
ISM	**2.4GHz**	**12.5 cm**	**Item management**

Table-1: Frequency ranges used for RFID-systems

VI. Conclusion

To evaluate the system for implementing applications like hospital management system and student information system by using RFID technology.

To design the system for achieve the above objective by designing the hardware system and software system.

To design the system the developed database is more secured and user friendly. Further the system can be implemented for real time problems

ACKNOWLEDGEMENTS

My sincere thanks to my gurus Dr. M.J. Rao Director delta studies A.U, waltair and Dr. P.Premchand Professor in Computer Science and engineering, O.U, Hyderabad for their valuable guidance in this regard.

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