

INTELLIGENT LIBRARY MANAGEMENT SYSTEM

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TADEPALLIGUDEM-534101, INDIA

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INTELLIGENT LIBRARY MANAGEMENT SYSTEM

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of

Bachelor of Technology

by

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Date: _____

CERTIFICATE

It is certified that the work contained in the report titled “**INTELLIGENT LIBRARY MANAGEMENT SYSTEM**” by “VISWA KIRAN ANDRAJU, bearing Roll No: 421273” and “KUMMITHI THARUN SAI KUMAR REDDY, bearing Roll No: 421204” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

Signature

Dr. KARTHICK S

DCSE

N.I.T. Andhra Pradesh

May, 2023

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LIST OF FIGURES

S.No	FIGURE NAME	PAGE NO.
1.	Home Page	5
2.	Login Page	5
3.	Library Info	6
4.	Admin Page	7
5.	Adding Students	7
6.	Adding Books	8
7.	Issuing Books	8
8.	Returning Books	9
9.	Searching Students	9
10.	Viewing Books	10
11.	Viewing Students	10
12.	Removing Students	11
13.	Removing Books	11
14.	Issue Fines	12
15.	Removing Fines	12
16.	Viewing Fines	13
17.	Searching Log Record	13
18.	Viewing Log Record	13
19.	Student Page	14
20.	Viewing Student Issued Books	14
21.	Viewing Books	15
22.	Viewing Fines	15
23.	Viewing Student Log Record	16
24.	Relation Schema for Database	17
25.	Feature Detection	18
26.	Feature Matching	19

Abstract

The Intelligent Library Management System project aims to develop a comprehensive library management system that uses the latest web technologies and computer vision algorithms to efficiently and accurately manage library resources. The system is designed to address the challenges associated with traditional library management systems by integrating inventory management, student management and book classification functions. This project is a web-based application built using HTML, CSS, JavaScript, and Node.js for the front end and MySQL for the back end. The system provides an easy-to-use interface that allows students and librarians to easily browse and access library resources. The system's inventory management features ensure that library inventories are current by allowing librarians to add, modify, and delete book records. Additionally, the system's book classification feature uses computer vision algorithms to automatically classify books by subject and genre, making it easier for librarians to find books on each shelf. The project's student management features allow librarians to manage student records and borrowing histories, including book issuance and return. The system keeps records of all books published and returned, and produces detailed reports on all expired books. The system also includes a student log feature that records when students enter and leave the library and provides librarians with information on student attendance patterns. By using computer vision technology in the project, the system can efficiently classify books based on genre, subject matter, and shelf placement. The system captures images of returned books with cameras and uses computer vision algorithms to process the images and locate the books on the shelf. This system eliminates the need for manual classification and frees librarians to focus on other important tasks. In summary, a library management system is a comprehensive solution that provides an efficient and precise approach to library resource management. The system uses computer vision algorithms to ensure that books are accurately categorized and placed on their respective shelves. The Student Management feature also provides librarians with a convenient and reliable way to manage student files and track book borrowing history. With an intuitive interface and robust feature set, this project is poised to revolutionize the way libraries are managed and improve the user experience for both students and librarians.

Contents

1	Introduction	1
2	Functional Specifications	2
2.1	Student Management	2
2.1.1	Add Students	2
2.1.2	Remove Students	2
2.1.3	Viewing Students Info	2
2.1.4	Viewing Books for students	2
2.2	Books Management	2
2.2.1	Add Books	2
2.2.2	Remove Books	3
2.3	Stock Management	3
2.4	Issuing and returning books	3
2.4.1	Issuing Books	3
2.4.2	Returning Books	3
2.5	Fines management	3
2.6	Search functionality	3
2.6.1	Searching based on books	3
2.6.2	Searching based on students	4
2.7	Student Log	4
2.7.1	Entering Library	4
2.7.2	Exiting Library	4
2.8	OpenCV integration	4
3	Workflow	5
3.1	Home Page	5
3.1.1	Authorization Login	5
3.1.2	Captcha	6
3.1.3	Library Info - About Us	6
3.1.4	Library Info - Library Timings	6
3.1.5	Library Info - Contact Us	6
3.2	Admin Page	7
3.2.1	Adding Students	7
3.2.2	Adding Books	8
3.2.3	Issuing Books	8
3.3	Returning Books	9
3.3.1	Searching Students	9
3.3.2	Viewing Books	10
3.4	Viewing Students	10
3.4.1	Removing Students	10
3.4.2	Remove Books	11
3.4.3	Issue Fines	11
3.4.4	Remove Fines	12
3.4.5	Viewing Fines	12
3.4.6	Student Log	13

4 Student Page	14
4.0.1 Viewing Issued Books	14
4.0.2 Viewing Books in Library	14
4.0.3 Viewing Fines	15
4.0.4 Viewing Student Log Records	15
5 Tech Stack	16
5.1 Frontend	16
5.2 Backend	16
5.3 MySQL Database	17
5.4 OpenCV	18
5.4.1 Feature detection and description	18
5.4.2 ORB Algorithm	18
5.4.3 Brute-Force k-th Nearest Neighbor Matcher	19
5.4.4 Benefits of Using OpenCV in Library Management	19
5.5 Conclusion	20
6 References	20

1 Introduction

The traditional library management system is a manual process that involves keeping track of books and their borrowers using pen-and-paper methods. This process is time-consuming and prone to errors, resulting in wasting resources. Additionally, the system does not provide an efficient way to monitor the status of books, including their availability and location. The system also lacks inventory management system to help librarians easily track the status of books, manage stock levels and order new books when needed.

The disadvantages in the traditional library management system lead to several issues such as lost or misplaced books, delayed book returns, inaccurate inventory counts, and difficulty in identifying books that require maintenance or repair. Additionally, students may waste their valuable time, they come to borrow the book which is in high demand from library and find out that the book is not available.

To address these issues, a more efficient and automated system is needed. This system should be able to track the status of books in real-time, provide instant updates on the availability and location of books, and automate key library management functions such as inventory management, book issues and book returns. Such a system would save librarians time and effort, improve the overall borrowing experience for students, and help to ensure that the library remains a valuable community resource for years to come.

This project is a modern Library Management System designed to automate the day-to-day operations of a library. It is a web-based application that provides a user-friendly interface for students, librarians, and administrators to access and manage library resources. The project is built using HTML, CSS, JavaScript, Node.js and MySQL.

The main goal of the project is to simplify the traditional library management system and make it more efficient. The system is designed to handle all the basic library functions such as book issuing, returning, and managing stock. It also allows librarians to keep track of student records, book records, book issue/return records and student log records.

The project additionally increases the productivity of the librarians by decreasing the workload. Once the books are returned by the students, it is librarian to place the books into the rack where the cluster of books are grouped or organized. OpenCV helps us by giving rack number the books that have to be placed by using preprocessed data given by the librarian. The duty of librarian is to scan and place the book in the respective rack.

2 Functional Specifications

2.1 Student Management

In the project, student management is an essential part of the library management system. The system allows the librarian to keep track of student information, including their personal details, borrowing history, current status of borrowed books, returned books history and fines.

2.1.1 Add Students

The system provides admin an interface to add new students to the library database. The interface requires the following information: student ID, name, email, phone number, and gender. The system then validates the entered data to ensure it is in the correct format and matches the database schema. The system should check for duplicate student IDs and display an error message if a duplicate is found. Once the information is validated, the system should insert the new student record into the students table in the database.

2.1.2 Remove Students

The system provides admin an interface to remove existing students from the library database. The interface requires the student ID of the student to be removed. The system checks if the student ID exists in the students table in the database. If the student ID exists, the system should display a confirmation message to ensure the correct student is being removed. Once the removal is confirmed, the system should delete the corresponding student record from the students table in the database.

2.1.3 Viewing Students Info

The system provides admin an interface to view existing students from the library database. The interface requires the student ID of the student to be viewed. The system checks if the student ID exists in the students table in the database. If the student ID exists, the system would display the books borrowed, books returned, library log record of the student, fines of the student to be paid if any.

2.1.4 Viewing Books for students

The system provides students an interface to view existing books from the library database with smaller view of the database. The interface requires the login of the student into his account. Then student can view his/her own issued books and total books in the library along with the availability of each book.

