Library Management System

A PROJECT REPORT

Submitted by

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IN

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BONAFIDE CERTIFICATE

Certified that this project report **"Library Management System"** is the Bonafide work of "**Harsh Nama**" who carried out the project work under my/our supervision.

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INTERNAL EXAMINAR

EXTERNAL EXAMINAR

ABSTRACT

The **Library Management System** is a console-based application designed to manage a library's collection of books. It offers a streamlined solution for both **administrators** and **students** to handle various tasks associated with library management. The system provides two distinct user interfaces: an admin interface and a student interface, each with its own set of functionalities.

Goal and Functionality: The primary goal of the system is to manage the inventory of books efficiently, allowing for easy addition, searching, issuing, and returning of books. The system ensures that students can access available books and that administrators can maintain the library catalog without complications.

Key Features:

- **Book Addition**: Admins can add new books to the library by providing essential details like title, author, number of pages, and price.
- **Book Search**: Students can search for books by title, checking their availability and issue status.
- **Listing by Author**: Admins can list all books written by a specific author, aiding in organizing and retrieving specific collections.
- **Book Count**: The total number of books in the library can be displayed.
- **Issue/Return Management**: Students can issue books, and once issued, the system marks the book as unavailable until it is returned. Similarly, they can return books they have borrowed.

Outcome:
The system ensures a smooth and structured flow for managing books, making it easier for both administrators and students to track and utilize the library's resources. The inclusion of functionalities such as issuing and returning books provides a more comprehensive solution for library management.

ACKNOWLEDGEMENT

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Introduction

Libraries are critical resources for both educational and recreational purposes. They provide a vast repository of knowledge through books, journals, and other media. However, managing a library efficiently can become challenging as the number of books and users increases. To address these issues, a **Library Management System (LMS)** is essential. This system simplifies and automates many tasks involved in managing a library, making it easier for librarians and users alike to interact with the available resources.

In today's fast-paced digital world, automation and organization are vital in ensuring that library resources are utilized effectively. A Library Management System helps organize and manage books, track user activity, streamline book borrowing and returning processes, and maintain accurate records, ensuring a smooth operational workflow for library administrators and providing convenient access to users.

Purpose of the Project

The purpose of this project is to develop a **Library Management System** that streamlines the processes involved in managing a library. It offers a user-friendly interface where both **administrators (librarians)** and **students (users)** can interact with the library's resources. The primary objectives of this system are to:

- **Efficiently track** the addition and management of books.
- Allow users to **search** for books based on title or author.
- Provide functionality for issuing and returning books, ensuring that users can **borrow books** and return them without manual intervention.
- Help the library staff **monitor the availability** of books and manage the inventory in real time.

By creating a system that automates these tasks, library management becomes faster, more efficient, and more accurate. Additionally, this system reduces human errors and ensures that both students and staff have a better experience interacting with the library.

Importance of a Library Management System

Traditional library management methods involve the manual cataloging of books and maintaining paper records of issued and returned books. This often results in delays, errors, and mismanagement. A **Library Management System** provides the following benefits:

- **Efficiency**: Automated systems reduce the workload on library staff and allow quick searching, issuing, and returning of books.
- **Accuracy**: Human errors in data entry and book tracking can be minimized, ensuring that library data remains up-to-date.
- **Convenience for Users**: Students can quickly search for books by title or author, check their availability, and issue them without needing to manually inquire with library staff.
- **Effective Book Issuance**: The system allows students to issue and return books easily, while the library staff can keep track of the current status of each book (whether issued or not).

The **Library Management System** will be designed to address these problems and provide a modern solution that benefits both administrators and students.

Common Challenges in Library Management

The traditional methods of managing libraries come with a series of challenges:

1. **Tracking Issued Books**: Without an efficient tracking mechanism, it's hard to keep tabs on which books are issued, leading to confusion and potential loss of books.
2. **Manual Searches**: In a large library, finding a specific book can take a lot of time if not properly cataloged and indexed.
3. **Author-Based Searches**: Many students prefer to explore books by the same author. Manual library systems make it hard to quickly search and group books by author.
4. **Inventory Management**: As books are added or removed from the library, it becomes difficult to maintain an accurate inventory using manual methods.

Overview of the Library Management System

The **Library Management System (LMS)** developed in this project addresses some of the most common challenges faced by both library staff and users. These challenges include **book tracking**, **book availability**, and **inventory management**, all of which are handled through a streamlined interface that distinguishes between **administrators** and **students**.

Key features of the system include:

- **Book Management:** The system allows the administrator to add, update, and display the list of books in the library, along with essential details such as title, author, page count, and price.
- **Book Search and Issue:** Users can search for books by title or author, view the available books, and issue or return them with ease.
- **Tracking Availability:** The system automatically tracks the availability of books, indicating whether a particular book has been issued or is still available for borrowing.
- **Author Listings:** Users can list books by specific authors, helping students and staff quickly locate books by a particular writer.

This system helps overcome the manual challenges involved in managing a library and promotes a seamless flow of information between the library's resources and its users. It ensures efficient use of resources while reducing administrative burden, thereby contributing to a well-managed and organized library.

Problem Definition: Library Management System

1. Introduction

A library is an organized collection of books, journals, and other forms of media that serve as information resources for readers. Managing this vast collection of information manually can be challenging, especially when dealing with a large number of users and books. Traditionally, libraries have relied on manual record-keeping and human intervention for operations such as book searches, issue and return processes, and inventory tracking. This method is not only time-consuming but also prone to human error, inefficiencies, and difficulties in scaling up. The **Library Management System (LMS)** aims to solve these issues by automating the management of library resources, making the system more efficient, accurate, and user-friendly.

