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MICROCONTROLLER AND RFID BASED LIBRARY CATALOG SYSTEM

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ABSTRACT

This paper is based on Radio frequency technology and microcontroller. The book catalog is maintained constantly by updating it, list is updated whenever a user takes book from the library or returns the same. The availability and non-availability can easily be checked by scrolling the list of books using the touch screen pad. Required book can be selected from the list. Book will be present in the library only if it is in the list. If it is not in the list, it has already been issued. This system would be able to issue and return books via RFID tag. This system makes it easy to know that book is available or not.

INTRODUCTION

Radio-frequency identification (RFID) is an automatic identification method, which can store and remotely retrieve data using devices called RFID tags. [1]The technology requires cooperation of RFID reader and RFID tag. The RFID based LMS facilitates the fast issuing and returning of books with the help of RFID enabled modules. It directly provides the book information and library member information to the library management system and does not need the manual typing. This technology has slowly begun to replace the traditional barcodes [8] on library items and has advantages as well as disadvantages over existing barcodes [2].The RFID tag can contain identifying information, such as a book's title or code, without having to be pointed to a separate database. The information is read by a RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk. For which utmost care has been taken to remove manual book keeping of records, reduce time consumption as line of sight and manual interaction are not needed for RFID-tag reading and improve utilization of resources like manpower, infrastructure etc.

ABOUT RFID TECHNOLOGY

The concept [1][2][3] of RFID can be viewed as an extension to electronic barcode[8], which can be used to identify, track, or detect holdings in the daily maintenance of library. Radio frequency holdings in the daily maintenance of library. Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of co-operation of an RFID reader and an RFID tag. An RFID tag is an

object that can be applied to a product or person for the purpose of identification and tracking using radio waves sight of the reader [10].

A basic RFID system consists of three components:

1. An antenna or coil
2. A transceiver (with decoder)
3. A transponder (RF tag)

Electronically programmed with unique information. There are many different types of RFID system and they are categorized according to their frequency ranges. Some of the most commonly used RFID kits are as follows:

1. Low-frequency (30 KHz to 500 KHz)
2. Mid-Frequency (900 KHz to 1500MHz)
3. High Frequency (2.4GHz to 2.5GHz)

These frequency ranges mostly tell the RF ranges of the tags from low frequency tag ranging from 3m to 5m, mid frequency
ranging from 5m to 17m and high frequency
ranging from 5ft to 90ft. RFID have following components.

1. An antenna or coil
2. A transceiver (with decoder)
3. A transponder (RF tag) electronically programmed with unique information.

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. Often the antenna is packaged with the transceiver and decoder to become a reader, 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. 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

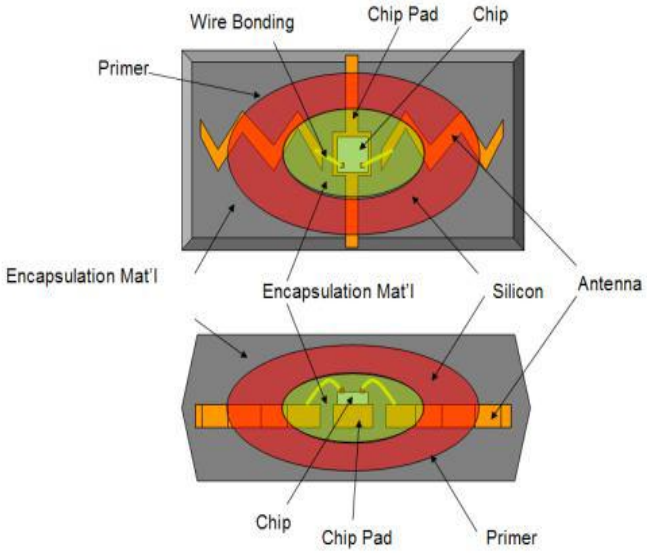
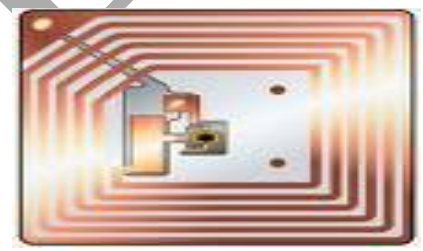


Fig.: Working of Antenna[12]

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. Tags come in a variety of types, with a variety of capabilities. Key variables include **"Read-only" versus "read-write"**. There are three options in terms of how data can been coded on tags: (1) Read-only tags contain data such as a serialized tracking number, which is pre-written onto them by the tag manufacturer or distributor. These are generally the least expensive tags because they cannot have any additional information. (2) "Write once" tags enable a user to write data to the tag one time in production or distribution processes. Again, this may include a serial number, but perhaps other data such as a lot or batch number. (3) Full "read-write" tags allow new data to be written to the tag as needed and even written over the original data. While these are the most costly of the three tag types and are not practical for tracking inexpensive items, future standards for electronic product codes (EPC) appear to be headed in this direction.



