1.1. Library

A library is an organized collection of information resources made accessible to a defined community for reference or borrowing. A library's collection[1] can include books, periodicals, newspapers, manuscripts, films, maps, prints, documents, microform, CDs, cassettes, videotapes, DVDs, Blue-ray Discs, e-books, audio books, databases, and other formats. Library Management System supports the general requirement of the library like acquisition, cataloguing, circulation.

Library management system that offers many flexible and convenient features by allowing librarians and library users to maximize time and efficiency [2]. Library System gives the all detailed information about students, staff and books. It will track on the how many books available in library and books issued to the students and also popular book among the students. It will provide book lost in library.

1.2. Objectives of a library

Strategic planning and development of a library is guided mainly by the goals and objectives of the parent institution of which the library is a part. In any given adult education set-up [3], the following are objectives of the library along the following lines.

i) Facilitate access to information for knowledge, education, and learning.

ii) Support research activities and programs of the set-up by offering proactive information services
iii) Support outreach programs of the adult education set-up, designed to educate and inform adult user groups on social, economic and educational issues, problems, and opportunities of interest them.

iv) Offer proactive services for effective use of all types of library materials.

v) Store and preserve information of archival nature such as local traditions, customs, and locally generated process documentation reports; etc.

vi) Use library as the platform for social, economic, and cultural development of the target communities. Resources and in leading their human capital are known to give better performance

1.3. Management of Library

Library management involves functions such as planning, organizing, leading, and controlling. Planning is about systematically making decisions about the library goals. Organizing is about.

Assembling and coordinating human, financial, physical, informational, and other resources needed to achieve library goals. Leading is about functions that involve efforts on the part of the Librarian to stimulate high performance by employees, and controlling about monitoring various library operations and services. These four management functions are highly integrated, but libraries that excel in organizing material.

Step 1 : Defining library policies for collection development

Step 2 : Defining library authority and library advisory committee

Step 3 : Define procedures for library organization and administration

Step 4 : Defining library space, equipment and tools for library operations and services

Step 5 : Defining procedures for maintenance of library collections Let us discuss each step in a little more detail.
1.4. Types of Libraries

The general descriptions of the major types of libraries as well as other opportunities [4] to consider:

i) Academic libraries serve colleges and universities, their students, staff and faculty. Larger institutions may have several libraries on their campuses dedicated to serving particular schools such as law and science libraries. Many academic librarians become specialists in an area of knowledge and can have faculty status.

ii) Public libraries serve communities of all sizes and types, "from cradle to grave" as more than one public librarian has been heard to say. Public libraries often have departments that focus on areas of service, such as youth, teens and adults.

iii) School libraries are usually part of a school system, and serve students between Kindergarten and grade 12.

iv) Special libraries offer unique opportunities to work in a specialized environment of interest, such as corporations, hospitals, the military, museums, private businesses, and the government.

v) There are also other options to consider in pursuing a library career. These include library and information science instruction and research.

1.5. Library Classification

1.5.1. Definition: A library classification is a system of coding and organizing library materials (books, serials, audiovisual, computer files, maps, photographs, manuscripts, regalia, gramophone records, tape records, microfilm and so on) according to their subject. It provides formal access to documents in a library.

The emphasis is on usefulness so that the users can locate the document without complication. According to Margaret Mann, classification is "the arranging of things according to likeness and unlikeness. The first of these ordinal numbers is called the class
number of the book. The second ordinal numbers is called its book number. The class number and the book number together constitute the call number of the book.

The Dewey Decimal Classification (DDC) system is a general knowledge organization tool that is continuously revised to keep pace with the development of knowledge. It is the most widely used classification scheme in the world.

1.5.2. Different Schemes of Classification: To derive the particular class number different libraries use different classification schemes. All classification schemes can be categorized into three kinds—based on the language, based on the synthesis and based on arrangement. Let us discuss them in detail,

Based on the language library classification can be

i) **English-Speaking World:** In the English-speaking countries Dewey Decimal Classification (DDC), Library of Congress Classification (LC), Bliss Bibliographic Classification (BC), and Dickinson Classification are generally followed.

ii) **Non English Speaking World:** Non English speaking countries use Nippon Decimal Classification (NDC), Principesde Classement des Documents Musicaux (PCDM), Chinese Library Classification (CLC), Korean Decimal Classification (KDC), etc. Synthesis means combining codes from different lists to represent the different attributes of a work. Based on synthesis library classification may be Bibliographic Classification by Bliss, Colon Classification by Ranganathan, Expansive Classification by Cutter, Universal Decimal Classification, etc.

