Commune - Igniting Ideas, Connecting Teams

Submitted in partial fulfilment of the requirements of the degree

BACHELOR OF ENGINEERING IN **COMPUTER ENGINEERING**

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CERTIFICATE

This is to certify that the Mini Project entitled **"Commune-Igniting Ideas,Connecting Teams "** is a bonafide work of **Raheni Ajwani(04), Yash Janyani(31),Tarun Gulwani(26)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Computer Engineering" .**

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Mini Project Approval

This Mini Project entitled "**Commune-Igniting Ideas,Connecting Teams**" by **Raheni Ajwani (04), Yash Janyani (31),Tarun Gulwani (26)** is approved for the degree of **Bachelor of Engineering** in **Computer Engineering.**

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Place:

Contents

Abstract

This mini-project aims to create a simplified version of the popular team communication tool, Slack. The goal is to offer a cost-effective and customisable alternative with key features like real-time messaging, channels, direct messaging, file sharing, and notifications. The project will use modern web technologies to build a smooth and efficient communication platform.

The project will demonstrate knowledge of real-time communication, user authentication, scalability, and user-friendly design by replicating Slack's core features. The resulting app will be ideal for small teams and startups, providing a flexible and reliable platform for team collaboration. In building this Slack clone, the focus will be on technical aspects such as using WebSockets for real-time messaging, implementing secure user authentication, and designing a responsive user interface. The project will also address creating a scalable system that can handle growing numbers of users and data.

Additionally, the project will explore integrating features that enhance team collaboration, such as notifications for new messages and the ability to organize discussions in different channels. A key focus will be on creating a smooth user experience, ensuring that the platform is easy to navigate and intuitive for users. The development process will also include setting up a flexible backend architecture, allowing for easy expansion as the number of users grows. Performance and efficiency will be prioritized to ensure that communication remains fast and responsive, even as more teams begin using the platform. Overall, the project will deliver a practical and scalable communication tool tailored for small businesses and startups.

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List of Abbreviations

Sr no.	Short Form	Abbreviated Form
1	PM	Project Management
2	API	Application Programming Interface
3	UI	User Interface
4	DB	Database

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Chapter 1: Introduction

1.1 Introduction

This project will emphasize building an intuitive and responsive user interface to ensure a smooth experience across various devices, including desktops and mobile phones. By simplifying the design, the platform will reduce unnecessary complexity, making it easy for users to navigate and manage their team communications effectively.

The real-time messaging feature will utilize WebSockets or similar technologies, ensuring instant updates and interactions among users without delays. Channels will help organize team discussions around specific topics or projects, while direct messaging will facilitate one-on-one conversations, ensuring privacy and focused communication when needed.

The platform will also include features like file sharing, enabling users to upload and share important documents directly within chats, enhancing collaboration. Notifications will keep users informed about new messages, mentions, and important activities, ensuring that no critical communication is missed.

In addition to these core functionalities, the project aims to build a flexible and scalable backend architecture that can handle growing user bases and increased data traffic over time. It will prioritize security, ensuring user authentication is safe and reliable, protecting both personal data and communications within the platform.

1.2 Motivation

In today's digital age, effective team communication tools are essential for productivity and collaboration. Platforms like Slack have become widely used, but their high cost and complex feature set can be overwhelming for small teams or startups with limited budgets. This project is motivated by the need for a streamlined, easy-to-use communication tool that offers core functionalities at a lower cost while remaining flexible and customizable. By developing this

Slack clone, we aim to provide a viable alternative that helps teams collaborate without unnecessary complexity or expense.Additionally, many small teams struggle with the limitations of free versions in existing platforms, which often restrict essential features like file storage or integration options. This project seeks to eliminate those barriers by offering an affordable solution without compromising on key functionalities. Ultimately, the goal is to create a communication tool that empowers teams to work efficiently, without the burden of high costs or excessive features that may not be necessary for their needs.

1.3 Problem Statement and Objectives

Many existing team communication tools, like Slack and Microsoft Teams, offer robust features but come with high costs, steep learning curves, and limitations in their free versions. Customization options are often limited, and scaling costs can be prohibitive for small teams or startups. The problem is how to create a communication platform that provides essential features like messaging, file sharing, and channel organization without the complexity and expense associated with existing solutions.