RFID Tags.

DATA CAPACITY

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.

PASSIVE VERSUS ACTIVE

Passive tags have no battery and broadcast their data only when energized by a reader. That means they must be actively polled to send information. Active tags are capable of broadcasting their data using their

own battery power. In general, this means that the read ranges are much greater for active tags than they are for passive tags, perhaps a read range of 100 feet or more, versus 15 feet or less for most passive tags. The extra capability and read ranges of active tags, however, come with a cost; they are several times more expensive than passive tags.

FREQUENCIES

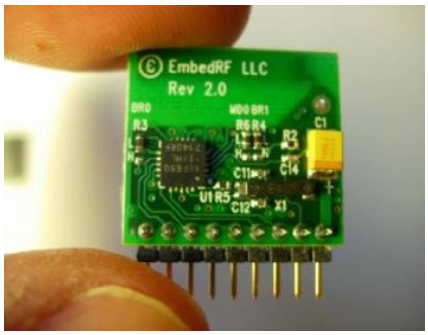
Like all wireless communications, there are a variety of frequencies or spectra through which RFID tags can communicate with readers. Again, there are trade-offs among cost, performance and application requirements. For instance, low-frequency tags are cheaper than ultra-high frequency (UHF) tags, use less power and are better able to penetrate non-metallic substances. They are ideal for scanning objects with high water content, such as fruit, at close range. UHF frequencies typically offer better range and can transfer data faster. But they use more power and are less likely to pass through some materials.

EPC Tags

EPC (electronic product code) refers to an emerging specification for RFID tags, readers and business applications first developed at the Auto-ID Center at the MIT. This organization has provided significant intellectual leadership toward the use and application of RFID technology. EPC represents a specific approach to item identification, including an emerging standard for the tags themselves, including both the data content of the tag and open wireless communication protocols. In a sense, the EPC movement is combining the data standards embodied in certain bar code specifications, such as the UPC or UCC-128 bar code standards, with the wireless data communication standards that have been developed by ANSI and other groups.

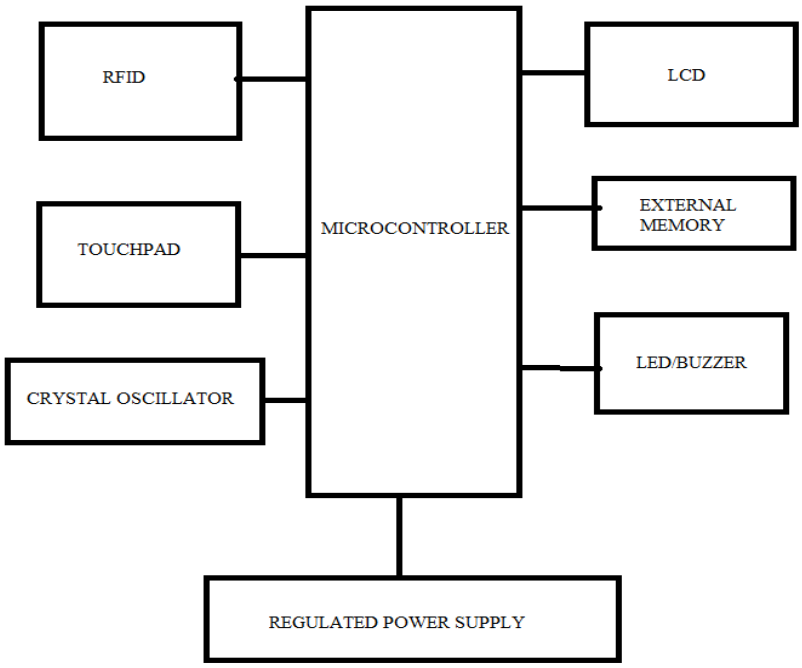
RF TRANSCEIVER

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 transceivers commonly referred to as an RF module.[5] The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive FID tag.



