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# LIBRARY MANAGEMENT SYSTEM

– For Butwal High School

BACHELOR'S THESIS | ABSTRACT

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# LIBRARY MANAGEMENT SYSTEM

- For Butwal High School

After a study in a small-sized high school in Nepal, a need for a library management system was observed. The management system would hold information on the books, students and faculty members, with the main objective of keeping track of the books and helping the librarian perform his daily task efficiently.

Therefore, a library management system was developed using C# in the .Net framework. The new system helps to store information (id, name, address and other relevant data) of all the students as well as book records. Using this system, students can check the availability of books and reserve them. Also, librarians can issue and collect books. The user can generate various reports, such as fine charges, a list of issued books and books that are overdue. The system reduces the time required to search the student's records and provides readily calculated reports which helps the librarian save time.

## KEYWORDS:

CMS, Library, management system, database

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# 1 INTRODUCTION

During a research conducted by company named Surfmandu for the purpose of improving school in a cost effective way, it was observed that one could only borrow books from the library by asking a librarian for it. The librarian had to manually search through all the books in the library for a particular book and then issue it. Much time was wasted to retrieve one book out of the library if the book was available. Even when issuing a book, the librarian had to manually keep record of whom the book has been issued to. The process was very long and time-consuming.

Here, an attempt has been made to develop a Library Management System. This management system has been developed and designed to have a well-managed user friendly application where students can access a database of the books with a status on the availability and with the feature of reserving a book in advance. The librarian holds the authority to administer the system with functions such as add or delete books and students, issue and retrieve books, issue fines on late returns. This system helps maintain data related to books as well as transactions in the library. This helps the librarian maintain and administer the bookings, subscriptions and management such that it is easy to track targets systematically and within more efficacy.

This system requires the users to sign-in whenever they have to work with it. The information related to the library and the users is stored in the database. This helps the user save time and find the required material easily from any smart device.

## **1.1 Statement of the problem**

The traditional system of maintaining a library is time-consuming and difficult. A simple task takes much time to complete. There is no proper record of the books or the students.

A library management system helps make the process easier and efficient so that the librarian can perform daily tasks in the library. Besides, it has a greater contribution to increasing the efficiency and in the maintenance of the historical records of the data. In addition to searching the books, it helps to reserve the books.

## **1.2 Objectives**

The main objective of the application is to digitize and automate the existing system of manually maintaining the records of the books issued, returned from the student, catalogues and book search. Therefore, time-consuming tasks, such as the issuing of books, returning, and searching will be faster. The objectives to be fulfilled are:

1. To store records of the books.
2. To create friendly and simple web environment for students of different ages/classes to use.
3. To make renewing and issuing of the books for both students and librarian easy.
4. To help the librarian complete work within a short time.
5. To make searching and discovering of library resources easy for all.
6. To make a economical system.

### **1.3 Scope of the application**

Any educational institute can make use of this application by providing information about the available books. An advanced programmer could modify the framework to be further used in offices and modifications can be easily made according to requirements.

Using this system, a librarian can generate some reports, such as the total number of books, issued books, due books, fine collection, search books using keywords, view books in the different categories (such as author index, subject index etc.).

Along with this, the application has a membership feature and the connection is encrypted using SSL certificates that creates a secure connection between the website and clients' devices, ensuring that no third party can quietly slip in-between and monitor, hijack, or shut down any transactions taking place. This system can run on any operating system as it is browser-based.

### **1.4 Limitations**

The system user will need an internet connection. Since the internet is not quite widely used in some parts of the Nepal, there might be difficulty accessing the application. The web app is comparatively slower than the applications hosted on the local server. The server available for hosting might crash during which the application cannot be accessed.

This system does not have SMS/Email notification features. During this phase, the system has only been tested on computers but it is yet to be tested on handheld devices.

## **2 STUDY OF EXISTING SYSTEM**

To prepare this project, 'Butwal High School' has been selected as the focus of study, where it is found that the traditional record-keeping system has been followed. The school has a total number of 550 students. They simply issue and receive books using a register, that means they do not have a proper system to follow up with students who do not return the books on time. With the help of this Library Management System, their problem could be solved easily.

### **2.1 Data Collection**

Data collection is a term used to describe the preparation and assembly of data. [1] The purpose of data collection here is to obtain information, where information means book details, student details and the availability of books. To develop this project, an interview was conducted with the librarian of the institute, while the second member of that team has been observing the day-to-day transactions to understand the need of the library.