Based on the arrangement there are three main types of classification systems

i) **Enumerative:** Produce an alphabetical list of subject headings; assign numbers to each heading in alphabetical order. The most common classification systems, LC
and DDC, are essentially enumerative, though with some hierarchical and faceted elements, especially at the broadest and most general level.

\( ii \) **Hierarchical**: Divides subjects hierarchically, from general to specific.

\( iii \) **Faceted or analytic-synthetic**: Divides subjects into mutually exclusive orthogonal facets. The first true faceted system was the Colon classification of S. R. Ranganathan.

\( iv \) **Specialist Classification**: Specialist classification systems have been developed for particular subject areas, and some specialist libraries develop their own classification system that emphasizes those areas they specialize in.

### 1.5.3. Dewey Decimal Classification

The Dewey Decimal Classification (DDC) system is the world’s most widely used library classification system. American librarian and library educator Melville Dewey devised the system in 1873 while he was a student at Amherst College in Massachusetts. The Dewey Decimal system was first published in 1876 as “A Classification and Subject Index for Cataloguing and Arranging the Books and Pamphlets of a Library”. For example in this manual label created by librarian, in its two columns one for call number based on Dewey Decimal Classification and second is Access number based on serial number of the documentation. Show following figure 1.

![Figure 1 : Manual label](image)

### 1.6. Types of technologies for library management system

#### 1.6.1. Manual for Public and Community Libraries: The primary purpose of public and community libraries is to provide information resources and services that meet the needs of
the community both individuals and groups in education, information and personal development; including recreation and leisure.

![Figure 2: Manual Libraries](image)

The manual should be read carefully by all involved in running the library. It is divided into four sections as follows:

i) Section 1: Background information on libraries and administrative matters.

ii) Section 2: Front desk routines.

iii) Section 3: Technical operations—acquiring, and preparing information resources for use.

iv) Section 4: Outreach Services—interacting with the general public including library users and nonusers.

v) Section 5: Report Writing

vi) Section 6: Training Library staff should feel free to raise any queries, suggestions and recommendations regarding the manual. Adjustments will be made to the manual from time to times and when they become necessary or to replace outdated practices with the new.

1.6.2. Bar Code Technology in Libraries:

A bar code symbol is simply an array of bars and spaces which represent a group of numbers and/or letters. These characters, in turn, typically represent something tangible: Once a bar code symbol is applied to a book and the symbol is linked to a database record,
the book will circulate through the automated system by scanning the bar code symbol into the computer software’s circulation function. Scanning bar codes is much faster than keying in the data, and infinitely more accurate.

Bar Code Symbols

There are two avenues available to libraries regarding the bar code labeling of library materials. The first, and most popular, is by adopting the North American de facto library standard of a 14-digit label, using the Coda bar symbology. (A symbology is much like a language of bar codes.)

This 14-digit symbol is broken down in the following way:

Digit # Description 1 either ‘2’ or ‘3’. 2 signifies a patron label, 3 a title label 2 Four-digit library identifier 5-13 Consecutive numbers 14 Check digits.

Figure 3 : Barcode label

1.6.3: RFID (Radio Frequency Identification) Technology in Libraries:

RFID is a technology that offers many more benefits compared to other identification technologies [5] such as bar coding and magnetic stripe. This emerging technology is not new in fact; it is currently being used, in numerous applications throughout Canada and the world. Originally, implemented during World War II to identify and authenticate allied planes, this was known as Friend or Foe. RFID is still being used today for the same purposes. In 1990’s RFID saw the wide scale deployment of electronic toll collection in the United States and the installation of over 3 million RFID tags on rail cars in North America [6].
The main component of this technology is the transponder/tag, which in most cases comprises of a chip and antenna mounted onto a substrate or an enclosure. The chip consists of a processor, memory and radio transmitter. These transponders communicate via radio frequency to a reader, which has its own antennas. The readers can interface through wired or wireless medium to a main computer. Transponders are also known as smart or radio tags. The memory will vary, depending on the manufacturer, from just a few characters to kilobytes.

![Figure 4: RFID Fixed System](image)

**COMPONENTS OF RFID**

Basic RFID systems consist of three components:

- An antenna or coil
- A transceiver (with decoder)
- A transponder (RF tag) electronically programmed with unique information

**1.6.3.1: 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; 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 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.

![Figure 5: Antenna in tag](image)

1.6.3.2: RFID 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.

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 data can be encoded on tags

i. 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 included as they move throughout the supply chain.
ii. "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.

iii. Full "read-write" tags allow new data to be written to the tag as needed and even written over the original data. Examples for the latter capability might include the time and date of ownership transfer or updating the repair history of a fixed asset.

