VIPS | VIVEKANANDA SCHOOL OF ENGINEERING AND TECHNOLOGY

योग: कर्मसु कौशलम्
IN PURSUIT OF PERFECTION

Practicum Report
"INTELLIGENT LIBRARY SYSTEM"

Under the Guidance
of
"Dr. Ashish Kumar"

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DECLARATION

This is to certify that Practicum Report titled "**IntelLIB-Intelligent Library System**" for the Practicum course with AIML260 is submitted by **Vansh Sharma (35817711622) and Karamveer Singh (36017711622**) of AIML B and **Sneha Bhasin (04117711622) and Anshul Bansal (01917711622**) of AIML A in partial fulfillment of the requirement for the award of degree B.Tech. in Artificial Intelligence and Machine Learning/ Artificial Intelligence and Data Science/ Industrial Internet of Things, VIPS-TC, GGSIP University, Dwarka, Delhi. It comprises of our original work. The due affirmation has been made within the report for utilizing the referenced work.

Date:

Vansh Sharma (35817711622):

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Certificate by Supervisor

This is to certify that Practicum Report titled "**IntelLIB-Intelligent Library System**" for the Practicum course with AIML260 is submitted by **Vansh Sharma (35817711622) and Karamveer Singh (36017711622**) of AIML B and **Sneha Bhasin (04117711622) and Anshul Bansal (01917711622**) of AIML A in partial fulfillment of the requirement for the award of degree B.Tech in Artificial Intelligence and Machine Learning/ Artificial Intelligence and Data Science/ Industrial Internet of Things, VIPS-TC, GGSIP University, Dwarka, Delhi. It is a record of the candidates own work carried out by them under my supervision. The matter embodied in this Report is original and has not been submitted for the award of any other degree.

Date: **(Signature)**

                                                      SUPERVISOR DR. ASHISH KUMAR

Signature of HOD   **Signature of Branch Coordinator**

Acknowledgement

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Chapter 1: INTRODUCTION

Our project, an intelligent library system, aims to revolutionize the way how libraries operates. The motivation behind this project is to streamline the process of issuing and returning books, making it more efficient and user-friendly. This system reduces manual work, saves time for both students and library staff, and minimizes human errors. By leveraging technologies like image recognition and database management, it aims to create a simple, cost effective solution that represents significant step towards digitizing libraries and making it more accessible and efficient for everyone.

First, we'll deploy a camera in the library, which will be used for two processes:

Book Issue Process:

We detect the enrollment number from the student's college ID card image, and we also identify the book from its cover image. Then, the book is issued under that student's enrollment number.

Book return process:

In the book return process, the camera again detects the student's enrollment number from their college ID card. It also identifies the book the student wants to return from the book's cover image. The system then verifies this information from the database where all the issue and return details are stored, and removes the book's name from that student's enrollment number.

We will provide an application to the library that includes book issue and return processes, and updates all the information in the database. Additionally, we will provide an application to students where they can see their issued books under their enrollment number, as well as the deadlines for returning their currently issued books.

Chapter 2: RELATED WORK

According to Research paper **"Title: Computer Vision-Based Library Management System (https://ieeexplore.ieee.org/document/10170541/)"**

Traditional methods of managing a library have their disadvantages like long waiting queues and expensive scanner machines. This paper aims to overcome these drawbacks by introducing a new application that makes use of face and text recognition to issue books from the library. The main idea is that a picture of the book with the issuer will be taken from which the required data will be extracted. The account of the user will be created by the library admin by uploading a picture of the face of the user. The application consists of two types of logins - user and admin, where administrators can keep track of user transactions and history. The face recognition algorithm and book recognition algorithm gave an overall accuracy of 99.43% and 82.5% respectively. The user can also see the information related to books and this information is extracted from a third-party API. Further, easy payment and reissue options for the books on the application have also been implemented.