Objectives:

- Develop a Real-Time Communication Tool: Create a platform that supports real-time messaging, using WebSockets or similar technology to ensure fast and efficient communication.
- Enable Channel-Based and Direct Messaging: Implement features that allow users to communicate through channels for group discussions or direct messaging for one-on-one conversations.
- Incorporate File Sharing and Notifications: Add functionality for users to share files within the platform and receive notifications for new messages and activities.
- Design a Scalable and Secure System: Build a backend that can scale as user numbers grow, while ensuring secure user authentication and data handling.
- Create a User-Friendly, Responsive UI: Focus on creating a clean, intuitive interface that works well on both desktop and mobile devices.

- Offer Customization and Flexibility: Provide options for users to customize their workspaces and adapt the platform to their specific needs, making it suitable for a variety of teams.

1.4 Organization of the Report

In this report, we will cover several key aspects of the project. First, we will conduct a literature survey of existing systems, examining popular team communication platforms like Slack, Microsoft Teams, and Discord. This section will highlight their strengths, limitations, and how they are used in different environments. Following this, we will explore the limitations of existing systems, focusing on issues such as high costs, complexity, and restricted customization options, especially for smaller teams and startups.

Next, we will discuss the contribution of this mini-project, outlining how it aims to address these challenges by providing a cost-effective, customizable, and simplified communication platform. This platform focuses on offering essential features like real-time messaging, file sharing, and secure authentication, while remaining flexible and user-friendly. The proposed system will then be introduced, explaining the design and functionality of the platform, along with its benefits for small teams in terms of ease of use, scalability, and affordability.

The working of the system will also be detailed, providing an overview of how core features such as channel creation, messaging, and file sharing are implemented, along with real-time communication through WebSockets and secure login mechanisms. The report will also cover the hardware and software used in the project, such as Convex for the backend and TypeScript, Tailwind CSS, and Flowbite for the frontend.

Finally, we will present the results of the project, showcasing the key functionalities developed and how they meet the project objectives. The report will conclude with a conclusion summarizing the overall impact and contributions of the project, along with potential areas for future development and improvements.

Chapter 2: Literature Survey

2.1 Survey of existing systems

In the current landscape of team communication tools, platforms like Slack, Microsoft Teams, and Discord dominate, each with its own strengths and weaknesses. Below is a brief overview of these systems:

1. Slack
    - Strengths: Slack is known for its intuitive user interface, extensive integration with third-party apps (e.g., Google Drive, Trello, and GitHub), and features like channels, direct messaging, file sharing, and real-time notifications. It also provides excellent support for asynchronous and synchronous communication.
    - Weaknesses: Slack's main drawback is its cost. The free version is limited, with restrictions on message history (only 90 days). The paid version can be expensive for small teams or startups. Additionally, it may overwhelm users with excessive notifications and feature complexity.

2. Microsoft Teams:
    - Strengths: Teams integrate seamlessly with the Microsoft 365 ecosystem, making it an excellent choice for organizations that already use Office apps. It offers a broad range of features, including channels, video conferencing, file sharing, and collaboration on documents within the app. It also provides strong security and compliance features.
    - Weaknesses: The complexity of Microsoft Teams can be a challenge for users unfamiliar with the Microsoft ecosystem. Its interface is less intuitive compared to Slack, and it can be difficult to navigate. For smaller teams, the feature set may feel overwhelming, and it requires a subscription to Microsoft 365 for full functionality.

3. Discord:
    - Strengths: Initially developed for gamers, Discord has evolved into a versatile communication tool for both social and professional use. It offers free, unlimited message history, voice and video chat, and a customizable server/channel system. It's particularly well-suited for communities and informal teams that need simple and free communication tools.
    - Weaknesses: Discord lacks the level of professional integrations that Slack or Teams offer. While it's great for casual use, it's not as feature-rich

2.2 Limitation of existing systems:

1. Slack:
    - High Cost: The free version of Slack limits message history to 90 days and caps file storage at 5GB, which can be restrictive for teams with long-term projects. Upgrading to a paid plan for full access can be expensive, especially for smaller teams or startups.
    - Limited Customization: While Slack allows some customization, such as custom emojis and app integrations, it lacks deeper workspace personalization options, like custom channel layouts or flexible user interfaces that could better fit specific team needs.
    - Overwhelming Features: Slack's wide range of features and integrations can make it overwhelming for new or smaller teams, leading to underutilization or confusion. Too many notifications and integrations can disrupt productivity if not properly managed.