2.2 Books Management

The project allows librarian to manage books in the library. They can add and delete books and maintain their inventory. The system also provides the option to classify books based on subjects, authors, publishers, and ISBN numbers.

2.2.1 Add Books

The project system allows librarians to add new books to the library's collection. The librarian selects the "Add Book" option from the admin dashboard. The librarian enters the book's title, author, ISBN, publisher, publication date, edition, subject, category, quantity, availability, and rack number in the appropriate fields. The system validates the entered data to ensure that all required fields are filled and that the ISBN is unique. If the validation is successful, the system adds the book to the books table in the database and updates the inventory count. If the validation fails, the librarian is prompted to correct the errors and resubmit the information.

2.2.2 Remove Books

The librarian selects the "Remove Book" option from the main menu. The librarian enters the book's id in the appropriate field. The system validates the entered data to ensure that the ISBN exists in the books table. If the validation is successful, the system prompts the librarian to confirm the removal of the book. If the confirmation is received, the system removes the book from the books table in the database and updates the inventory count. If the confirmation is not received, the librarian can cancel the operation.

2.3 Stock Management

Stock management of books is an important part of library management systems. It involves maintaining the inventory of books, keeping track of their availability, and ensuring that there are enough copies of each book to meet the demand. Stock management of books involves several tasks, such as receiving new books, updating inventory and removing damaged or outdated books.

2.4 Issuing and returning books

The project provides a simple and easy way for users to borrow and return books. Librarians can issue books to users and set the due date. When a book is returned, the system updates the stock level and records the return date.

2.4.1 Issuing Books

The system allows librarians to issue books to students who need the book. The librarian selects the "Issue Book" option from the admin dashboard. The librarian enters the issue ID, student's ID, book's ID, date of borrowing and due date to return the book in the appropriate fields. The system validates the entered data to ensure that the student and book exist in the student and book tables. The system also checks if the book is available for issuing. If the validation is successful, the system updates the issuing table in the database with the student and book information and update the book availability in the books table.

2.4.2 Returning Books

The system allows students to return books they have borrowed from the library. The librarian selects the "Return Book" option from the admin dashboard. The librarian enters the return ID, book's ID and returned date in the appropriate fields. The system validates the entered data to ensure that the student and book exist in the student and book tables and that the student has issued the book. If the validation is successful, the system updates the returning table in the database with the student and book information and updates the book availability in the books table. The system also records the transaction in the student log table and calculates any fines, if any, based on the return date and due date. The librarian can then access the fines table to manage any outstanding fines.

2.5 Fines management

The project allows librarians to manage fines for late returns. The system calculates the fine based on the due date and the actual return date. The librarian can view and collect the fines from students.

2.6 Search functionality

2.6.1 Searching based on books

The project provides an efficient search function for librarian and students to find books based on various criteria such as title, author, subject and ISBN number.

2.6.2 Searching based on students

The project provides an efficient search function for librarian to find students based on various criteria such as roll number, issued and returned books.

2.7 Student Log

The student log feature in the project is designed to keep track of the students who enter and exit the library. The student log feature also enables the library staff to search for the log of a particular student using their ID. They can easily retrieve the entry and exit times of the student, which can help them monitor the student's activity in the library.

2.7.1 Entering Library

When a student enters the library, they will tell their student id number to the librarian . The system will then log the student's ID, entry time, and date. This information is stored in the student log table in the database.

2.7.2 Exiting Library

When the student exits the library, they will tell their student id number to the librarian again. The system will then log the exit time and date. The information is stored in the exit time column in the student log table in the database.

2.8 OpenCV integration

The project uses OpenCV to classify books based on their rack numbers. When a book is returned, the librarian captures an image of the book cover and uses computer vision to determine the correct rack number. This feature reduces the workload of librarians and ensures accurate classification. Further sections of the report will explain about the working of the book classification in great detail.

3 Workflow

3.1 Home Page

The home page of the project consists of two main parts - the login section and the library information section. The login section is where students can access their accounts and perform various actions such as viewing issued books, total books in library, fines paid and student log record. The library information section provides details about the library such as its location, working hours, services offered and link to college library website. In order to ensure the security of user accounts and prevent unauthorized access, project uses authorization login and captcha.¹

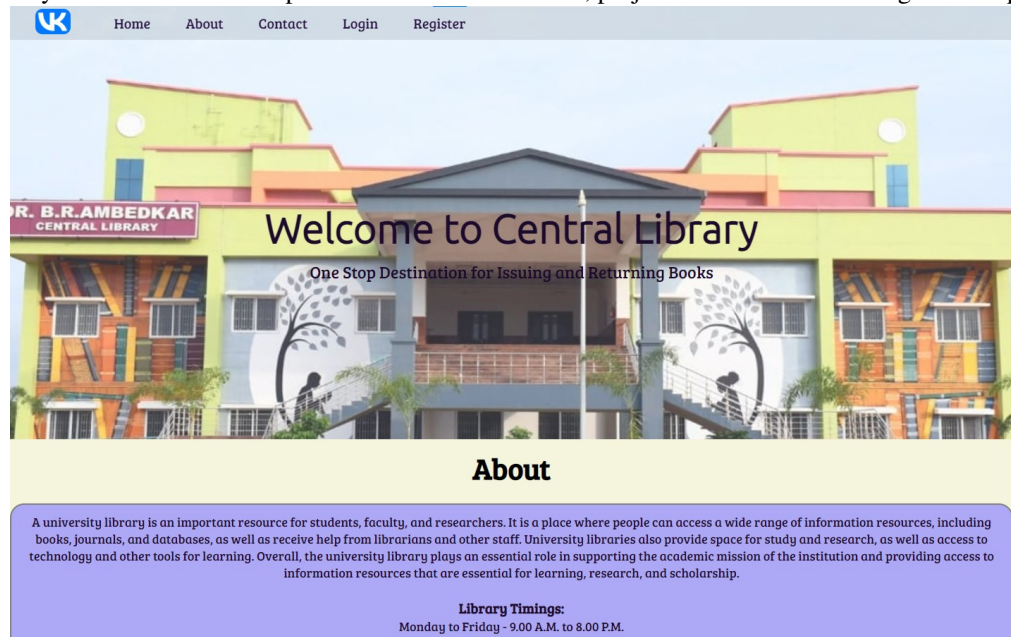


Figure 1 : Home Page

3.1.1 Authorization Login

Authorization login is a security feature that ensures only authorized students have access to the library management system. Students must enter their login credentials (i.e., username and password) to access their accounts. The project uses a secure login system that encrypts user data and stores it in a database.³

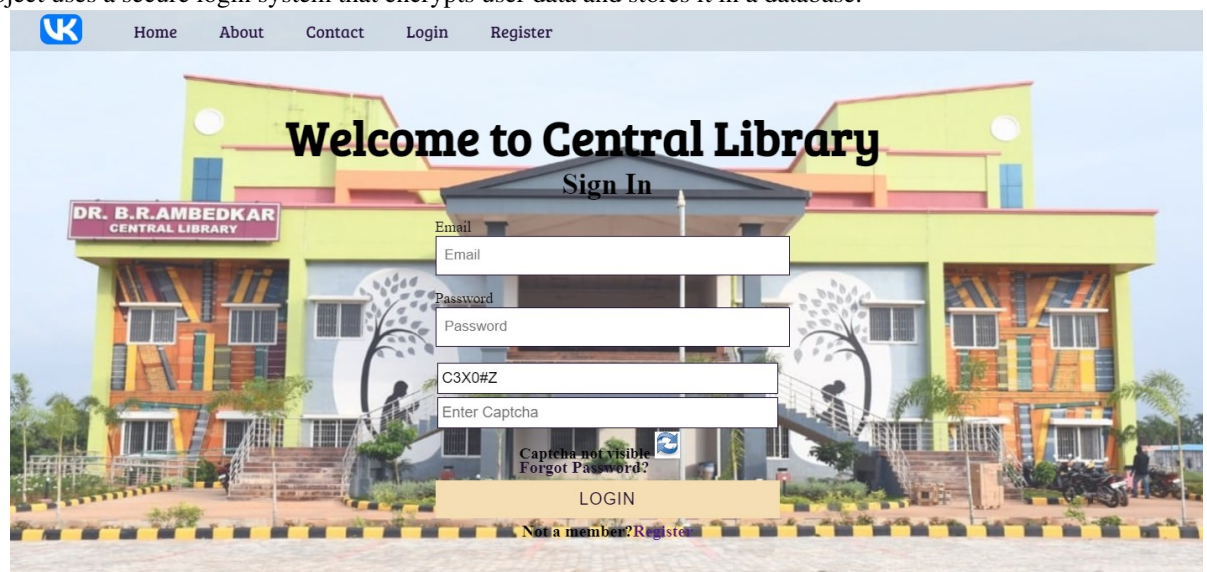


Figure 2 : Login Page

3.1.2 Captcha

Captcha is a security feature that prevents automated programs (known as bots) from accessing the library management system. Captcha requires users to complete a task that only a human can perform such as identifying the objects in an image or solving a simple math problem.⁴

3.1.3 Library Info - About Us

This section provides information about the library's history, mission and goals. It can also include information about the library's collection, services and staff.