Chapter 3: PROBLEM STATEMENT and OBJECTIVES

Our project aims to address the shortcomings of traditional library systems by introducing an automated solution that streamlines operations, reduces manual efforts, minimizes errors, and enhances the overall user experience. The key objectives of our project include:

- Automation of Processes: Implement automated systems for issuing, returning, and tracking books to reduce reliance on manual processes. By automating these tasks, we aim to improve efficiency and accuracy while minimizing the scope for errors.

- Integration of Notification Systems: Develop notification systems to alert students about upcoming book return deadlines. By providing timely reminders, we aim to reduce instances of late returns and associated penalties, thereby improving the overall user experience.

- Enhanced User Experience: Design a user-friendly interface that simplifies access to library services and resources. By prioritizing user experience, we aim to encourage greater engagement with the library system and foster positive interactions between users and the library staff.

- Data Management and Tracking: Implement robust data management and tracking mechanisms to maintain accurate records of book issues, returns, and overdue fines. By ensuring the integrity and accessibility of library data,

we aim to facilitate informed decision-making and improve overall operational efficiency.

- Scalability and Flexibility: Design the system to be scalable and adaptable to accommodate future growth and changes in user needs. By building a flexible architecture, we aim to future-proof the library system and support its long-term sustainability and relevance.

- Training and Support: Provide training and support to library staff members to effectively utilize and manage the new automated system. By empowering staff with the necessary skills and knowledge, we aim to maximize the benefits of the system and ensure its successful implementation and adoption.

In summary, our project seeks to revolutionize traditional library systems by leveraging automation, notification systems, and user-centric design principles to create a more efficient, error-free, and user-friendly environment for both library staff and users. Through these efforts, we aim to transform the library experience and enhance access to educational resources for all stakeholders.

