

Smart Library

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Abstract: This paper presents the idea about radio frequency identification (RFID) technology in library automation. The use of RFID technology is a major factor to create a move towards self service operations and other aspects of improving efficiency in library. The drawbacks of current library automation and the need for new design principles that take advantage of technology such as RFID. The goal of this paper is to find out whether RFID render any significant benefits to library management and how these benefits reflect to customer satisfaction. In this paper we are using the RFID technology for identifying the books and persons based on unique Tag number and Microcontroller which is 89s52 architecture will process the data and sends it to a personal computer side data base in which the data base will be maintained about the person. The GSM sim300 is then interfaced to the personal computer that keeps track of the return date of the books and sends a reminder to the patron.

Keywords: RFID, Smart Library.

1. INTRODUCTION

Radio-Frequency Identification (RFID) devices have an important presence in our daily life and they will become appearing in the near future. RFID technology is being implemented in a number of industries. Supply chain implementation is perhaps one of the most frequently mentioned applications of RFID tags and equipment.

The bar-code system used in libraries is very time consuming and labor intensive. In the opposite, the RFID system provides a solution to effectively collect, manage, and distribute items.

The RFID tag does not have to be visible for detection. It can be read even when it is embedded in an item, such as in the cardboard cover of a book or in the packaging of a product. It can also store data such as stack number, accession number, book number, author information etc. but barcode is limited to just an identification number. . RFID significantly reduces the efforts involved in management of records.

The Electronic product code (EPC) is read by Radio frequency technology regardless of item orientation or alignment. The web based software recognizes the unique id and then grants access to one's account. Every individual can check the availability, issue and return the book using his card. RFID tag will also be attached to each and every book to prevent book theft. RFID reader will be placed in the circulation counter, entrance of library and reference section reading table. In this paper we mention about the use of passive rfid tags. 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 can be 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.

2. RFID IN LIBRARY

A library is a collection of information, sources, resources, books, and services, and the structure in which it is housed. Apart from books many libraries are now also repositories and access points for maps, prints, or other documents on various storage media such as microformes (microfilm/microfiche), audio tapes, CDs, LPs, cassettes, vidéo tapes, and DVDs. Libraries have materials arranged in a specified order according to a library classification system, so that items may be located quickly and collections may be browsed efficiently. Reference stacks are different which has only reference books and only selected members.

The following are the tasks to be performed in the library.

1. Circulation: handling user accounts and issuing/returning and shelving of materials.
2. Collection, development, order materials, maintain materials' budgets.
3. Technical Services work behind the scenes cataloguing and processing new materials and de-accessioning weeded materials.

Utmost care has been taken to provide following features to the Library using RFID technology: To remove manual book keeping of records, traceability of books and library members as they move, less time consumption as line of sight and manual interaction are not needed for RFID-tag reading, to provide 2 meters read range antennas, to minimize the manual intervention, to minimize the manual errors, to provide the long lasting labels and to provide fast searching of books.

III. METHODOLOGY

RFID is a sensor-based technology consisting of three key elements: RFID tags (transponders), RFID readers. (transceivers), and a data collection, distribution, and management system (middleware) that has the ability to identify or scan information with increased speed and accuracy.



Fig.1 Smart Library

RFID technology is involved in various modules in libraries. Such as Tagging station to tag the RFID label to each library material; patrons self-check-out station to borrow the books using the self service; book drop station is used to return the books; and anti-theft security gates ensure the items are checked-out before leaving the library by detecting if the RFID label that are attached in the item is activated; and finally as to the self-management, for example patrons can track the searching items that were miss-shelved by the use of RFID handheld reader.

The main library adopts RFID technology aim of improving the self service. Patrons can borrow and return the items using automatic lending machines, which require a library card and a PIN. Self-service becomes much easier with this new technology as it does not require line of sight. Aim of this paper is implementing new generation of Library Management system. A simple diagram of this implementation can be show as below:

The Patron Self Check-in station is basically a display with a keypad and a built-in RFID reader, plus special software for personal identification, book and other media handling and circulation. After identifying the patron with a library ID

card, a RFID card, or his personal ID number (PIN), the patron is asked to choose the next action (check-in of one or several books).