3.1.4 Library Info - Library Timings

This section lists the library's hours of operation, including any special hours or closures.

3.1.5 Library Info - Contact Us

This section includes information about how to contact the library, including phone numbers, email addresses and physical addresses. It also includes the college library website link to be directed.

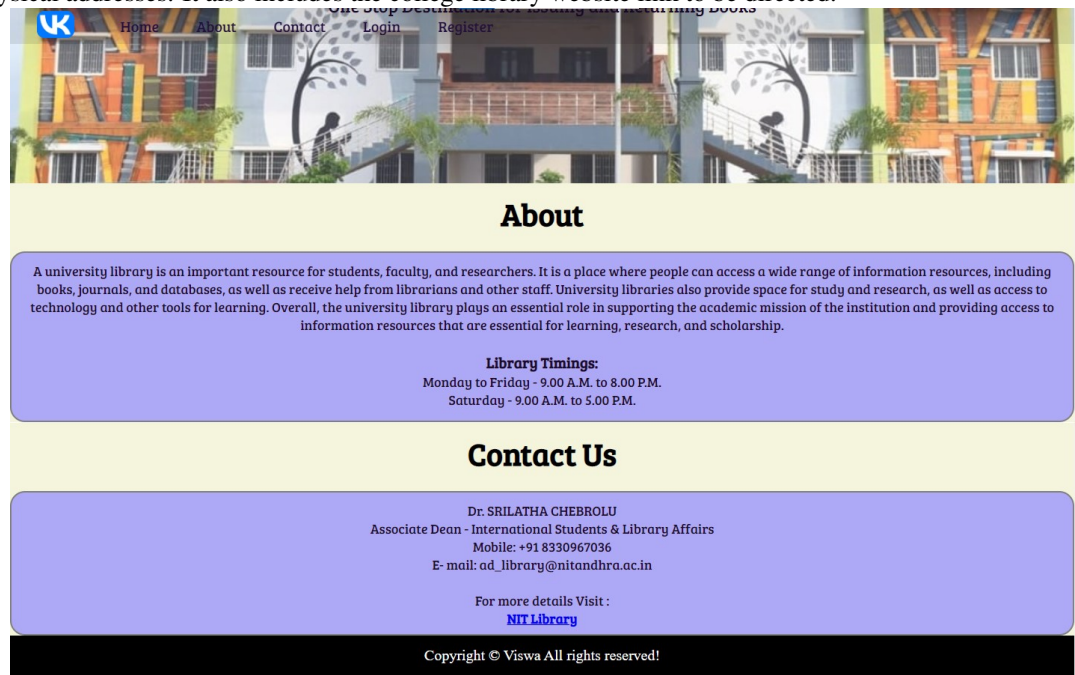


Figure 3 : Library Info

3.2 Admin Page

The admin page or dashboard in the project is the central hub for managing the library system. The admin has access to a range of features, including adding and removing books, adding and removing students, issuing and returning books, and managing fines. The admin page also allows for searching and viewing of student records, book records, and fine records. The interface is user-friendly, with clear and intuitive options for managing the library system efficiently. Overall, the admin page is an essential component of the project, allowing for easy management and efficient tracking of library resources.

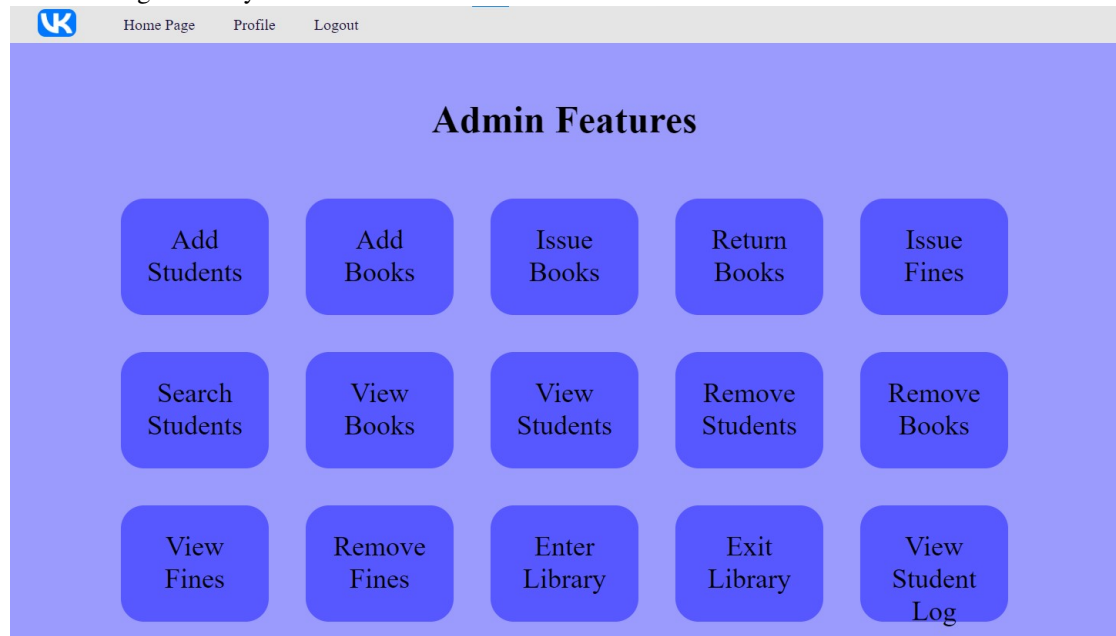


Figure 4 : Admin Page

3.2.1 Adding Students

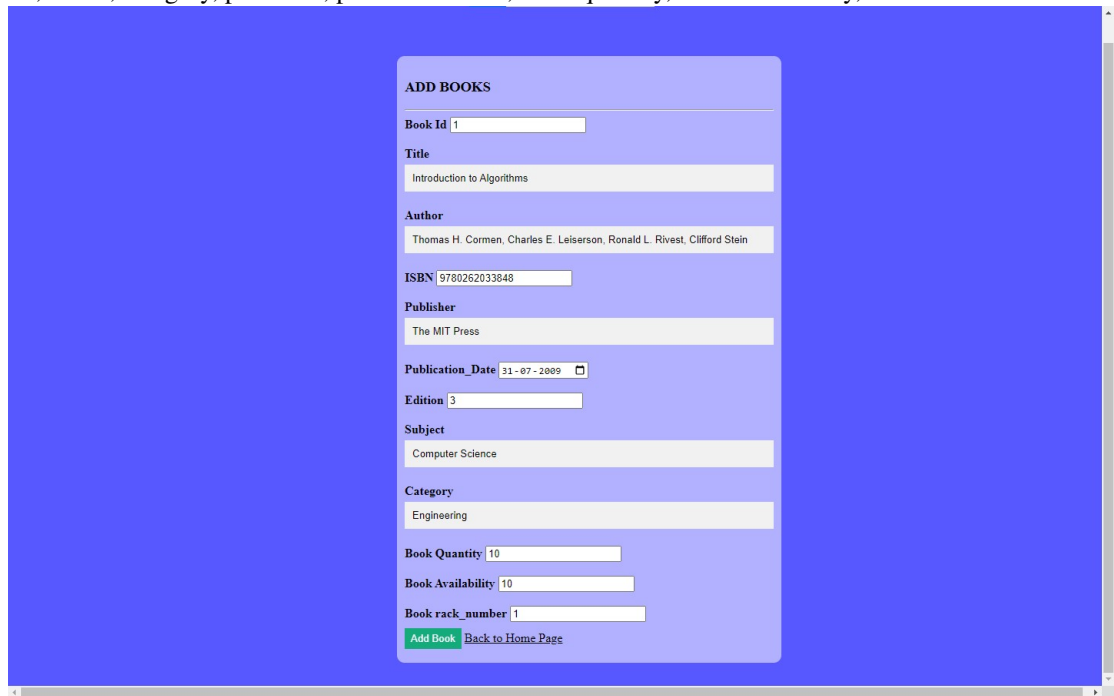
In this section, an admin can add new students to the system by giving the required fields such as name, ID number, contact details etc.

