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SPL LAB PROJECTS AND PRODUCT PORTFOLIO MANAGEMENT SYSTEM

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Abstract - SPL Lab Project Management App is a web and mobile-based application designed to streamline the management of software projects developed within the Software Projects Lab (SPL). It provides a centralized platform for tracking project details, monitoring progress, and enhancing collaboration among team members, project leads, and stakeholders. By integrating robust tracking and reporting features, the app ensures better transparency, communication, and productivity across the team.

This paper presents the system architecture, features, and technological stack used in the development of the application. The app leverages Next.js for the frontend, Node.js for the backend, MySQL for database management, and Tailwind CSS for styling. With the implementation of role-based access control, real-time task tracking, and document management, the system ensures efficiency in project monitoring and collaboration. The app allows users to create, manage, and track software projects while providing a structured workflow for product lifecycle management, including development, testing, deployment, and maintenance. Additionally, it offers features such as task prioritization, milestone tracking, and detailed reporting tools.

SPL Lab Project Management App enhances team productivity by facilitating seamless communication through integrated chat and notification systems. The document repository with version control ensures secure access and proper documentation of project resources. The app's search and filtering capabilities make project retrieval easy, improving accessibility and user experience. By leveraging modern technologies and best practices, the platform delivers an efficient and scalable solution for managing software development projects. Future enhancements include AI-driven project timeline predictions, analytics, and mobile app expansion, making it a robust tool for software teams.

***Key Words:** Centralized Platform, Projects, NextJs, NodeJs, Mysql, Project Calendar*

1.INTRODUCTION

Traditional project management approaches often struggle with lack of visibility, inefficient communication, and difficulty in tracking project progress. The SPL Lab Project Management App overcomes these challenges by integrating modern web and mobile technologies to offer real-time updates, role-based access control, and detailed reporting. Users can create and manage projects, assign and monitor tasks, share documents, and track product life cycles efficiently. The platform ensures that all stakeholders are well-informed and aligned with project goals. The application utilizes a three-tier architecture, incorporating Next.js for an interactive frontend, Node.js for a scalable backend, and MySQL for structured data management. It also employs Tailwind CSS for a sleek and responsive user interface.

1.1 Background Work

The SPL Lab Project Management App is a web-based platform designed to streamline project tracking, team collaboration, and task management for research and development initiatives within the SPL Lab. Traditional project management in academic and research settings often relies on manual tracking methods such as spreadsheets, emails, and physical documentation, leading to inefficiencies and a lack of centralized data management. While generic project management tools like Trello, Asana, and Jira provide solutions, they lack the customization required for academic and research-focused projects, particularly in terms of integrating with version control systems like GitLab, research documentation, and academic progress tracking. To address these challenges, the SPL Lab Project Management App introduces a specialized system that enables centralized project tracking through a dedicated dashboard, facilitates seamless collaboration with built-in communication and task delegation features, and integrates directly with GitLab for real-time tracking of commits, issues, and documentation updates. The system is designed with role-based access control, ensuring secure and structured project participation for students, mentors,

and administrators. The development of this platform is influenced by Agile and Scrum methodologies, ensuring iterative development and continuous feedback, while also incorporating best practices from industry-standard project management tools. By bridging the gap between research-driven project tracking and efficient software engineering workflows, the SPL Lab Project Management App provides an optimized and scalable solution tailored to the needs of academic research teams, enhancing transparency, efficiency, and accountability in project execution.

1.2 Problem Statement

In academic and research environments, project management often lacks a structured and centralized system, leading to inefficiencies in tracking progress, assigning tasks, and maintaining documentation. Traditional methods, such as spreadsheets, email communication, and generic project management tools, fail to cater to the specific needs of research-oriented projects, particularly in integrating version control, milestone tracking, and collaborative development. The absence of a dedicated system results in difficulties in monitoring student contributions, tracking project deadlines, and ensuring seamless collaboration between team members and mentors. Additionally, existing solutions do not offer real-time synchronization with platforms like GitLab, making it challenging to assess progress based on code commits, issue tracking, and documentation updates. This lack of an integrated and structured project management approach often leads to delays, miscommunication, and a lack of accountability. The **SPL Lab Project Management App** aims to address these challenges by providing a comprehensive web-based platform tailored to research project tracking, team collaboration, and seamless integration with GitLab, ensuring transparency, efficiency, and structured project execution within the SPL Lab.

