International Journal of Advance and Innovative Research
Volume 13, Issue 2: April - June 2026
ISSN 2394 - 7780

PROUP: A UNIFIED CLOUD-BASED PROJECT MANAGEMENT AND REAL-TIME COLLABORATION PLATFORM FOR WORKFLOW OPTIMIZATION

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ABSTRACT
In the present digital environment, different tools are being used for project management, communication, and collaboration. In this environment, fragmented workflow management using different tools leads to inefficiencies, a lack of transparency, and a lack of proper coordination among the team members. In this context, the present paper proposes a unified cloud-based system named ProUp for project management and collaboration. The proposed system will not only optimize workflow management but will also increase the productivity and communication among the team members. The proposed system will be a unified system for task management, real-time collaboration, workflow management, and analytics. The proposed system will be developed using modern technologies like React, Node.js, Prisma, and Socket.io. The proposed system will be a solution for the limitations faced by the team members using different tools like Jira, Trello, and Asana. The experimental observations and evaluation of the system will clearly indicate the advantages of the proposed system. The proposed system will be a small contribution to the optimization of workflow management. The present system will be a starting point for the development of a smart system in the future.
Keywords - Project Management, Collaboration Platform, Workflow Automation, Cloud Computing, Real-Time Systems, Productivity Optimization

1. Introduction
The rapid evolution of digital technologies, along with the proliferation of working from home or remote working, has significantly changed the way projects are planned, executed, and managed [1], [2]. In a globally interconnected world, teams are not geographically bound; rather, they are spread out in different geographic locations. This has significantly increased the need for digital technologies in terms of workflow management. Organizations, academic centers, startups, and freelance teams rely on digital technologies to manage projects. This includes software platforms used to coordinate team activities, share information, and monitor projects in real-time [1], [2].
The availability of numerous project management and collaboration tools still does not address one of the biggest challenges faced by teams in terms of workflow management. One of the biggest challenges faced by teams in a globally interconnected world is fragmentation. In general terms, teams use numerous independent software platforms to manage different activities. For example, a messaging app can be used for communication, a spreadsheet can be used for tracking, cloud storage services can be used for document sharing, and a separate analytics tool can be used for tracking progress. Though each of these tools may be used for their respective purposes in an effective manner, the absence of integration between them can cause disorganized information and inefficient workflow [2], [4]. The team members will be forced to switch between different platforms, which will not only be cognitively tiring but will also increase the chances of errors [2].

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The next major concern in such existing systems would be the absence of a centralized view and real-time synchronization. In most of the existing systems, changes in information pertaining to tasks, deadlines, and progress of projects are not synchronized in real time [4]. This will not only cause discommunication but will also make it difficult for the project managers to get a unified view of the projects. This will not only impact the decision-making process [1] but will also impact the projects in an adverse manner. The absence of real-time tracking will not only make it difficult for an organization to identify potential problems but will also impact the decision-making process.

Besides fragmentation and visibility, the tools that are currently used have the problem of a trade-off between functionality and usability. Advanced platforms, which are normally meant for large enterprises or software development environments, normally have a number of features. However, these platforms are normally complex. As a result, they require a lot of configurations [1], [2]. On the other hand, simple tools normally require less complexity. However, they normally lack complex features such as automation [2], integration, or even analytics. As a result, the problem is created since there is a need to balance the two.

The problem with the project management is further complicated with the introduction of the problem of remote teams. In a remote team environment, team members normally work in different locations. As a result, communication is a problem in a remote team environment [3], [7]. The traditional means of communication is normally not effective in a remote team environment. As a result, the team needs a digital solution for communication [3]. Without a digital solution for communication, there is a communication problem for the team. Moreover, the lack of automation in the systems means that there is tedious work for the team. As a result, there is less time for the team to focus on other important activities.

In an attempt to address these shortcomings, there is a rising need for a unified platform for project management. A unified platform refers to a system that integrates all aspects of project management. The main objective of a unified platform for project management is to ensure that there are no multiple tools for project management. A unified platform refers to a comprehensive system that integrates task management, communication, file sharing, scheduling, and reporting. A unified platform enables organizations to achieve transparency, efficiency, and collaboration. Additionally, a unified platform enables organizations to ensure consistency, avoid redundancy, and make informed decisions.