The image shows a web application interface for adding a new student. It features a light blue background with a central white form titled 'ADD STUDENT'. The form contains several input fields: 'Student Id' with a placeholder 'Enter Student Id', 'Student Name' with a placeholder 'Enter name', 'Phone Number' with a placeholder 'Enter Phone number', and 'Email Id' with a placeholder 'Enter Email Id'. Below these fields, there is a 'Gender' section with radio buttons for 'Male' and 'Female'. At the bottom of the form, there are two buttons: a green 'Add Student' button and a blue 'Back to Home Page' button. Below the buttons, there is a section labeled 'Data Inserted'.

Figure 5 : Adding Students

3.2.2 Adding Books

In this section, an admin can add new books to the system by giving the required fields such as book id, book title, author, ISBN, category, publisher, publication date, book quantity, book availability, book rack number etc.



ADD BOOKS

Book Id 1

Title
Introduction to Algorithms

Author
Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein

ISBN 9780262033848

Publisher
The MIT Press

Publication Date 31-07-2009

Edition 3

Subject
Computer Science

Category
Engineering

Book Quantity 10

Book Availability 10

Book rack_number 1

[Add Book](#) [Back to Home Page](#)

Figure 6 : Adding Books

3.2.3 Issuing Books

In this section, an admin can issue books to students to the system by giving the required fields such as Issuing ID number, Student ID number, Book ID number, Issue date and Due date etc.



ISSUE BOOKS

Issue ID 10

Student ID 421273

Book ID 12

Issue Date 15-03-2023

Due Date 30-03-2023

[Issue Book](#) [Back to Home Page](#)

Figure 7 : Issuing Books

3.3 Returning Books

In this section, an admin can add books returned by students to the system by giving the required fields such as Returning ID number, Student ID number, Book ID number, Returned date etc.



RETURN BOOKS

Return ID 2

Student ID 421272

Book ID 8

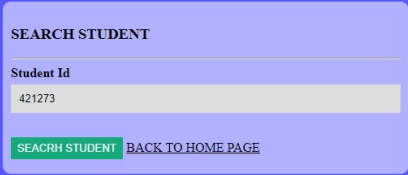
Return Date 16-04-2023

Return Book Back to Home Page

Figure 8 : Returning Books

3.3.1 Searching Students

In this section, an admin can search for students using Student ID number etc.



SEARCH STUDENT

Student Id 421273

SEACRH STUDENT BACK TO HOME PAGE

Figure 9 : Searching Students

3.3.2 Viewing Books

In this section, an admin can view a list of all the books in the system including their book details, book stock and book availability etc.³

Book ID	Title	Author	ISBN	Publisher	Publication_Date	Edition	Subject	Category	Quantity	Availability	Rack_number
1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	9780262033848	The MIT Press	Fri Jul 31 2009 00:00:00 GMT+0530 (India Standard Time)	3rd	Computer Science	Engineering	10	10	1
2	Computer Organization and Design	David A. Patterson, John L. Hennessy	9780123747501	Morgan Kaufmann	Mon Sep 30 2013 00:00:00 GMT+0530 (India Standard Time)	5th	Computer Science	Engineering	5	5	1
3	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	9780136042594	Pearson	Fri Dec 11 2009 00:00:00 GMT+0530 (India Standard Time)	3rd	Computer Science	Engineering	8	8	1
4	The C Programming Language	Brian W. Kernighan, Dennis M. Ritchie	9780131103627	Prentice Hall	Mon Feb 22 1988 00:00:00 GMT+0530 (India Standard Time)	2nd	Computer Science	Engineering	15	15	1
5	Digital Signal Processing	Alan V. Oppenheim, Ronald W. Schaffer	9780132131085	Pearson	Tue Aug 31 2010 00:00:00 GMT+0530 (India Standard Time)	3rd	Electrical Engineering	Engineering	7	7	3
6	Control Systems Engineering	Norman S. Nise	9781118170519	Wiley	Mon Apr 08 2013 00:00:00 GMT+0530 (India Standard Time)	7th	Electrical Engineering	Engineering	12	12	3
7	Mechanics of Materials	Russell C. Hibbeler	9780133254426	Pearson	Sun Jan 12 2014 00:00:00 GMT+0530 (India Standard Time)	9th	Mechanical Engineering	Engineering	6	6	4
8	Thermodynamics: An Engineering Approach	Yunus A. Cengel, Michael A. Boles	9780073398174	McGraw-Hill Education	Fri Feb 14 2014 00:00:00 GMT+0530 (India Standard Time)	8th	Mechanical Engineering	Engineering	9	9	4

Figure 10 : Viewing Books

3.4 Viewing Students

In this section, an admin can view a list of all the students in the system including their contact details etc.³

Student ID	Student Name	Email Id	Phone	Gender
421273	Viswa	421273@student.nitandhra.ac.in	123456891	Male
421274	Nivi	421274@student.nitandhra.ac.in	987654321	Female
421275	Pavan	421275@student.nitandhra.ac.in	123459876	Male
421276	Rash	421276@student.nitandhra.ac.in	123459876	Female

Close Save changes

BACK TO HOME PAGE

Figure 11 : Viewing Students

3.4.1 Removing Students

In this section, an admin can remove a student from the system, including the steps to be taken if the student has borrowed books or has fines.

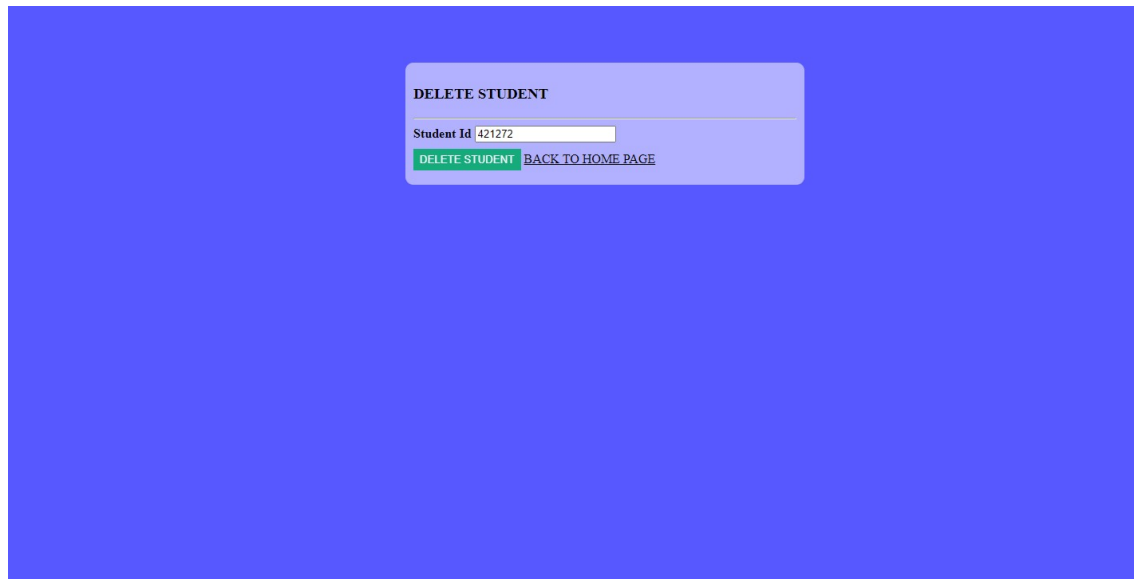


Figure 12 : Removing Students

3.4.2 Remove Books

In this section, an admin can remove a book from the system including the steps to be taken if the book has been borrowed by a student.