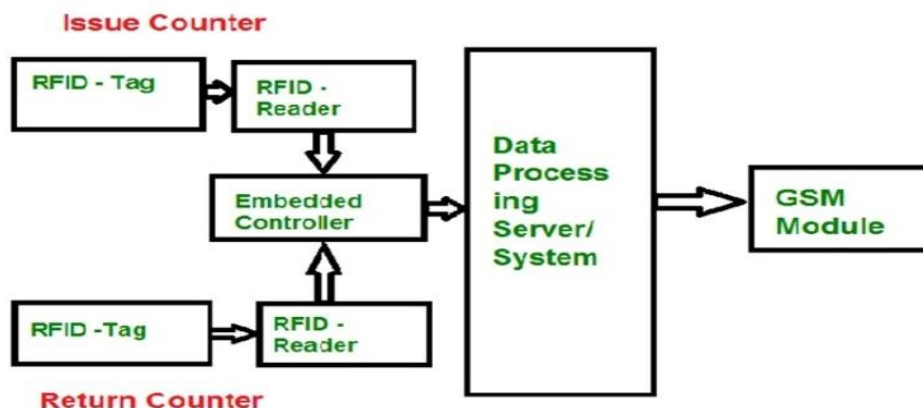


Fig.2 Block Diagram

After choosing check-in , the patron puts the books in front of the screen on the RFID reader and the display will show the book title and its ID number (other optional information can be shown if desired).Then patron chooses return and then puts one book or a stack of books onto the reader. Patron will receive a confirmation. This flow is illustrated by Fig.3.

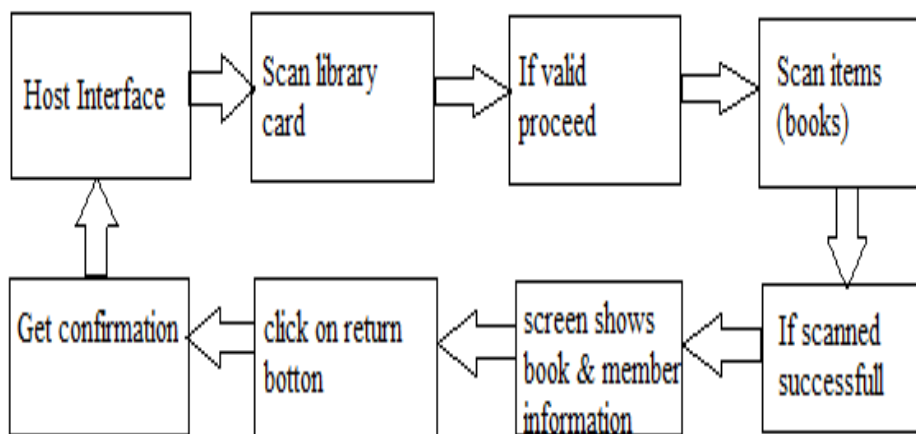


Fig.3 Flow diagram of System

The additional feature of our project that is presented in this paper is the GSM (Global System for Mobile) which keeps a track of the return date and when due reminds the patron to return the book.

In the background of the working hardware is a strong software that is programmed to maintain a database of all the patrons using vb.net language in visual studio. The software so designed takes in the entry of the new patrons by creating a database in MS-Access, updates it as per the books issued and returned and also maintains a counter internally that reminds the system about the patron's return date and simultaneously sends a message to the GSM Sim300 module.

The overall system is designed to be Smart thus reducing the efforts of manual intervention to a great extent.

1) Microcontroller:

We know that there so many types of micro controller families. Those are 8051,AVR microcontroller, PIC microcontroller, ARM.

We are choosing 89s52 because it is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. It is compatible with the industry-standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

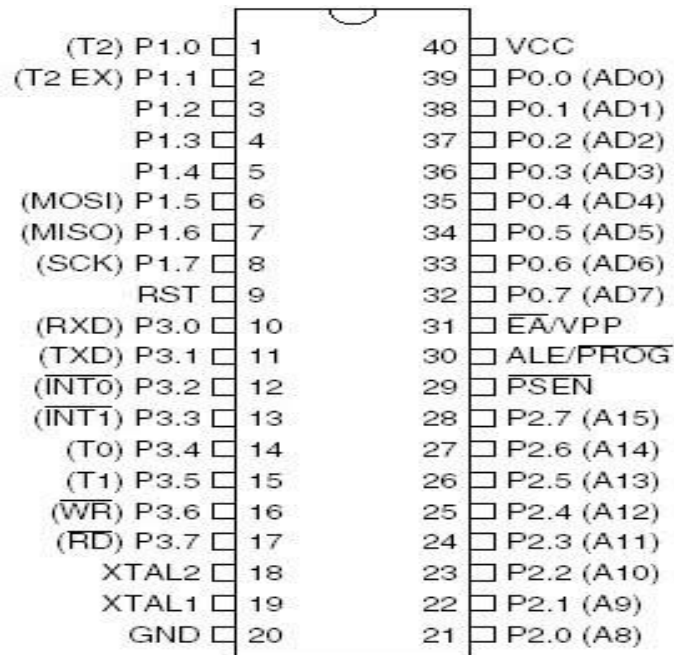


Fig.4 Microcontroller 89s52

2) RFID Reader:

