COLLEGE CODE :- 9509

COLLEGE NAME :- Holy Cross Engineering College

DEPARTMENT :- CSE

STUDENT NM-ID:-

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DATE :- 15/09/2025

Completed the project named as:

CHAT UI APPLICATION

SUBMITTED BY,

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1. Tech Stack Selection

The chosen stack prioritizes developer experience, performance, and a rich ecosystem.

Layer	Technology	Justification
Frontend Framework	**React 18+** with **TypeScript**	Component-based architecture is ideal for UI. TypeScript ensures type safety, reducing bugs and improving developer collaboration.
Build Tool	**Vite**	Faster builds and Hot Module Replacement (HMR) than alternatives like Create React App, leading to a better development experience.
Styling	**Tailwind CSS**	Utility-first CSS framework allows for rapid, consistent UI development without context switching. Easy to create responsive designs.
State Management	**Zustand** (Primary) / **React Context** (Theming)	Zustand is a simple, unopinionated state management solution perfect for managing chat state (messages, rooms, online users). Lightweight and easy to use. Context is sufficient for theming.
Data Fetching	**TanStack Query (React Query)**	Handles server state, caching, background updates, and pagination effortlessly. Perfect for fetching message history and user lists.
Real-Time Communication	**WebSocket** (via socket.io-client)	The standard for bidirectional, real-time communication. Socket.io provides a robust client library and fallback mechanisms.

Layer	Technology	Justification
UI Components	**Headless UI** or **Radix UI**	For accessible unstyled components (dropdowns, modals). We'll style them with Tailwind, maintaining full design control.
Testing	**Jest** (Unit) + **React Testing Library**	Industry standard for testing React components and logic.
Deployment	**Vercel** / **Netlify**	Zero-config deployment, perfect CI/CD integration with Git, and excellent performance for SPAs.

UI Structure (Wireframe Breakdown)

The UI is divided into three primary columns:

1. **Sidebar/Navigation:** Contains user profile, list of channels/rooms, and direct message conversations.
2. **Messages Panel:** The main area displaying the message history for the selected conversation.
3. **Members Sidebar (Optional):** Displays the list of users currently online in the selected room/channel.

Component Tree:

text

<App>

├— <ThemeProvider> (Context

├— <SocketProvider> (Context for Socket.IO connection)

├— <ChatProvider> (Zustand store for global chat state)

└— <Layout>

│

├— <Sidebar>

│ ├— <UserProfile />

│ ├— <SearchBar />

```
│   ├── <ConversationList> (Channels & DMs)
│   │   └── <ConversationListItem />
│   └── <CreateRoomButton />
│
├── <MainContent>
│   ├── <MessageHeader> (Room name, topic, users online)
│   ├── <MessageList>
│   │   └── <MessageBubble />
│   ├── <TypingIndicator />
│   └── <MessageInput />
│
└── <MembersSidebar> (Conditionally Rendered)
    └── <MemberListItem />
```

API Schema Design (Key Endpoints & WebSocket Events)

We assume a RESTful API for initial data fetching and WebSockets for real-time updates.

REST Endpoints (via React Query):

- GET /api/conversations - Fetch the user's list of conversations (rooms & DMs).
- GET /api/messages?conversationId=:id&page=:page - Fetch paginated message history for a conversation.
- GET /api/users/me - Fetch current user's profile.
- GET /api/users?conversationId=:id - Fetch members of a specific conversation.

WebSocket Events (via Socket.IO):

- **Client -> Server:**
  - join_room ({ roomId: string }) - Join a specific room to receive messages.
  - send_message ({ roomId: string, content: string }) - Send a new message.
  - typing_start ({ roomId: string }) - Notify others that the user is typing.
  - typing_stop ({ roomId: string }) - Notify others that the user stopped typing.
- **Server -> Client:**
  - message ({ id: string, userId: string, content: string, timestamp: Date }) - Receive a new message.
  - user_joined ({ userId: string }) - A user joined the current room.
  - user_left ({ userId: string }) - A user left the current room.
  - user_typing ({ userId: string, username: string }) - A user is typing.

- user_stopped_typing ({ userId: string }) - A user stopped typing.