1.3 Objectives and Scope of the System

Develop a web-based SPL Lab Project Management App to streamline project tracking and collaboration. Enable efficient task allocation and progress monitoring for students and mentors. Provide a centralized dashboard with real-time project insights, deadlines, and team performance metrics. Implement role-based access control (RBAC) to ensure secure and structured project management. Facilitate document sharing and version control
for research reports, proposals, and technical documentation. Enhance communication and collaboration through discussion forums and notifications. Implements secure authentication using JWT-based login with GitLab OAuth integration. Allows multi-user collaboration, enabling students, mentors, and administrators to interact effectively. Ensures scalability, allowing new projects, students, and mentors to be onboarded without disruptions. Offers mobile responsiveness, ensuring accessibility across various devices.

2. LITERATURE SURVEY

Project management in academic and research environments has evolved significantly with the advent of digital tools and platforms. Traditional project tracking methods, such as spreadsheets and offline documentation, often lead to inefficiencies, miscommunication, and a lack of real-time updates. To address these challenges, modern project management systems integrate automation, real-time collaboration, and analytics.

Several existing project management tools, such as JIRA, Trello, and Asana, offer robust features for tracking progress, assigning tasks, and managing deadlines. However, these platforms are often generic and not tailored to the specific needs of academic research and student project management. Academic institutions frequently use Moodle and Google Classroom, but these platforms focus more on learning management rather than project tracking.

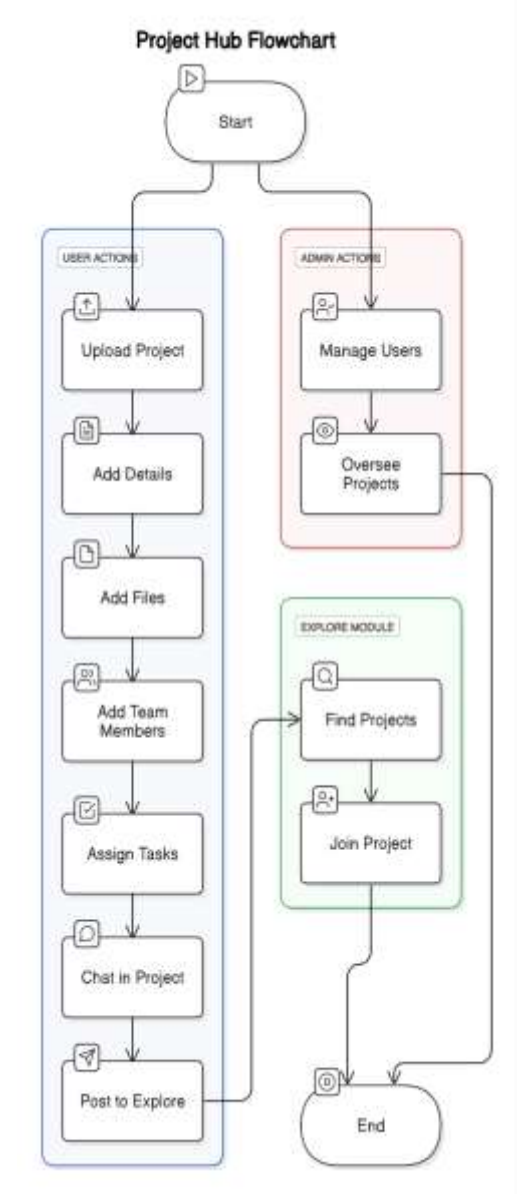
Furthermore, the integration of Git-based project management is crucial for software development and research-based projects. Platforms like GitLab, GitHub, and Bitbucket provide repository management, version control, and CI/CD pipelines, but they lack comprehensive academic project monitoring features such as mentor-student interactions, document tracking, and structured milestone evaluation.