In addressing these challenges, this paper proposes a cloud-based project management system that enables collaboration. The system that this paper proposes is called ProUp. The system aims to ensure efficiency in workflow as well as improve productivity. The proposed system will ensure a comprehensive system in terms of task management, communication, workflow automation, file sharing, as well as analysis. The system will incorporate modern technologies such as React, Node.js [5], as well as real-time communication to ensure a scalable, responsive, as well as synchronized system. Additionally, the system will incorporate role-based access control to ensure a structured workflow.

The proposed system would have a special feature in terms of flexibility in workflow management. This would allow the system to be used in different domains, such as academic project management, business management, startup management, and freelance management. Unlike other systems, which may have poor flexibility in terms of workflow management, the proposed system would have a balanced feature in terms of usability and functionality. Thus, both technical and non-technical users would be able to use the proposed system. The proposed system would have an improved workflow feature by integrating automation features. Thus, there would be no error caused by human interference.

The main objective of this research is to create a unified platform that would overcome the problems associated with current project management tools. The research would prove that a unified system would allow for a reduction in workflow fragmentation, real-time collaboration, and productivity. In addition, the research would explore the potential of current web technologies for creating a

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collaborative system. In conclusion, it is clear that with the increasing complexity of project environments, there is a need for intelligent systems for project management.

2. Literature Review

The ever-changing nature of digital collaboration has led to a variety of project management systems. In this chapter, the theoretical background of project management will be presented, and a comparison of existing tools will be provided in order to understand the gaps in the research that ProUp fills.

2.1 Theoretical Framework: PMBOK Knowledge Areas

Project management is not merely an issue of managing the tasks of a project; it is conducted in a field of knowledge called Project Management Body of Knowledge (PMBOK). According to the PMBOK guide, project management has nine different knowledge areas, each of which plays a vital role in the successful completion of a project [1]:

- **Integration and Scope Management:** This involves integrating all activities of a project in a manner that allows for a clear scope of work without a "creep".
- **Time and Cost Management:** This involves managing a project in a timely manner and within a given budget.
- **Communication and Risk Management:** This involves using a centralized software system to better manage team coordination and a proactive approach to prevent disasters.

2.2 Comparative Analysis of Existing Systems

The current market offerings make teams choose between depth and usability. The following table is a summary of the prominent tools based on the above analysis:

Table 1: Comparative Analysis of Market-Leading Project Management Tools

Platform	Core Methodology	Strengths	Critical Limitations
Jira	Agile (Scrum/Kanban)	Powerful issue tracking and bug management.	Steep learning curve; overly complex for non-technical users.
Trello	Visual Boards	Highly intuitive board-and-card system.	Lacks deep automation, native chat, and advanced analytics.
Asana	Task Lists/Timelines	Strong accountability and mobile support.	Premium features are cost-prohibitive for small teams; limited native automation.
ClickUp	All-in-One	Combines docs, tasks, and goals in one ecosystem.	Significant "feature overload" leading to interface fatigue and high cognitive load.

2.3 Identification of Research Gaps

However, despite the current state of the tools, there are a few "pain points" associated with the current workflow, making it a requirement to develop a unified system:

1. **Fragmentation of Tools:** Many teams are accustomed to jumping between different tools for communication (Slack) [4], task management (Trello) [4], and documentation (Drive).
2. **Lack of Real-Time Visibility:** Many tools do not allow for the real-time synchronization of task changes.
3. **Lack of Integrated Analytics:** Managers do not have a single platform for tracking task progress and identifying problems.
4. **The Complexity Barrier:** There is a notable absence of tools with features such as Socket.io for real-time updates and Prisma for data integrity with a simple and accessible UI.

