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RADIO FREQUENCY IDENTIFICATION BASED LIBRARY MANAGEMENT SYSTEM

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ABSTRACT

Radio frequency identification (RFID) is a rapidly emerging technology which allows productivity and convenience. Radio Frequency Identification (RFID) is a new generation of Auto Identification and Data collection technology which helps to automate business processes and allows identification of large number of tagged objects like books, using radio waves. This paper proposes RFID Based Library Management System that would allow fast Transaction flow and will make it easy to handle the issue and return of books from the library without much intervention of manual book keeping which benefits by adding properties of traceability and security. The proposed system is based on RFID readers and passive RFID tags that are able to electronically store information that can be read with the help of the RFID reader. This system would be able to issue and return books via RFID tags and also calculates the corresponding fine associated with the time period of the absence of the book from the library database.

KEYWORDS—radio frequency identification (RFID), RFID tags, RFID reader, microcontroller, GSM.

INTRODUCTION

Radio-Frequency Identification (RFID) devices have importance in our daily life and they will become appearing in the near future. There is a tremendous growth in the industry to use RFID technology in the recent years. Research and development in this field has made this technology to be used in supply chain management, attendance management, library management, automated toll collection etc. RFID is an electronic technology whereby digital data encoded in an RFID tag is retrieved utilizing a reader. In contrast to bar code technology, RFID systems do not require line-of-sight access to the tag in order to retrieve the tag's data. Passive RFID is sure to replace bar codes in library applications. The bar-code system used in libraries is very time consuming and labor-intensive. The RFID based LMS facilitates the fast issuing, reissuing 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. The RFID tag can contain identifying information which is unique, such as a book's title or code, without having to be pointed to a separate database. The information is read by an RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk. One step is to decide on which kind of RFID reader and tag is used for library automation. The importance of reader are what kind of tag it reads, its operating frequency, capability of near reading, writing inside the tag ,connection type with computer 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 thereader.Further; tags which are located in book are binding with the specific Id. In modern passive RFID devices; the tag consists of a small integrated circuit 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 canbe read even from the card. In practical applications of using RFID technology, a tag is attached to an object used to identify the target, when the target object pass through the area that the reader can read, the tag and the reader builds up the radio signal connections,the tag sends its information to the reader, such as unique code and

other data stored on, the reader receives those information and decodes them, and then sends to a host computer so as to complete the whole information processing.

SYSTEM DESIGN

A.CONCEPT

Each book would be uniquely identified via the RFID tags attached to it and communication would be done wirelessly. An RFID sensor would be placed near the library desk wherein one should only place the book near the sensor and it would get reissued/issued/returned depending on the actions required. Moreover information regarding the asset i.e. Book can be gained by both the authority and students remotely instead of the traditional way of manually searching the book. This would save a lot of time and enable efficient queue management. As actions on these tagged assets are being recorded, data can be usefully exploited as per librarian's need. Hence, it is tracking books within a limited transmission range.

B. COMPONENTS

The system consists of following components:

RFID READER: It communicates with the tags through an RF channel to obtain identifying information. Depending on the type of tag, this communication may be a simple ping or maybe a more complex multi-round protocol. In environments with many tags, a reader may have to perform an anti-collision protocol to ensure that communication conflicts don't occur. Anti-collision protocols permit readers to rapidly communicate with many tags in serial order.

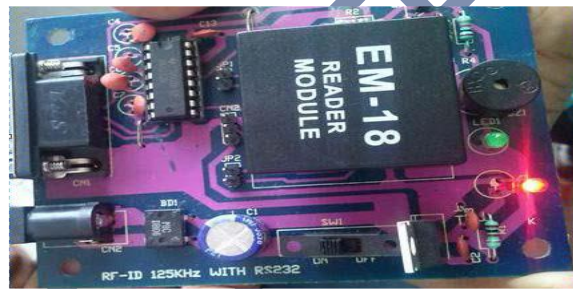


Figure 1: RFID Reader

RFID TAGS: These are the tags that have a magnetic coil within them and are used to generate radiofrequency waves. They are passive in nature i.e. they can be read up to a small distance of 10-15 cm, so the system is static. A passive tag is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. The tag is typically much less expensive to manufacture. All tags have unique identification number (15 characters long) which is quite useful and these tags can be re-used. One set of library tags are attached within the Library cards of the books and details of books can be accessed and actions like Issue/Re-Issue can be done in the library interface after the tags are scanned. Other set of tags are used as Library identity cards of student to get the details of the student.



Figure 2: RFID Tags

ANTENNA: The antenna resides inside the reader. It generates electromagnetic field. Whenever a tag comes in close proximity of the electromagnetic field it gets activated and it is able to read and write data to the reader by producing radio signals. Antenna behaves like a communication media between the tag and the reader.

SERVER: Server is a computer that contains a database where information related to book's issue and return are stored and this information can be retrieved when needed. Server connected to the reader via a cable. It receives information from the readers when the tag is brought in close proximity of the reader.

