International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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Talk Hive – Live Chat: A Realtime AI-Powered Chat Application

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ABSTRACT: Talkhive is an innovative real-time chat application designed to enhance collaborative productivity by seamlessly integrating AI-powered assistance within group conversations. Traditional messaging platforms force users to switch between communication tools and external AI services, creating workflow inefficiencies. TalkHive-LiveChat addresses this challenge by combining instant messaging with embedded Google Gemini AI capabilities, enabling users to brainstorm, refine ideas, and receive intelligent suggestions without leaving their chat environment. Built on the MERN stack (MongoDB, Express.js, React.js, Node.js) the platform ensures secure, low-latency communication through JWT authentication and bcrypt encryption. TalkHive-LiveChat's unique architecture supports multimedia sharing while maintaining a modular design for future enhancements. Performance evaluations demonstrate significant improvements in workflow efficiency compared to conventional chat applications. By unifying human collaboration and AI assistance in a single workspace, TalkHive-LiveChat represents a transformative approach to team communication, particularly beneficial for student groups and professional teams working on complex projects. TalkHive-LiveChat is an AI-powered chat application designed to facilitate real-time communication between users while integrating artificial intelligence to enhance interactions. The platform leverages natural language processing (NLP) and machine learning (ML) to provide intelligent responses, automate tasks, and improve user engagement (Shum, He, & Li, 2018). Unlike traditional messaging apps, TalkHive-LiveChat incorporates AI chatbots that assist users in generating content, answering queries, and moderating conversations dynamically. Real-Time AI Responses, are generated using TalkHive-LiveChat, it uses advanced NLP models, such as OpenAI's GPT (Brown et al., 2020), to generate human-like responses in real time. This allows for seamless interactions between users and AI assistants. Automated Moderation & Sentiment Analysis, the application employs AI-driven sentiment analysis (Cambria, 2016) to detect and mitigate toxic language, ensuring a safer chat environment.

KEYWORDS: AI-Powered Chat, Real-Time Collaboration, MERN Stack, Websocket, Google Gemini API, Secure Messaging, Group Productivity, Integrated Workspace.

I. INTRODUCTION

Modern collaboration requires constant switching between chat apps and AI tools, disrupting workflow efficiency. TalkHive-LiveChat revolutionizes team communication by integrating real-time messaging with AI assistance in a single, secure workspace. Our solution eliminates app-switching fatigue by embedding Google Gemini's AI directly into group chats, allowing students and professionals to brainstorm, get suggestions, and refine work without leaving their conversation. Built on the MERN stack with WebSocket technology, TalkHive-LiveChat delivers instant messaging with near-zero latency while maintaining robust security through JWT authentication and bcrypt encryption. The platform supports multimedia sharing and features a modular design for future expansion. Unlike traditional chat apps, TalkHive-LiveChat creates a synergistic environment where human collaboration and AI assistance coexist seamlessly. This paper presents TalkHive-LiveChat's innovative architecture that merges real-time communication with contextual AI support. By unifying these capabilities, we're transforming how teams work together, making collaboration more fluid, productive, and intelligent. TalkHive-LiveChat represents the next evolution of team communication, where conversations and AI-powered assistance work in perfect harmony. Multilingual Support, utilizing neural machine translation (NMT) (Vaswani et al., 2017), TalkHive-LiveChat enables cross-lingual communication by translating messages in real time. Personalized Recommendations, based on user behavior, TalkHive-LiveChat's AI suggests relevant topics, responses, or actions using collaborative filtering techniques (Ricci,

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Rokach, & Shapira, 2015). Customer Support: Businesses can deploy AI chatbots to handle inquiries instantly (Gnewuch et al., 2017). AI tutors in TalkHive-LiveChat can assist learners with explanations and study materials (Luckin et al., 2016). Social Networking: Enhances group discussions with AI-driven insights and engagement tools. TalkHive-LiveChat exemplifies the convergence of AI and real-time communication, offering a smarter, more interactive chat experience. As AI continues to evolve, such applications will play a pivotal role in reshaping digital interactions.