**RFID Tags Types**

<table>
<thead>
<tr>
<th>Active or passive</th>
<th>Other Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive (no battery)</td>
<td>Data storage (Programming)</td>
</tr>
<tr>
<td>Smaller, Lighter</td>
<td>Read Only</td>
</tr>
<tr>
<td>Shorter range (&lt;3m)</td>
<td>Write once</td>
</tr>
<tr>
<td>Smaller data storage</td>
<td>Read/write</td>
</tr>
<tr>
<td>Lower cost</td>
<td></td>
</tr>
<tr>
<td>Active (with battery)</td>
<td>Frequencies</td>
</tr>
<tr>
<td>Larger, Heavier</td>
<td>Low—135 kHz</td>
</tr>
<tr>
<td>Longer range (up to 100m)</td>
<td>VHF—13.5 MHz</td>
</tr>
<tr>
<td>Larger data storage</td>
<td>UHF—860MHz</td>
</tr>
<tr>
<td>Higher cost</td>
<td>Microwave—2.4 GHz</td>
</tr>
</tbody>
</table>

Table 1: Difference between active and passive tags

There are several versions of RFID that operate at different radio frequencies. The choice of frequency is dependent on the business requirements and read environment, it is not a technology in which 'one size fits all' applications.

The primary frequency bands are being used for RFID.
The frequency of RFID tags can be classified into low frequency (LF), high frequency (HF), ultrahigh frequency (UHF), and microwave [7].

<table>
<thead>
<tr>
<th>Type</th>
<th>LF</th>
<th>HF</th>
<th>UHF</th>
<th>Microwave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq. Range</td>
<td>125 - 134KHZ</td>
<td>13.56 MHz</td>
<td>866 - 915MHZ</td>
<td>2.45 - 5.8 GHz</td>
</tr>
<tr>
<td>Read Range</td>
<td>10 cm</td>
<td>1M</td>
<td>2-7 M</td>
<td>1M</td>
</tr>
<tr>
<td>Market share</td>
<td>74%</td>
<td>17%</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>Coupling</td>
<td>Magnetic</td>
<td>Magnetic</td>
<td>Electro magnetic</td>
<td>Electro magnetic</td>
</tr>
<tr>
<td>Existing standards</td>
<td>11784/85, 14223</td>
<td>15000-3.1, 15693,14443 A, B, and C</td>
<td>EPC CO, CI, C1G2, 18000-6</td>
<td>18000-4</td>
</tr>
<tr>
<td>Application</td>
<td>Smart Card, Ticketing, animal tagging, Access, Laundry</td>
<td>Small item management, supply chain, Anti-theft, library, transportation</td>
<td>Transportation vehicle ID, Access/Security, large item management, supply chain</td>
<td>Transportation vehicle ID (road toll), Access/Security, large item management, supply chain</td>
</tr>
</tbody>
</table>

Table 2: Frequency based RFID tags

![Electromagnetic Spectrum](image)

Figure 6: Illustrates of different frequencies that are used for RFID Tags

Types of Tags

Depend upon the usage RFID tags are passive, active, semi passive, semi active tags.

Passive Tags

Passive tags are tags which are powered by the RFID reader. When the tag is within range of the radio frequency field, the reader sends out electromagnetic waves which power the microchip on the tag. Once the power to the microchip on the tag meets the minimum voltage, the microchip can send back information on the same wave. Reading range is limited when using passive tags as shown in figure 8.
Active Tags

An active tag can have a reading range of many tens of meters and because of their size, sophistication, larger batteries and stronger antennas; these tags are more expensive than passive tags as shown in figure 9.

Semi-passive Tags

A semi-passive tag, also known as a Battery Assisted Passive (BAP) tag can provide a greater reading range and readability than passive tags. The battery in the BAP tag runs the microchip’s circuitry and reflects the radio waves generated by the reader. A non-BAP tag uses some of the readers signal to power its microchip and a BAP tag reflects back more of the reader’s radio waves as shown in figure 10.
Semi-active Tags

A semi active tag has a small battery which keeps the microchip alert which makes the tag respond faster. This type of tag can be used on vehicle for road toll payment. The semi active tag is powered by an internal battery to run the microchip’s circuitry and to broadcast a signal to the reader. The principle of semi passive and semi active tags were similar. Some book regards these two terms as the same type of tag as shown in figure 11.