Readers come in many forms, operate on different frequencies, and may offer a wide range of functionality. Readers may have their own processing power and internal storage, and may offer network connectivity .



Fig.5 RFID Reader

They are electronically programmed with unique information. There are many different types of RFID systems out in the market. 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, which is the one that we have chosen.

3) LCD:

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. LCD (liquid crystal display) projectors usually contain three separate LCD glass panels, one each for the red, green, and blue components of the video signal being fed into the projector. As light passes through the LCD panels,

individual pixels ("picture elements") can be opened to allow light to pass or closed to block the light, as if each little pixel were fitted with a Venetian blind.

This activity modulates the light and produces the image that is projected onto the screen. We decided to use LCD because of following reasons.

1. The decreasing prices of LCD's.
2. The ability to display numbers, characters and graphics. LCD displays two lines, 20 characters per line, which is interfaced to the microcontroller.
3. Simplicity of programming for characters and graphics.



Fig:6 LCD Display

4) GSM:

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

In our project we have programmed the GSM SIM300 using the hyper terminal Putty software and given commands that are interfaced via the personal computer.



Fig.7 Core Sim300 GSM modem With Antenna

5) RFID Tags:

A RFID tag is shown in figure .The antenna is clearly visible. The antenna has the largest impact of the size of the tag. The microchip is visible in the center of the tag, and since this is a passive tag it does not have an internal power source .RFID Tags are attached to books and student identity card. Radio Frequency (RF) tags or transponders transmit the data to a reader . Tag readers interrogate tags for their contents by broadcasting an RF signal. Tags respond by transmitting back resident data, typically including a unique serial number. RFID tags store some sort of identification number .A reader retrieves information about the ID number from a database, and acts upon it accordingly. RFID

tags can also contain writable memory, which can store information for transfer to various RFID readers in different locations.

This information can track the movement of the tagged item, making that information available to each reader. RFID tags fall into two general categories, active and passive, depending on their source of electrical power. Active RFID tags contain their own power source, usually an on-board battery (2). Passive tags obtain power from the signal of an external reader

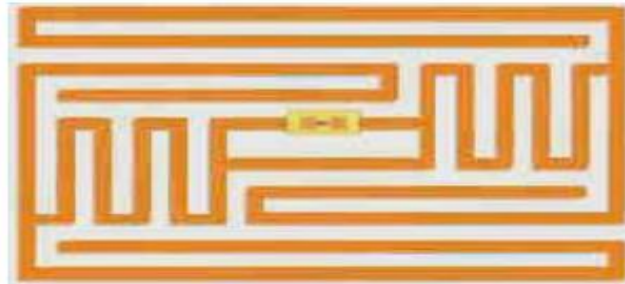


Fig.8 RFID Tag

6) Power Supply:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Here in our application we need a 5v DC power supply for all electronics involved in the project. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power.

Transformer consists of:

- A primary coil or winding.
- A secondary coil or winding.
- A core that supports the coils or windings.

Refer to the transformer circuit in figure as you read the following explanation: The primary winding is connected to a 60-hertz ac voltage source. The magnetic field (flux) builds up (expands) and collapses (contracts) about the primary winding. The expanding and contracting magnetic field around the primary winding cuts the secondary winding and induces an alternating voltage into the winding. This voltage causes alternating current to flow through the load. The voltage may be stepped up or down depending on the design of the primary and secondary windings.

7) Regulator IC (78XX)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current.