### **2.2 Feasibility Analysis**

A feasibility analysis is aimed to determine whether, given the project environment, a project will be successful, or not. A feasibility analysis may be conducted for a project with an emphasis on financial viability, environmental integrity, cultural acceptability, or political practicability. [2]

This analysis determines the likelihood of success for the system. The three analyses considered in this study are:



### **2.2.1 Technical Feasibility**

This system is a totally web-based application developed in C# programming language in a .NET framework. As a web-based application, it is platform independent thus it can run on any operating system. The system will involve minimum technical infrastructure, so it is technically feasible.

### **2.2.2 Economical Feasibility**

The proposed application is economically feasible as the application will provide a fast, efficient and automated environment instead of a slow and error-prone manual one. This will aid in reducing both time and manpower spent in running the system.

As there was already basic infrastructure such as computers and books available for the library, there was no need to invest anything other than time. Even in the future, the system once completed would require little economical upkeep.

### **2.2.3 Operational Feasibility**

This application is easy to operate as it is made user-friendly and students of different ages and classes can readily use it. Little training is required to learn it and it will provide services and access to different information that may be required for some decision making. User reviews are being taken and the user experience is being updated as per need.

### **2.3 System Planning**

The goal of system analysis is to determine the problem and attempt to fix the system. This step involves breaking down the system into different pieces to analyze the situation, project goals, break down what needs to be created and attempt to engage users so that specific objective can be fulfilled.

Requirements analysis at times requires individuals/teams from the client, as well as service provider sides to get detailed and accurate requirements; often there has to be a lot of communication to and from to understand these requirements. Requirement gathering is the most critical aspect as many times communication gaps arise in this phase and this leads to validation errors and bugs in the software program.

### **2.4 Project Methodology**

Choosing a suitable project methodology is important because it serves as a guideline when developing the system step by step. There are many different methodologies that have been crafted to serve certain system development. Without proper guidance from any of these methodologies, the application development always fails due to poor planning and management. [3][4]

Incremental software development process is selected as the software development process for this project. Although the incremental process is quite similar to the Waterfall Model, it can overcome the problem that the Waterfall Model has and cover the disadvantages.

It is a method of software development where the product is designed, implemented and tested incrementally (a little more is added each time) until the product is finished. It involves both a development and maintenance process. The product is described as finished when it fulfills all its requirements. [5] This model combines the elements of the waterfall model with the iterative philosophy of prototyping.

In the Waterfall Model, once one phase of software development is completed, the development of the next phase will start and there is no turning back. [6] Hence

incremental development is used to solve the problem. This development could exit at any phase and return to the previous phase to ensure a positive outcome at the end of the project.

### 3 SYSTEM ARCHITECTURE

A three-tier architecture has been implemented in the system development. It is a very common architecture that is typically split into a presentation or GUI tier, an application logic tier, and a data tier. [7]

Figure 1 illustrates a 3-tier architecture:

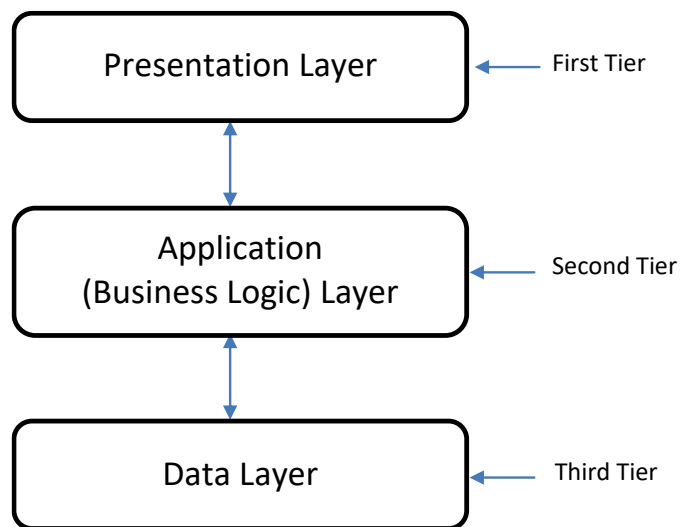


Figure 1. System Architecture.

The presentation layer is the uppermost level of the application and contains the user interface of the application. It does not make any application decisions. It just forwards the user's events to the application logic tier. If the user needs to enter information, it is done in the presentation tier too.

The application logic tier is where all the application decisions are made. This is where the "business logic" is located. The application layer knows what is possible, and what is allowed. The application layer reads and stores data in the data tier.

Data used in the application is stored in the third tier known as the data layer. The data tier can typically store data securely, perform transactions and search through huge amounts of data quickly. MySQL has been used to store data.