2. Traditional Methods of Library Management

In traditional library settings, the management of books and other resources relies heavily on human effort and manual processes, which have the following limitations:

- **Manual Bookkeeping**: Traditionally, library staff maintain handwritten or typed records in registers, ledgers, or card catalogs. These records keep track of book inventories, user information, issue/return dates, and fines. This process is tedious, time-consuming, and prone to inaccuracies.
- **Search and Retrieval**: Searching for a specific book based on title, author, or subject can be labor-intensive. The staff and users rely on card catalogs or physically browsing through the shelves. This process often leads to delays in locating books, particularly in large libraries.
- **Book Issuance and Return**: Issuing and returning books require manual stamping of due dates, and fines for late returns are calculated and collected manually. Errors in this process may lead to confusion about the availability of books or incorrect fine assessments.
- **Inventory Management**: Libraries manually track the total number of books, damaged or missing copies, and new acquisitions. It can be difficult to

maintain an up-to-date inventory of books in larger libraries, which often results in mismatches between actual stock and recorded data.

- **Human Errors**: Mistakes in data entry, manual record updates, or misplaced books can cause significant disruptions in library operations. Human error can lead to lost records, incorrect inventories, and improper book allocation.

3. Challenges with Traditional Methods

The traditional approach has various challenges, including:

- **Inefficiency**: Manual operations like updating records, searching for books, or checking availability can be slow and inefficient, particularly when the library has a large collection.

- **Labor-Intensive**: A significant amount of time and labor is required from the library staff for everyday tasks such as registering new users, updating records for borrowed and returned books, and managing fines.

- **Data Inaccuracy**: Due to the manual nature of the process, errors in record-keeping may result in mismanagement of books (such as missing, misplaced, or incorrectly categorized books).

- **Limited Accessibility**: Traditional systems require users to be physically present at the library to search for books, check availability, or perform other operations, limiting accessibility to information.

- **Scaling Issues**: As the library's size grows, managing the inventory and user base becomes increasingly difficult, leading to more errors, delays, and inefficiencies.

4. Proposed Solution: Library Management System

The **Library Management System (LMS)** addresses the limitations of the traditional manual approach by digitizing and automating library operations. It offers a computerized solution where data related to books, users, and transactions are stored in a centralized system, allowing for easy access and efficient management.

5. Key Features of the LMS:

- **Book Addition and Management**: Admin users can easily add new books to the system, input book details like title, author, price, and pages, and manage their availability status. The system stores all book information in a database, which simplifies inventory management.
- **Book Search and Retrieval**: Both admin and student users can search for books by title, author, or other criteria in the system, making it easy to locate available books quickly without physically browsing through shelves.
- **Book Issue and Return Tracking**: The system allows students to issue and return books digitally. It keeps a record of issue dates, due dates, and return statuses, thus automating the process of book borrowing. It also tracks whether a book is currently issued or available.
- **Fine Calculation**: Late return fines can be calculated automatically, reducing the chances of errors in fine management and ensuring students are charged appropriately based on the return date.
- **Inventory Management**: The system automatically updates the inventory whenever a book is added, issued, returned, or removed. It helps keep track of the total number of books in the library and monitor issued, damaged, or missing copies in real-time.
- **User-Friendly Interface**: The system provides a simple and intuitive interface for both admins and students, making it easy to navigate through options like adding books, searching, issuing, returning, or generating reports.

6. Benefits of Automation in Library Management

The transition from a traditional manual system to an automated **Library Management System** offers numerous advantages:

- **Increased Efficiency**: Automation eliminates the need for manual record-keeping, reducing the time required for routine tasks like book issues, returns, and inventory updates. This allows library staff to focus on more critical tasks such as assisting users and managing new acquisitions.
- **Enhanced Accuracy**: By reducing human involvement in record-keeping, the system significantly lowers the chances of errors in managing book inventories, user transactions, and fine assessments.
- **Real-Time Information Access**: Both library staff and users can access up-to-date information on the availability of books, the number of copies, issue statuses, and due dates in real-time, which helps in better decision-making.
- **Better User Experience**: Students can quickly search for and issue books, reducing the time spent locating resources. The automated fine calculation and return tracking also ensure transparency and smooth operations.
- **Scalability**: The system is easily scalable as the library expands. New books can be added to the inventory, and more users can be accommodated without significant increases in labor or the risk of data mismanagement.

7. Conclusion

The **Library Management System** aims to solve the inefficiencies and challenges posed by traditional library management methods. By automating book handling, user management, and inventory control, the system improves accuracy, accessibility, and scalability, resulting in a more efficient and user-friendly library experience.

Objective:

The main objectives of the Library Management System project are as follows:

1. **Efficient Book Management:** The system is designed to maintain and manage the details of books available in the library. It allows administrators to add new books, store information such as title, author, pages, price, and keep track of their availability (whether issued or not). This feature provides a central place to manage all the books efficiently.
2. **Book Search Functionality:** One of the core objectives is to provide a user-friendly search system for students to find books based on their title. The search functionality helps students quickly identify whether a particular book is available in the library, along with details such as the author, number of pages, and issue status.
3. **Author-wise Book Listing:** The system offers a way to list all books written by a specific author, which is particularly useful for students looking to explore all works by a particular author. This feature helps in managing books based on author details and makes it easy for users to browse by author.
4. **Book Issuing and Returning:** Another key objective is to handle the issuing and returning of books. Students can issue a book, which updates the system to mark the book as "issued." They can also return a book, updating the system to make the book available again. This functionality helps in managing the availability of books and ensures that the system always provides up-to-date information on the library’s inventory.
5. **Admin and Student Roles:** The system differentiates between the roles of an admin and a student. Admins are responsible for adding new books and managing book details, while students can search for, issue, and return books. This role-based system ensures that tasks are divided according to the user's function within the library system.