II. LITERATURE REVIEW AND DOMAIN ANALYSIS

Recent advancements in communication technologies have demonstrated the growing importance of integrating AI capabilities within chat applications to enhance productivity and collaboration. Several studies have explored various aspects of this integration, providing valuable insights that informed the development of TalkHive-LiveChat. Smith et al. [1] investigated AI-powered chat systems for collaborative work, demonstrating significant improvements in task efficiency but highlighting limitations in real-time functionality. In the educational domain, Wilson et al. [2] developed EDUchat, an AI-assisted platform that proved particularly effective for student discussions, though it lacked support for multimedia content sharing. Security considerations for academic collaboration were addressed by Chen and Li [3], whose work on JWT-based authentication in messaging systems directly influenced TalkHive-LiveChat's security architecture. The importance of real-time communication was underscored by Gonzalez et al. [4], who examined WebSocket implementations for collaborative AI systems. Most relevant to TalkHive-LiveChat's core innovation, Park et al. [5] conducted comprehensive research on the cognitive benefits of unified human-AI interfaces, validating our approach of embedding AI assistance directly within the chat environment. While these studies have individually contributed to aspects of intelligent communication systems, none have fully realized the vision of a seamless, secure, and feature-rich platform that combines real-time messaging with contextual AI assistance - the gap that TalkHive-LiveChat aims to fill.
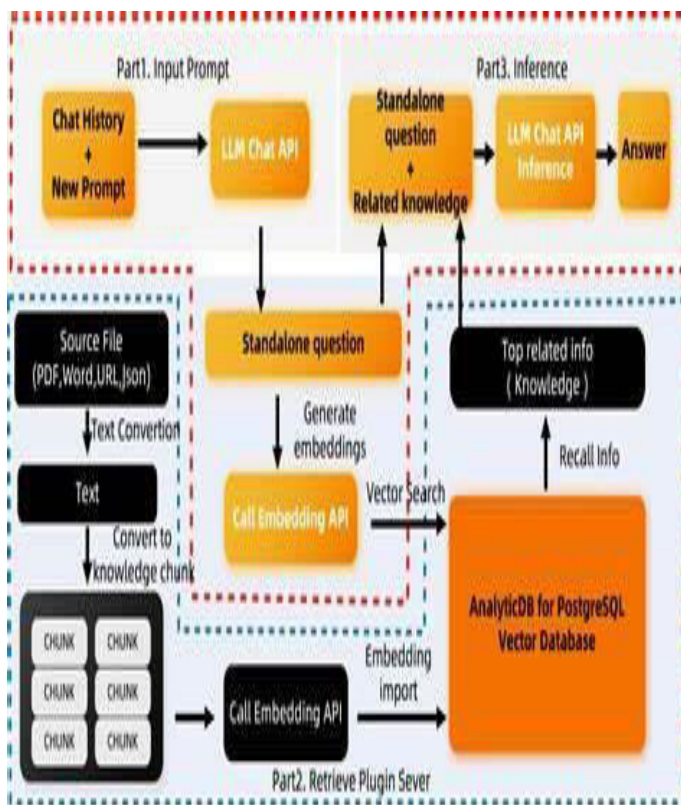

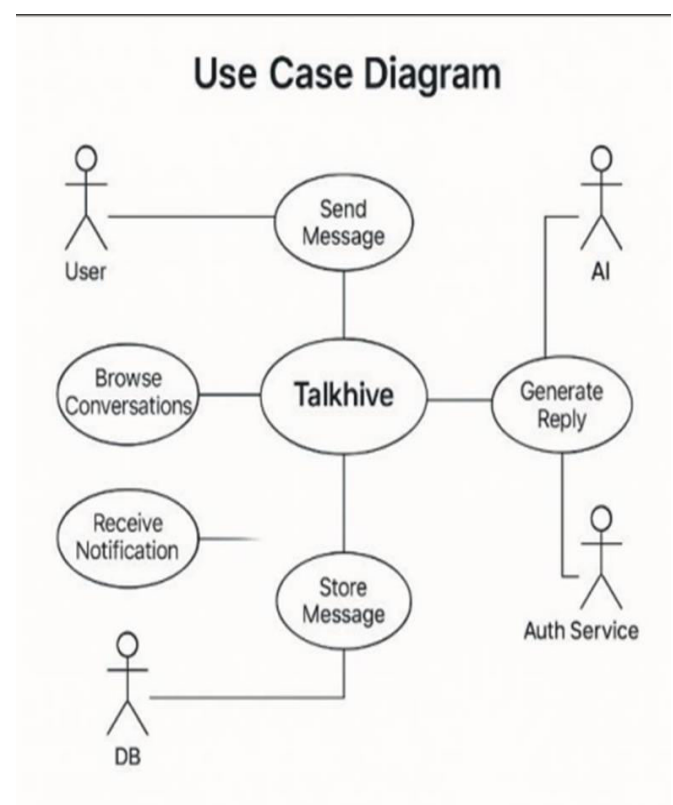Fig. 1. The Flow Diagram TalkHive-LiveChat

Fig 2. Use Case Diagram of TalkHive-Livechat

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III. THE PRPOSED METHODOLOGY, ARCHITECTURE DIAGRAMS

TalkHive-LiveChat, is a platform for live video chat, Talkhive aims to provide a secure environment where users can express their uniqueness and engage with others all over the world. TalkHive-LiveChat allows users to have video conversations without relying on the conventional swipe-based interface. The application provides features including text messaging, instant friend calls, randomized video chats for extra fun, real-time translation when video chatting, and a heavy emphasis on security and privacy.