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2.4 The ProUp Proposition

The ProUp platform not only promises to be a task management platform but a Unified Project Ecosystem, which will bridge the gap between Asynchronous Task Tracking and Synchronous Team Communication. In this regard, ProUp proposes a solution to the 'Tool Switching Tax' faced by team productivity in modern teams by providing a unified platform for all team communication and task management.

2.4.1 Architectural Integration

Unlike most platforms, which rely on third-party 'Power-Ups' or 'Extensions' for core functionality, ProUp proposes a 'Built-in First' approach. This has been made possible by a robust technology stack, which includes:

- **Real-Time Synchronization:** Using Socket.io, ProUp allows all changes, messages, and updates to be instantly propagated to all clients, providing sub-second latency for all changes to be reflected in real-time.
- **Data Integrity and Relationship Mapping:** With the help of Prisma ORM and a strict schema definition, ProUp maintains a structured SQLite/PostgreSQL database schema, which allows users to be connected with each other, hence providing a 'Single Source of Truth' feature.
- **Centralized Resource Management:** With the help of a local document management feature and a collaborative Whiteboard feature, ProUp allows team brainstorming sessions within tasks

2.4.2 Mental Effort Reduction via UI/UX Design

ProUp solves the problem of "Complexity vs. Usability" through the implementation of a "Simplified Unified Dashboard."

- **Contextual Views:** ProUp enables a toggle between Kanban Boards for workflow visualization, Global Calendars for deadline awareness, and Analytical Charts (using Recharts) for progress monitoring, all within the project interface.
- **Role-Based Focus:** ProUp uses Role-Based Access Control (RBAC) for information filtering depending on the role assigned to a specific user, with Team Leads having access to analytics, while Members are provided with a "My Tasks" view.

Table 2: ProUp's Unified Approach vs. Fragmented Workflow Requirements

Workflow Requirement	Fragmented Tool Approach	ProUp Unified Approach
Instant Communication	Slack / WhatsApp	Integrated Socket.io Chat
Task Management	Trello / Spreadsheets	Native Kanban & Task CRUD
Data Visualization	Manual Excel Charts	Live Recharts Dashboards
Brainstorming	Miro / Physical Boards	Integrated Collaborative Whiteboard
Documentation	Google Docs / Notion	Internal Document Module

2.4.3 Scalability and Domain Adaptability

It is created with domain independence in mind. Whether used for Academic Project Tracking (where student-faculty milestones are to be tracked), Startup Operations (where rapid iterations are a

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necessity), or Freelance Client Portals (where flexibility is key), the status workflow and notification trigger flexibility allow ProUp to scale with the sophistication of projects. As such, ProUp is envisioned to be a key component of future intelligent project management systems.

3. System Architecture and Methodology

The development of ProUp was informed by the need for a high-performance environment that unifies project management while removing latency and fragmentation from traditional project management systems. This section outlines the framework for the project as well as the development process that was followed to ensure a real-time system**.**

3.1 Agile-Scrum Development Methodology

The project was developed using an Agile Scrum approach [3], [7] to ensure continuous improvement and flexibility to respond to changes. The project was divided into four Sprints, with each Sprint building a functional element.

Table 3: Sprint-wise Development Lifecycle of ProUp

Sprint	Focus Area	Key Technical Deliverables
Sprint 1	Foundation	Environment setup, JWT Authentication, and Base Database Schema.
Sprint 2	Core Management	Project/Task CRUD, Deadline Logic, and RBAC implementation.
Sprint 3	Collaboration	Socket.io Chat, File Sharing, and Notification Engine.
Sprint 4	Optimization	Recharts Analytics, OAuth Integrations, and PWA Deployment.

3.2 System Architecture

ProUp leverages a modern Client-Server Architecture, well-suited for low-latency web interactions.