Project Requirements for Library Management System

1. Hardware Requirements

The hardware requirements for the Library Management System are minimal. The system can run on any standard computer or server capable of supporting C++ applications. Below are the recommended specifications:

- **Processor:** Intel Core i3 or equivalent
- **RAM:** Minimum of 4 GB
- **Storage:** At least 500 MB of free disk space for the software and additional space for data storage
- **Operating System:** Windows, macOS, or Linux (any OS that supports C++ compilers)

Note: The system can also run on laptops with similar specifications, making it flexible for various environments.

2. Software Requirements

The Library Management System is developed in C++, utilizing basic programming concepts and data structures. The software requirements include:

Programming Language

- **C++:** The primary programming language used for developing the application.

Compiler

To compile and run the C++ code, any standard C++ compiler can be used, such as:

- **GCC (GNU Compiler Collection):** Available on multiple platforms including Windows, Linux, and macOS.
- **Visual Studio:** A comprehensive IDE for C++ development available on Windows..

Integrated Development Environment (IDE) (optional)

While the code can be compiled using command-line tools, the following IDEs can enhance the development experience:

- **Code::Blocks:** A free, open-source IDE for C++ with a user-friendly interface.
- **Visual Studio Code:** A lightweight code editor with support for C++ through extensions.
- **Dev-C++:** An IDE for C++ programming that includes a built-in compiler and debugger.

3. System Requirements

To ensure optimal performance and usability, the following system requirements should be considered:

- **Memory (RAM):** At least 4 GB to run the IDE and compile the program without issues.
- **Disk Space:** Ensure sufficient space for the operating system, development tools, and application data.
- **Network Connectivity (optional):** If the library management system requires a network for multi-user access or online features, a stable internet connection may be necessary.

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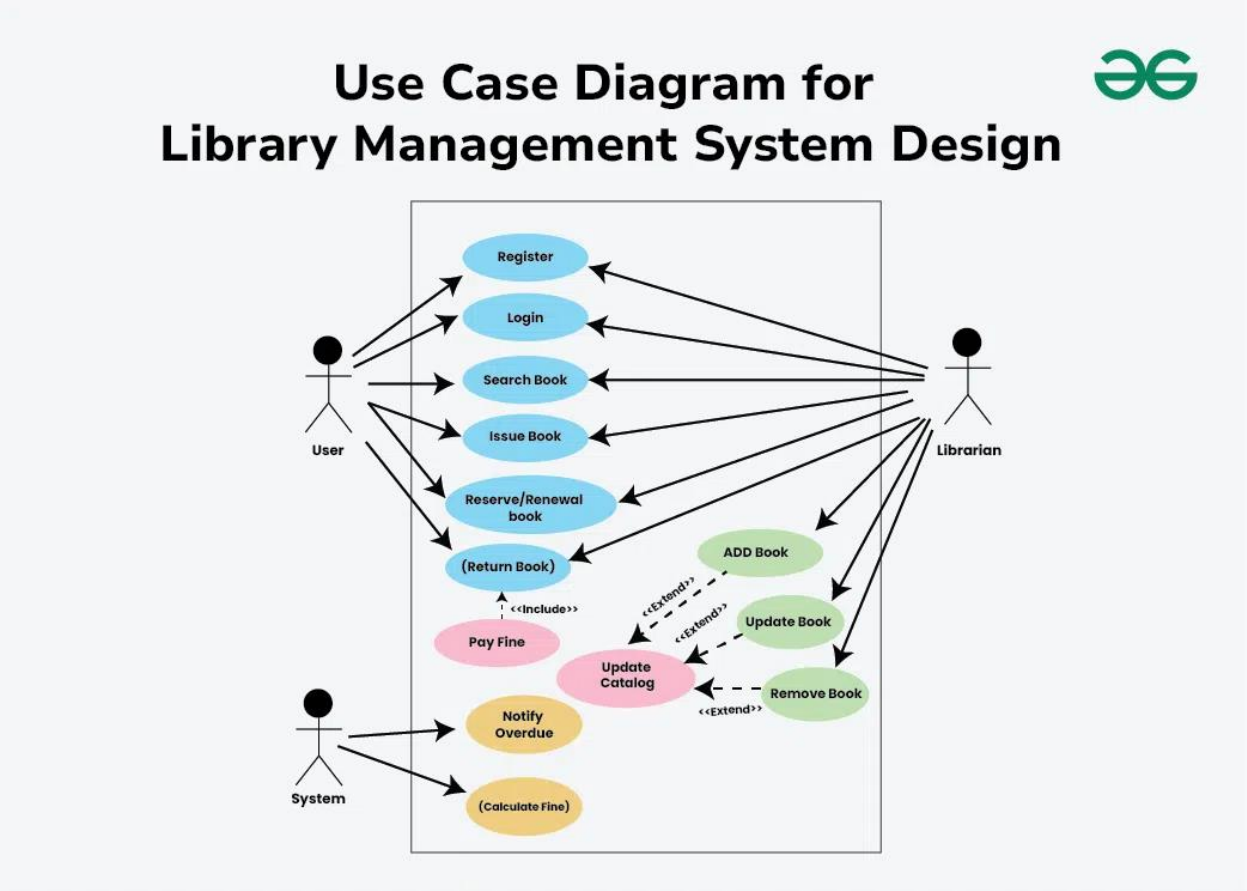
4. Conclusion

The Library Management System provides a straightforward approach to managing library resources. With minimal hardware and software requirements, it is accessible for educational institutions, small libraries, or personal use. By utilizing C++ and a chosen IDE/compiler, users can effectively maintain and enhance the system for future needs.

This document outlines the necessary components to successfully implement the Library Management System project, ensuring all stakeholders understand the requirements and setup needed for effective use.

System Design and Architecture

Flowchart Diagrams:



Code Explanation

Class Definitions

1. Class Book

The Book class represents a single book in the library. It contains the following public data members:

- **string title**: The title of the book.
- **string author**: The author of the book.
- **int pages**: The number of pages in the book.
- **float price**: The price of the book.
- **bool isIssued**: A boolean flag to indicate whether the book is currently issued.