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3. Data Handling Approach

- **Server State (Messages, Conversations, Users):**
  - Managed by **TanStack Query**.
  - Messages are fetched paginated. useInfiniteQuery will be used for seamless infinite scrolling.
  - The cache will be invalidated and refetched when needed (e.g., after sending a message or returning to an old conversation).
- **Real-Time State (New Messages, Typing Indicators, Online Users):**
  - Managed by the **Zustand** store.
  - When a message event is received via WebSocket, it is appended to the appropriate message list in the store *optimistically*. This provides instant UI feedback.
  - Typing statuses and online user lists are also held in the Zustand store and updated via WebSocket events.
- **UI State (Selected Conversation, Modal Open/Close, Theme):**
  - Local component state (useState) for isolated states (e.g., is a dropdown open?).
  - Zustand or Context for global UI state like the currently selected conversationId or theme preference.
- **Optimistic Updates:**
  - Crucial for a responsive chat experience.
  - **Process:** 1) User sends a message. 2) Message is immediately added to the UI (Zustand store). 3) The send_message event is emitted. 4) On acknowledgement from the server, the message is marked as "delivered" or an error is shown.

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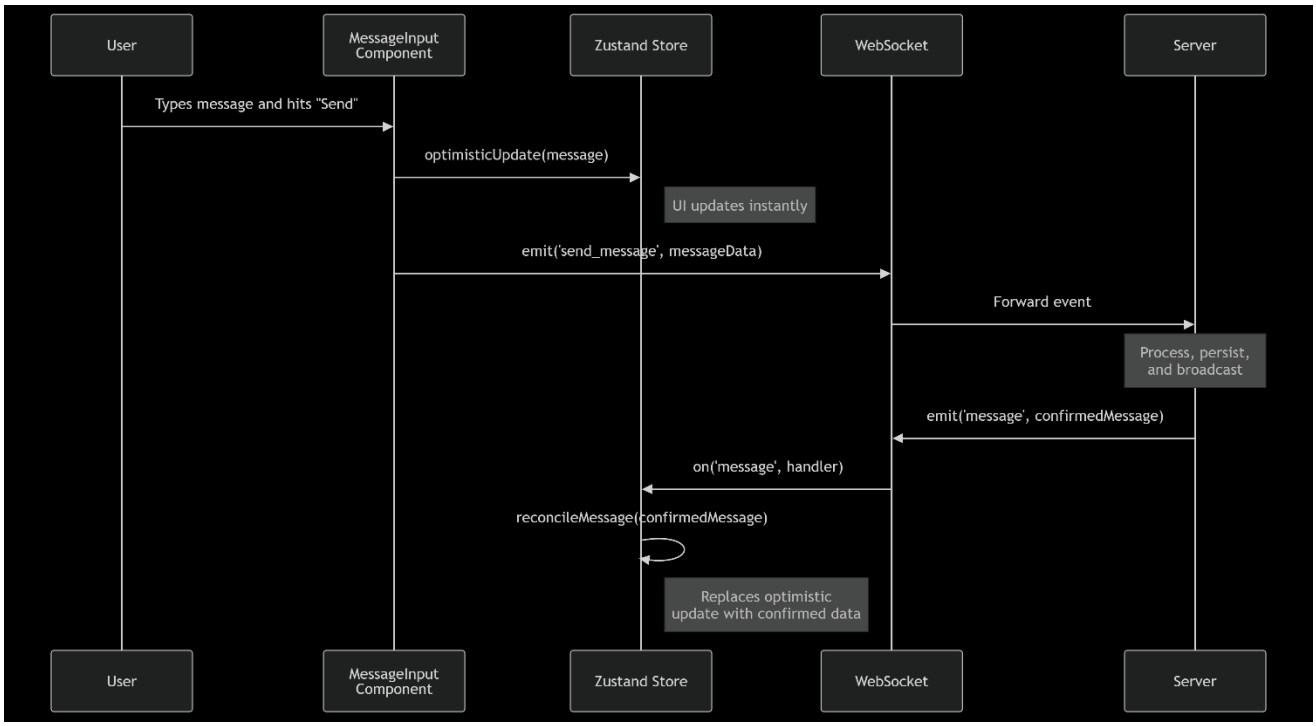
4. Component / Module Diagram