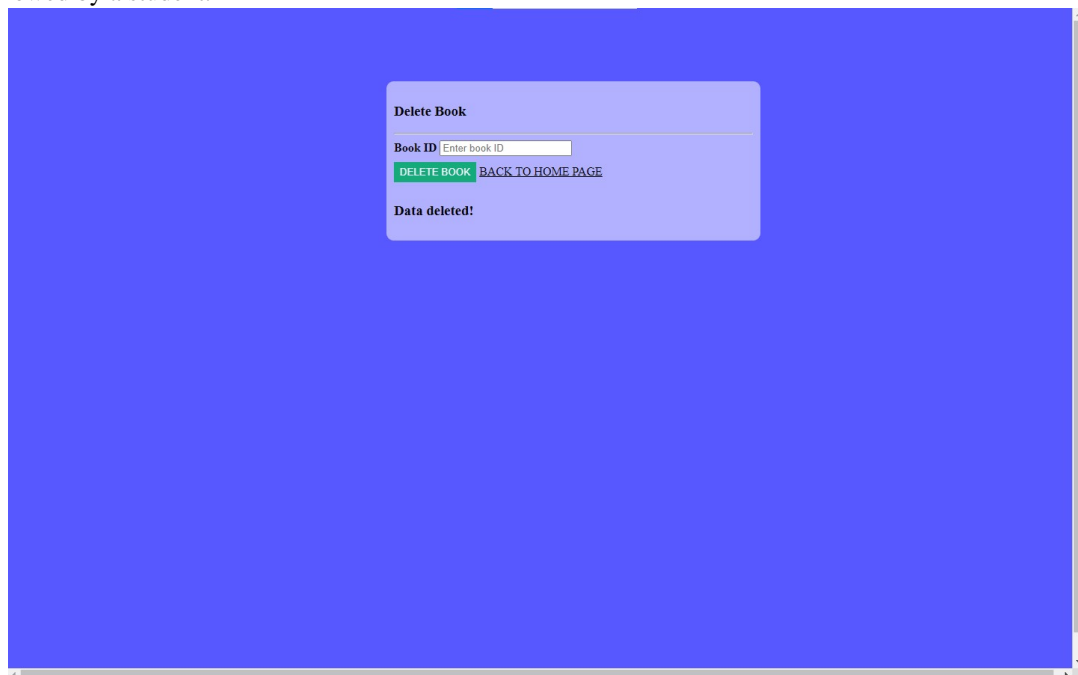
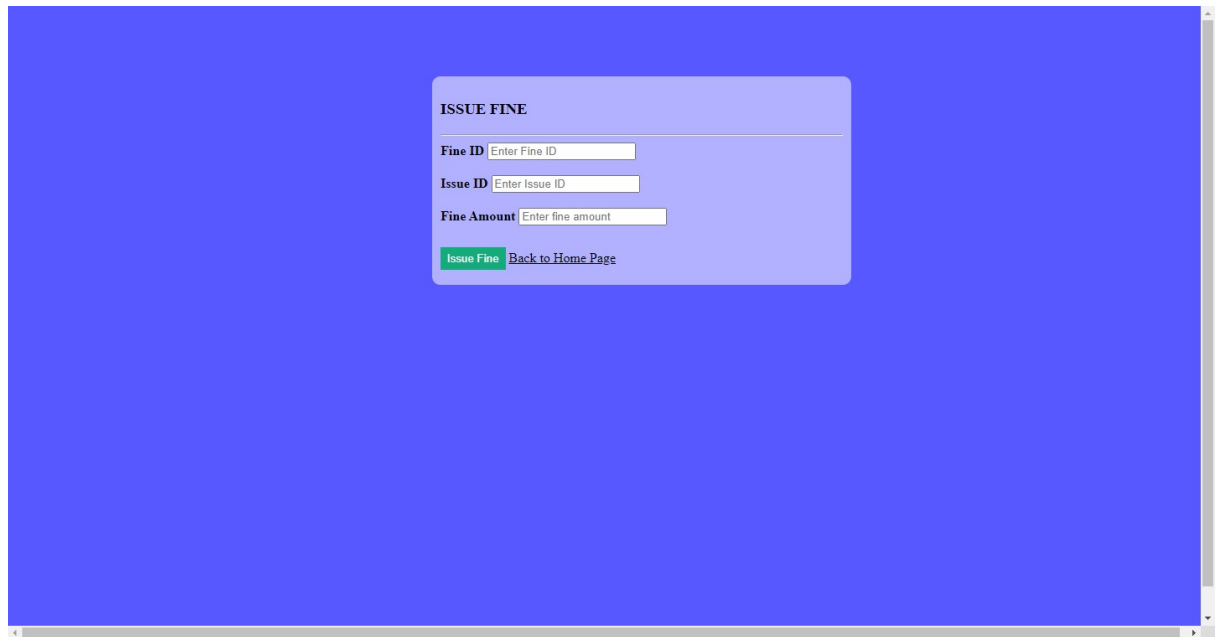


Figure 13 : Removing Books

3.4.3 Issue Fines

In this section, an admin can issue a fine to a student by giving the fine ID, Issue ID and fine amount as per calculated difference between due date and returned date.

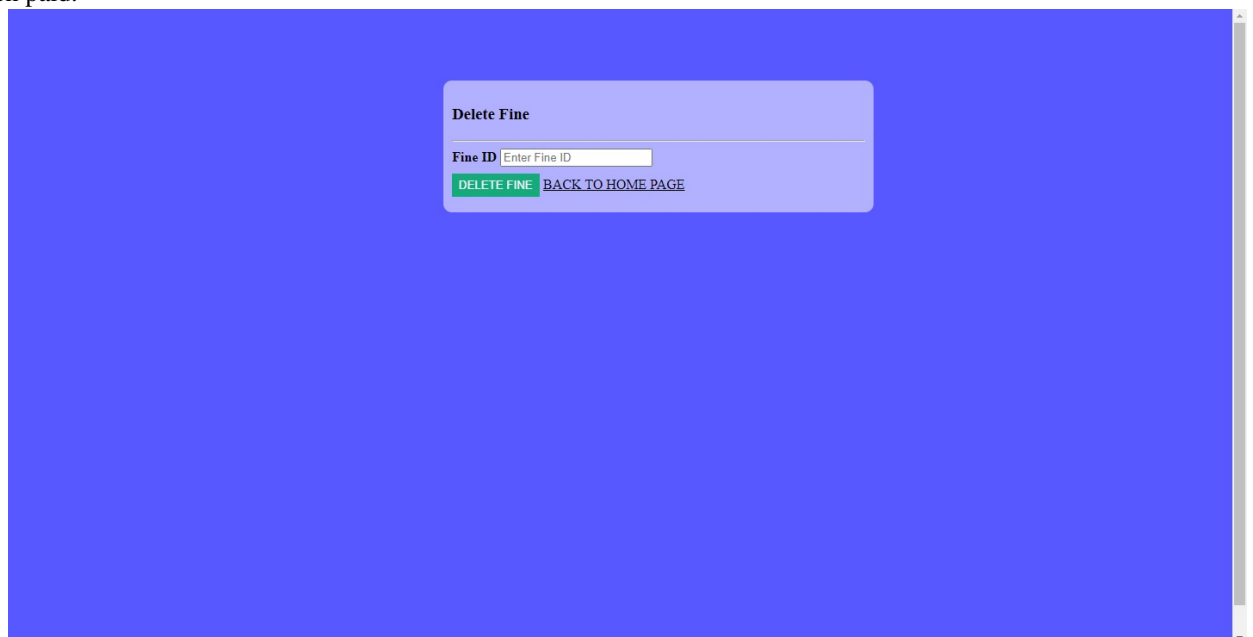


The screenshot shows a web application interface with a solid blue background. In the center, there is a light purple rectangular box titled "ISSUE FINE". Inside this box, there are three input fields: "Fine ID" with the placeholder text "Enter Fine ID", "Issue ID" with the placeholder text "Enter Issue ID", and "Fine Amount" with the placeholder text "Enter fine amount". Below these fields, there are two buttons: a green button labeled "Issue Fine" and a blue button labeled "Back to Home Page".

Figure 14 : Issue Fines

3.4.4 Remove Fines

In this section, an admin can remove a fine issued to a student including the steps to be taken if the fine has already been paid.



The screenshot shows a web application interface with a solid blue background. In the center, there is a light purple rectangular box titled "Delete Fine". Inside this box, there is one input field: "Fine ID" with the placeholder text "Enter Fine ID". Below this field, there are two buttons: a green button labeled "DELETE FINE" and a blue button labeled "BACK TO HOME PAGE".