Chapter 4: PROJECT ANALSIS AND DESIGN

4.1: Hardware and Software Requirement Specifications

- Python

- Tesseract ocr

- SQL for database management

- Barcode Reader
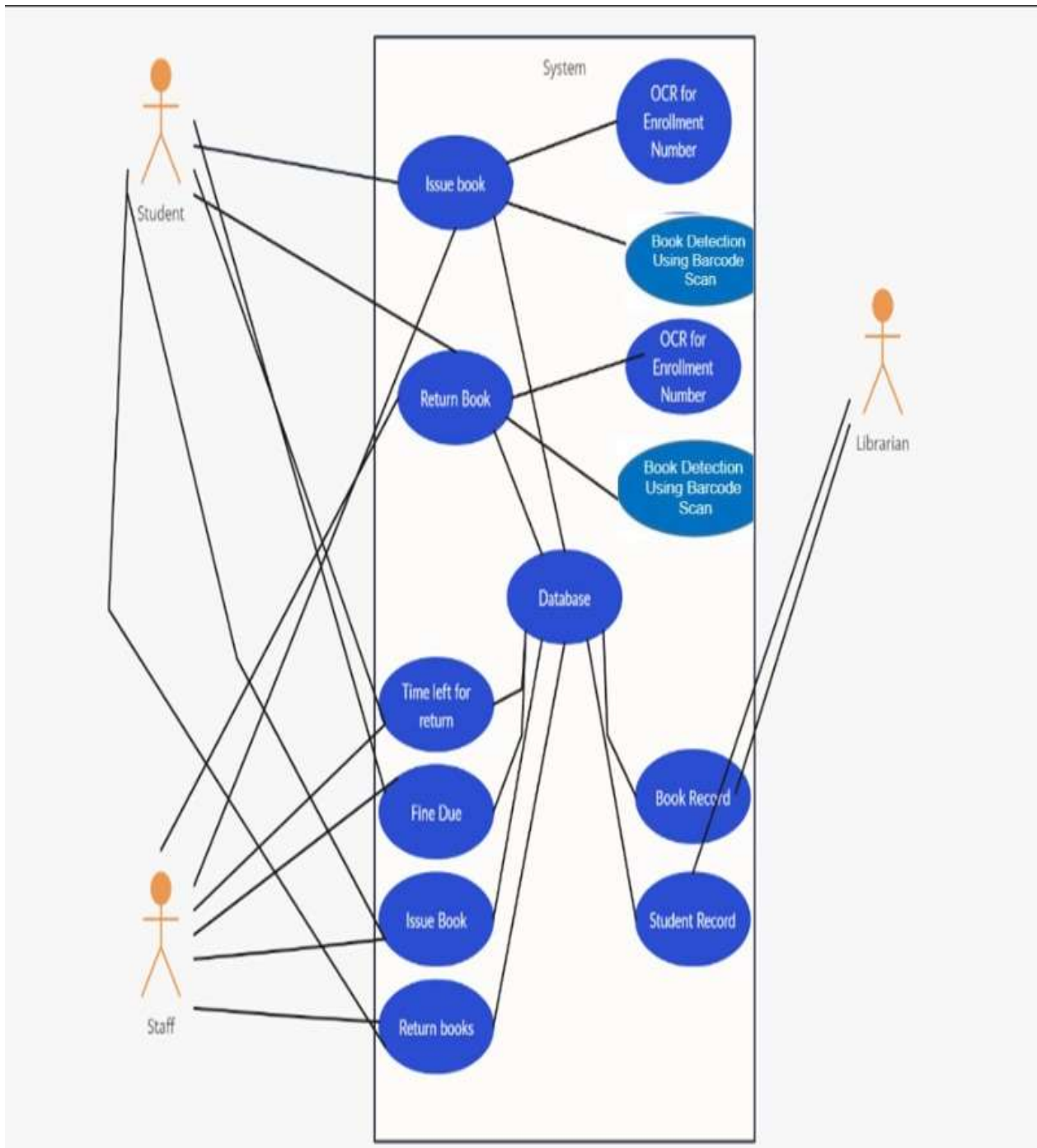
- A WEBCAM

4.2: Use Case Diagram

Fig. I :- USE-CASE DIAGRAM

Chapter 5: Proposed Work and Methodology Adopted

1. Set Up Database

- MySQL Database Creation: Install MySQL if not already installed and create a new database named "Intellib".
- Table Creation: Define two tables within the "Intellib" database: "book_issue" and "student_record".
- Fields for Book Issue Table: Include fields such as book ID, issue date, return date, enrollment number, and status to track book borrowing and returns.
- Fields for Student Record Table: Include fields for student details like enrollment number, first name, last name, semester, and contact details to maintain student records.
- Primary Keys and Relationships: Establish primary keys for each table and define relationships between tables if necessary, like linking the enrollment number between the two tables.
- Data Types and Constraints: Define appropriate data types for each field and enforce constraints like NOT NULL and unique constraints where needed.
- Indexes and Optimization: Consider adding indexes to fields frequently used in queries for better performance and optimization of database operations.

2. Design Frontend:

- Tkinter Interface Creation: Develop a GUI using Tkinter to design the frontend of the library system.
- Main Menu Section: Create a main menu section with buttons or menus for easy navigation to different functionalities.
- Enrollment Capture Section: Design a section for capturing student enrollment numbers, allowing for manual entry or image recognition.
- Book Barcode Capture Section: Implement a section for capturing book barcodes through webcam images.
- Button Navigation: Utilize buttons for user actions and provide clear navigation between different sections.
- Simple and Intuitive Design: Keep the interface layout simple and intuitive for users to easily understand and navigate.
- Error Handling: Implement error handling mechanisms to guide users in case of input errors or system issues.

3. Capture Enrollment Numbers:

- Pytesseract and OpenCV Integration**: Integrate Pytesseract and OpenCV libraries to extract enrollment numbers from ID card images.
- Automatic Detection**: Implement automatic detection of enrollment numbers from images using image processing techniques.
- Manual Entry: Allow users to manually enter enrollment numbers if automatic detection fails or for cases where ID cards are unavailable.
- Data Validation: Validate extracted or manually entered enrollment numbers to ensure correctness and prevent data entry errors.