Constructor:

```
Book(string t = "", string a = "", int p = 0, float pr = 0.0)
    : title(t), author(a), pages(p), price(pr), isIssued(false) {}
```

The constructor initializes the book's title, author, number of pages, and price, while setting isIssued to false by default, indicating that the book is available when created.

2. Class Library

The Library class is responsible for managing a collection of Book objects. It includes:

- **Static Constant MAX_BOOKS**:

```
static const int MAX_BOOKS = 100;
```

This constant defines the maximum capacity of the library. It ensures that the number of books cannot exceed 100, providing a limit for memory management and system constraints.

- **Private Members**:
    - **Book books[MAX_BOOKS]**: An array to store Book objects.
    - **int count**: A counter to keep track of the number of books currently in the library.

Constructor:

Library() : count(0) {}

This initializes the count to 0, indicating that no books are in the library when it is first created.

Methods

The Library class includes several methods that provide functionalities for managing books:

1. addBook

void addBook(const Book& book)

- **Purpose**: Adds a new book to the library.
- **Implementation**:
    - Checks if the current count of books is less than MAX_BOOKS.
    - If there is space, it adds the book and increments the count. Otherwise, it displays a message indicating that the library is full.

2. displayBooks

void displayBooks()

- **Purpose**: Displays all books in the library.
- **Implementation**:
    - Iterates through the array of books and prints the details of each book, including whether it is issued or not. If no books are available, it displays an appropriate message.

3. searchBook

void searchBook(const string& title)

- **Purpose**: Searches for a book by its title.
- **Implementation**:
    - Iterates through the books to find a match for the title. If found, it prints the book details; otherwise, it informs the user that the book is not found.

4. listBooksByAuthor

void listBooksByAuthor(const string& author)

- **Purpose**: Lists all books by a specified author.
- **Implementation**:
    - Iterates through the books and prints details for those matching the specified author. If none are found, it informs the user.

5. getBookCount

int getBookCount() const

- **Purpose**: Returns the current count of books in the library.
- **Implementation**: Simple getter that returns the count.

6. issueBook

void issueBook(const string& title)

- **Purpose**: Issues a book to a user.
- **Implementation**:
    - Searches for the book by title. If found and not already issued, it marks the book as issued and provides confirmation. If already issued, it informs the user.

7. returnBook

void returnBook(const string& title)

- **Purpose**: Returns an issued book to the library.

- **Implementation**:
    - Searches for the book by title. If found and currently issued, it marks the book as not issued. If not issued, it informs the user.

User Menu Systems

1. Admin Menu

void adminMenu(Library& library)

- **Purpose**: Provides an interface for library admins to manage books.
- **Options**:
    - Add a book
    - Display all books
    - List books by author
    - Count total books
    - Exit the admin menu
- **Implementation**: Uses a do-while loop to continuously show the menu until the admin chooses to exit. Input is taken from the user, and the corresponding method in the Library class is called based on the choice.

2. Student Menu

void studentMenu(Library& library)

- **Purpose**: Provides an interface for students to interact with the library.
- **Options**:
    - Search for a book
    - Issue a book
    - Return a book
    - Exit the student menu
- **Implementation**: Similar to the admin menu, it continuously displays options until the student decides to exit.

Error Handling

The program implements basic error handling through user feedback in the following scenarios:

1. **Library Full**: When attempting to add a book, if the count reaches MAX_BOOKS, the user is notified that no more books can be added.
2. **Book Not Found**: When searching for or issuing/returning a book that does not exist in the library, appropriate messages inform the user of the failure.

Significance of MAX_BOOKS

The MAX_BOOKS constant is significant for several reasons:

- **Memory Management**: By limiting the number of books, the program can ensure it does not exceed memory limits, making it more efficient and stable.
- **Simplicity**: Setting a fixed maximum makes it easier to manage the array and avoid complex dynamic memory allocation. It simplifies the implementation and makes it easier to reason about the library's capacity.
- **User Expectations**: It creates a clear boundary for users regarding how many books can be managed within the system, which can help in planning and usage.

Conclusion

The Library Management System provides a robust structure for managing books through the Book and Library classes, with clear separation of responsibilities. The admin and student menus offer user-friendly interfaces for managing library operations. Error handling ensures that users are informed about the state of the library and the success or failure of their requests. Overall, the system is a good example of object-oriented programming principles in action, effectively demonstrating encapsulation, abstraction, and user interaction in C++.