Figure 15 : Removing Fines

3.4.5 Viewing Fines

In this section, an admin can view a list of all the fines issued to students including the amount, date and reason.³

Fine ID	Issue Id	Fine Amount
2	13	15

[Close](#)
[Save changes](#)

BACK TO HOME PAGE

Figure 16 : Viewing Fines

3.4.6 Student Log

In this section, the system records the entry and exit of students to the library, Instead of carrying out the manual method of writing the record in the log book and wasting the time.

Enter Student Id

Student ID

[Enter Library](#)
[BACK TO HOME PAGE](#)

Figure 17 : Searching Log Record

ID	Student Id	Enter Time	Exit Time
1	421273	Fri Mar 31 2023 22:05:01 GMT+0530 (India Standard Time)	Fri Mar 31 2023 22:06:58 GMT+0530 (India Standard Time)
2	421274	Tue Apr 04 2023 18:16:34 GMT+0530 (India Standard Time)	Tue Apr 04 2023 18:18:20 GMT+0530 (India Standard Time)
5	421275	Mon Apr 10 2023 11:38:02 GMT+0530 (India Standard Time)	

[Close](#)
[Save changes](#)

BACK TO HOME PAGE

Figure 18 : Viewing Log Record

4 Student Page

The student dashboard in the project is the central hub for students to manage their library accounts. Students have access to a range of features such as viewing the books they have borrowed, searching for available books, viewing their fines, and checking their student log records. The interface is user-friendly with many options for students to manage their accounts efficiently. Overall, the student dashboard is an essential component of the project, allowing students to manage their library accounts easily and efficiently.

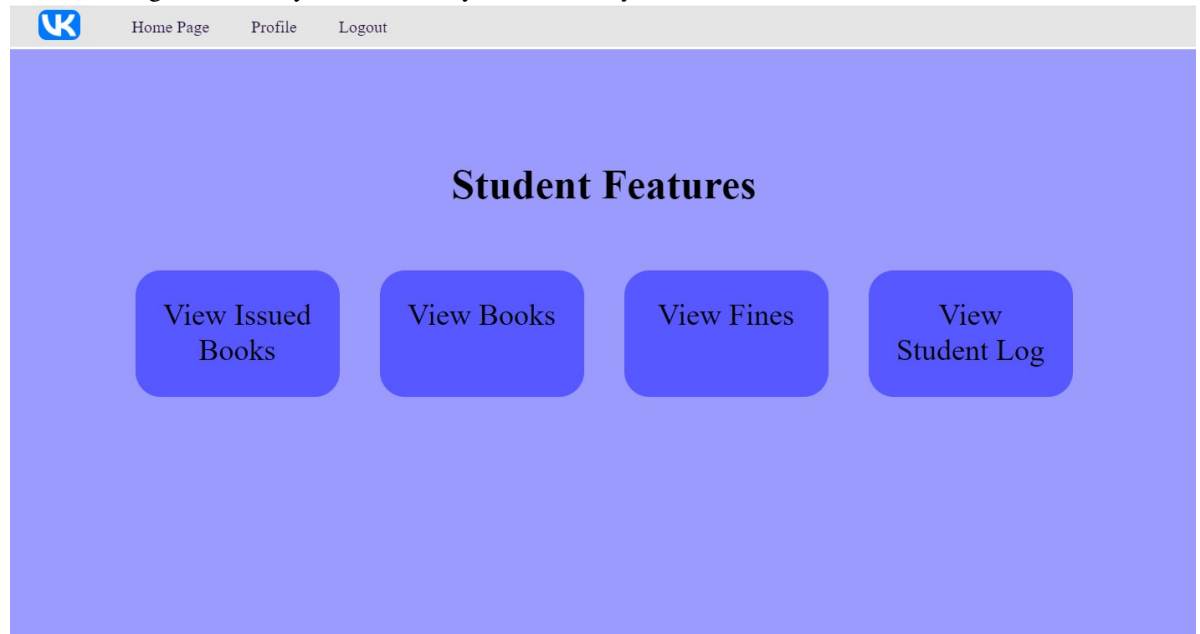


Figure 19 : Student Page

4.0.1 Viewing Issued Books

In this section, a student can view the list of books they have borrowed from the library, including the due date and any fines incurred.³

Book ID	Title	Author	ISBN	Publisher	Publication_Date	Edition	Subject
1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	9780262033848	The MIT Press	Fri Jul 31 2009 00:00:00 GMT+0530 (India Standard Time)	3rd	Computer Science
4	The C Programming Language	Brian W. Kernighan, Dennis M. Ritchie	9780131103627	Prentice Hall	Mon Feb 22 1988 00:00:00 GMT+0530 (India Standard Time)	2nd	Computer Science
7	Mechanics of Materials	Russell C. Hibbeler	9780133254426	Pearson	Sun Jan 12 2014 00:00:00 GMT+0530 (India Standard Time)	9th	Mechanical Engineering
9	Machine Design	Robert L. Norton	9780133356717	Pearson	Fri Jan 17 2014 00:00:00 GMT+0530 (India Standard Time)	5th	Mechanical Engineering

[Close](#)
[Save changes](#)

BACK TO HOME PAGE

Figure 20 : Viewing Student Issued Books

4.0.2 Viewing Books in Library

In this section, a student can view the list of books available in the library, including the title, author, ISBN, category and availability.³

Book ID	Title	Author	ISBN	Publisher	Publication_Date	Edition	Subject	Category	Quantity	Availability	Rack_number
1	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	9780262033848	The MIT Press	Fri Jul 31 2009 00:00:00 GMT+0530 (India Standard Time)	3rd	Computer Science	Engineering	10	10	1
2	Computer Organization and Design	David A. Patterson, John L. Hennessy	9780123747501	Morgan Kaufmann	Mon Sep 30 2013 00:00:00 GMT+0530 (India Standard Time)	5th	Computer Science	Engineering	5	5	1
3	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	9780136042594	Pearson	Fri Dec 11 2009 00:00:00 GMT+0530 (India Standard Time)	3rd	Computer Science	Engineering	8	8	1
4	The C Programming Language	Brian W. Kernighan, Dennis M. Ritchie	9780131103627	Prentice Hall	Mon Feb 22 1988 00:00:00 GMT+0530 (India Standard Time)	2nd	Computer Science	Engineering	15	15	1
5	Digital Signal Processing	Alan V. Oppenheim, Ronald W. Schaffer	9780132131085	Pearson	Tue Aug 31 2010 00:00:00 GMT+0530 (India Standard Time)	3rd	Electrical Engineering	Engineering	7	7	3
6	Control Systems Engineering	Norman S. Nise	9781118170519	Wiley	Mon Apr 08 2013 00:00:00 GMT+0530 (India Standard Time)	7th	Electrical Engineering	Engineering	12	12	3
7	Mechanics of Materials	Russell C. Hibbeler	9780133254426	Pearson	Sun Jan 12 2014 00:00:00 GMT+0530 (India Standard Time)	9th	Mechanical Engineering	Engineering	6	6	4
8	Thermodynamics: An Engineering Approach	Yunus A. Cengel, Michael A. Boles	9780073398174	McGraw-Hill Education	Fri Feb 14 2014 00:00:00 GMT+0530 (India Standard Time)	8th	Mechanical Engineering	Engineering	9	9	4

Figure 21 : Viewing Books

4.0.3 Viewing Fines

In this section, a student can view the list of fines they have incurred for overdue books, including the amount, date and reason.³