- Error Handling: Implement error handling for cases where enrollment numbers cannot be extracted or entered incorrectly.
- Database Storage: Store the enrollment numbers in the database for future reference and tracking.

4. Capture Book Barcodes:

- OpenCV Integration: Utilize OpenCV to capture images of book barcodes from the webcam.
- Pyzbar Library: Decode captured barcodes using the Pyzbar library to extract information encoded in them.
- Barcode Information Extraction: Extract relevant information from decoded barcodes, such as book ID or ISBN.
- Association with Enrollment Numbers: Save the barcode information along with the corresponding enrollment numbers in the database.
- Error Handling: Implement error handling for cases where barcodes cannot be captured or decoded successfully.
- Database Storage: Save the barcode information in the database to track book issues and returns accurately.

5. Set Up Backend:

- Python and MySQL Connector: Use Python along with the MySQL connector library to establish a connection to the MySQL database.

- Function Development: Write functions to interact with the database, such as adding student records, managing book issues, and updating book statuses.

- SQL Queries: Utilize SQL queries to perform operations like inserting, updating, and retrieving data from the database efficiently.

- Error Handling: Implement error handling in backend functions to handle database connection errors, query failures, and data validation issues.

- Transaction Management: Implement transaction management to ensure data integrity and consistency during database operations.

- Security Considerations: Implement security measures like parameterized queries to prevent SQL injection attacks and ensure data security.

6. Integration:

- Seamless Integration: Integrate the frontend and backend components of the system seamlessly to provide a cohesive user experience.

- Event Handling: Ensure that frontend actions trigger the appropriate backend functions based on user input through event handling mechanisms.

- Data Flow Management: Establish smooth communication between the frontend and backend to ensure accurate and consistent data flow throughout the system.

- Error Propagation: Implement error propagation mechanisms to handle errors gracefully and provide meaningful feedback to users.

- Testing Integration: Test the integration between frontend and backend components to ensure that they work together as expected.

- Performance Optimization: Optimize integration processes to minimize latency and enhance system performance.

7. Testing:

- Functional Testing: Thoroughly test the entire system to verify its functionality and correctness.
- Enrollment Number and Barcode Capture Testing**: Test the enrollment number and barcode capture mechanisms to ensure accurate data extraction and decoding.
- Data Storage and Retrieval Testing**: Validate data storage and retrieval operations to confirm that information is stored and retrieved correctly from the database.
- Boundary Testing**: Test the system with boundary inputs to ensure it handles extreme cases gracefully.
- User Acceptance Testing**: Involve users in testing to gather feedback on usability and identify areas for improvement.
- Regression Testing: Perform regression testing after making changes to the system to ensure that existing functionalities are not affected.
- Bug Fixing: Address any issues or bugs encountered during testing promptly to ensure a stable and reliable system.

8. Documentation:

- Comprehensive Guide: Create comprehensive documentation for the library system, covering all aspects of its setup, functionality, and usage.

- Setup Instructions: Document the setup process, including installation requirements and configuration steps for both frontend and backend components.

- User Guide: Provide clear instructions on how to use the system, including navigation guidelines and usage examples.

- Technical Documentation: Document the frontend design, backend implementation, and database schema to help developers understand the system's architecture and implementation details.

- Troubleshooting Guide: Include a troubleshooting guide to help users and administrators resolve common issues encountered during setup or usage.

- Examples and Tutorials: Provide examples and tutorials to demonstrate key features and functionalities of the library system.