### 3.1 System Modules Description

This application uses different modules to accomplish various tasks easily. These modules help access or modify data quickly and effectively. The modules present in the application comprise of the following:

- **Items:** This module consists of the details of the books available in the library and their categories. It also has the list of books in each category and their details.
- **Manage Books:** Here, the librarian can check which book is available and issued.
- **Member Account:** To issue a book from the library, one should have an account in the library. The registration contains all the details about the student like registration number, name, address, contact number.
- **Book Request:** This module is used by the member to request a book from the library. The search can be performed by using a name of the book or accession number.
- **Book Reservation:** This module is used by the member to reserve a book from any network computer. The member must log in for reservation.
- **Issue of books:** This module is used by the librarian for issuing books based on the request made by the student.
- **Renewal of books:** This module is used by the admin for renewing the books. It checks if the book has already been reserved for others. If so, that book will not be renewed.

- **Returning Books:** In this module, the librarian maintains the details of the books returned by the student, which also includes the fine details.
- **Reports:** This module includes all the details about the issued books, returned books, student reports, fine reports, or details of the book which are not returned.

### 3.2 Context Diagram

A context flow diagram is a top-level data flow diagram also referred to as level 0. It only has one process node (process 0) that generalizes the function of the entire system in relationship to external entities. In the context diagram, the entire system is treated as a single process and all its inputs, outputs, sinks and sources are identified and shown. Context Flow Diagrams show external entity action on software in a single process.

#### Data Flow Diagram

A data flow diagram is a graphical representation of how the data flows through an information system. It can also be used for the visualization of data processing. It is common practice among the designers to draw a context level DFD (Data Flow Diagram) first which shows the interaction between the system and outside entities. This context-level DFD is then expanded to show more detail of the system being modeled. [8]

A DFD represents the flow of data through a system. These diagrams are commonly used during problem analysis. It views a system as a function that transforms the input into the desired output. A DFD shows the movement of data through the different transformations or processes in the system.

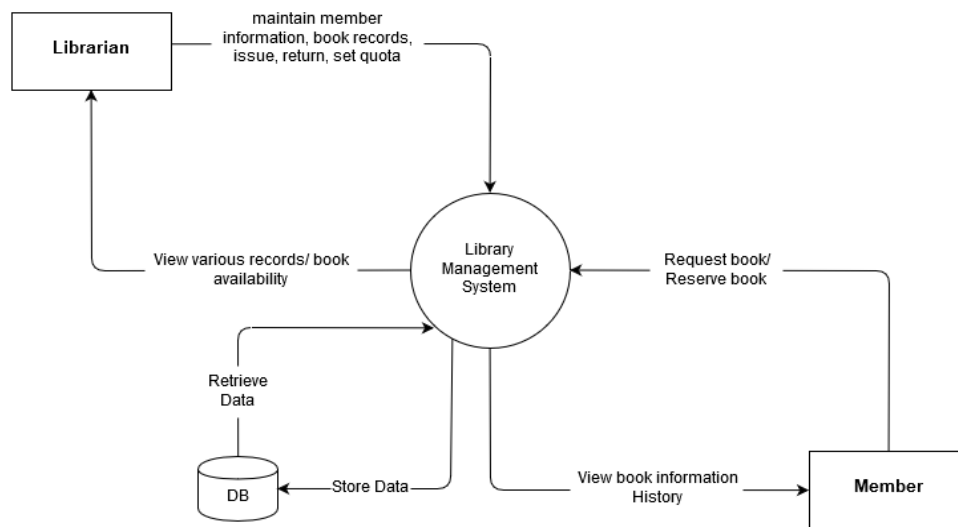


Figure 2. DFD Level O.

In Figure 2 we can observe how the data is being moved when either the librarian or the member calls for the data. The main system can be accessed by librarian to maintain the records and view while the member can only request to view the data. All the data is stored in a database from where it is accessed. Furthermore, detailed dataflow for the librarian and the member can be seen in Figure 3 and Figure 4 respectively.