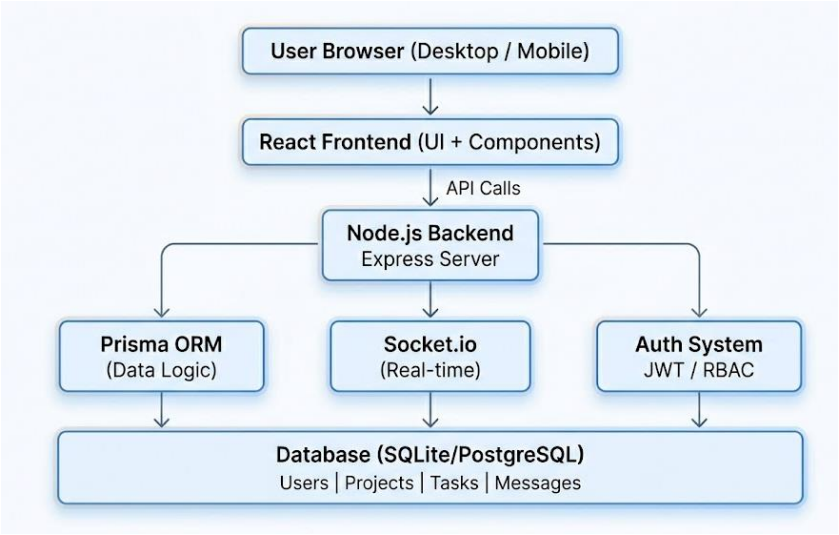

Fig. 1: System Architecture of ProUp Platform

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3.2.1 Technology Stack

The robustness of the platform is based on the chosen technology stack from the latest technologies:

- **Frontend (React 18.3.1 [5] & TypeScript):** Provides a type-safe interface for dynamic rendering of Kanban boards and calendars.
- **Real-Time Engine [6] (Socket.io 4.8.3):** Uses bidirectional communication based on events for real-time chat.
- **Backend (Node.js & Express 5.1.0) [5]:** Manages API Routes and backend logic.
- **Data Layer (Prisma ORM & SQLite) [2]:** Provides a safe interface for managing users, tasks, and file BLOBs.

3.3 Functional Module Design

The ProUp architecture is divided into various modules, which are reflected in the live environment.

- **Analytics Hub (Dashboard):** The Recharts library is used to transform the information on tasks into visual metrics such as productivity or the ratio of completed tasks.
- **Personalized Workspace (My Tasks):** Using filtered view logic to aggregate global tasks into a unified interface for the end user.
- **Communication Engine (Inbox & Projects):** Combining system notifications with real-time project chat into a unified messaging feed.
- **Temporal Logic (Calendar):** Using the FullCalendar library version 6.1.20 to aggregate project deadlines into a unified global calendar.
- **External Integration Layer:** Using an OAuth 2.0 gateway to integrate with Google Drive, GitHub, Figma, Slack, and Notion.
- **Well-being & Accountability (Journal & My Pet):** Using a digital ledger for self-reflection and a gamification engine for user engagement.
- **Iterative Review (Sprint Retro):** Using a dedicated interface for team analysis of sprint performance to identify improvements for future iterations.

3.4 Data Integrity and "Single Source of Truth" Flow

The key technical innovation behind ProUp is that it allows for a Single Source of Truth [1], [2]. In a fragmented system, if a person changes a task, there is a chance that others may not be aware of it until they refresh their screen or check their email. ProUp removes this 'information lag' through a synchronized three-step process.

3.4.1 The Entity-Relationship (ER) Foundation

- **The Chain of Command**: A User is associated with a Project, a Project has multiple Tasks, and Tasks have multiple Messages or Notifications attached to them.
- **Why it matters**: This is a strict hierarchy, which means a task cannot exist without being associated with a person accountable for it and a project goal.

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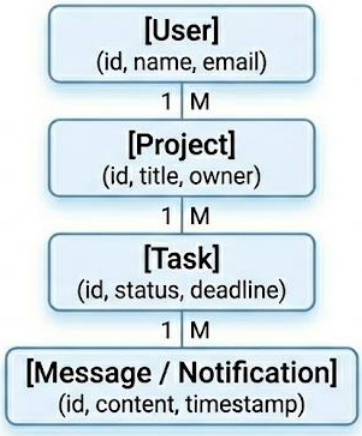

Fig. 2: Entity Relationship Diagram of ProUp

3.4.2 The "Update-and-Broadcast" Logic

To better grasp how this works in real-time, think of a virtual whiteboard where, as soon as you draw a line, it instantly appears on everyone else's screen.