Recent studies highlight the need for customized project management applications that combine the functionalities of task tracking, real-time collaboration, and Git repository monitoring. Research also suggests that automated progress tracking using commit history and issue tracking can provide a data-driven approach to project evaluation.

The SPL Lab Project Management App aims to bridge this gap by integrating GitLab APIs for automated tracking, providing role-based dashboards for students and mentors, and offering academic-specific project management features such as structured evaluations, document sharing, and real-time notifications. This solution seeks to enhance collaboration, transparency, and efficiency in managing academic and research projects within SPL Lab.

3. SYSTEM ARCHITECTURE

The SPL Lab Project Management App is designed with a modular and scalable architecture to efficiently handle academic project tracking, student progress monitoring, and mentor oversight. The system follows a three-tier architecture, ensuring separation of concerns and smooth interaction between different components.



3.1 Overview of the System

The system is built on a three-tier architecture, consisting of:

Frontend (User Interface & Interaction Layer)
Enables intuitive interaction with the platform.
Backend (Business Logic & API Layer) – Handles authentication, project management, and data processing.
Database (Storage & Data Management Layer) –
Stores project details, user data, and task information.
The platform allows students to upload projects, assign tasks, communicate with teammates, and explore other projects. Administrators oversee user activities and project progress, while the explore module enables users to discover and join relevant projects. The system integrates with GitLab APIs for version control and uses Docker for deployment, ensuring scalability and maintainability.

By leveraging modern technologies like React.js, Golang, MySQL, and Prometheus, the system provides a secure, efficient, and real-time collaborative experience tailored for academic and research project management.

3.2 Components of the System

The SPL Lab Project Management App consists of several core modules that work together to facilitate efficient project management, collaboration, and exploration. The main components of the system are as follows:

3.2.1. User Module

This module handles user authentication, roles, and permissions. Users interact with the system based on their assigned roles:
Project Owner – The creator of a project, responsible for adding team members, managing tasks, and tracking progress. Team Member – Contributes to a project, completes assigned tasks, and communicates with the team.

3.2.2. Admin Module

Administrators oversee the platform, ensuring smooth operation and user management. The admin functionalities include:
Managing Users – Approving or removing users, assigning roles, and handling user access. Overseeing Projects – Monitoring project status, ensuring compliance with platform policies, and resolving issues.

3.2.3. Project Module

This module enables users to manage project-related activities efficiently. Key features include:

Uploading Projects – Allows users to create and register new projects. Adding Details and Files – Enables storing project descriptions, documentation, and resources. Team Collaboration – Users can add members, assign tasks, and communicate within the project. Project Chat – Facilitates team discussions for seamless collaboration. Publishing to Explore – Allows project owners to showcase their work in the explore module.

3.24. Explore Module

This module helps users discover and join projects based on their interests. It includes:
Finding Projects – Users can search and filter projects by category, tags, or relevance. Joining Projects – Interested users can request to join or contribute to open projects. By integrating these modules, the system provides a structured, user-friendly, and collaborative environment for project management within the SPL Lab.

3.3 Data Processing and Storage

The SPL Lab Project Management App processes and stores data efficiently to ensure smooth project management, collaboration, and secure access control. The system follows a structured approach to data handling, leveraging a relational database for structured storage and NoSQL solutions for real-time interactions.

3.31. Data Processing Workflow

The system follows a structured data flow to ensure efficient management of user requests and responses:

User Input Handling – Users provide input such as project details, tasks, and messages, which are validated before storage. Data Validation & Security – The system applies validation checks and authentication mechanisms to prevent unauthorized access and data corruption. Storage & Retrieval – Data is stored in a MySQL/PostgreSQL database for structured records, while real-time interactions such as chat messages are handled via Redis or MongoDB. Data Updates & Synchronization – Any updates to project details, task assignments, or user roles are reflected instantly across all connected clients using WebSockets.