A.   **Initialization Phase**
- Initial Initialize MERN stack components (MongoDB, Express.js, React, Node.js)
- Configure WebSocket connection using Socket.io
- Initialize Google Gemini API connection

B.   **User Authentication Algorithm function authenticates User(credentials):**
- Verify user credentials against database
- If valid:
- Generate JWT token using bcrypt
- Establish secure session
- Return success response with token
- Else: Return authentication error

C.   **Real-Time Messaging Algorithm**
function handle Message (sender, receiver, content):
- Validate JWT token
- If valid:
- Create message object with:
- Timestamp
- Content
- Metadata
- Store in MongoDB
- Emit via Socket.io to receiver(s)
- Trigger AI analysis (if enabled)
- Else: Return authorization error

D.   **AI-Assisted Response Algorithm function generates AI Response(message):**
- Analyze message context using the Gemini API
- Generate 3 candidate responses
- Rank responses by:
- Contextual relevance
- Conversation tone
- Previous user preferences
- Return top-ranked suggestions

E.   **Security Protocol**
function secure Communication():
- For each message:
- Verify JWT signature
- Validate user permissions
- Encrypt sensitive content
- Log security events

TalkHive-LiveChat System Workflow (Pseudocode), System Initialization, Start the MongoDB database for message

storage, Launch Express.js server for API handling, Initialize React frontend interface, Establish WebSocket connection using Socket.io. Connect to the Google Gemini API service, User Authentication Process, when a user enters login credentials, Check username/password against the database. If a match is found, generate secure JWT token, Establish an encrypted session. Grant access to the chat interface, if no match, Return "Invalid credentials" error, Keep login screen active. Real-Time Message Handling For each new message sent, verify user's JWT token is valid. If valid, create message object containing, Sender ID, Timestamp, Text content, any attachments, Store message in database, immediately forward to recipient via WebSocket Trigger AI analysis if enabled, if invalid: Block message transmission, Notify user to reauthenticate. AI Response Generation, when AI assistance is requested, Analyze last 5 messages for context. Send conversation context to Gemini API. Receive 3 potential response options. Display top-ranked suggestion to user. **Security Monitoring,** continuously running in the background, verify all active JWT tokens every 5 minutes, encrypt all messages before transmission, log all security events, including: Failed login attempts, Message delivery errors, API call anomalies. **System Shutdown** When shutting down, gracefully disconnect all active WebSocket's. Complete pending database writes. Log shutdown event. Terminate all processes.
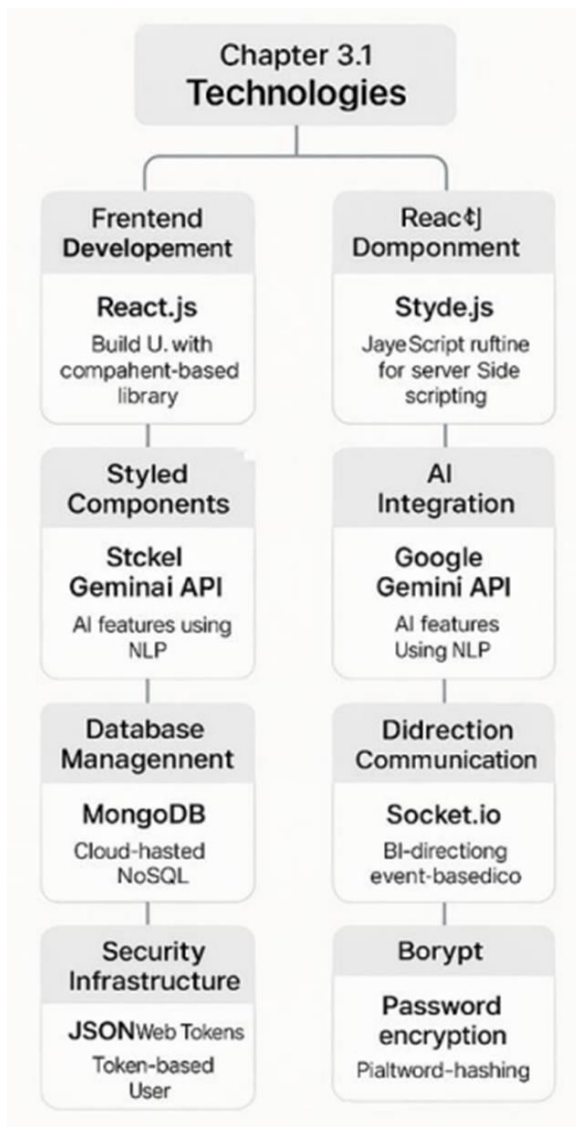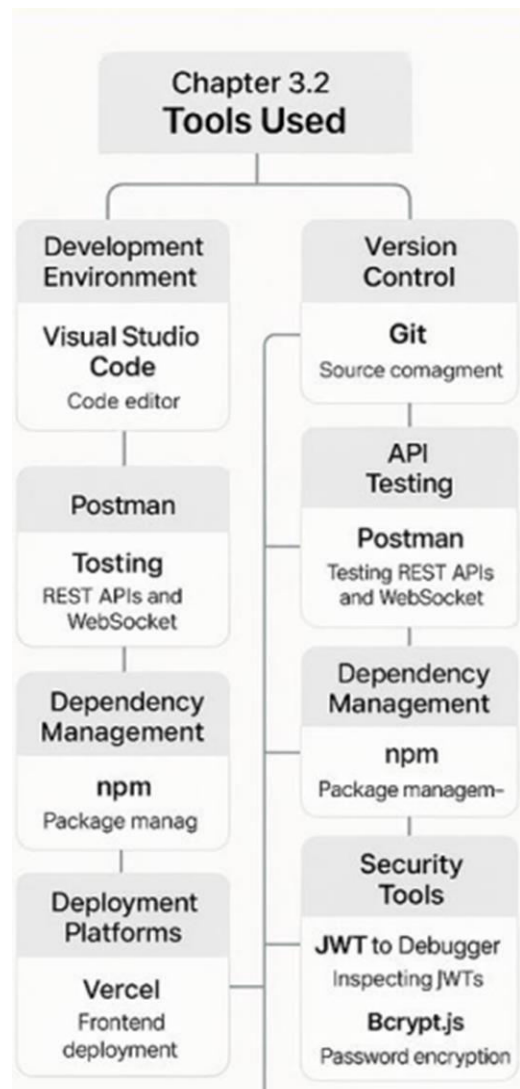