- Accessibility Considerations: Ensure that the documentation is accessible and easy to follow for users with varying levels of technical expertise.
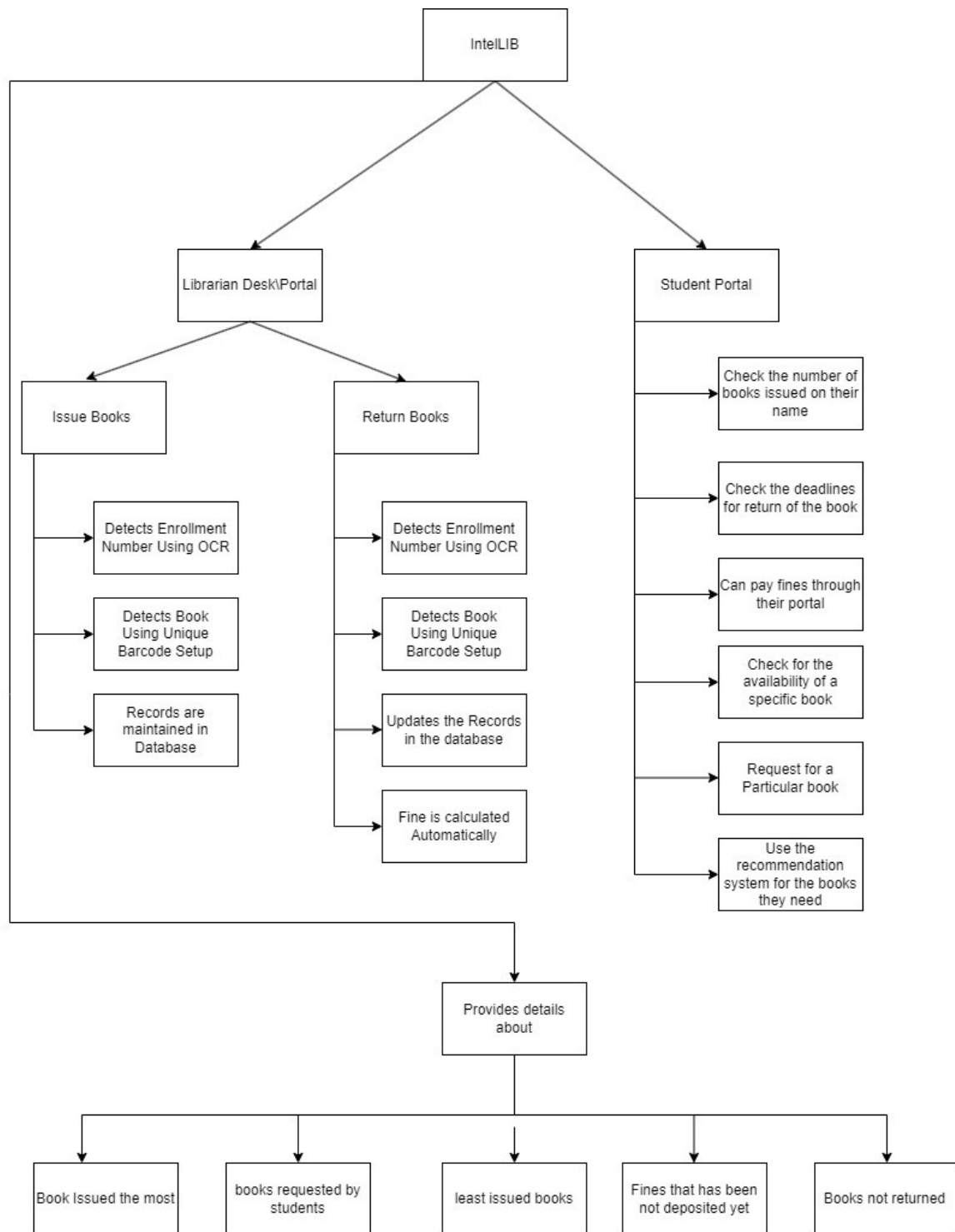
Fig. II :- FLOWCHART

Chapter 6: Results and Discussion

- Storing data in an SQL database helped keep all information about books and students in one place. This made it easy to find and manage data when needed.

- Automation saves time because machines work faster and don't need breaks like humans. Automated systems also make fewer mistakes because they follow precise instructions. This means tasks are done accurately and reliably.