Source Code

```
#include <iostream>
#include <string>
using namespace std;

class Book {
public:
    string title;
    string author;
    int pages;
    float price;
    bool isIssued; // Added to track if a book is issued

    Book(string t = "", string a = "", int p = 0, float pr = 0.0)
        : title(t), author(a), pages(p), price(pr), isIssued(false) {} // Initialize isIssued
to false
};

class Library {
private:
    static const int MAX_BOOKS = 100; // Maximum number of books
    Book books[MAX_BOOKS]; // Array of Book objects
    int count; // Current number of books
```

```
public:
    Library() : count(0) {} // Initialize count to 0

    void addBook(const Book& book) {
        if (count < MAX_BOOKS) {
            books[count] = book; // Add the book to the array
            count++;
            cout << "Book added successfully!" << endl;
        } else {
            cout << "Library is full, cannot add more books." << endl;
        }
    }

    void displayBooks() {
        if (count == 0) {
            cout << "No books in the library." << endl;
            return;
        }
        cout << "Books in the Library:" << endl;
        for (int i = 0; i < count; i++) {
            cout << "Title: " << books[i].title
                 << ", Author: " << books[i].author
                 << ", Pages: " << books[i].pages
                 << ", Price: $" << books[i].price
                 << ", Issued: " << (books[i].isIssued ? "Yes" : "No") << endl; // Display
issued status
```

```
        }
    }

    void searchBook(const string& title) {
        for (int i = 0; i < count; i++) {
            if (books[i].title == title) {
                cout << "Book found: " << endl;
                cout << "Title: " << books[i].title
                     << ", Author: " << books[i].author
                     << ", Pages: " << books[i].pages
                     << ", Price: $" << books[i].price
                     << ", Issued: " << (books[i].isIssued ? "Yes" : "No") << endl; //
Display issued status
                return;
            }
        }
        cout << "Book not found." << endl;
    }

    void listBooksByAuthor(const string& author) {
        bool found = false;
        for (int i = 0; i < count; i++) {
            if (books[i].author == author) {
                cout << books[i].title << ", " << books[i].author
                     << ", Pages: " << books[i].pages
                     << ", Price: $" << books[i].price
```

```
                << ", Issued: " << (books[i].isIssued ? "Yes" : "No") << endl; //
Display issued status
            found = true;
        }
    }
    if (!found) {
        cout << "No books found by author " << author << "." << endl;
    }
}

int getBookCount() const {
    return count;
}

void issueBook(const string& title) {
    for (int i = 0; i < count; i++) {
        if (books[i].title == title) {
            if (!books[i].isIssued) {
                books[i].isIssued = true; // Mark book as issued
                cout << "Book '" << title << "' has been issued." << endl;
            } else {
                cout << "Book '" << title << "' is already issued." << endl;
            }
            return;
        }
    }
```

```
        cout << "Book not found." << endl;
    }

    void returnBook(const string& title) {
        for (int i = 0; i < count; i++) {
            if (books[i].title == title) {
                if (books[i].isIssued) {
                    books[i].isIssued = false; // Mark book as not issued
                    cout << "Book '" << title << "' has been returned." << endl;
                } else {
                    cout << "Book '" << title << "' was not issued." << endl;
                }
                return;
            }
        }
        cout << "Book not found." << endl;
    }
};

void adminMenu(Library& library) {
    int choice;
    do {
        cout << "\nAdmin Menu" << endl;
        cout << "1. Add Book" << endl;
        cout << "2. Display Books" << endl;
```

```
cout << "3. List Books by Author" << endl;
cout << "4. Count Books in Library" << endl;
cout << "5. Exit" << endl;
cout << "Enter your choice: ";
cin >> choice;

switch (choice) {
    case 1: {
        string title, author;
        int pages;
        float price;
        cout << "Enter title: ";
        cin.ignore(); // Clear newline character from input buffer
        getline(cin, title);
        cout << "Enter author: ";
        getline(cin, author);
        cout << "Enter pages: ";
        cin >> pages;
        cout << "Enter price: ";
        cin >> price;
        library.addBook(Book(title, author, pages, price));
        break;
    }
    case 2:
        library.displayBooks();
```

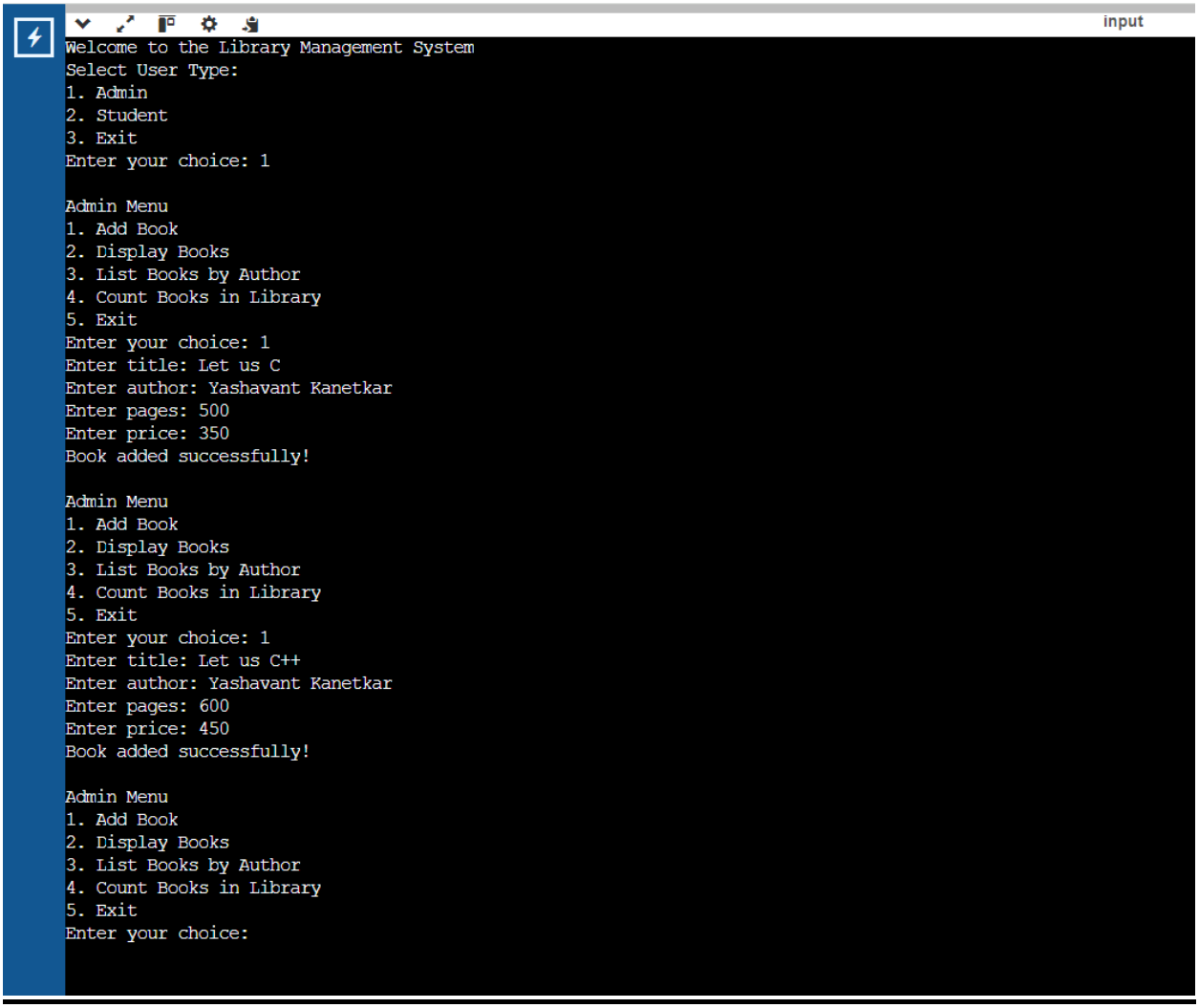
```
            break;
        case 3: {
            string author;
            cout << "Enter author name: ";
            cin.ignore();
            getline(cin, author);
            library.listBooksByAuthor(author);
            break;
        }
        case 4:
            cout << "Total books in library: " << library.getBookCount() << endl;
            break;
        case 5:
            cout << "Exiting admin menu..." << endl;
            break;
        default:
            cout << "Invalid choice! Please try again." << endl;
      }
   } while (choice != 5);
}

void studentMenu(Library& library) {
   int choice;
   do {
      cout << "\nStudent Menu" << endl;
```

