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Department of Internet of Things and Robotics Engineering (IRE)
Faculty of Cyber Physical Systems

Project Report

Course Title: Software Engineering Lab

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Project Report: LabAssist, A Comprehensive Lab Management System.

1. Introduction

In modern educational environments, managing lab equipment efficiently is essential to ensure the smooth operation of lab sessions. Traditional methods, such as manual requests and paper records, are prone to errors, inefficiencies, and administrative overload. The LabAssist, A Comprehensive Lab Management System seeks to address these challenges by automating the process of equipment management in a lab.

The system is designed to reduce paperwork, increase transparency, and streamline the process for both students and staff. With features like real-time availability checks, automated approval workflows, and role-based access, LabAssist enhances the overall lab experience for students, teachers, and lab instructors.

This project aims to create a seamless, paperless system where students can request equipment, teachers can approve these requests, and lab instructors can issue equipment based on the approval. Furthermore, the system supports checking the real-time availability of equipment before making a request, reducing unnecessary administrative work.

2. Objectives

The objectives of the LabAssist system are as follows:

1. **Reduce Paperwork**: Digitizing the equipment borrowing process eliminates physical paperwork, streamlining operations and ensuring easier tracking and auditing.
2. **Automate the Equipment Borrowing Process**: The system automates the equipment request and approval workflow, ensuring efficiency and clarity at each step.

3. **Check Real-Time Equipment Availability**: The system allows both students and teachers to check whether equipment is available before making requests, preventing unnecessary conflicts.
4. **Improve Workflow Efficiency**: The system ensures that requests, approvals, and equipment issuance follow a logical, automated sequence that minimizes delays and administrative overhead.

3. Requirement Analysis

- **Functional Requirements:**

1. User will be able to register and login (role based)
2. student will be able to view available lab instruments, and submit request for specific items.
3. Teachers will be able to receive notification of new request and able to review and approve or deny them.
4. Students will be able to access the history of their past request, including status updates.
5. Instructor will be able to add new instruments, updates existing instrument details and remove them.
6. Instructor will be able to check out the requested instruments to the students
7. Teachers will be able to view reports indicating which students have returned instruments on time and which have not.
8. Users should receive notifications for important actions, such as request approvals, denials, upcoming return dates.
9. Admins will be able to manage user accounts (creating, updating, deleting)
10. The system will be able to do audit logs of all significant actions taken within the system, including requests, approvals, updates and return.

- **Non-Functional Requirements**

1. system will be able to provide response in a very less response time (5 seconds)

2. System will be able to support at least 500 concurrent users.

3. system will be able to have an availability for at least all the working days

4. System will be able to introduce multilayer security to the sensitive data

5. System will and be able to provide an intuitive user-friendly interface.

6. System will be able to ensure the ease of maintenance, modification and extension by future developers

7. system will be able to integrate existing lab management system and instruments.