Fine ID	Issue Id	Fine Amount
2	13	15

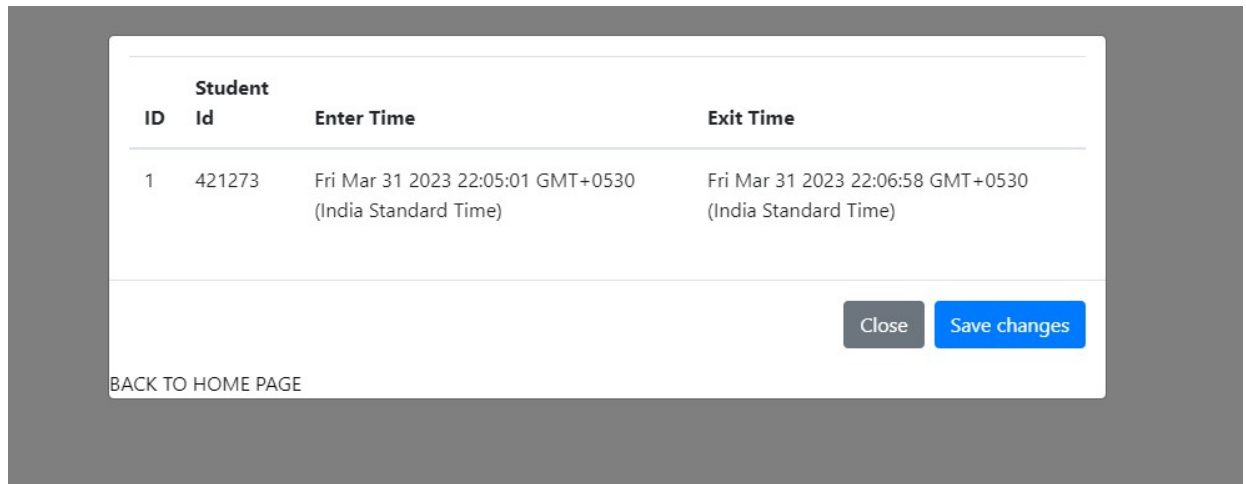
Close
Save changes

BACK TO HOME PAGE

Figure 22 : Viewing Fines

4.0.4 Viewing Student Log Records

In this section, a student can view the log records of their entry and exit to the library, including the purpose of the log and the information captured.³



ID	Student Id	Enter Time	Exit Time
1	421273	Fri Mar 31 2023 22:05:01 GMT+0530 (India Standard Time)	Fri Mar 31 2023 22:06:58 GMT+0530 (India Standard Time)

Close Save changes

BACK TO HOME PAGE

Figure 23 : Viewing Student Log Record

5 Tech Stack

5.1 Frontend

The front-end of the system is developed using HTML, CSS and JavaScript. HTML is used to define the structure of the web page, CSS is used to style the web page and JavaScript is used to add interactivity to the web page. The front-end is designed to be user-friendly, easy to navigate and enabling librarians and students to access the system easily.

The navigation bar is present at the top of the page, allowing admin/students to access various sections of the system such as Home, Profile and Logout. The home page of the system is the main landing page for the users. It provides basic information about the library and its operations, including the library's contact details and a brief overview of the library's mission and values. The admin page displays the system dashboard, providing admin with an overview of the library's resources such as available books, borrowed books, fines and more. The Profile page allows admin to view their personal information including their name and contact information. Finally, the Logout button logs the admin out of the system, ensuring secure access to the library's resources. The student page consists of student issued books, total information on books in library, student log record. Finally, the Logout button logs the student out of the system, ensuring secure access to the library's resources.

In the project, Bootstrap was used to display the student/books records in a clear and organized manner. The system uses Bootstrap's tables to show the books, students and fines in a 2D format for aesthetic look. Overall, Bootstrap helps to enhance the usability and visual appeal of the system.

5.2 Backend

The project's backend is built using Node.js and the Express.js framework. Node.js is a powerful JavaScript runtime that allows developers to create high-performance server-side applications. Express.js is a lightweight web application framework built on top of Node.js, offering a good set of features.

The project also uses Handlebars (hbs) as a templating engine, which allows the creation of reusable HTML templates with dynamic content. This makes it easier to create modular views and components that can be reused throughout the application.

Using Node.js and Express.js ensures fast and reliable performance, even with a high volume of requests. Handlebars simplifies the process of creating dynamic views and components, making it easier to maintain and update the application over time.

5.3 MySQL Database

The database management system of the project is developed using MySQL, a relational database management system. MySQL is a popular choice for building database management systems due to its ease of use. The database management system of the project is designed to store the data related to the books, students, issuing, returning, fines and student log.

The library management system project makes managing library operations easier and more automatic. It includes a database that stores information about books, students, fines, and library transactions such as issuing and returning of books. This helps librarians manage resources more effectively and securely, making it more convenient for students to access library resources. The system aims to reduce manual record-keeping and human error, improving library operations and creating a better experience for students.

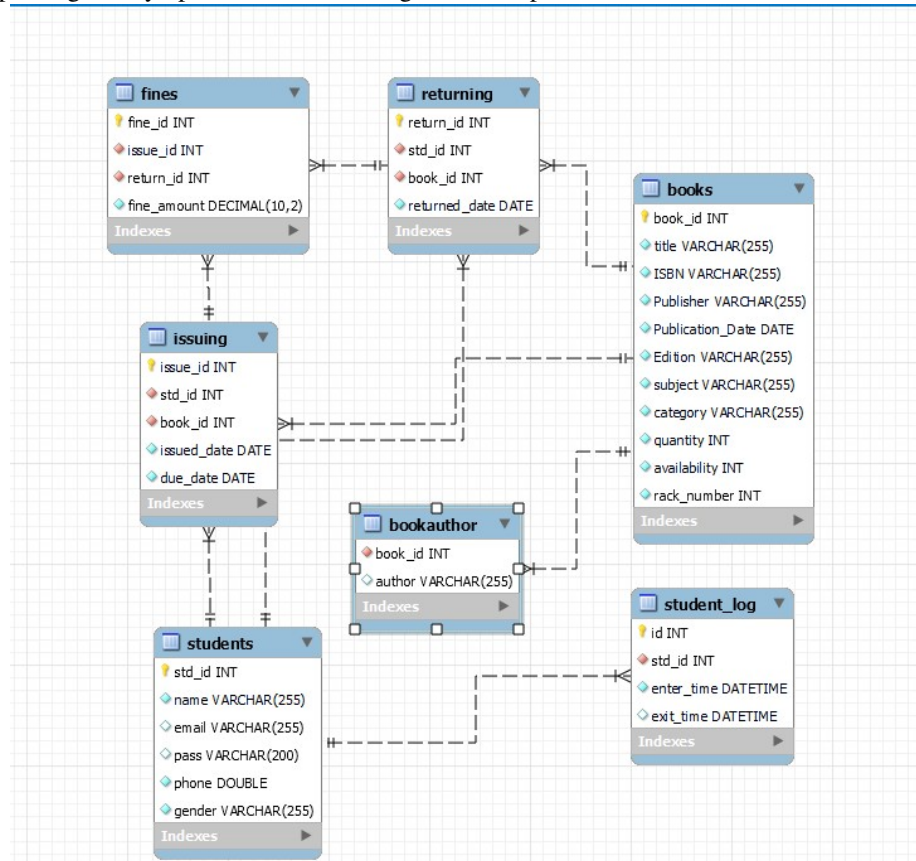


Figure 24 : Relation Schema for Database

Books Table: This table stores information about the books available in the library. It includes columns such as book ID, book title, author name, publisher, publication year, genre and availability status.

Students Table: This table stores information about the students who have registered with the library. It includes columns such as student ID, student name, contact information and enrollment year.

Issuing Table: This table tracks the issuing of books to students. It includes columns such as issue ID, book ID, student ID, date of issue, and due date.

Returning Table: This table tracks the returning of books by students. It includes columns such as return ID, book ID, student ID and date of return.

Student Log Table: This table stores a log of all the transactions made by each student, including the books they have borrowed and returned and any fines they have incurred.

Fines Table: This table stores information about the fines incurred by students, including columns such as fine ID, student ID, date of fine, amount and status (paid/unpaid).

5.4 OpenCV

The project also provides a feature that uses OpenCV to classify books based on their subject and rack number, making it easier for librarians to manage and organize books. This feature is a major advantage for the library, as it saves a significant amount of time that would otherwise be spent manually sorting and ordering books in the racks which is time consuming.

OpenCV Open Source Computer Vision Library is a powerful tool used for computer vision and image processing. In the project, OpenCV is used to classify books and place them in the correct location on the bookshelf based on their rack number. This is achieved using the ORB - Oriented FAST and rotated BRIEF(Binary Robust Independent Elementary Features) algorithm and the Brute-Force k-th Nearest Neighbor (BF-kNN) matcher. The combination of OpenCV in the project allows for efficient and accurate management of library resources, reducing the workload on library staff and improving the productivity. In the project, OpenCV is used to classify books and place them in the correct location on the bookshelf based on their rack number.