3.3.2. Storage Mechanism

The system incorporates a hybrid storage approach:

Relational Database (MySQL/PostgreSQL) – Used for storing structured project data, user roles, tasks, and permissions.
NoSQL Database (MongoDB/Redis) – Used for real-time communication, caching frequently accessed data, and handling temporary session storage. File Storage (Cloud/Local Server) – Used for storing uploaded project files, documentation, and other resources. Backup & Recovery Mechanism – Regular backups are maintained to prevent data loss, with automated snapshots and disaster recovery procedures.

3.3.3. Data Access & Security

Role-Based Access Control (RBAC) – Ensures users can only access data relevant to their roles (e.g., project owners can modify tasks, team members can only update assigned tasks). Encryption & Secure Communication – All sensitive data is encrypted, and interactions take place over HTTPS and WebSocket Secure (WSS) for real-time updates. Audit Logging & Monitoring – All user activities and changes are logged for security and accountability.

By implementing efficient data processing and secure storage mechanisms, the system ensures scalability, reliability, and security, making it a robust solution for project management.

3.4 Working Flow

The SPL Lab Project Management App follows a structured workflow that enables users to efficiently manage projects, collaborate with team members, and explore available projects. The system workflow is divided into User Actions, Admin Actions, and the Explore Module, ensuring a seamless experience for different roles.

3.4.1. System Initialization

The system starts with a login/authentication process, where users sign in using their credentials.Based on their role (Project Owner, Team Member, or Admin), they are directed to the appropriate dashboard.

3.4.2. User Module *(Project Owners and Team Members)*

Upload Project – Users can create and upload new projects, entering key details such as project title, description, and goals. Add Details – Additional project information, such as deadlines, technologies used, and objectives, is provided. Add Files – Users can upload necessary documents, source code, or other project-related files. Add Team Members – Project owners invite team members to collaborate on the project. Assign Tasks – Tasks are created and assigned to team members, with deadlines and priority levels. Chat in Project – A real-time chat feature enables discussions and updates within the project team. Post to Explore – Project owners can choose to make their projects publicly visible for potential collaborators.

3.4.3. Admin Module *(Admin Actions)*

Manage Users – Admins can oversee registered users, assign roles, and monitor their activities. Oversee Projects – Admins have the authority to review, approve, or flag projects based on compliance and relevance.

3.4.4. Explore Module *(Discovering and Joining Projects)*

Find Projects – Users can explore available projects based on their interests, expertise, or field. Join Project – Interested users can request to join a project, and project owners can approve or deny requests.

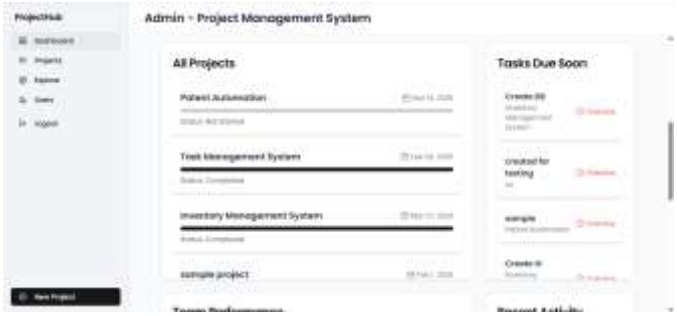
3.4.5. System Conclusion

Once tasks are completed and the project reaches its final stage, it can be marked as "Completed."All changes, activities, and discussions remain stored for reference and accountability. This structured workflow ensures an efficient and collaborative project management experience, allowing users to create, manage, and explore projects effectively while maintaining a well-organized system architecture.