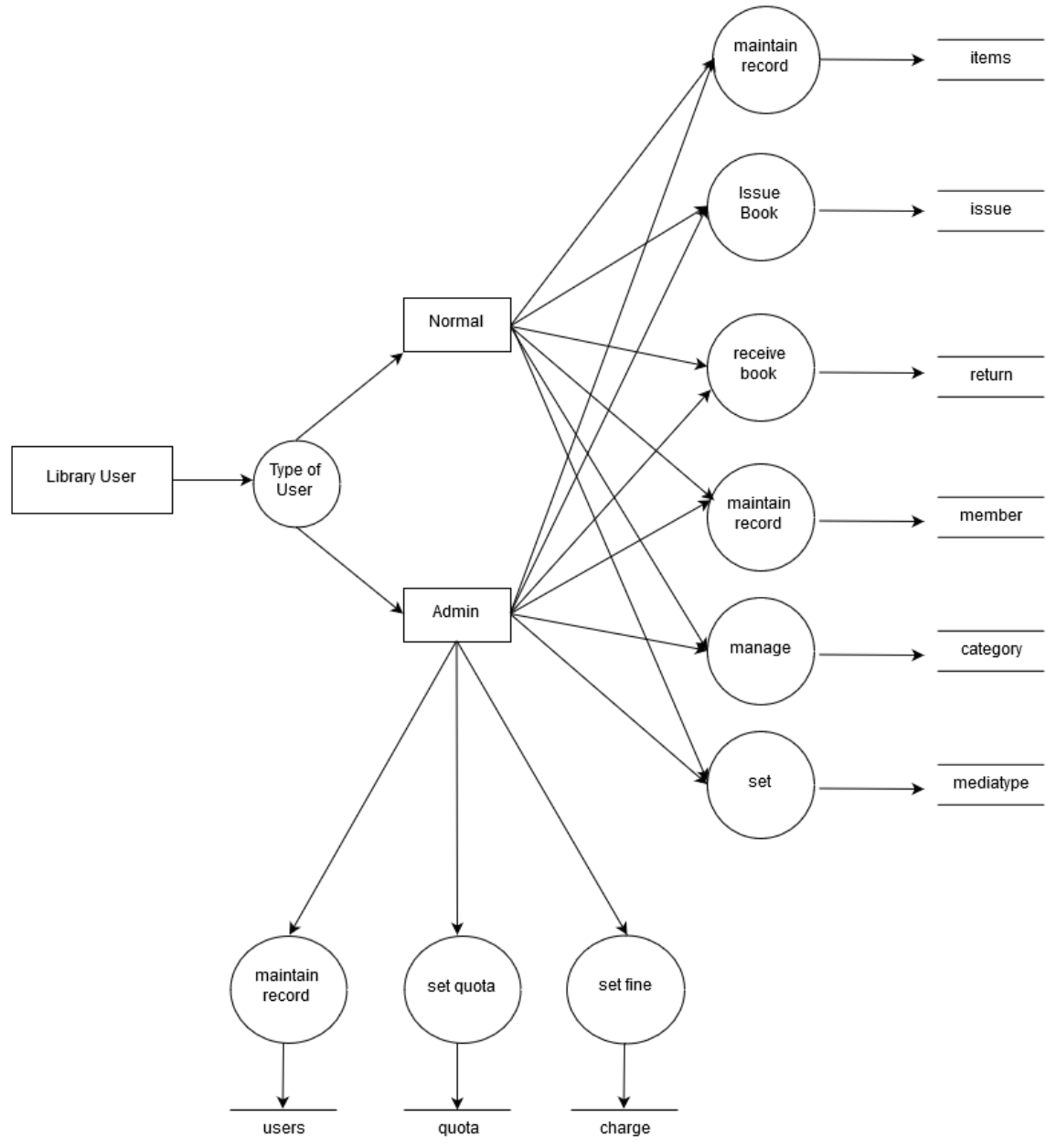


Figure 3. DFD Level 1 for Librarian.

In Figure 3 above we can see how the data can be manipulated by a librarian. During the research it was found that the school had two librarians. One being the main librarian and other as a part time librarian. In order to differentiate, two users had to be created, first of which was a normal librarian which had access



to use the basic function such as maintain record or members(students), issue and receive book etc.

And other is admin which has function of setting quota, set fines as well as create other new users.