8. System will be able to include detailed user documentation and technical documentation

4. Usecase Diagram:

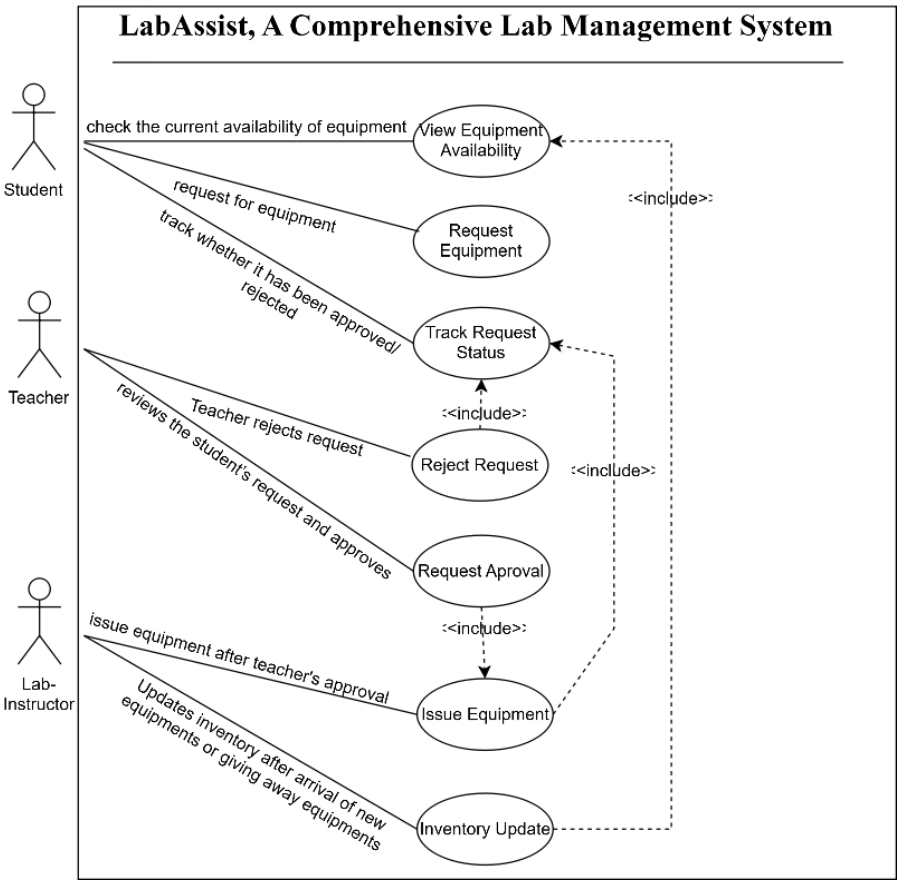


Fig: Usecase Diagram

5. System Features

The LabAssist system includes several key features designed to facilitate a seamless user experience:

5.1 User Management

LabAssist supports three main user roles: Student, Teacher, and Lab Instructor. Each user role has different permissions and access rights:

- **Students** can view available equipment, submit borrowing requests, and track the status of their requests.
- **Teachers** approve or reject students' borrowing requests based on the availability of equipment and other factors.
- **Lab Instructors** are responsible for issuing the approved equipment to students and managing equipment returns.

5.2 Equipment Request System

- Students can view all available equipment and request it based on their needs.
- The system automatically checks the availability of requested equipment and only allows requests when the equipment is available.
- Each equipment request is time-stamped for tracking purposes.

5.3 Approval Workflow

Once a student submits an equipment request, the system notifies the teacher associated with the course. Teachers have the ability to:

- **Approve**: If the equipment is available and the student’s request meets necessary criteria.
- **Reject**: If the equipment is unavailable or if other conditions are not met.

5.4 Equipment Issuance

- After a request is approved, the lab instructor is notified and can issue the requested equipment to the student.
- The instructor logs the issuance details, including the time, equipment condition, and any necessary notes.

5.5 Real-Time Availability Check

The system provides real-time data on the availability of each piece of equipment, ensuring that students can make informed decisions when submitting requests.

5.6 Audit and Reporting

The system maintains a comprehensive log of all requests, approvals, and equipment issuances. This log can be reviewed for auditing purposes, ensuring transparency and accountability.

6.Flowchart of the Project

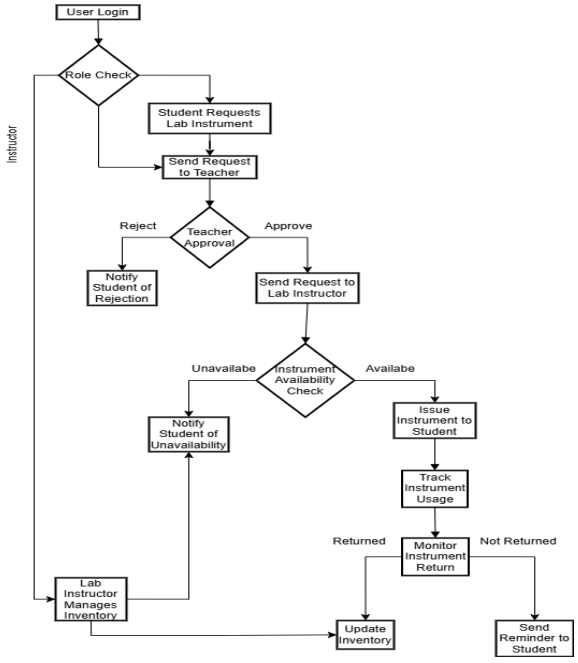


Fig: Flowchart

7. System Design

7.1 Architecture

The LabAssist system follows a client-server architecture with a central database to store data about users, equipment, and requests. The system is designed to be scalable, ensuring that it can handle additional equipment, users, and features in the future.

- **Frontend**: The frontend of the system is developed using HTML, CSS, and JavaScript. React.js is used for dynamic content rendering and ensuring a responsive, user-friendly interface.
- **Backend**: The backend is developed using Node.js with the Express framework. This ensures a fast, lightweight system capable of handling multiple simultaneous requests from users.
- **Database**: MySQL is used for storing user information, equipment data, request logs, and other essential details. These relational databases ensure data integrity and enable complex queries when needed.
- **Version Control**: GitHub is used for version control, enabling collaboration between team members, tracking changes, and managing code repositories.

7.2 Security

Security measures are implemented to protect sensitive data and ensure proper authorization:

- **Authentication**: The system uses JWT (JSON Web Tokens) for secure user authentication.
- **Authorization**: Role-based access control (RBAC) ensures that users can only access features based on their role (Student, Teacher, or Lab Instructor).
- **Data Security**: All data transmissions are encrypted using HTTPS, ensuring secure communication between clients and servers.