4. RESULTS AND DISCUSSIONS

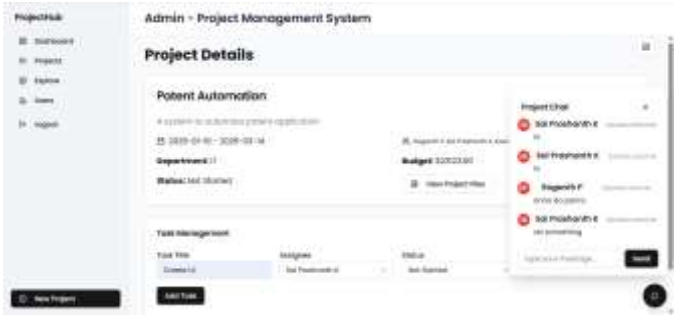
4.1 Results

The SPL Lab Project Management App was successfully implemented and tested for its core functionalities, including project creation, task management, team collaboration, and user role management. The results demonstrate that the system effectively streamlines project workflows by allowing project owners to create and manage projects efficiently, assign tasks to team members, and track progress in real-time. The explore module enables users to find and join projects based on their skills and interests, fostering collaboration and knowledge sharing.



Performance tests indicate that the system operates smoothly with minimal response time, even when handling multiple concurrent users. The database structure ensures efficient storage and retrieval of project-related data, reducing redundancy and improving accessibility. The user authentication and authorization mechanisms function as expected, ensuring secure access control for different roles, such as project owners, team members, and administrators. Additionally, the integrated chat feature enhances communication among team members, improving coordination and productivity.

Overall, the results confirm that the SPL Lab Project Management App meets the intended objectives, providing an efficient, scalable, and user-friendly project management solution. Future enhancements may include advanced analytics, automated task recommendations, and integration with third-party collaboration tools to further optimize the platform's capabilities.



4.2 Discussions

The development and implementation of the SPL Lab Project Management App highlight the significance of an integrated platform for project tracking, collaboration, and resource management. The system successfully addresses common challenges in project management, such as task allocation, team coordination, and progress monitoring. By incorporating role-based access control, the platform ensures that project owners, team members, and administrators have appropriate permissions, preventing unauthorized modifications and enhancing data security.

One of the key strengths of the system is its modular architecture, which allows for seamless scalability and future upgrades. The user module effectively supports project owners in creating and managing projects, while the explore module fosters collaboration by enabling users to discover and join relevant projects. The real-time chat feature enhances communication, reducing delays and misunderstandings among team members.

However, certain limitations were identified during testing. For instance, while the task assignment feature functions well, incorporating AI-based workload distribution could further optimize team efficiency. Additionally, while the current authentication system provides secure login mechanisms, integrating multi-factor authentication (MFA) would enhance security. The database performance remains optimal under standard load conditions, but stress testing under extreme usage scenarios may be required to ensure robustness.

In conclusion, the SPL Lab Project Management App successfully provides a structured approach to project management, improving collaboration and productivity. Future iterations could focus on enhancing automation, refining UI/UX design, and integrating external tools to further elevate user experience and efficiency.

5. CONCLUSIONS

The SPL Lab Project Management App provides a structured, web-based platform that streamlines project management, enhances collaboration, and improves task tracking. By integrating key features such as role-based access control, real-time communication, task management, and project exploration, the system effectively addresses challenges in team coordination and progress monitoring.

The modular architecture ensures scalability, allowing for future enhancements and seamless integration with other tools. The user module efficiently manages project owners and team members, while the explore module encourages knowledge sharing and collaboration. The admin module ensures smooth system governance by overseeing projects and user management.

Although the system meets its primary objectives, potential improvements include AI-driven task allocation, enhanced security mechanisms like multi-factor authentication, and performance optimization under high-load conditions. Future developments could also focus on advanced analytics, predictive insights, and improved UI/UX design to provide a more comprehensive project management experience.

Overall, the SPL Lab Project Management App serves as a valuable tool for project tracking and collaboration, offering an efficient and scalable solution for managing academic and professional projects.

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