- Automated systems reduce errors that can happen in manual systems. They use checks to catch mistakes like typos and store data securely so it's not lost. Automation also speeds up processes, so there's less waiting for information.

- Automated systems are accessible from anywhere with an internet connection. This means team members can work together and access information in real-time. Plus, automation lets people focus on important tasks while routine ones are taken care of automatically. This makes work more efficient and uses everyone's skills better.
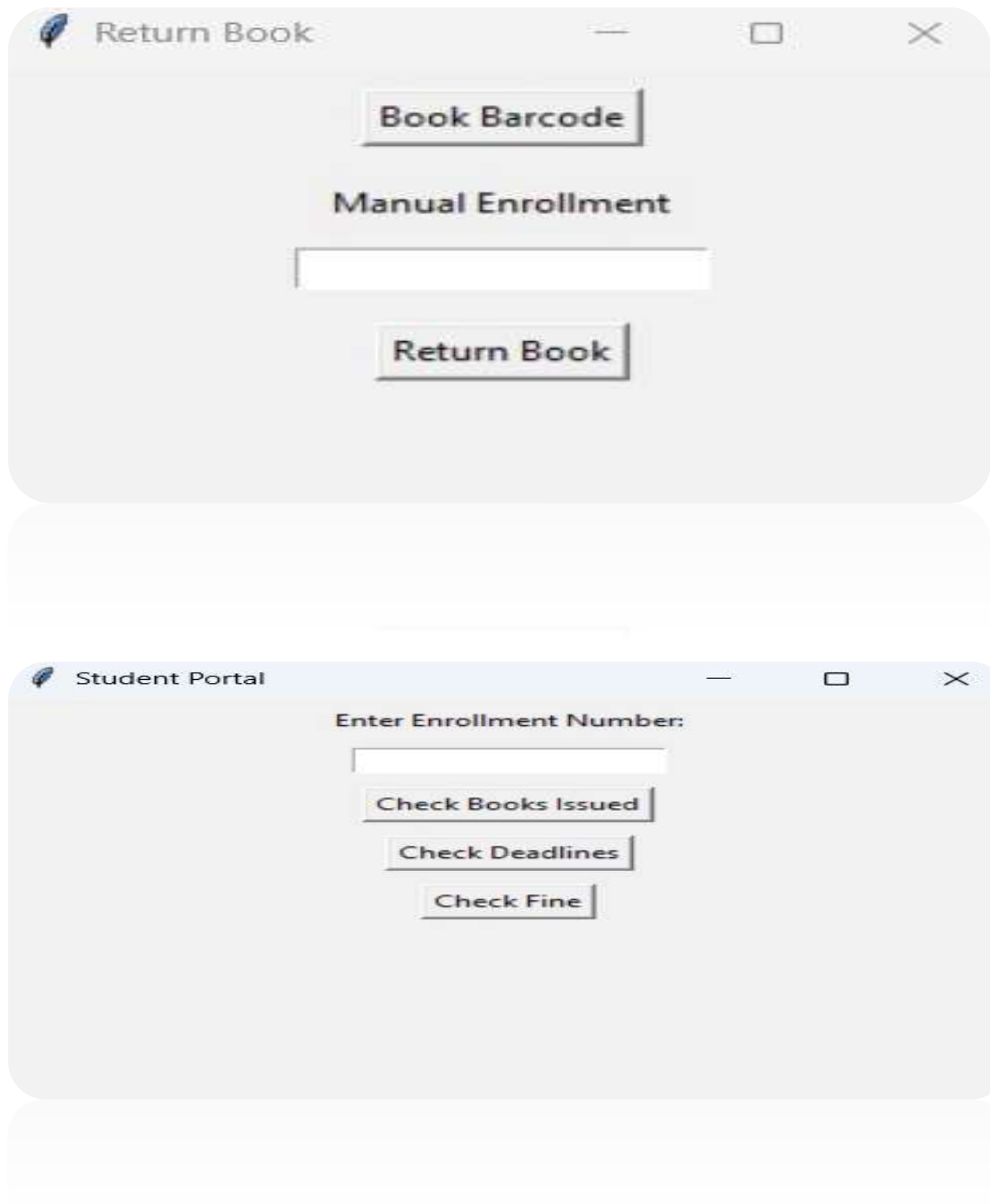
6.1 <u>Frontend</u>