8. Technical Stack

The following technologies were used to develop the LabAssist system:

- **Frontend**: HTML, CSS, JavaScript (React.js)
- **Backend**: Node.js with Express.js
- **Database**: MongoDB or PostgreSQL
- **Version Control**: GitHub for collaborative development
- **Authentication**: JWT (JSON Web Tokens) for secure user login

9. Development Process

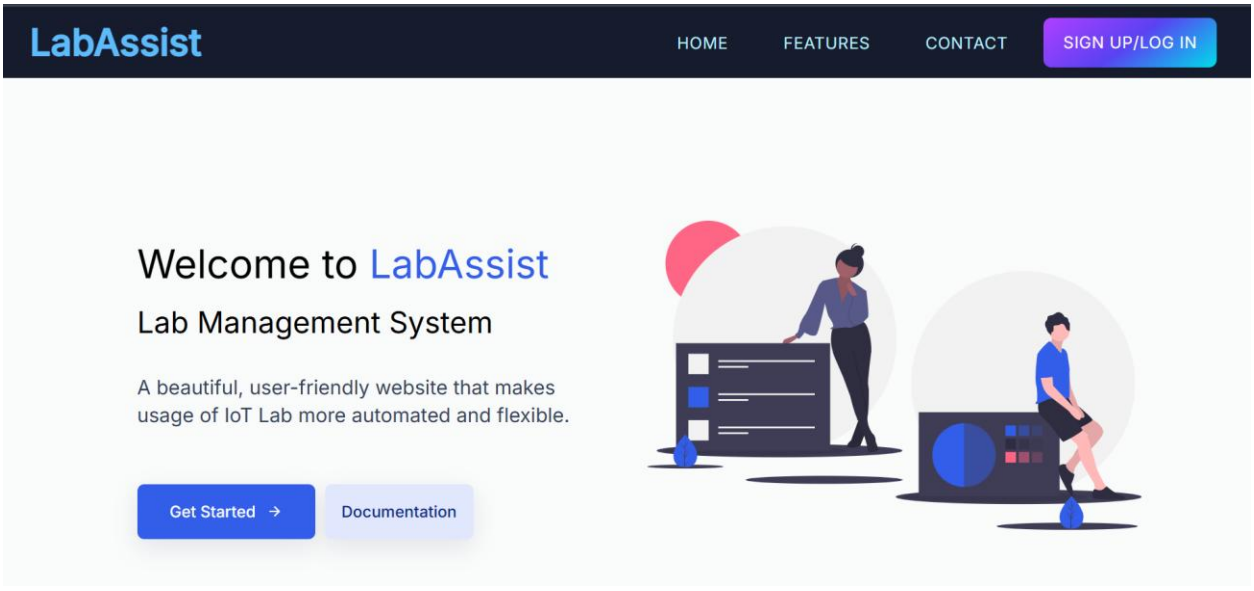
The development process followed the Agile methodology with iterations that allowed for feedback and improvements throughout the development cycle.

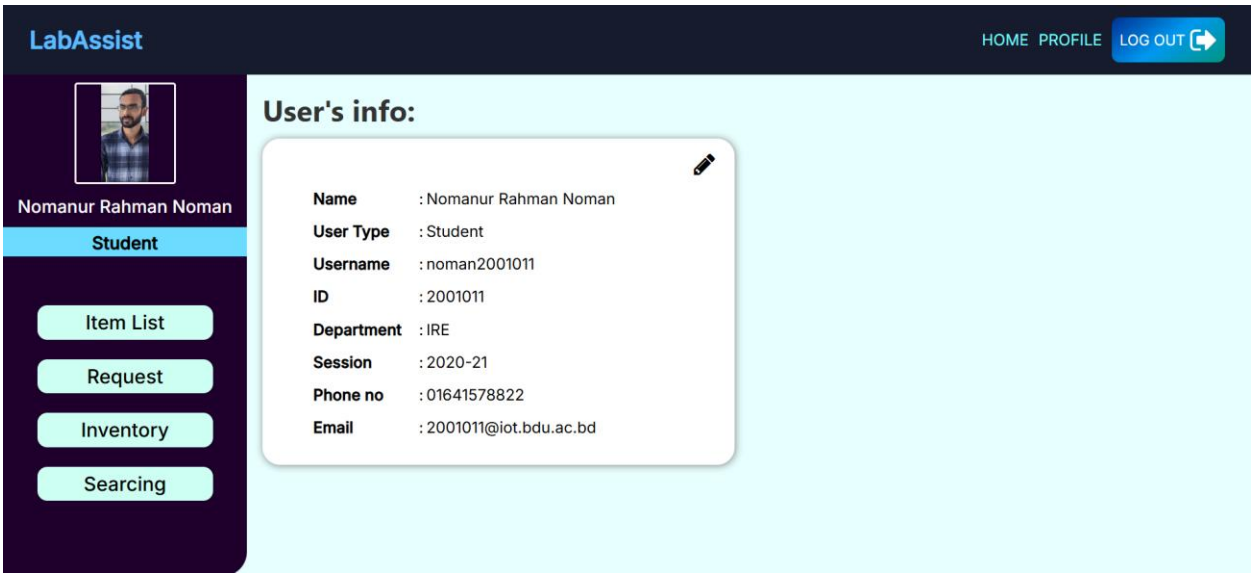
- **Planning**: Initial requirements were gathered, and a clear set of functionalities were defined.
- **Design**: Detailed design was carried out, including user interfaces, database schema, and system architecture.
- **Development**: The system was developed in stages, starting with basic user authentication and progressing to equipment management and the approval workflow.
- **Testing**: Regular testing was carried out to ensure that all features were functioning as expected. Unit tests and integration tests were written to ensure reliability.
- **Deployment**: After completing development, the system was deployed on a staging server for final testing before production deployment.