Figure 10: Some Low-frequency Tags

1.6.3.4: READERS (A.K.A. INTERROGATORS)

Readers read or interrogate the tags. In reading, the signal is sent out continually by the (active) tag whereas in interrogation, the reader sends a signal to the tag and listens. RFID reduced that to just three minutes. This result was in an 83% reduction in reading time for each tagged dolly.

The scheme where the reader controls the response timing of the tags is known as reader talk’s first method. Conversely, the scheme where tags start beaming their data as soon as they are energized by the reader is known as tag talk first method. The former method is more accurate but is slower compared to the latter.

Readers work at different frequencies, from a low of about 100 KHz to a high of about 5.8 GHz. The Tries S2000 reader used in our laboratory experiments works at 134.2 kHz, which is at the low end.

Some readers can also write to the tags which mean that data on the read/write tags may be changed and added to in real time Read/write tags are reusable which reduces long
term operating costs. A typical RFID system includes four different kinds of readers, also
known as sensors or scanners. These devices are designed to detect and read tags to obtain
the information stored thereon.

(i) **Staff workstations** for circulation desk charging and discharging. It also supports
all RFID functions like anti-collision feature allowing to identify multiple labels
simultaneously, present in the reader field and full read/write capability. It is used
at the issue/return counters at the library and also for label personalization.

(ii) **Self-check-in/ check-out stations** for allowing users to borrow books without
assistance from the library staff. It is an interactive station/kiosk with touch screen
which prompts the user to enter library card. The validity of the library card is
checked and user is prompts to place the books on to the deck of the Borrowing
Station.

(iii) **Exit sensors** at exit are of two types; one reads the information on the tag(s) going
by and communicates that information to a server. The server, after checking
against the circulation database, activates an alarm if the material is not properly
checked-out. Another type relies on a "theft" byte in the tag that is turned on or
off to show that the item has been charged or not. It is then not necessary to
communicate with the circulation database.

(iv) **Portable scanner** or inventory wand, which can be moved along the items on the
shelves without touching them. The data goes to a storage unit, which can be
downloaded at a docking station or a server later on, or it can go to a unit which
will transmit it to the server using wireless technology.

(v) **Book drop Kiosk** checks in books when users drop them in the book drop.

Libraries can offer a distinct service that is very useful for users, such as the
ability to return books when the library is closed.
1.7. Advantages of RFID Over Bar Coding and Applications

1. No "line of sight" requirements: Bar code reads can sometimes be limited or problematic due to the need to have a direct "line of sight" between a scanner and a bar code. RFID tags can be read through materials without line of sight.

2. More automated reading: RFID tags can be read automatically when a tagged product comes past or near a reader, reducing the labor required to scan product and allowing more proactive, real-time tracking.

3. Improved read rates: RFID tags ultimately offer the promise of higher read rates than bar codes, especially in high-speed operations such as carton sortation.

4. Greater data capacity: RFID tags can be easily encoded with item details such as lot and batch, weight, etc.

5. "Write" capabilities: Because RFID tags can be rewritten with new data as supply chain activities are completed, tagged products carry updated information as they move throughout the supply chain.

Typical Applications for RFID

- Automatic Vehicle identification
- Inventory Management
1.8. Need of RFID Implementation

Due to the low cost of barcodes, this automatic identification system has been extensively applied in the management of library collections. Barcodes simplify the identification of items for library circulation and archives [8]. A better solution for the storage of recognizable information and transactions is to use integrated circuit (IC) memory cards or smart cards to convey data.

However, this kind of contact type IC card must work through a reader contact to have power and to transmit materials. The shortcoming of usage includes lower processing speed and abrasion of an electronic contact. On the other hand, the contact-less IC card technique transmits data between card and reader through radio waves. The power also can be converted from radio waves or built-in batteries in cards.

Because of the transport of power and information through radio waves, contactless auto-IDs are called radio frequency identification (RFID) systems. Technically it is 'a technology that consists of a system and tiny tags, which uses radio waves to automatically identify people or objects'. This wireless automatic identification data capture systems allow for non-contact reading or writing of data and they are highly effective in manufacturing and other hostile environment where barcode labels cannot survive. It consists of a transponder with antenna and a chip and a reader which attached to a computer to identify the item.

The complete set of these items is called a tag or a label. Data or information can be written on the chip (barcode etc.) and stored in the tag or label that is attached to the item to be identified and reader is non-movable (fixed at security gate or so).
RFID plays a vital role in redefining the library process to make everyone's job easier right from the users to library staff. It provides a platform to automate most of the process performed by the library staff like check-in, check-out, sorting, stock management and inventory control. RFID is an innovative automated library system for automatic identification and tracking of library material. As it is combination of radio-frequency-based technology and microchip technology and can be used to identify, track, sort or detect library holdings.