Fig. III :- FRONTEND
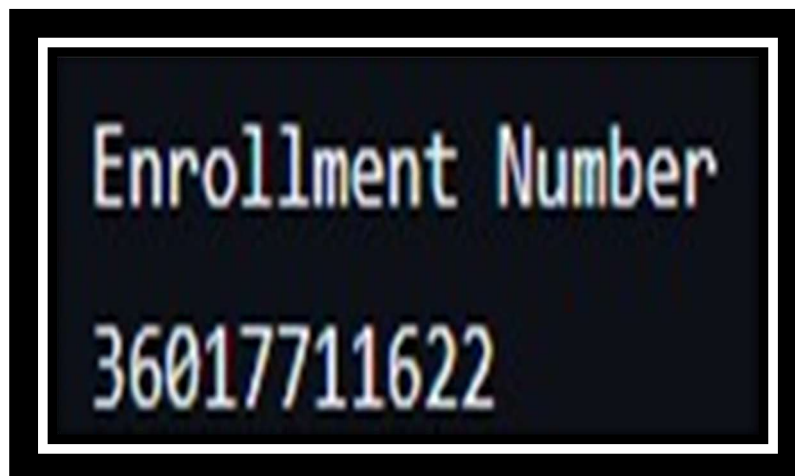
6.2 Enrollment Number Detection

Fig. IV :- Enrollment Number Detection

6.3 Book Detection Model

Fig. V :- Book Detection using barcode

6.4   Backend

```
mysql> use intellib;
Database changed
mysql> show tables;
+--------------------+
| Tables_in_intellib |
+--------------------+
| book_issue         |
| student_record     |
+--------------------+
2 rows in set (0.01 sec)

mysql> select * from student_record;
+---------------+------------+-----------+----------+-----------------+
| enrollment_no | first_name | last_name | semester | contact_details |
+---------------+------------+-----------+----------+-----------------+
| 35817711622   | vansh      | sharma    |        4 | 9315688144      |
| 35817711633   | anshul     | bansal    |        3 | 9315688454      |
| 36017711622   | karamveer  | singh     |        4 | 9315688134      |
+---------------+------------+-----------+----------+-----------------+
3 rows in set (0.00 sec)

mysql> select * from book_issue;
+---------+-------------+------------+-------------+---------------+-------------------+------------------+-----------------+------+
| book_id | book_issued | issue_date | return_date | enrollment_no | issuer_first_name | issuer_last_name | issuer_semester | fine |
+---------+-------------+------------+-------------+---------------+-------------------+------------------+-----------------+------+
|       1 | book2       | 2024-04-14 | 2024-04-21  | 35817711622   | vansh             | sharma           |               4 | 0.00 |
|       2 | book2       | 2024-04-17 | 2024-04-24  | 35817711633   | anshul            | bansal           |               3 | 0.00 |
|       3 | book2       | 2024-04-17 | 2024-04-24  | 35817711633   | anshul            | bansal           |               3 | 0.00 |
+---------+-------------+------------+-------------+---------------+-------------------+------------------+-----------------+------+
3 rows in set (0.00 sec)
```

Fig. V :- BACKEND SERVER

Chapter 6: Conclusion

- **Achievement of Goals:** The IntelliLib project successfully met its objectives by effectively integrating OCR (Optical Character Recognition), barcode, and MySQL database technologies into library management. This integration streamlined the library's operations, making it easier to manage and access resources. The use of OCR helped in digitizing printed materials, making them searchable and accessible digitally. The barcode system facilitated the easy tracking and management of books, while the MySQL database provided a robust and efficient platform for storing and retrieving data.