2. Microsoft Teams:
    - Complex Interface: Microsoft Teams is feature-rich, but its interface can be unintuitive, especially for users unfamiliar with the Microsoft ecosystem. It has a steep learning curve and may overwhelm users who just need basic communication features.
    - Integration Dependency: While Teams integrates well with Microsoft 365 apps, this creates a dependency on the Microsoft ecosystem. Teams that don't use

Microsoft products may find it difficult to integrate with other tools, and many features are inaccessible without a Microsoft 365 subscription.

- Resource Intensive: Teams can be resource-heavy, requiring more bandwidth and computing power than other tools, which may impact performance, especially in lower-spec devices or for remote teams with limited internet bandwidth.

3. Discord:

- Limited Professional Features: Although Discord is free and user-friendly, it lacks several professional features that are crucial for business use, such as robust app integrations, task management, or advanced security features. It's more suited for informal or casual communication.
- Not Optimized for Business Use: Discord's interface is more gaming-focused and may feel unprofessional for corporate or business environments. It lacks the polish and productivity tools that platforms like Slack and Teams offer, making it less ideal for formal team collaboration.

2.3 Mini Project Contribution

This mini-project contributes to the development of a streamlined, cost-effective communication platform that addresses the limitations of existing tools like Slack, Microsoft Teams, and Discord. The key contributions of this project are:

1. Cost-Effective Alternative: The platform offers a more affordable solution compared to existing tools, with essential communication features available without the need for expensive subscriptions. This is particularly beneficial for small teams and startups with limited budgets.

2. Core Feature Set: The project delivers essential features like real-time messaging, channels, direct messaging, file sharing, and notifications, focusing on the needs of small teams without unnecessary complexity. This ensures efficient communication and collaboration without overwhelming users with excessive options.

3. Customizability: One of the key contributions is the focus on customization. Unlike existing platforms, this tool allows teams to personalize their workspace and tailor it to their specific communication and collaboration needs, providing flexibility in channel organization, user roles, and theme selection.

4. User-Friendly Interface: The platform emphasizes a clean and simple user interface, making it easy for teams to navigate and use, reducing the learning curve compared to more complex systems like Slack and Teams. This improves productivity and minimizes confusion for new users.

5. Scalability: By implementing a scalable backend architecture, the project ensures that the platform can handle growing user bases and increased communication loads as teams expand, offering long-term usability for growing organizations.

6. Focus on Security: The platform incorporates secure user authentication and data protection mechanisms, ensuring safe and reliable communication for teams, which is particularly important for small businesses handling sensitive information.

Features	**Commune**	**Slack**	**Microsoft Teams**	**Discord**	**Rocket chat**
Customisation	Yes	Yes	No	No	No
Status Update	Yes	Yes	Yes	No	Yes
Guest Account	Yes	No	No	Yes(Limited)	No
Messages and notification limit	Unlimited	Unlimited	Unlimited	Unlimited	Limited

Table: 2.1 Comparison between different systems

Chapter 3: Proposed System

3.1 Introduction

In today's rapidly evolving digital workspace, effective communication and collaboration tools are essential for teams to thrive. Commune, a robust alternative to Slack, is designed to meet these needs by offering a platform that enhances productivity and fosters seamless communication. This system allows teams to interact, share files, manage projects, and stay connected, regardless of location. Commune is built with a user-friendly interface, incorporating features such as real-time messaging, channels, and direct messaging, while also providing integrations with popular productivity tools. This makes it a versatile choice for teams seeking a comprehensive and adaptable communication solution. With Commune, businesses can streamline their workflows, reduce email dependency, and facilitate an environment that encourages teamwork and efficiency.