1. **The Trigger (User Action)**: A user changes the status of a task from "In Progress" to "Done" on the Kanban board.
2. **The Handshake (Prisma ORM)**: The system instantly tells the database to save this change permanently. ProUp makes use of a "translator" named Prisma.
3. **The Megaphone (Socket.io)**: At the same time, the server immediately "shouts" this information to all other team members who are logged in.
4. **The Result**: Without needing to click "Refresh," the screens of all other team members immediately show the task is done.

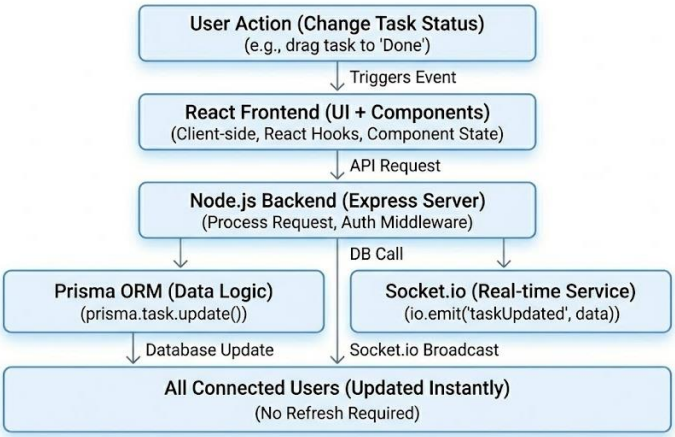

Fig. 3: Real-Time Update and Broadcast Mechanism

4. Implementation and Functional Evaluation

The implementation of ProUp can be considered a physical manifestation of a unified productivity system. The transition from third-party solutions to a unified system helps reduce the cognitive switching cost associated with a project team. In this section, a detailed analysis of the different modules of a live platform will be provided.

4.1 Management and Structural Interfaces

The top management interface is used to manage all aspects of a project, starting from planning to completion.

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- **Unified Dashboard (The Command Center):** The Unified Dashboard, based on Recharts [5], allows for a real-time graphical representation of team performance. It includes a 'Productivity Index,' a 'Task Completion Progress' bar, and a 'Project Distribution' chart.

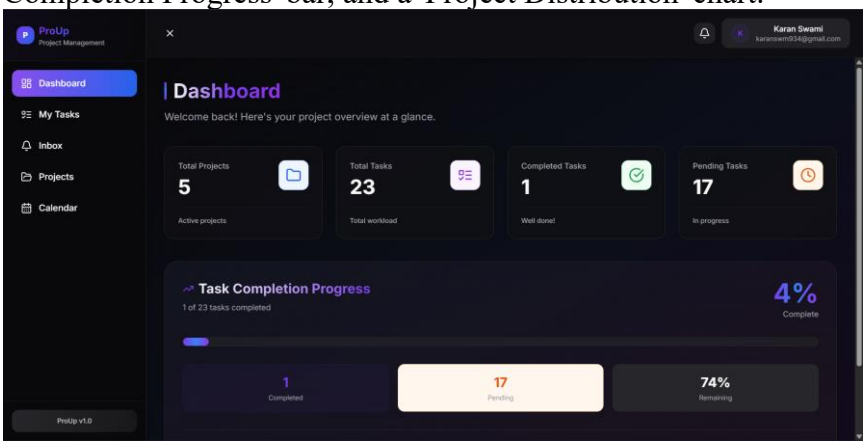

Fig. 4: Dashboard Interface

- **"My Tasks" Personalized View:** To avoid information overload, a personalized view of all tasks from different projects, where the current user is the primary assignee, is provided. Tasks are grouped by priority (High, Medium, Low) and status.