5.4.1 Feature detection and description

Feature detection refers to the process of identifying specific areas or points in an image that are unique and distinguishable from the surrounding areas. These areas are called keypoints. Once keypoints have been detected, the next step is feature description. Feature description refers to the process of extracting information from the keypoints to create a unique and descriptor that can be used for matching the images.⁶

5.4.2 ORB Algorithm

The ORB (Oriented FAST and Rotated BRIEF) algorithm is a computer vision algorithm used for feature detection and feature description of images. ORB is an efficient alternative to other feature detectors like SIFT (Scale-Invariant Feature Transform) and SURF (Speeded-Up Robust Features) that are patented and not free to use. ORB is based on the combination of the FAST keypoint detector and the BRIEF descriptor, but it also incorporates some modifications to improve its performance.⁷

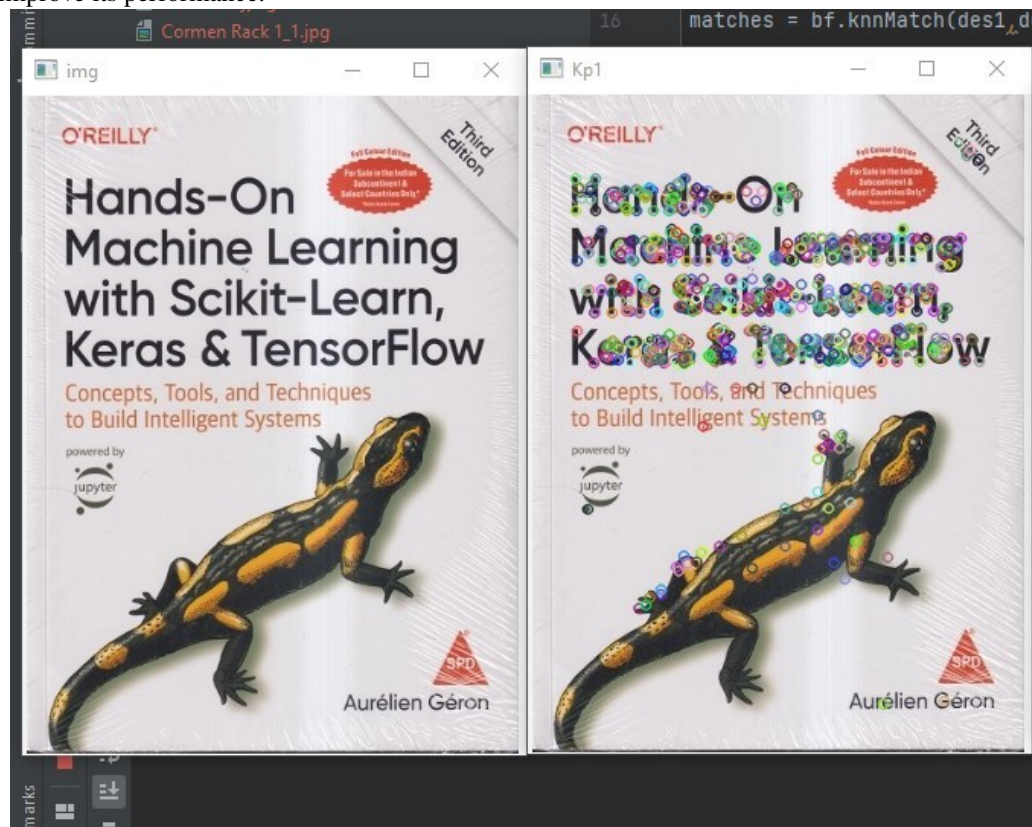


Figure 25 : Feature Detection

5.4.3 Brute-Force k-th Nearest Neighbor Matcher

The Brute-Force k-th Nearest Neighbor (BF-kNN) matcher is used in the project to match ORB features between book cover images and images of bookshelves. This allows for accurate placement of books on the shelf. The algorithm works by finding the closest matches between feature descriptors in two images. It uses a brute-force approach to compare each feature descriptor in one image to all feature descriptors in the other image, then selects the k closest matches based on a distance metric such as Euclidean distance.⁷

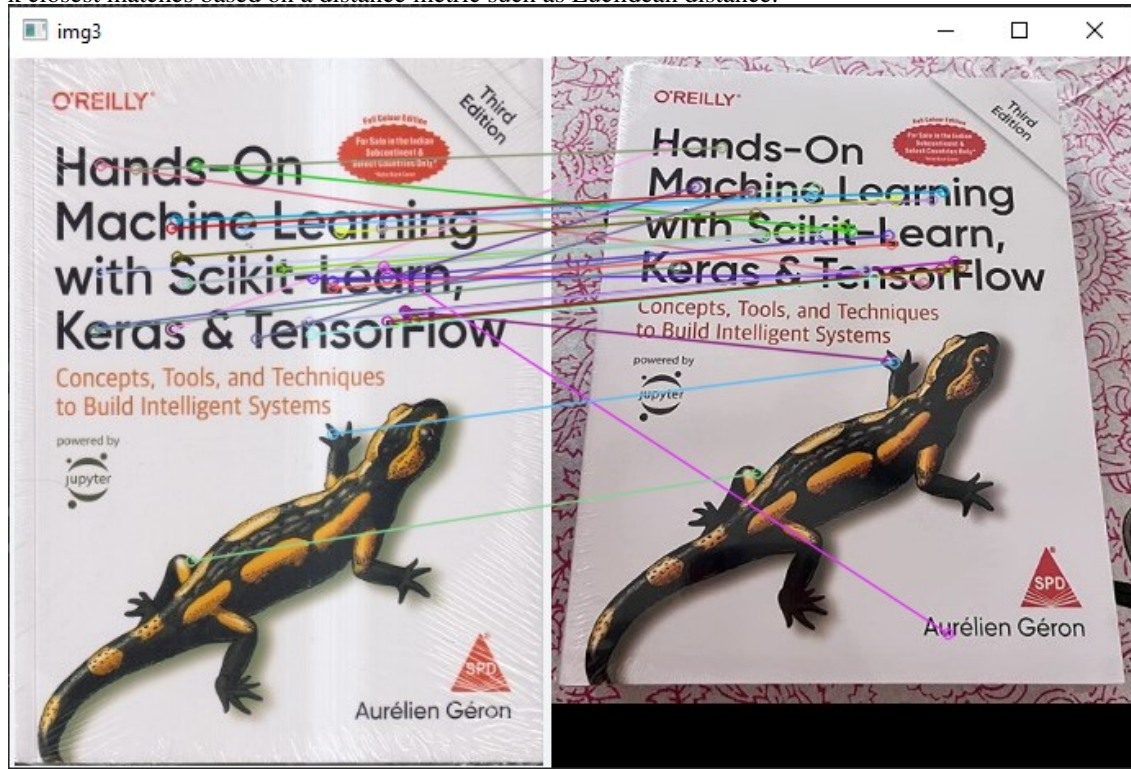


Figure 26 : Feature Matching

5.4.4 Benefits of Using OpenCV in Library Management

The integration of OpenCV in the project has number of benefits, including accurate book placement, reduced workload for library staff and improved experience for students. By using the power of OpenCV, the project is able to simplify library management processes and provides more efficient and user-friendly library experience.

5.5 Conclusion

In summary, this project is a powerful and efficient web-based library management system that integrates OpenCV for book classification. This project aims to streamline the library management process and provide a more user-friendly experience for both library staff and students.

By using OpenCV, the project will be able to accurately classify books and place them on the correct shelf based on shelf number, reducing the workload of library staff and improving the overall efficiency of the library management system. Additionally, the web development integration with OpenCV makes it easy for students to access and borrow books from the library for a seamless and user-friendly experience.

Additionally, the project includes a comprehensive set of features for library staff and students. B. Add and Remove Books, Apply Fines, Find Students or Books. The system also includes a student dashboard where students can easily view published books, fines, and student logs.

Despite its many advantages, the project faces some challenges and limitations. For example, the accuracy of book placement depends on the quality of the book cover image and the availability of a consistent lighting environment within the library. Additionally, OpenCV and its web development implementation requires a certain level of technical expertise and resources, which can be an obstacle for some libraries.

Overall, this project is a promising solution for modern library management that harnesses the power of OpenCV and web development to create a more efficient and user-friendly library experience. This project has the potential to revolutionize library management systems and provide a more seamless experience for both library staff and students.

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