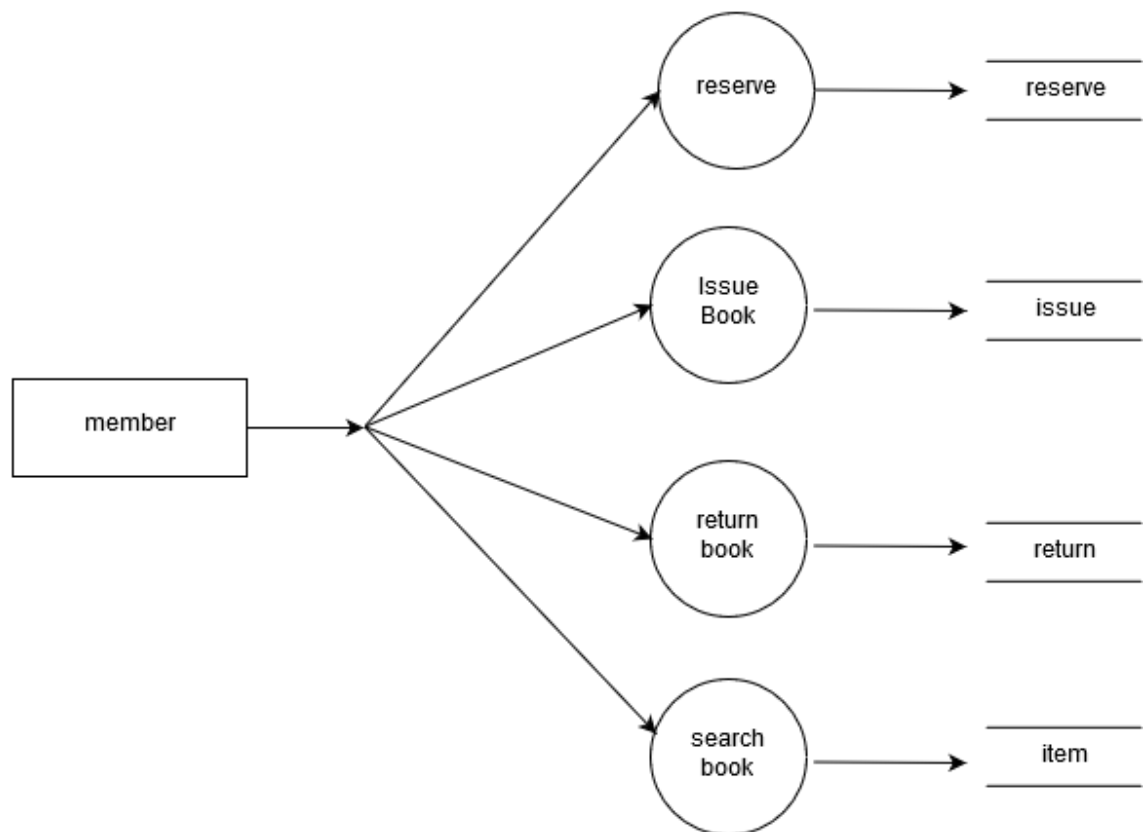


Figure 4. DFD Level 1 for Member.

In the Figure 4 we can see the dataflow for the members(students). Members have a limited operation they can perform. They can search, reserve, issue or return the book.

### 3.3 ER Diagram:

An *entity-relationship model* also called an *entity-relationship (ER) diagram*, is a graphical representation of entities and their relationships to each other, typically used in computing with regard to the organization of data within databases or information systems. An entity is a piece of data – an object or concept about which data is stored. [9] The ER Diagram for this Library Management System is shown in Figure 5.