- **Demonstration of Effectiveness:** The successful implementation of these technologies demonstrated their effectiveness in improving library management. The system became more efficient, user-friendly, and less prone to errors, leading to improved user satisfaction and operational efficiency.

- **Support for Continued Use and Future Expansion:** The positive results from the IntelliLib project support its continued use. The system's scalability allows for potential expansion in the future, accommodating growth in library resources and user base. This could include adding more features, integrating with other systems, or expanding to other libraries.

- **Inspiration for Further Development:** The success of the IntelliLib project can inspire further development in library management systems. This could include more advanced integration with existing systems, such as inter-library loan systems or digital resource management systems. Additionally, there is scope for enhancing security measures, like implementing user authentication, secure data transmission, and data privacy measures.

Chapter 7: Future Scope of Work

- **Patenting the Idea:** Given the unique features and capabilities of the Intelligent Library Management System, you could consider applying for a patent to protect your idea. This would involve documenting the system's functionality in detail, demonstrating its novelty and usefulness, and filing a patent application with the relevant patent office.

- **DEPLOYMENT:** The system is planned to be deployed in your own library for real-time usage. This means that once the system is fully developed and tested, it will be installed and used in your library. Real-time usage will allow you to monitor the system's performance closely, make necessary adjustments, and fix any issues promptly. It will also give you a better understanding of how the system is improving library management and user experience.

- **INTEGRATION WITH KOHA:** KOHA is one of the largest library management systems used worldwide. By integrating your system with KOHA, you can extend its reach to libraries around the world that use KOHA. This integration will allow these libraries to benefit from the features of your system, such as OCR, barcode scanning, and the student app. It will also enable data exchange between your system and KOHA, ensuring that library records are synchronized and up-to-date across both systems.

Chapter 8: REFERENCES

1. Title: Computer Vision-Based Library Management System (https://ieeexplore.ieee.org/document/10170541/)

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(https://www.emeraldgrouppublishing.com/how-to/librarians/librarian-corner)

11. Opencv - (https://docs.opencv.org/4.x/index.html)

12. Pytesseract- (https://pypi.org/project/pytesseract/)

APPENDIX

<u>Project Name</u>

Intelligent Library Management System

<u>Project Description</u>

The project aims to develop an intelligent library management system that leverages technology to streamline and automate the process of issuing and returning books.

<u>Key Components:</u>

- **Website for Librarians:** A dedicated website will be developed for librarians. This website will serve as the primary interface for librarians to manage book issues and returns. It will provide functionalities such as tracking book availability, managing student records, and generating reports.

- **Student Identification**: The system will use the student's ID card for enrollment number detection. This will ensure that the books are issued to the correct student and help maintain accurate records.

- **Book Detection**: Each book in the library will be tagged with a QR code. When a book is to be issued, the QR code will be scanned to detect the book. This will automate the process of book detection and reduce the chances of errors.

- **Database Management:** Upon successful detection of the student's enrollment number and the book's QR code, the book will be issued on the student's enrollment number in the database. This will keep the library records up-to-date and facilitate efficient management of library resources.

Additional Details

- **System Architecture:** The system will be built using a robust and scalable architecture to handle a growing number of users and books. It will use a MySQL database for storing and retrieving data, and OCR technology for digitizing printed materials.

- **Security Measures**: The system will implement robust security measures to protect sensitive information like student enrollment numbers and book details. This could include encryption, secure data transmission, and regular security audits.

- **User Interface Design:** The design of the website and the student app will be user-friendly and intuitive. This will ensure that users can easily navigate through the system and perform tasks efficiently.

- **Training and Support:** Once the system is deployed, training sessions could be organized for librarians and students to familiarize them with the system. Additionally, a support system could be set up to address any issues or queries users might have.

Future Scope

The project has the potential to revolutionize library management by making it more efficient and less prone to errors. It can be further enhanced by integrating with other technologies such as RFID for book tracking, AI for book recommendations, and so on.