C. OPERATING PRINCIPLE

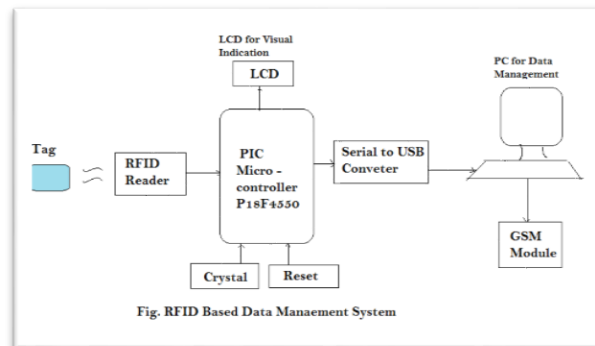


Figure 3: Block diagram

DESCRIPTION

The main objective of this system is to design a system for efficient library management. We are designing this system using radio frequency identification technology. The RFID tag would be with all the students and books. Whenever student enters the library, he will be given access by this system. All information regarding this student will be stored in this system. RFID tags will be given to each and every student and information for each tag will be stored in microcontroller. When tag given to student swiped, information of particular student will be displayed on LCD and PC through HyperTerminal. The information may contain roll number; class etc. RFID stands for Radio-Frequency Identification. This is sometimes referred to as contact-less technology and a typical RFID system is made up of three components: tags, readers and the host computer system. Also RFID tags will be attached with every book and after swapping this book it will be assigned to that student. The sequence of swapping will be like this: First the student will have to swap the card and then the student should have to swipe the book. Also GSM is attached to this system for sending as SMS to student in case if student is not returning book after due date. Message will be generated by PC automatically to which GSM module is attached.

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 field. 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.

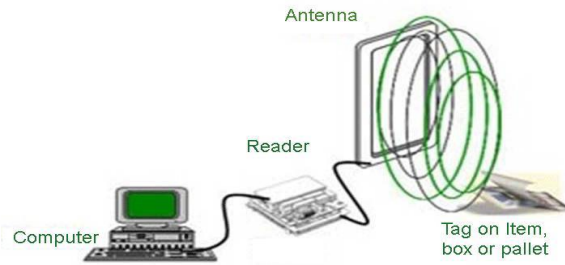


Figure 4. Inductive Coupling: Electromagnetic Field Generated Between Tags and Reader.

The efficiency of power transfer between the antenna coil of the reader and the 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 five modules that are described as follows [3]:

A. MODULE 1 THE INITIAL SETUP

Whenever a new book is acquired by the library, an RFID tag is attached into the book with the relevant information like, call number, accession number, book number, etc. The detailed information regarding the book is also captured in the computer database. The computer database also stores all information for individual users (patrons) of the library. Each patron is supplied with registered RFID cards. These cards carry identification data and other associated details like: address, roll no., and telephone no. etc for each patron.

B. MODULE 2 THE LOGIN PROCESS

There is an administrator with special privileges who has a unique master password controlling the GUI of the RFID LMS system. As soon as he powers on the system, the first screen displays the LOGIN dialogue box. The admin then enters the corresponding password and enables the system for further usage [5].

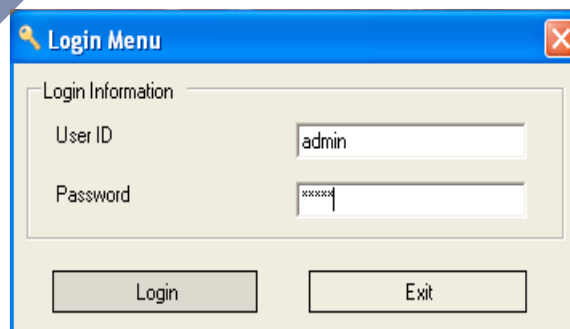


Figure 5. Login Page for Administrator

C. MODULE 3 THE ISSUE PROCESS

When a patron needs to get a book issued, he can get it done without any manual intervention. He simply flashes RFID card in front of the RFID reader and it automatically opens his/her login account page. He then flashes the selected books to be issued, one by one in front of the RFID reader. The computer records all these data against his name. Finally a message is displayed informing the patron that the ISSUE has been successful [9]. The user takes the books for a specified time from the library after which he has to return the books to the library.

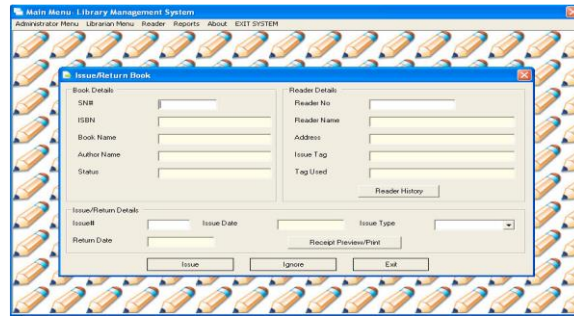


Figure 6. Issue of Books

D. MODULE 4 THE RETURN PROCESS

When a patron wants to return books, he simply places the books again in front of the RFID controller and the books automatically are adjusted for return against the patron's name[9].



Figure 7. Return of Book

E. MODULE 5 FINE CALCULATION

When a patron wants to return books, he simply places the books again in front of the RFID controller and the books automatically are adjusted for return against the patron's name. For this the patron during the time of returning the book, clicks or activates the fine calculation button on the display area or GUI panel. The same returns the fine.

CONCLUSION

Radio Frequency Identification (RFID) Systems have been in use in libraries for book identification, for self checkout, for anti-theft control, for inventory control, and for the sorting and conveying of library books. These applications can lead to significant savings in labor costs, enhance customer service, lower book theft 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. To yield best performance, RFID readers and RFID tags to be used must be of good quality.

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