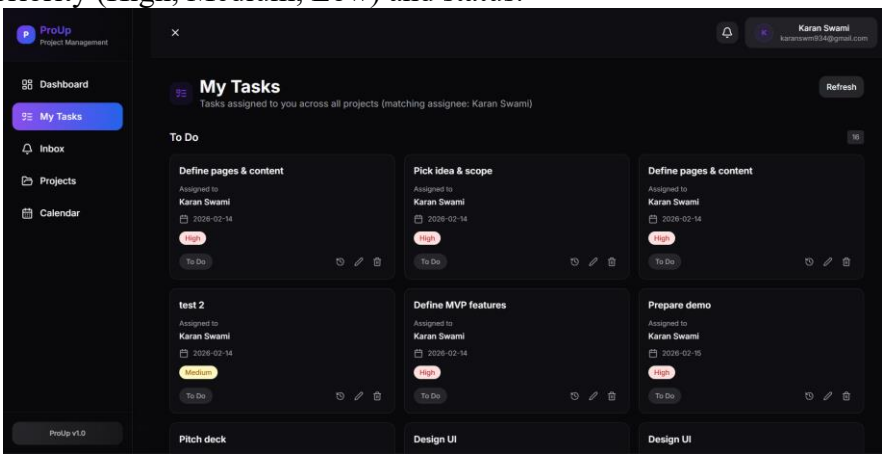

Fig. 5: Task Management (Kanban Board)

- **Projects and Team Management:** The 'Projects' page is a directory of all projects currently in progress. In a project, the Team Page enables the project owner to manage 'Role-Based Access Control' (RBAC), i.e., invite team members and assign different permission levels (Admin, Team Lead, Member) for a project.

4.2 Collaborative Execution and Document Modules

ProUp closes the gap between task tracking and resource generation by directly integrating collaborative tools within the workspace.

- **Integrated Documents and Spreadsheets:** Unlike other tools, ProUp does not require linking other tools for documents and spreadsheet generation. It comes with a native Documents feature for text-based specification generation and a Spreadsheets feature for data tracking.
- **Real-Time Whiteboard:** With tldraw, ProUp has a dedicated Whiteboard feature for team brainstorming, creating diagrams of system architectures, or creating wireframes of UI components within live meetings.
- **Communication Hub (Inbox & Chat):** ProUp leverages Socket.io to power its real-time communication features, including a centralized Inbox. This ensures there are no communication silos since team discussions are archived within the task itself.

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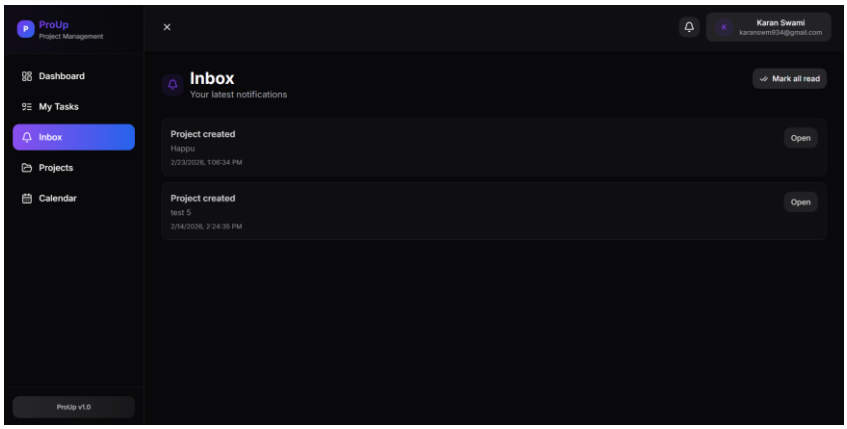

Fig. 6: Chat / Inbox

4.3 Behavioral and Specialized Utility Modules

The system includes special "Human-Centric" modules for team well-being and long-term project health.

- **Reflective Journal and Sprint Retro:** n order to comply with the Agile methodology, the Journal module allows team members to reflect on their experiences each day. This information will be used on the Sprint Retro page to analyze team performance after each development period.
- **Third-Party Integration Layer:** The Integrations page includes a secure OAuth 2.0 gateway to the rest of the professional world. This includes Google Drive, GitHub, Figma, Slack, and Notion. Users can connect code or design files directly to their ProUp dashboard.
- **Global Calendar:** This module includes a high-level view of the organization's timeline. It syncs all task deadlines in one place, where users can reschedule using a drag-and-drop interface.