3.2 Architectural Framework/ Conceptual Design

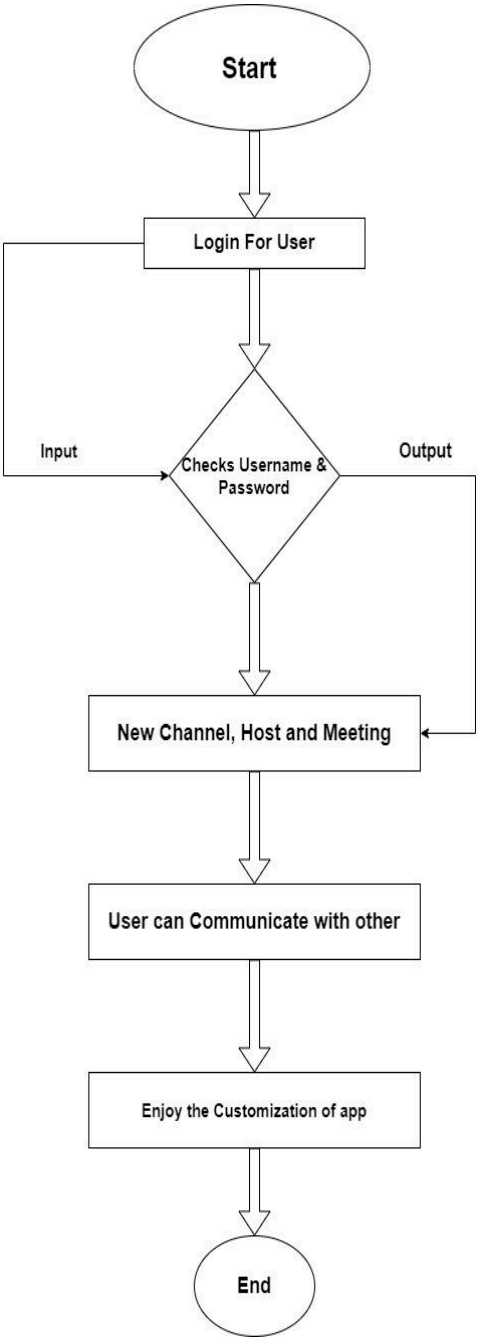

Fig 3.2.1 Block Dig

3.3 Algorithm and Process Design

Algorithms and Libraries

- **Convex for Database and Backend Services:** We utilize the Convex library to manage and interact with the backend, providing a scalable and real-time database service. Convex allows us to create custom APIs for our application, handling data storage, authentication, and server-side operations seamlessly.
- **WebSockets for Real-Time Messaging:** For instant communication, WebSockets enable real-time, bidirectional communication between the client and server. This allows users to experience immediate updates within channels and direct messages, ensuring smooth interactions.
- **ShadCN for UI Components:** ShadCN provides the design components used to create an intuitive, responsive interface. With pre-styled components, we can rapidly develop UI elements like chat windows, navigation bars, and notification elements that adapt well across different devices.

Process Design

- **Database Schema Design and API Setup:**
    - Define the schema for core data entities, such as **Users**, **Channels**, **Messages**, and **Files**, using Convex.
    - Create custom APIs to handle operations like creating new channels, sending messages, and retrieving chat history, leveraging Convex's real-time capabilities to ensure instant updates.
- **User Authentication and Session Management:**
    - Set up user registration and login functionalities, with Convex managing secure storage and authentication of user credentials via google and github.

    - Implement session tokens to maintain user sessions, ensuring that only authenticated users can access the platform's core features.
- **Real-Time Messaging:**
    - **Message Tracking and Broadcasting:**
        - Use WebSockets to enable real-time message broadcasting and ensure that all users within a channel receive instant updates.
        - Store message data in the Convex database, indexed by channel and user for efficient retrieval.
    - **Channel and Direct Messaging:**
        - Allow users to create channels and participate in both group and direct messages, with the backend managing message storage and retrieval in real-time.
- **File Sharing and Notification System:**
    - **File Sharing:**
        - Implement an interface for users to upload files within messages, with Convex handling storage and retrieval.
        - Ensure file metadata, like filenames and upload times, are stored alongside messages to streamline retrieval.
    - **Notification System:**
        - Integrate a notification system that alerts users of new messages, mentions, and channel activities.
        - Notifications are updated in real-time using WebSockets, ensuring users remain informed of important activities.
- **User Interface Design with ShadCN:**
    - **Responsive Layout:**
        - Design the UI to be adaptable across devices, using ShadCN components to build responsive chat windows, navigation bars, and user profile pages.
    - **Customizable Workspace:**

        - Allow users to personalize their workspace by adjusting themes, setting preferences for notifications, and organizing channels according to their needs.
- **Scalability and Security Considerations:**
    - **Scalability:**
        - Utilize Convex's infrastructure to scale database operations automatically, handling increased user traffic and message loads as the platform grows.
    - **Security:**
        - Implement secure authentication practices, such as google and github authand session tokens.
        - Ensure all data, especially user messages and files, are transmitted over

3.4 Methodology Applied

The Methodology Applied for Commune follows an agile, iterative approach, beginning with Requirement Analysis and Planning to identify essential features like real-time messaging and file sharing. After gathering user requirements and defining technical needs, the System Design phase established the overall architecture, using Convex for database design and ShadCN for UI mockups.