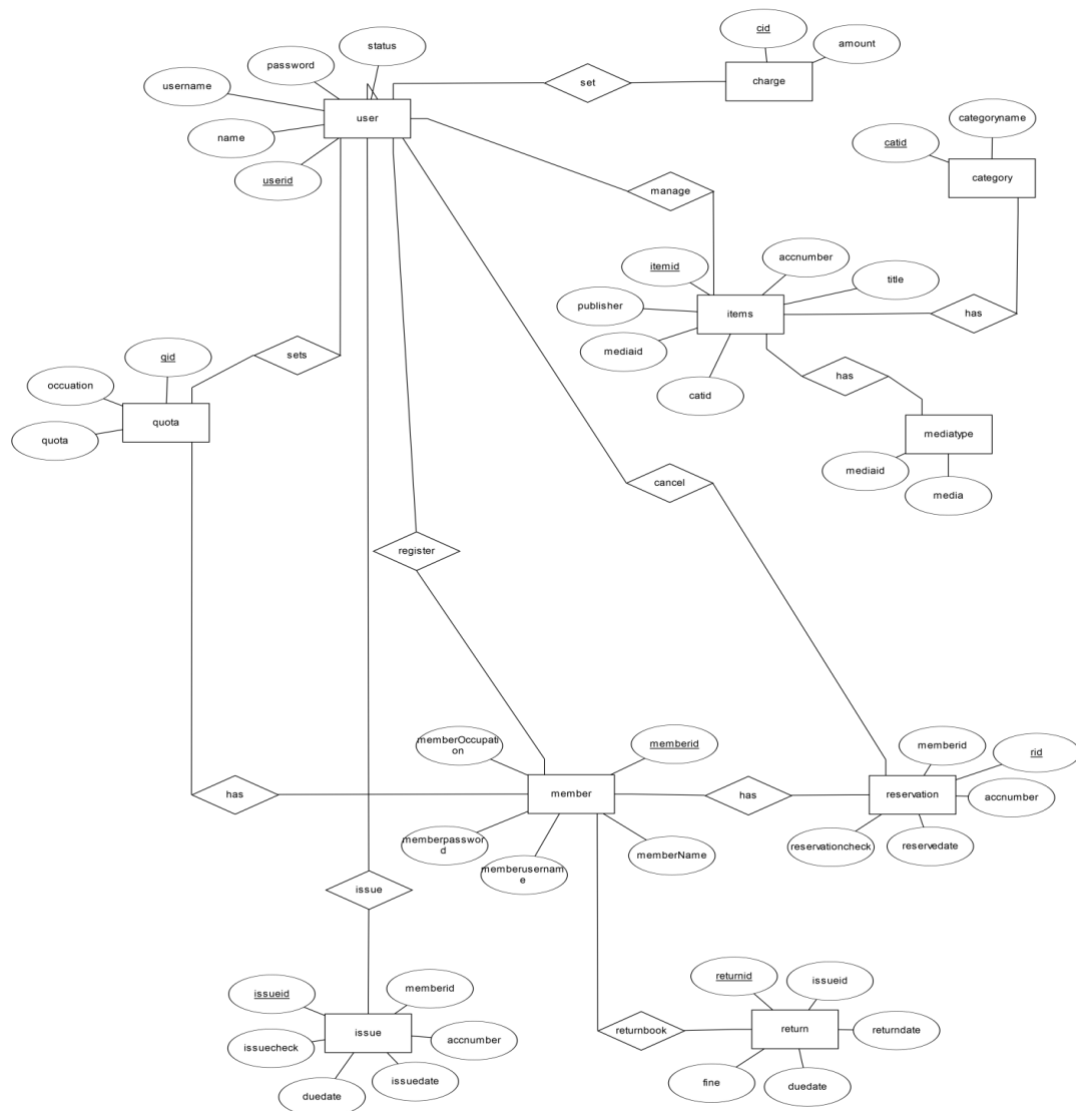


Figure 5. ER Diagram.

### 3.4 Use Case

A use case is an approach used in system analysis to identify, clarify, and organize system requirements. The use case is built of a set of possible sequences of interactions between systems and users in a particular environment and relate to a particular goal. It consists of a group of elements (for example, classes and interfaces) that can be used together in a way that will have an effect larger than the sum of the separate elements combined. The use case should contain all system activities that have significance to the users. A use case can be thought of as a collection of possible scenarios related to a goal, indeed, the use case and goal are sometimes considered to be synonymous. [10]

Here, two use cases have been implemented. The first one, admin vs normal user, where the librarians are admins and have all the functions ready to be used, whereas students are normal users and have limited access. For the second one, the member use case, the students are the members and we focus more on defining rules of what a member can and cannot do. Figure 6 and Figure 7 show the two use cases used respectively.