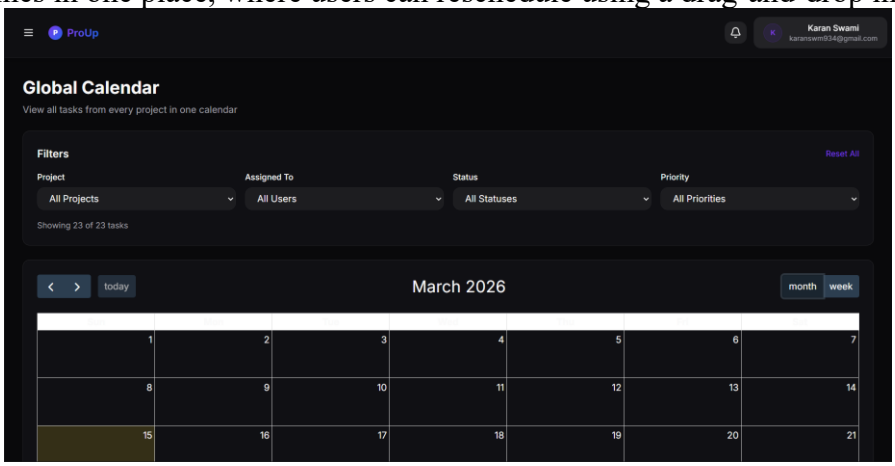

Fig. 7: Calendar View

- **Engagement Gamification (My Pet):** In order to motivate users to be productive, the system includes a special "My Pet" module. Users will be able to care for a virtual pet, which will grow or deteriorate based on their completion rate and use of "Focus Audio."

4.4 Functional Evaluation Results

The system was tested using simulated team environments to evaluate real-time performance.

Table 5: Performance and Functional Outcomes

Module	Technical "Hero"	Result/Observation
Real-Time Sync	**Socket.io**	Updates (Chat/Task moves) broadcasted to all clients in <200ms.

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Data Relationships	**Prisma ORM**	Zero orphan records; all Tasks strictly linked to Users and Projects.
Resource Storage	**SQLite BLOBs**	Documents and Whiteboard states persist reliably without external storage.
User Security	**JWT & RBAC**	Unauthorized users were successfully blocked from Project Team settings.

The implementation successfully demonstrates the possibility of replacing the current fragmented 'Tool Juggling' model used in industry with a single, cohesive platform.

5. Discussion and Future Scope

The use of ProUp proves that a unified cloud-based ecosystem [1], [2] is capable of dealing with the technical and cognitive difficulties of contemporary project management. The unification of fragmented tools into a single high-performance environment offers a scalable solution for different organizational models.

5.1 Discussion of Current Impact

The primary objective of this research was to eliminate the "tool-switching tax," which impacts the productivity of teams. The current implementation has successfully achieved the following critical milestones:

- **Centralized Visibility:** The "Single Source of Truth" concept is achieved through the Dashboard and Global Calendar, which minimizes the chances of miscommunication regarding project deadlines and project health.
- **Operational Efficiency:** The implementation of Socket.io for real-time chat and Prisma for data integrity ensures smooth information flow without any latency, enabling teams to work together from a distance.
- **Accountability:** The implementation of features such as the Reflective Journal and Role-Based Access Control (RBAC) ensures that responsibilities are clearly defined.

5.2 Future Scope: Intelligent Workflow Optimization

Though the current version of ProUp successfully integrates the required productivity tools, the roadmap for the development of the project reveals a future direction towards the development of an Intelligent Project Assistant.