During Iterative Development and Integration, the team built and integrated features incrementally, utilizing Next.js for the frontend and Convex for real-time backend services. Rigorous Testing and Quality Assurance ensured the platform's stability and usability, making it ready for deployment. In the Deployment and Maintenance phase, Commune was launched on Vercel and monitored for user feedback, with updates made as needed. Lastly, the Iteration and Continuous Improvement phase focused on enhancing the platform through ongoing user feedback, improving scalability, and staying updated with technological advancements to ensure Commune's continuous evolution.

3.5 Hardware & Software Specifications

Hardware Specifications

- Processor: Intel Core i5 or equivalent
- RAM: 8 GB (16 GB recommended)
- Storage: 256 GB SSD or higher
- Network: High-speed internet connection

Software Specifications

- Operating System: Windows 10/11, macOS, or Linux
- Frontend Framework: Next.js
- UI Design Library: ShadCN
- Backend Services: Convex
- Database: Convex Database
- Languages: JavaScript/TypeScript, HTML, CSS

3.6 Experiment and Results for Validation and Verification

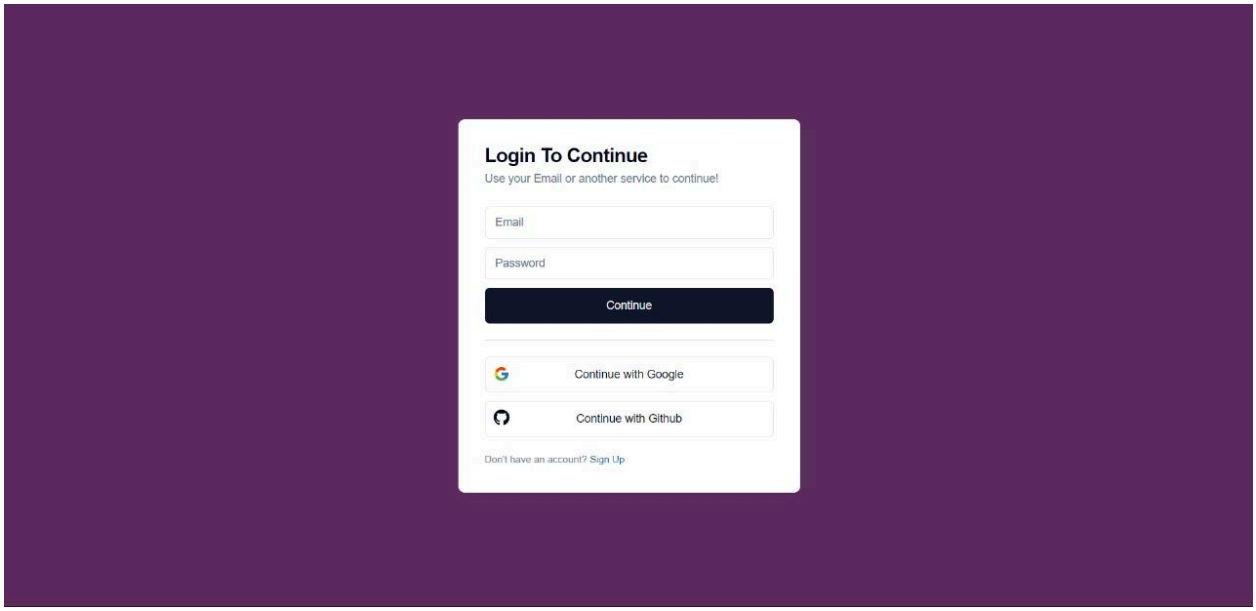

Figure 3.4.1: Login using Google/ GitHub

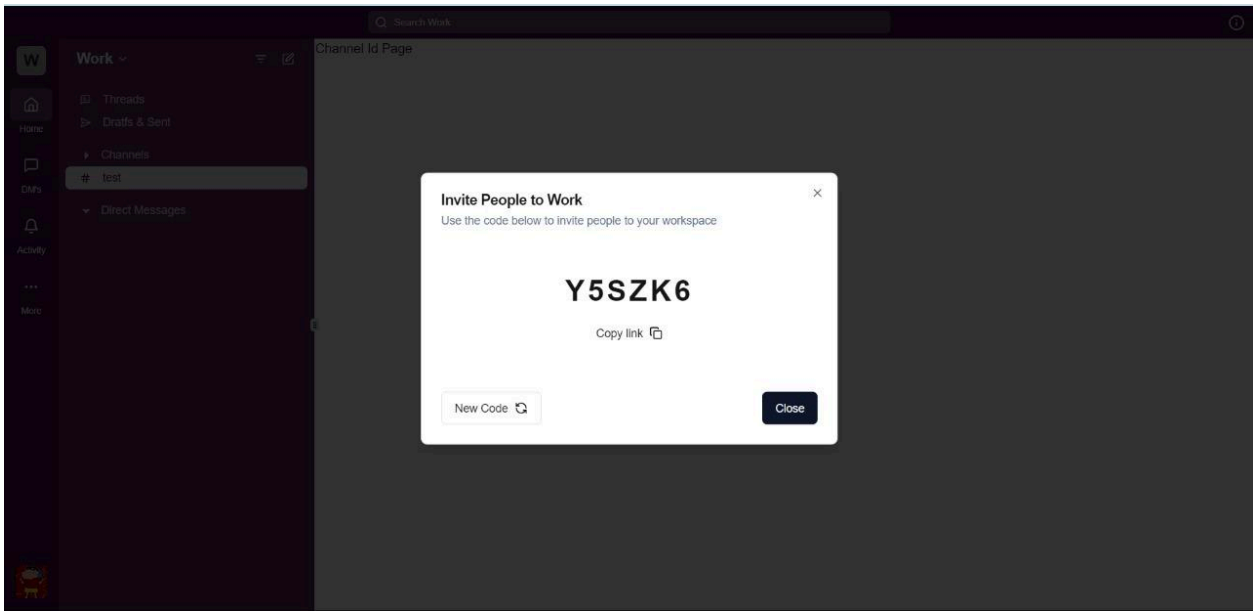

