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Department of Computer Engineering 2023-24

Distributed Computing Lab

LinkUP : A real time collaboration system

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TE Comps B | Batch A
LinkUp

1. Project Scope

1.1. Project Overview

The project involves developing LinkUp, a real-time messaging and collaboration tool for teams. The application will offer features like instant messaging, video and voice calls, channel-based communication, and workspace management. The platform aims to facilitate seamless communication and collaboration among team members within an organization, mimicking the core functionalities of Slack.

1.2. Objectives

- **User Authentication**: Implement secure sign-up and login functionality using Supabase with options for Google, GitHub, and Email authentication.
- **Real-Time Communication**: Enable real-time text-based chat, voice calls, and video calls using technologies like socket.IO, Websockets, and WebRTC.
- **Channel and Workspace Management**: Allow users to create and manage channels and workspaces, supporting both public and private channels.
- **Role Management**: Differentiate user roles between Admin and User, with Admins having the ability to manage channels, workspaces, and user permissions.
- **Data Persistence**: Store and manage user data, chat messages, and other related information in Supabase, utilizing its capabilities for RPC, storage, SQL, and role-level security.
- **Scalability and Security**: Ensure that the platform is scalable to handle multiple users and channels, with robust security features to protect user data.

1.3. Deliverables

- **Frontend Interface**: A responsive web application with a user-friendly interface for accessing the platform's features.
- **Authentication System**: Integration with Supabase for secure user authentication.

- **Chat System**: Real-time chat service with support for individual and group conversations within channels.
- **Voice and Video Calls**: Implementation of voice and video call features using WebRTC.
- **Channel and Workspace Management**: Functionality for creating and managing channels and workspaces, with options for public and private settings.
- **Admin Dashboard**: An interface for Admins to manage users, channels, and workspaces.

2. Problem Statement

Teams often struggle with fragmented communication and high costs associated with existing tools like Slack. Small to medium-sized organizations need a cost-effective, customizable, and self-hosted platform that integrates real-time messaging, voice and video calls, and workspace management. Our project aims to develop LinkUp to meet these needs, providing an efficient, scalable, and secure solution for seamless team collaboration.

2.1 Objectives

1. **User Authentication**:
   - Implement secure sign-up and login options using Google, GitHub, and Email via Supabase.
2. **Real-Time Communication**:
   - Enable real-time text-based messaging, voice calls, and video calls using socket.IO, Websockets, and WebRTC.
3. **Channel and Workspace Management**:
   - Allow users to create, manage, and organize channels and workspaces, with support for both public and private settings.
4. **Role-Based Access Control**:

- Differentiate between Admin and User roles, where Admins can manage users, channels, and workspaces.

5. **Data Persistence and Security**:
   - Store and manage user data, chat messages, and related information securely using Supabase, ensuring role-level security.
6. **Scalability**:
   - Design the system to handle multiple users, channels, and workspaces efficiently, ensuring smooth performance as the user base grows.
7. **User-Friendly Interface**:
   - Develop a responsive and intuitive interface for seamless user interaction across all devices.
8. **Admin Dashboard**:
   - Provide Admins with tools to monitor and manage the platform, including user management, channel/workspace settings, and data analytics.
9. **Customizability**:
   - Ensure the system can be tailored to fit the unique needs of different organizations, allowing for future enhancements and integrations.

3. Functional Requirements

1. **User Authentication**:
   - Users must be able to sign up and log in using Google, GitHub, or Email.
   - Password reset functionality should be available.
2. **User Roles and Permissions**:
   - Admins must be able to create, modify, and delete channels and workspaces.
   - Admins should manage user permissions within channels and workspaces.
   - Users should have the ability to join and leave channels and workspaces.
3. **Real-Time Messaging**:
   - Users must be able to send and receive real-time text messages within channels.
   - The system should support direct messaging between users.