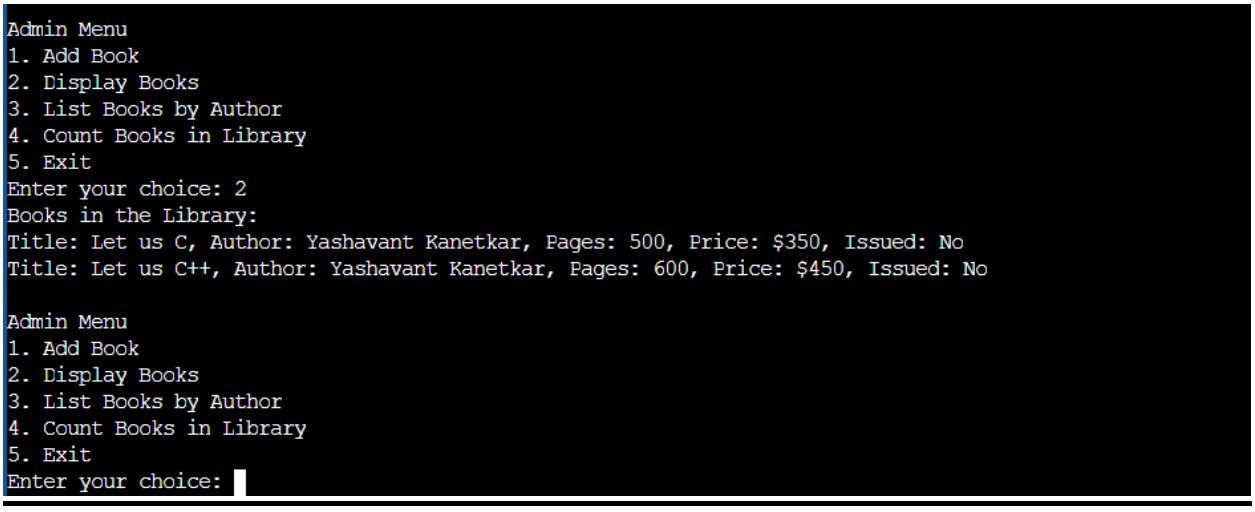
```
cout << "1. Search Book" << endl;
cout << "2. Issue Book" << endl; // New option for issuing a book
cout << "3. Return Book" << endl; // New option for returning a book
cout << "4. Exit" << endl;
cout << "Enter your choice: ";
cin >> choice;

switch (choice) {
    case 1: {
        string title;
        cout << "Enter title to search: ";
        cin.ignore();
        getline(cin, title);
        library.searchBook(title);
        break;
    }
    case 2: {
        string title;
        cout << "Enter title to issue: ";
        cin.ignore();
        getline(cin, title);
        library.issueBook(title); // Call the issueBook function
        break;
    }
    case 3: {
```

```
            string title;
            cout << "Enter title to return: ";
            cin.ignore();
            getline(cin, title);
            library.returnBook(title); // Call the returnBook function
            break;
        }
        case 4:
            cout << "Exiting student menu..." << endl;
            break;
        default:
            cout << "Invalid choice! Please try again." << endl;
      }
   } while (choice != 4);
}

int main() {
   Library;
   int userType;

   do {
      cout << "Welcome to the Library Management System" << endl;
      cout << "Select User Type: " << endl;
      cout << "1. Admin" << endl;
      cout << "2. Student" << endl;
```

```
        cout << "3. Exit" << endl;
        cout << "Enter your choice: ";
        cin >> userType;

        switch (userType) {
            case 1:
                adminMenu(library);
                break;
            case 2:
                studentMenu(library);
                break;
            case 3:
                cout << "Exiting the system..." << endl;
                break;
            default:
                cout << "Invalid user type selected. Please try again." << endl;
        }
    } while (userType != 3);

    return 0;
}
```