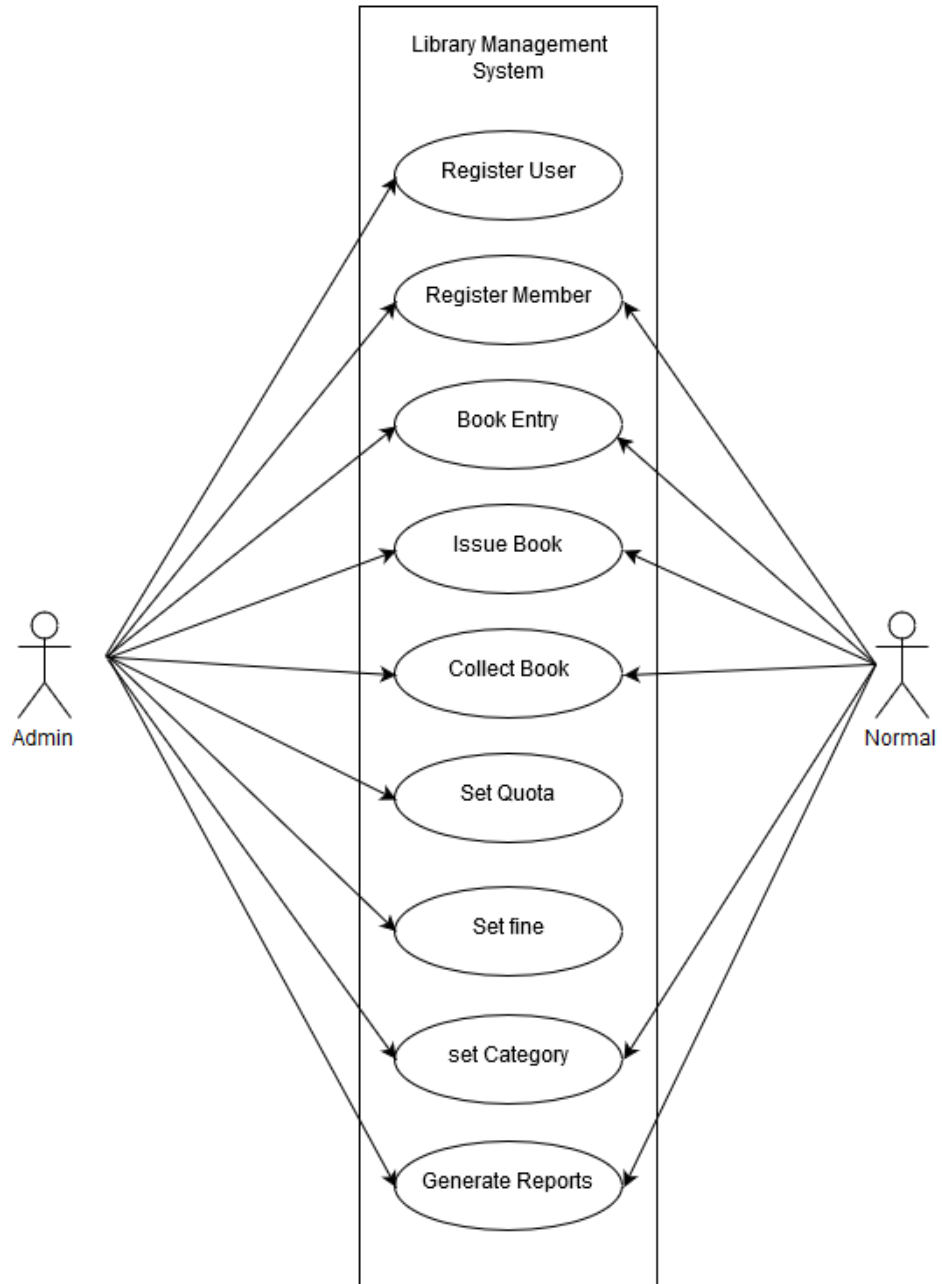


Figure 6. Use Case Admin vs Normal.

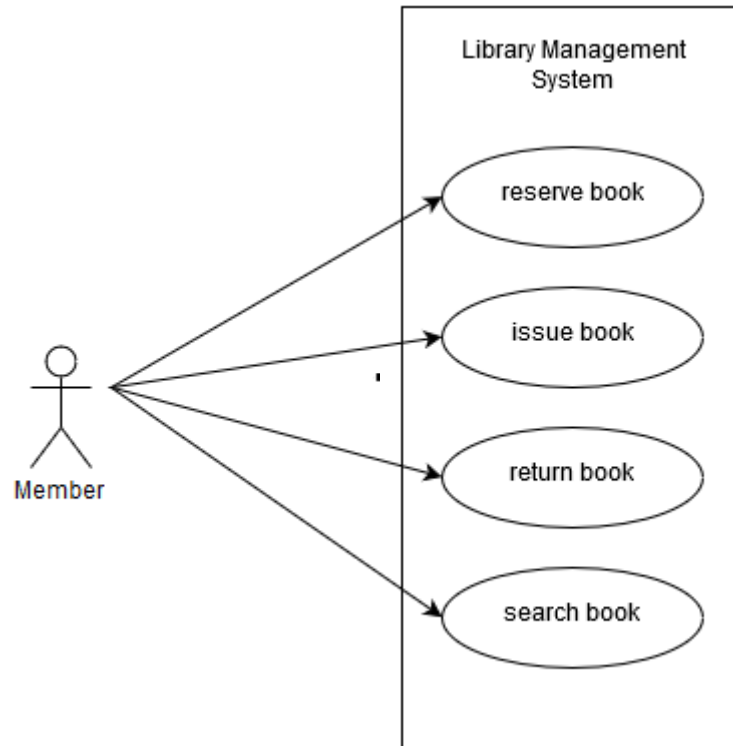


Figure 7. Use Case for member.

## 4 TESTING

Testing is very important for the success of the system. System testing makes a logical assumption that if all the parts of the system are correct, the goal will be successfully achieved. Testing is running the program (or product) under various circumstances and conditions to find errors and bugs in it. [11]

It is a critical part of software quality assurance and represents the ultimate review of specification, design, and coding. The testing phase involves testing a system using various test data. Testing involves the operation of the system or application under controlled conditions and evaluating the results. The controlled conditions should contain both normal and abnormal conditions.

### 4.1 Testing Objective

The test objectives are:

- To find out defects or issues in the application experienced by the end user
- To evaluate the performance of the application in order to improve it
- To ensure all the integrated modules are functioning correctly
- To ensure the application is running smoothly on different software

To ensure that these objectives were fulfilled, some testing was conducted. This has been further discussed in the following section.