RF transceiver

PROPOSED WORK



OPERATING PRINCIPLE

Inductive Coupling: Inductive Coupling is the transfer of energy from one circuit to another through a shared magnetic field which is produced due to mutual inductance between two circuits. In RFID systems based on inductive coupling, the reader antenna and the tag antenna each consists of a coil. An electric current passing through the coil of reader's antenna generates a magnetic field that induces an electric current in the coil present in the tag which is exposed to that field. Inductively coupled tags are said to be operated passively because all the energy required to activate the tag is provided by the reader. Tag does not contain any source for power supply to activate itself. When the tag is in the close proximity of the reader, the magnetic field emitted by the reader penetrates the coil of the tag. The tag then takes energy from this filed. By mutual inductance between the tag and the reader, a voltage is generated in the tag's coil. This voltage serves as the power supply for the microchip carrying the data which is present inside the tag. This voltage is used by the microchip to change the electrical load on the tag antenna. These changes are recorded by the reader antenna and are converted into a unique serial number. This data is stored in the reader's log file as the data read from the tag. Server connected to the reader then takes up this data for processing through Library Automation System. Electromagnetic Field Generated Between Tags and Reader is referred as the inductive coupling [4].

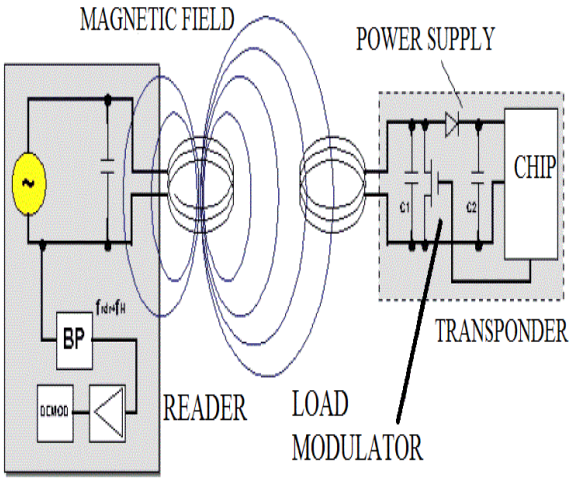


Figure: Inductive Coupling: Electromagnetic Field Generated Between Tags and Reader[12]

A capacitor is connected in parallel with the reader's antenna coil. The capacitor has capacitance such that it is compatible with the coil inductance of the antenna coil to form a parallel resonant circuit, with a resonant frequency that corresponds with the transmission frequency of the reader [11]. The resonance step-up in the parallel resonant circuit generates high current in the antenna coil of the reader, which can be used to generate the required magnetic field to activate the remote tag. The antenna coil of the tag and the capacitor C1 to form a resonant circuit tuned to the transmission frequency of the reader. The voltage U in the tag coil reaches a maximum due to resonance step-up in the parallel resonant circuit. The efficiency of power transfer between the antenna coil of the reader and tag is proportional to the operating frequency f, the number of windings n, the area A enclosed by the transponder coil, the angle of the two coils relative to each other and the distance between the two coils. Generally, the operating frequencies up to 135 KHz are used. As frequency f increases, the required coil inductance of the tag coil, and thus the number of windings n decreases. Because the voltage induced in the tag is still proportional to frequency f, the reduced number of windings barely affects the efficiency of power transfer at higher frequencies.

METHODOLOGY

The process involved is divided into a total of three steps.

Step 1: Initialization of library system using RFID
The system will be initialized only when RFID card comes in contact with the reader and then user can choose from available options (issue or return).

Step 2: Desired operation
If user wishes to issue the book then he is supposed to select the book from available list by scrolling up and down using touchpad. Similarly return option can be selected.

Step 3: Updating the list
Name of the book will be removed or added to the list on selection of issue or return options respectively.

CONCLUSION

Radio Frequency Identification (RFID) Systems have been in use in libraries for book identification, for self-checkout, and for the sorting and conveying of library books. These applications can lead to significant savings in labor costs, enhance customer service and provide a constant record update of new collections of books. It also speeds up book borrowing, returning and monitoring, and thus frees staff from doing manual work so that they could be used to enhance user-services task. The efficiency of the system depends upon the information to be written in tag.

In future security system can be added to this book catalog system, and identity of the person issuing the book can be stored using a computer.

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