This is an effective way of managing collections of the library and providing enhanced services to the users having following benefits:

❖ 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.
❖ Hassle free issue/return of books since several books in a pile can be issued/returned at a time.
❖ Does not need the manual typing so ensuring accuracy in routine works
❖ Helpful in identifying misfiled items.
❖ Inventory visibility, accuracy and efficiency.
❖ Automated Issue/Return
❖ No lines or greatly reduced lines at the checkout counter.
❖ Increases the security function in library.
❖ Instant update of the databases is possible.
❖ Improved utilization of resources like manpower, infrastructure etc.
❖ Less time consumption as line of sight and manual interaction are not needed for RFID-tag reading.
- Flexible library timings by use of Books Drop Kiosk for returning library materials.
- Unique ID of RFID tag prevents counterfeiting.
- Open access system promotes chances of theft of books, so to secure the valuable resources from anti-social elements.
- Traditional methods of stock verification are not feasible for libraries having large collections.
- Automation of repetitive work such as lending or returning of items.

1.9. Earlier Literature of LMS:

From the literature work surveyed it has been observed that the development of library management system at present. The manual and Barcode Technologies are replaced at Radio Frequency Identification Technology (RFID).

1. L. Radha Alias Nagalakshmi [9] has proposed development of Deployment of RFID (Radio Frequency Identification) at Indian academic libraries, Issues and best practice. This paper deals with deployment of RFID technology and its issues and best practice at libraries. RFID technology is applied to various activities in libraries like automated check in /check out (without the intervention of the library staff), theft detection, stock verification etc.

2. Dhanalakshmi M, Uppala Mamatha [10] has also proposed development of RFID Based Library Management System. Radio Frequency Identification (RFID) is a new generation of Auto Identification and Data collection technology the proposed system is based on UHF RFID readers, supported with antennas at gate and transaction sections, and library cards containing RFID-transponders which are able to electronically store information that can be read / written even without the physical
contact with the help of radio medium. This paper presents the experiments conducted to set up RFID based LMS.

3. Jung-Wook Choi, Dong-Ik Oh, Sang-Jung Park, Im-Yeong Lee [11] has proposed developed Development of an RFID based Book Retrieval System. One of the noticeable challenges is to ease the process of locating books users want. The main purpose of this research is to develop a tag positioning system that can help library users to locate books without going through tedious shelf searching process.

4. Simson Garfinkel, Henry Holtzman, have proposed UNDERSTANDING RFID TECHNOLOGY a technical introduction to the RFID, the Electronic Product Code (EPC), and the Object Name Service (ONS). It then looks at two specific RFID applications that have been fielded over the past ten years.

5. Dhaval H Kotecha, [12] have invented on Automation in Library using RFID Technology Libraries are using cutting edge item level RFID technology in a closed loop system. The paper discusses underline NCIP standards development, practical issues related to RFID working in a library environment and touch upon basic RFID issues concerning equipment maintenance and support; software compatibility; privacy and standardization.

6. Cheng Feng [13] in his work explained that the RFID in the library lending and management advantages, in recent years, the library at home and abroad began to be widely used. Automatic identification technology with the traditional comparison, RFID has advantages just as scanning quickly, non-contact reading and writing, long service life, high information content etc. This paper analyzed the advantages of RFID technology, and studied the application of RFID technology in libraries.
7. Sanjay Waykar, [15] Amruta Shelar, Sushant Zanjure, Sayali Vibhute, Abhishek Singh, proposed the work on, Radio frequency identification (RFID) based library management using decision support system (DSS) is the most rare and uniquely found integration of two cutting edge technologies that is RFID and DSS, which has led to tremendous increase in the speed, efficiency and accuracy of the library. 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.

1.10. Objective of the present work

The main objective of the present work is to develop hardware and software and its implementation for the RFID based Library Management system using MATLAB easily and efficiently.

The present work was developed in integrating the RFID system and the creation of Graphical User Interface (GUI) at the host PC. The scope of work of the research is to develop an RFID based library management system to assist the librarians for more efficient management of books in the library. GUI for the system was developed using MATLAB. To store the details information of the book to the database. Subsequently all the book information is loaded in the RFID tag. This covers the database related to books and student based on UID.
REFERENCES


11) Jung-Wook Choi, Dong-Ik Oh, Sang-Jung Park, Im-Yeong Lee, Development of an RFID based Book Retrieval System Division of Information Technology Engineering, SoonChunHyang University, pp. 387-391.