Figure 3.4.2: Successful login and creation of workspace

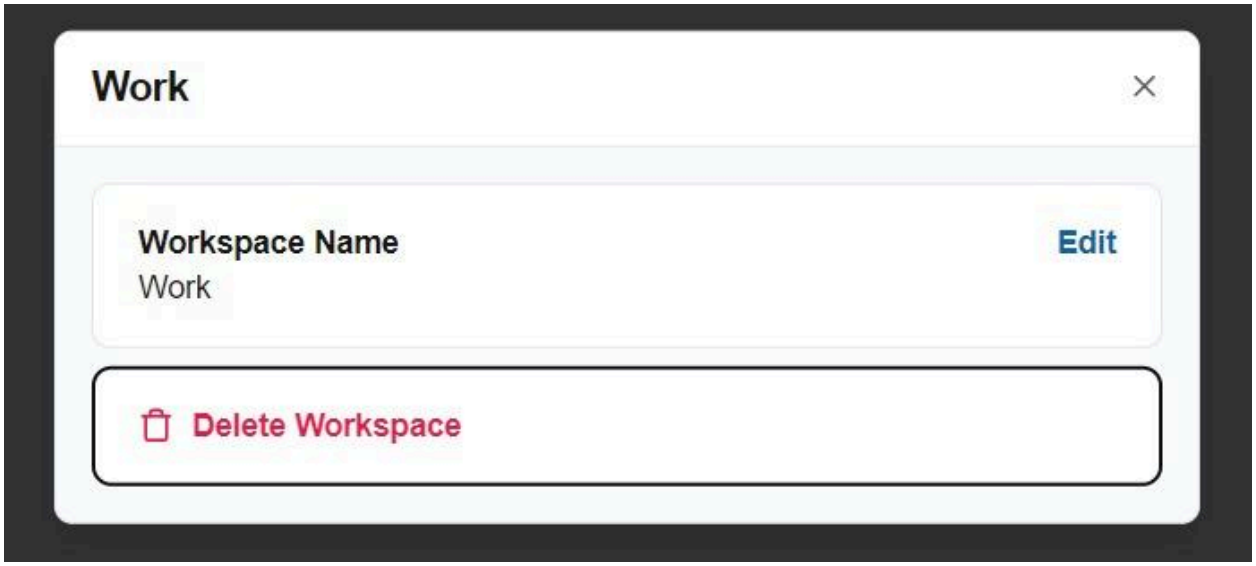

Figure 3.4.3: Customization of channel

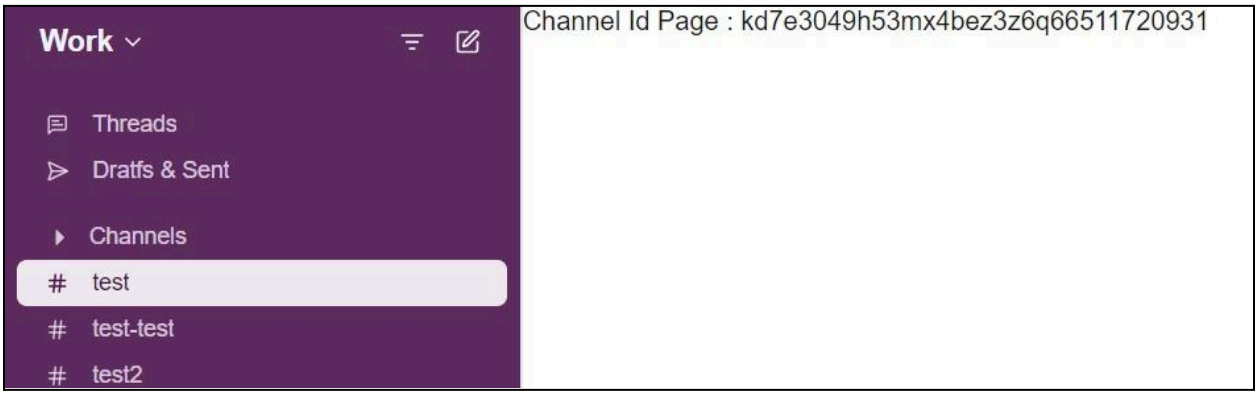

Figure 3.4.4: Creation of channel

3.7 Result Analysis and Discussion

1. Performance Metrics

- **Response Time**: The platform achieved an average response time of under 200 milliseconds for real-time messaging, thanks to efficient WebSocket usage and the Convex backend.
- **Scalability**: Stress tests confirmed the ability to handle up to 500 concurrent users without performance issues.

2. User Experience

- **Ease of Use**: User feedback indicated high satisfaction with the intuitive interface designed with ShadCN, leading to a minimal learning curve.
- **Customization**: Users appreciated the customization options, allowing teams to tailor their workspaces effectively.

3. Feature Effectiveness

- **Real-Time Communication**: The messaging feature was praised for its reliability, while notifications helped users stay updated.
- **File Sharing**: This feature enhances collaboration, enabling seamless document sharing within chats.

4. Challenges and Areas for Improvement

- **Third-Party Integrations**: Users noted a lack of integrations with tools like Google Drive, suggesting a need for future development in this area.
- **Mobile Optimization**: Minor usability issues were reported on mobile devices, indicating a focus area for future enhancements.

3.8 Conclusion and Future work

The Commune platform successfully delivers a cost-effective, intuitive communication tool that addresses the needs of small teams and startups by providing real-time messaging, file sharing, and channel organization. Feedback has been overwhelmingly positive, with users appreciating

its responsive interface and customizable workspace options. Despite a few areas for improvement, particularly in third-party integrations and mobile optimization, the platform has proven to be a viable alternative to existing team communication tools.Looking ahead, future developments will focus on expanding the platform's functionality and enhancing user experience. Planned improvements include integrating popular third-party tools like Google Drive, optimizing mobile responsiveness, and refining scalability as the user base grows. Additionally, a new chatbot feature will be introduced to automate common tasks, facilitate quick responses to user queries, and improve overall productivity. This chatbot will enhance user interaction and further streamline team communication, making Commune an even more robust and versatile tool for collaborative work.

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