5.2.1 Advanced Automated Workflows

Future versions of the project will shift from manual task handling towards automated work handling by the Intelligent Project Assistant:

- **Dynamic Task Transitioning:** Logic will be added to transition tasks across the Kanban board based on specific events happening outside the application, such as a "Pull Request" approved on GitHub or a design sign-off on Figma.
- **Intelligent Dependency Management:** The Intelligent Project Assistant will be designed to automatically adjust the schedule of a task if a prerequisite task is delayed, instantly notifying every affected team member through the notification engine.

5.2.2 Smart Mailing and Communication AI

The Intelligent Project Assistant will be designed to minimize "notification fatigue" by intelligently filtering communications:

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- **Contextual Email Summaries:** Using Nodemailer, the Intelligent Project Assistant will be designed to generate "Smart Digests"—daily/weekly email summaries of project progress, specific project information, and deadlines relevant to the specific role of the project team member.
- **Natural Language Reminders:** The Intelligent Project Assistant will be designed to use AI to craft project reminders through email and the Inbox feature of the project.

5.2.3 Pervasive AI Integration

The crux of the future ProUp ecosystem will be an AI engine embedded into each functional module:

- **AI-Driven Project Planning:** With an integrated AI assistant, the project planning feature will analyze the Product Backlog and suggest the best sprint size and task allocation based on team velocity.
- **Smart Journaling and Sentiment Analysis:** With the Journal feature, the team sentiment will be analyzed using NLP techniques, identifying "at-risk" project milestones or burn-out before it happens.
- **Automated Documentation:** AI assistance will be provided in creating project reports and Sprint Retros by collating information from team chats, whiteboard sketches, and task completions.

5.3 Benefits to Society

The intelligent implementation of the ProUp ecosystem will benefit different sectors of society:

- **Startups & Enterprises**: Boosts organizational productivity by eliminating mundane admin tasks.
- **Educational Institutions**: Increases productivity by facilitating faculty-student collaborations.
- **Remote Work Ecosystems**: Increases transparency and ensures team synchronization, irrespective of physical locations.

6. Conclusion

The creation and deployment of the ProUp – Project Management and Collaboration Platform is a prime example of the efficiency of a unified digital system in effectively addressing the common problem of fragmentation. By integrating task management, real-time communication, and analytical reporting under a single unified system, the fragmentation problem is effectively addressed by eliminating the "cognitive switching cost," which is the common problem affecting the efficiency of project teams. By harnessing the power of the latest technology stack, including React, Node.js, Prisma, Socket.io, among others, the ProUp system is a solution to the demands of modern project management. This research study validates the fact that a shift from fragmented, asynchronous application environments to a "Single Source of Truth" approach is a necessity for modern collaboration. The ability of the system to effectively synchronize team efforts across the globe in under 200ms is a validation that the importance of a real-time transparent system cannot be overstated, especially in the modern remote/hybrid work environment. By effectively balancing the needs of Role-Based Access Control (RBAC) and other robust features with a simple, intuitive interface, the system is a solution for non-technical teams and small-scale operations.

In the end, the ProUp platform is an important step forward in productivity software that provides a solid foundation for the future of intelligent management systems. With its proposed roadmap for pervasive AI integration, intelligent automation of its workflow, and mobile enablement, the platform has the potential to evolve from a passive tracking tool to an intelligent assistant for its projects. This study has concluded that the integration of contemporary web technologies and agile methodologies is the only way forward for the creation of an efficient, scalable, and human-centric collaboration solution.

7. Acknowledgements

This section is for acknowledging ones who have contributed to the development of the project.

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- **Faculty Guidance:** We express our gratitude to **Mr. Udbhav Ojha** for his guidance, and supervision.
- **Institutional Support:** We express our gratitude to **Dr. Anil Kumar (HOD, CSE)** and **Mr. Indra Kishor (Project Coordinator)** for providing us the required resources.
- **Administrative Leadership:** We express our heartfelt thanks to **Prof. (Dr.) Dinesh Goyal, Director of PIET**, for providing us the required opportunity to work on this project as a part of the B. Tech course.
- **Team Collaboration**: We acknowledge the efforts of the development team **Karan Swami, Kushagra Panwar, and Mahak Kankaria.**

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