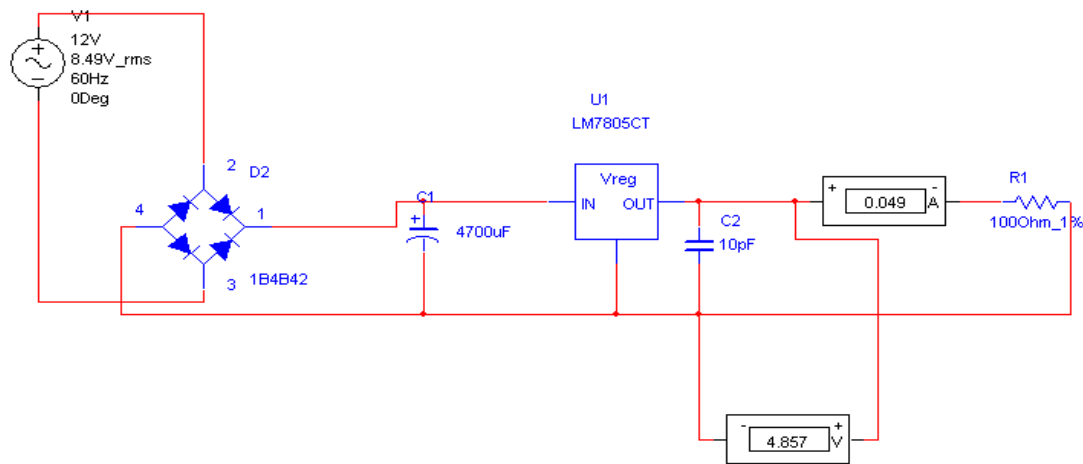


Figure 9. 78XX Regulator

8) The Capacitor Filter:

The simple capacitor filter is the most basic type of power supply filter.

CIRCUIT DIAGRAM OF POWER SUPPLY



IV. ADVANTAGES OF RFID IN LIBRARY

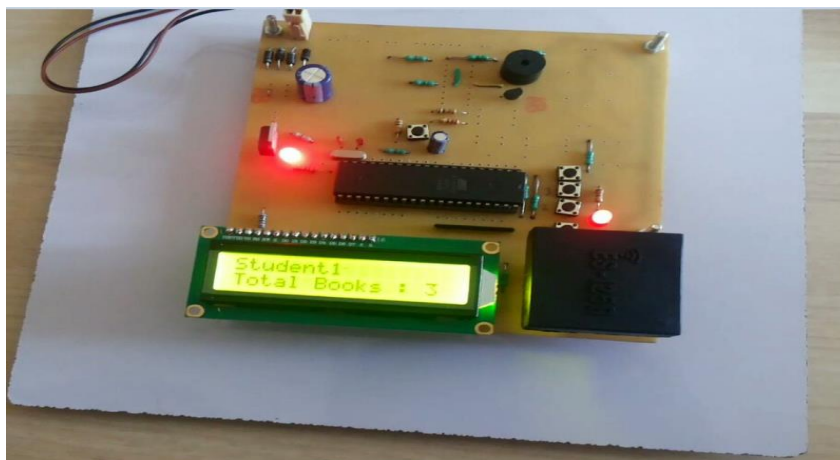
1. Rapid charging/discharging: The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.
2. Simplified patron self-charging/discharging: For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time. Patron self-discharging shifts that work from staff to patrons. Staff is relieved further when readers are installed in book drops.
3. High reliability: The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Were a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge.
4. High-speed inventorying: unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.
5. Automated materials handling: Another application of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for reshelving. Given the high cost of the equipment, this application has not been widely used.
6. Long tag life: Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.
7. Fast Track Circulation Operation: The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that 279several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.

V. DISADVANTAGES OF RFID IN LIBRARY

1. High cost: The major disadvantage of RFID technology is its cost.
2. Vulnerability to compromise: It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.
3. Removal of exposed tags: The RFID Tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books, however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

VI. RESULTS AND CONCLUSION

The system is successfully implemented where the assembled hardware is shown in the figure below.



This paper is intended to give overall view of RFID technology to library fraternity. The information has been gathered and compiled with our inputs for librarians to refer this paper as a base, when planning to go for a RFID solution without getting into technical jargons. It is an attempt to touch base with all the areas relating to use of RFID in Libraries in simple language.

The paper stands as a ready reference for librarians when they commence conversation with vendors for implementation of RFID in their libraries. It mainly focuses on low cost in order to be implemented in libraries all over India on a larger platform. The implementation of GSM module has brought about complete automation in the library management thus making it a Smart Library.

This future scope of this key technology can be combined with the working principle of IOT (internet of things), to bring about development at home and abroad, Its application in the library management, and prospects lies in development direction in the field of library management and promotion programs.

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