    - The chat system must support multimedia messages (images, files).
4. **Voice and Video Calls**:
    - Users should be able to initiate and join voice calls within channels or direct messages.
    - Users must be able to initiate and join video calls.
5. **Channel and Workspace Management**:
    - Users must be able to create public and private channels.
    - Users should be able to create and manage workspaces.
    - The system should allow for inviting users to specific channels and workspaces.
6. **Notifications**:
    - Users should receive real-time notifications for new messages, mentions, and calls.
    - Admins and users must be able to customize notification preferences.
7. **Data Persistence and Storage**:
    - All messages, user data, and files must be stored securely in the database.
    - Users should have access to their chat history and media files.
8. **Search Functionality**:
    - Users must be able to search for messages, users, and files within channels and workspaces.
9. **Security Features**:
    - The system must enforce role-based access control for different user roles.
    - All data should be encrypted both in transit and at rest.
    - The system must support two-factor authentication (2FA) for enhanced security.
10. **Admin Dashboard**:
    - Admins should have a dashboard to manage users, monitor channel activity, and view analytics.
    - The dashboard should include tools for managing system settings and user roles.
11. **Scalability**:

    - The system must handle a growing number of users, channels, and messages without performance degradation.

12. **Integration with Third-Party Services**:
    - The system should allow integration with third-party services like calendars, task management tools, or external file storage systems (optional but recommended for future versions).

4 . Non-Functional Requirements

1. **Performance**:
    - The system should respond to user actions within 2 seconds for typical operations (e.g., sending a message, switching channels).
    - The system must handle up to 10,000 concurrent users without noticeable performance degradation.
2. **Scalability**:
    - The architecture should support horizontal scaling to accommodate an increasing number of users, channels, and workspaces.
    - The system must be capable of scaling to support large organizations with thousands of users.
3. **Security**:
    - All user data must be encrypted in transit (using HTTPS) and at rest.
    - The system should implement role-based access control (RBAC) to restrict unauthorized access to certain features and data.
    - Support for two-factor authentication (2FA) should be implemented for enhanced user security.
    - Regular security audits and vulnerability assessments must be conducted.
4. **Reliability**:
    - The system should have 99.9% uptime, with minimal unplanned outages.

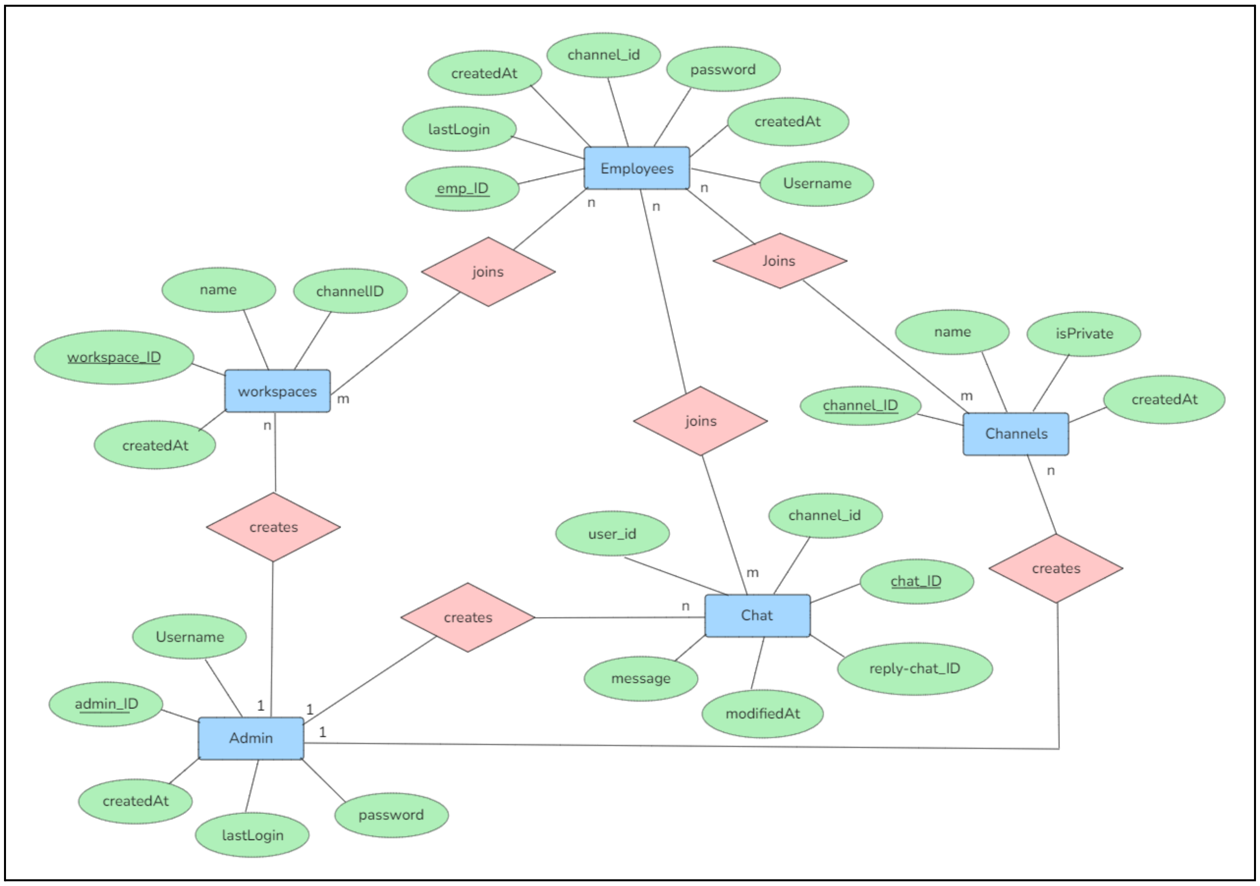
    - It must include mechanisms for automatic recovery from failures (e.g., database backups, server redundancy).