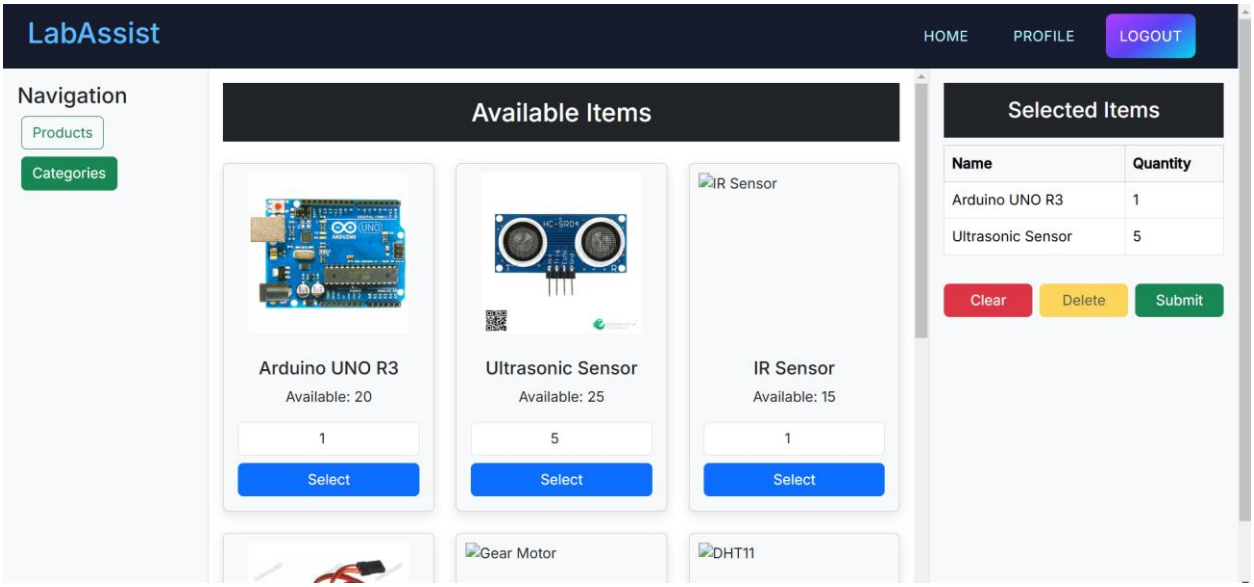
10. Result and Discussion

The LabAssist system has streamlined lab equipment management by automating requests, approvals, and issuance processes, reducing administrative workload and errors. Students benefited from real-time

equipment availability checks, while teachers and lab instructors experienced a more efficient workflow. Despite initial challenges, such as implementing real-time updates and transitioning users from manual methods, the system's intuitive interface and role-based access control ensured security, ease of use, and accountability. With features like audit logs and scalability for future enhancements, such as predictive analytic or mobile integration, LabAssist demonstrates significant potential for improving resource management in educational settings.







11.Project Link

The source code and documentation for LabAssist can be found on the following GitHub repository:

- **GitHub Repository**: https://github.com/Numan2001011/Software-Engineering-Lab

This repository contains all the necessary files for setting up the system, including installation instructions and configuration details.

12. Conclusion

The LabAssist, A Comprehensive Lab Management System provides a robust solution for managing equipment in educational labs. By automating the request and approval processes, the system reduces the administrative burden on both students and staff, ensuring a more efficient workflow. The real-time availability checks and audit trails improve transparency and accountability. This system not only meets the immediate needs of the lab environment but also offers scalability for future enhancements.