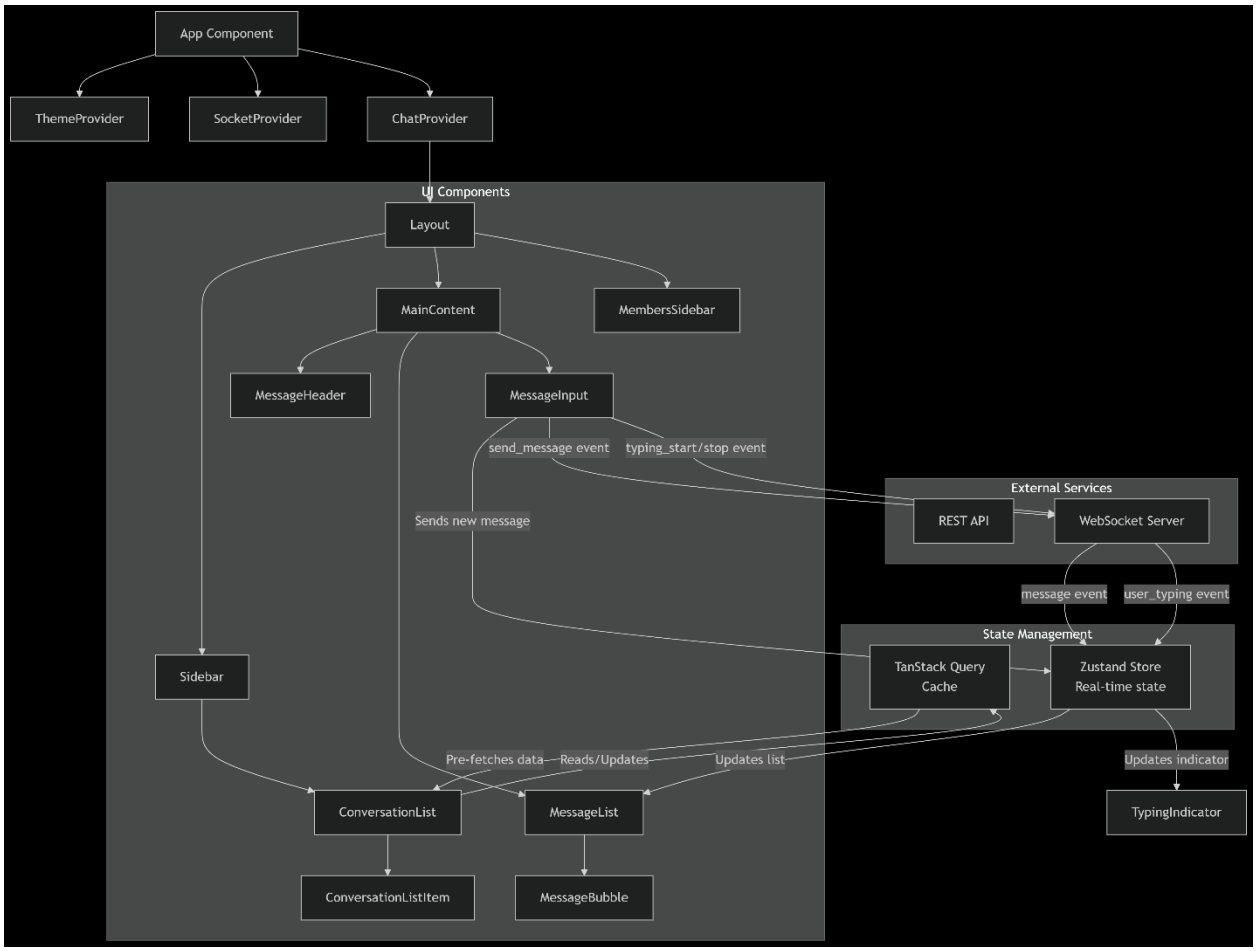
This diagram shows the hierarchy and data flow between the main components and external services.



5. Basic Flow Diagram

Primary User Flow: Sending a Message

This sequence diagram illustrates the process of a user sending a message, showcasing the interaction between UI components, state, and the backend.


App Component
ThemeProvider
SocketProvider
ChatProvider
UI Components
Layout
MainContent
MembersSidebar
MessageHeader
MessageInput
send_message event
typing_start/stop event
External Services
REST API
WebSocket Server
Sends new message
message event
user_typing event
State Management
TanStack Query
Cache
Zustand Store
Real-time state
Sidebar
Pre-fetches data
Reads/Updates
Updates list
Updates indicator
ConversationList
MessageList
TypingIndicator
ConversationListItem
MessageBubble