5. **Usability**:
    - The user interface must be intuitive, with a consistent design across all features.
    - The system should be accessible, adhering to standard accessibility guidelines (e.g., WCAG 2.1).
    - It should support multiple languages for a global user base.
6. **Maintainability**:
    - The codebase must be well-documented, with clear guidelines for adding new features or making modifications.
    - The system should support continuous integration and continuous deployment (CI/CD) to allow for rapid updates and bug fixes.
7. **Compatibility**:
    - The web application must be compatible with all major browsers (Chrome, Firefox, Safari, Edge).
    - The system should be responsive and work seamlessly across different devices (desktop, tablets, smartphones).
8. **Data Consistency**:
    - The system must ensure that data is consistent across all users and channels, with no discrepancies or data loss during operations.
9. **Data Retention and Backup**:
    - The system should implement regular backups of all user data, with the ability to restore data in case of failure.
    - Data retention policies must be configurable to meet organizational needs (e.g., for compliance purposes).
10. **Logging and Monitoring**:
    - The system should include comprehensive logging for tracking user actions, system events, and errors.

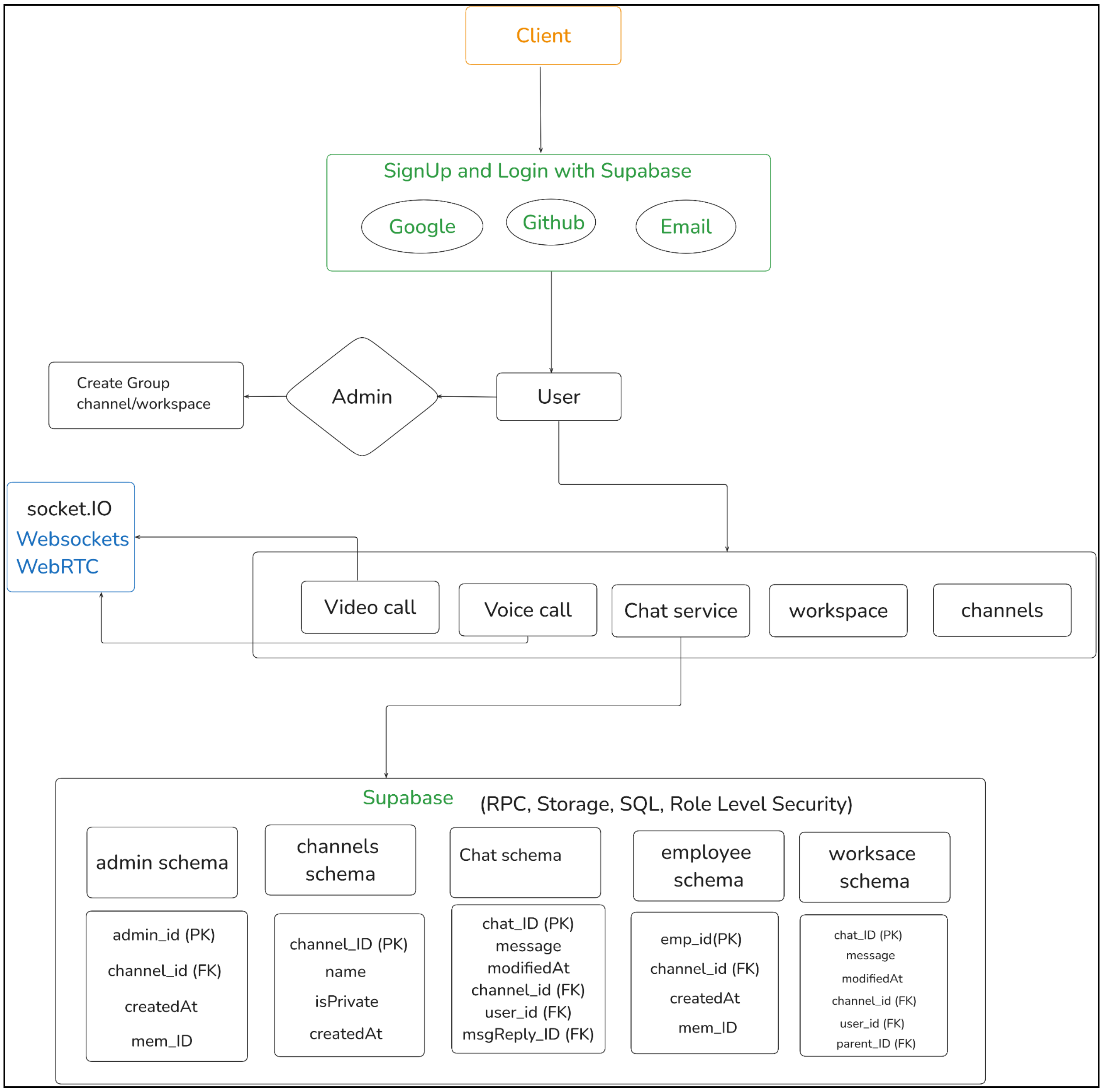
- Real-time monitoring tools should be implemented to detect and respond to issues promptly.

11. **Latency**:
    - The system should minimize latency for real-time communication features, ensuring voice and video calls have low lag (under 100ms for optimal experience).
12. **Disaster Recovery**:
    - A disaster recovery plan must be in place to ensure that the system can recover from catastrophic events with minimal data loss and downtime.

ER diagram :



System Design:


Client
SignUp and Login with Supabase
Google
Github
Email
User
Admin
Create Group channel/workspace
socket.IO
Websockets
WebRTC
Video call
Voice call
Chat service
workspace
channels
Supabase
(RPC, Storage, SQL, Role Level Security)
admin schema
admin_id (PK)
channel_id (FK)
createdAt
mem_ID
channels schema
channel_ID (PK)
name
isPrivate
createdAt
Chat schema
chat_ID (PK)
message
modifiedAt
channel_id (FK)
user_id (FK)
msgReply_ID (FK)
employee schema
emp_id(PK)
channel_id (FK)
createdAt
mem_ID
worksace schema
chat_ID (PK)
message
modifiedAt
channel_id (FK)
user_id (FK)
parent_ID (FK)