### 4.2 White Box Testing

White box testing, sometimes called glass-box testing, is a test case design philosophy that uses the control structure described as part of the component-level design to derive test cases. [12] Using White box testing methods it can be confirmed that:

- All independent paths inside a module have been exercised at least once
- All logical decisions have been implemented.

- All loops at their boundaries and within their operational bounds are implemented.
- All internal data structures have been exercised to ensure their validity.

### 4.3 Black Box Testing

Black Box Test is testing without knowledge of the internal workings of the item being tested. [13] When black box testing is practiced, the tester would only know the allowed inputs and what the expected outputs should be, but not how the program actually arrives at those outputs.

It is because of this that black box testing can be regarded as testing with respect to the specifications, no other knowledge of the program is necessary

### 4.4 Test Phase

**Unit Testing:** Unit testing is a software development process in which the smallest testable parts of an application, known as units, are individually and independently examined for proper operation. It refers to tests that verify the functionality of a specific section of code, usually at the function level. Unit testing was conducted to ascertain that the application functions properly and whether the function used in the application is operational or not. [14]

It is necessary to ensure the correct operation. Hence, each component/functionality has been tested and compared with the desired output.

In this application, various units like book entry, check publisher entry, check book availability, check valid members, user creation, member registration with a valid username, check quota assigned to various members and fine calculation have been tested.

**Integration Testing:** Integration testing is testing in which a group of components is combined to produce output. Also, the interaction between software and hardware is tested in this testing to check if software and hardware components have any relation. [15]

**Module Testing:** There are different modules in the application like book issue, return, renew, loss and fine calculation. Module testing was performed in order to know whether the modules do the task for which they were developed. After building the operational modules, they were tested to identify if there were any errors in the application. Various modules like book issue, book return, book renew, and book loss have been combinedly tested.

**System Testing:** System testing was done to test the functioning of the system as a whole. It determines if the discrete modules function together as planned and whether discrepancies exist between the ways the system actually works and the way it was conceived. As this system is web-based, it is tested in various environments like in windows operating system and Mac computers. [16]

**User Acceptance Testing:** An acceptance test has the goal of selling the user on the validity and reliability of the system. It verifies that the system's procedures operate as system specifications indicate, and that the integrity of important data is preserved. User acceptance test is then done by the users. A limited number of users are given access to use the application before it is officially released. User motivation is vital for the successful functioning of the system. After that, a comprehensive test report is prepared. The report after this testing shows the system's tolerance, performance range, error rate, and accuracy.



## **5 SUPPORT AND MAINTENANCE**

All systems need maintenance from time to time. It is important that software be maintained since there are often some residual errors or bugs in the system that must be removed as they are discovered.

Many of these issues surface only after the system has been in operation for a longer period of time. When these errors are discovered, they need to be removed, leading to having the software changed.

Maintenance involves understanding the effects of change, making the changes to both the code and documents, testing the new parts and retesting the old parts.

Support and maintenance on this application is ongoing.

### **5.1 Future Scope**

However efficient the system may be, there is always room for improvement in any software. In order to make improvements, the system should be flexible enough for future modifications. New technologies and features will be adapted to make it the best in the future so that this system can act as a complete library management system. The system is going to be a base for creating an e-learning environment.

### **5.2 Backup and Recovery**

Administrators have the privilege of backing-up and recovery. An admin is able to make a backup of the database and restore it in case of a system crash or any other need for a reinstall.

### **5.3 Security**

This system with its login feature along with its password encryption provides a secure system for educational use. Two different users can log into the system. One is the admins (librarians) and the other is a normal users (students). Admins have full access to all processes whereas normal users have restricted access only. Here the main objective is to secure is the data of the books and students. As the students have access to the page and cannot view other information apart from the information on books, the student information is safe and is stored in a database which has its own login system which has to be accessed in order to view or modify any information.

## 6 CONCLUSION

The main goal of this thesis was to explore the process of building a Library Management System with an intent to helping schools. The purpose of the study was to design a Library Management System with a user-friendly interface.

The Library Management System was built on an opensource platform; this significantly reduced the development cost. Further operation and maintenance costs are very low. As the project grows, more and more libraries will be integrated and the system will be updated regularly.

The system uses a fully graphical interface, which works very efficiently in the management system. The main objectives of the application are to digitise and automate the existing system of manually maintaining the records of the book issue, book return from the student, catalogue and book search. Therefore, the book processing such as issuing, returning, searching will be faster. Records of all the details of the users and library information are stored in database. The users need not visit the library every time to find an item; instead, they can search for items from their own smart device.

In the later part of the development process, the programmer would focus on creating an e-learning environment using this management system as the base. The maintenance of the system is also very important, as well as improving the efficiency of procedures by optimizing the database and simplifying the structure of the script.

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