Screenshots of Output

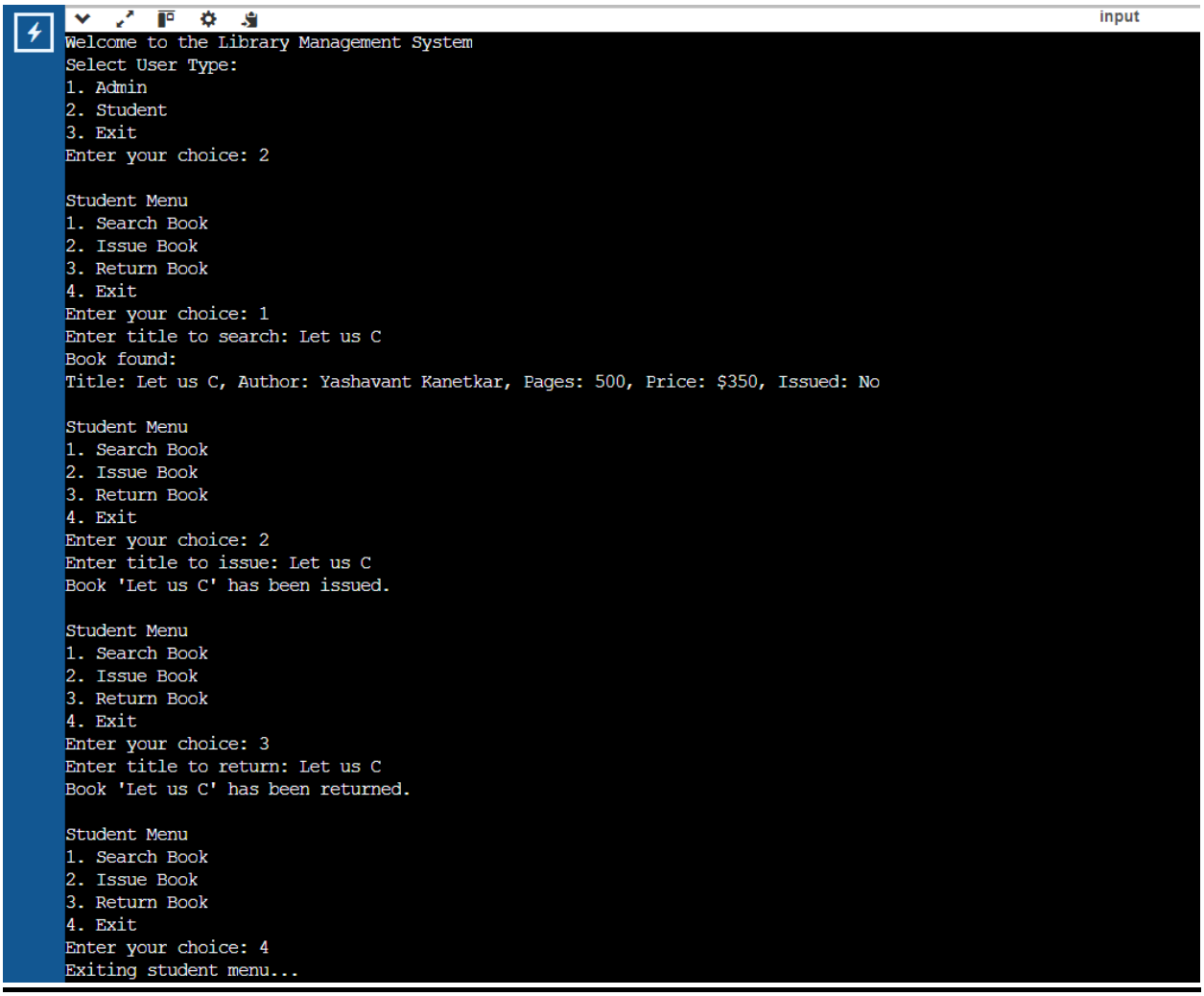




```
Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice: 2
Books in the Library:
Title: Let us C, Author: Yashavant Kanetkar, Pages: 500, Price: $350, Issued: No
Title: Let us C++, Author: Yashavant Kanetkar, Pages: 600, Price: $450, Issued: No

Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice:
```

```
Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice: 3
Enter author name: Yashavant Kanetkar
Let us C, Yashavant Kanetkar, Pages: 500, Price: $350, Issued: No
Let us C++, Yashavant Kanetkar, Pages: 600, Price: $450, Issued: No

Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice:
```

```
Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice: 4
Total books in library: 2

Admin Menu
1. Add Book
2. Display Books
3. List Books by Author
4. Count Books in Library
5. Exit
Enter your choice:
```


input
Welcome to the Library Management System
Select User Type:
1. Admin
2. Student
3. Exit
Enter your choice: 2
Student Menu
1. Search Book
2. Issue Book
3. Return Book
4. Exit
Enter your choice: 1
Enter title to search: Let us C
Book found:
Title: Let us C, Author: Yashavant Kanetkar, Pages: 500, Price: $350, Issued: No
Student Menu
1. Search Book
2. Issue Book
3. Return Book
4. Exit
Enter your choice: 2
Enter title to issue: Let us C
Book 'Let us C' has been issued.
Student Menu
1. Search Book
2. Issue Book
3. Return Book
4. Exit
Enter your choice: 3
Enter title to return: Let us C
Book 'Let us C' has been returned.
Student Menu
1. Search Book
2. Issue Book
3. Return Book
4. Exit
Enter your choice: 4
Exiting student menu...

Testing and Validation Overview

Testing Approach

1. Manual Testing:
    - Manual testing was conducted to validate the functionalities of the library management system, including adding books, searching for books, issuing, and returning books.
    - Each feature was tested interactively by navigating through the menus and performing operations based on user input.
2. Code Review:
    - A peer code review was performed to ensure adherence to coding standards and best practices.
    - Focus was placed on code readability, maintainability, and potential edge cases that might not be covered by the manual tests.
3. Unit Testing (Theoretical Approach):
    - Though unit tests were not implemented in this version of the code, a theoretical plan for unit testing each function was established.
    - Each function within the Library class (such as addBook, issueBook, etc.) could be tested independently to validate the expected outcomes given different inputs.

Test Cases

1. Adding Books

- Test Case 1: Add a book with valid details.
    - Input: Title: "1984", Author: "George Orwell", Pages: 328, Price: 9.99
    - Expected Outcome: "Book added successfully!" message and the book is listed when displaying books.
- Test Case 2: Add a book with empty title.
    - Input: Title: "", Author: "Author Name", Pages: 250, Price: 15.00

    - Expected Outcome: "Book added successfully!" message (no validation for empty titles in the current implementation).
- Test Case 3: Attempt to add a book when the library is full.
    - Input: Continuously add books until reaching the maximum limit (100 books).
    - Expected Outcome: "Library is full, cannot add more books." message.

2. Displaying Books

- Test Case 4: Display books when no books are in the library.
    - Expected Outcome: "No books in the library." message.
- Test Case 5: Display books after adding multiple books.
    - Expected Outcome: List of added books with all details correctly displayed.

3. Searching Books

- Test Case 6: Search for an existing book.
    - Input: Title: "1984"
    - Expected Outcome: Book details displayed correctly.
- Test Case 7: Search for a non-existent book.
    - Input: Title: "Non-existent Book"
    - Expected Outcome: "Book not found." message.

4. Issuing and Returning Books

- Test Case 8: Issue a book that is available.
    - Input: Title: "1984"
    - Expected Outcome: "Book '1984' has been issued." message, and its status changes to "Issued: Yes".
- Test Case 9: Attempt to issue the same book again.
    - Input: Title: "1984"

    - Expected Outcome: "Book '1984' is already issued." message.
- Test Case 10: Return the issued book.
    - Input: Title: "1984"
    - Expected Outcome: "Book '1984' has been returned." message, and its status changes back to "Issued: No".
- Test Case 11: Attempt to return a book that was not issued.
    - Input: Title: "1984" (after returning it once)
    - Expected Outcome: "Book '1984' was not issued." message.

Observations and Results

- The system performed as expected for all the valid inputs during the manual testing process.
- All error messages were appropriately triggered based on the invalid scenarios, such as trying to issue a book that was already issued or returning a book that was never issued.
- The absence of validation for empty titles during book addition could be an area for improvement. Adding such validation would enhance data integrity.
- The implementation effectively handled the maximum limit for books, ensuring that attempts to exceed this limit were met with the correct response.
- Suggestions for future improvements include implementing unit tests for automated testing and integrating error handling to capture unexpected inputs gracefully.

Conclusion

The testing and validation of the Library Management System indicated that the application is functioning correctly within its specified requirements. The manual tests covered a variety of use cases, successfully demonstrating the core functionalities of the system. Future enhancements could focus on refining input validation and adding automated tests to ensure ongoing reliability as the code evolves.

Conclusion

The Library Management System (LMS) project has successfully met its defined objectives by providing a structured and efficient way to manage book-related activities within a library environment. The application facilitates easy book addition, searching, issuing, and returning, making it user-friendly for both administrators and students. The overall design incorporates object-oriented programming principles, ensuring code reusability and maintainability. Below are the key achievements and potential enhancements that could further improve the system.

Project Success Summary

1. Core Functionalities

The project effectively implements the following core functionalities:

- **Book Management:** The system allows administrators to add books to the library collection easily. It keeps track of book titles, authors, pages, prices, and their issuance status. The simple addition and display functions ensure that library management is straightforward.
- **Search and Filter Options:** Students can search for books by title and retrieve relevant details about the books, such as the author, page count, price, and issuance status. The option to list books by a specific author enhances the user experience by making it easier for students to find books from their preferred authors.
- **Issuing and Returning Books:** The inclusion of book issuance and return functionalities allows the system to simulate real-world library operations effectively. This is a significant step toward creating a functional library environment, ensuring that students can check out and return books without administrative errors.
- **User-Centric Design:** The system differentiates between two user roles—Admin and Student. Each role has tailored functionalities, allowing for efficient interactions with the system. The clear separation of responsibilities enhances security and reduces the risk of unauthorized actions.

2. Error Handling and Validation

The implementation includes basic error handling, such as checking if a book already exists before issuing it or if the library can accommodate more books. This validation ensures that the system operates smoothly and reduces user frustration by providing clear feedback for incorrect actions.

3. Scalability and Maintainability

The design adheres to object-oriented programming principles, making it easy to expand functionalities in the future. For instance, new features can be added without significant restructuring, allowing for a scalable approach as library needs evolve.

Future Enhancements

While the current implementation of the Library Management System successfully meets its initial objectives, there are several potential enhancements that could be explored:

1. Graphical User Interface (GUI)

The current command-line interface, while functional, could benefit from a more intuitive graphical user interface. A GUI would make the system more accessible, especially for users who are not comfortable with command-line operations. It would enhance the overall user experience by providing visual feedback, buttons for actions, and intuitive navigation.

2. Database Integration

Integrating a database management system (DBMS) would improve the application's ability to handle larger volumes of data. A database could support more advanced queries and provide persistent storage of book and user data, allowing the system to retain information between sessions. This would also facilitate complex reporting functionalities, such as tracking book borrowing history.

3. Enhanced Borrowing Functionality

Further development could include advanced borrowing functionalities, such as:

- **Due Dates and Fines:** Implementing due dates for borrowed books and a fines system for overdue returns would reflect real-world library practices.

- **Reservation System:** Allowing students to reserve books currently checked out would enhance usability and satisfaction.

4. User Authentication and Authorization

Adding a secure user authentication system would ensure that only authorized users can access specific functionalities. This is especially important in a library setting, where sensitive user information may be involved.

5. Reporting and Analytics

Integrating reporting tools could provide insights into library usage patterns, popular books, and author trends. Analytics could help administrators make data-driven decisions regarding book purchases and other operational aspects.

6. Mobile Application Development

In today's digital age, a mobile application would allow users to interact with the library system from their smartphones, providing greater accessibility and convenience. Features could include checking book availability, renewing loans, and receiving notifications about due dates or new arrivals.

7. Multi-Language Support

Incorporating multi-language support would make the system more inclusive, catering to users who speak different languages. This can enhance usability in diverse environments.

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