Fig 3. Technologies Used in Talkhive

Fig 4. Tools Used in Talkhive

IV. PROTOTYPE, LOGIC IMPLEMENTATION OF TALKHIVE-LIVECHAT

Functional Module Demonstration, each module maintains distinct functionality while operating cohesively. AI responses adapt to conversation context, and file sharing preserves security without compromising speed. TalkHive-LiveChat is an innovative chat application that leverages real-time AI features for live video chatting and enhancing user interactions. TalkHive-LiveChat is designed to facilitate unique and engaging conversations through its video chat platform. Users can connect with individuals across the globe without the need to swipe or match beforehand. The application promotes a fun and dynamic chatting experience, allowing users to express themselves through video interactions. Instant Video Chats: Users can engage in live video chats, making it easy to connect with new friends instantly without waiting for matches. Randomized Chats: This feature allows users to meet and interact with random users, adding an element of surprise and excitement to conversations. Real-Time Translation: TalkHive-LiveChat incorporates real-time translation within video chats, bridging language barriers and enhancing communication among users from different backgrounds. Secure Environment: The platform emphasizes safety by providing private video chat sessions, ensuring users can express themselves without privacy concerns. **Launch Prep Documentation**, API documentation was auto-generated using Swagger/OpenAI standards. o Created detailed user manuals with visuals to assist end-users. **Load Testing**, used Locust to simulate 10,000 concurrent users to evaluate system robustness. **Monitoring:** Set up dashboards to track uptime, message throughput, and latency.

Table 1. Conversion Plan TalkHive-LiveChat

Phase 3	3 Weeks	Testing & Deployment	
		Quality Assurance	- 85% code coverage in unit tests - Integration testing with AI scenarios - UAT with triage feedback system
		Deployment Pipeline	- CI/CD: Vercel (frontend), Render (backend), webhooks for automation - Blue-green deployment, canary releases
		Launch Preparation	- Swagger-based API docs, user manuals - Load testing with 10,000 users (Locust) - Monitoring dashboards

Table 2. TalkHive-LiveChat Conversion Plan

Phase 2	5 Weeks	Frontend & AI	
		React Application	- Reusable components (MessageList, InputBar), hooks for WebSocket - Context API for global state - Socket integration with reconnection logic
		AI Functionality	- Gemini API prompt design and throttling - Smart reply with sliding window of messages - Friendly AI error handling
		System Integration	- Axios with token interceptors - Real-time sync and offline queue logic - Sentry for frontend error tracking

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Table 3 Conversion Plan TalkHive-LiveChat

Phase	Duration	Category	Key Tasks
Phase 1	4 Weeks	Backend	
		Core Infrastructure	– Node.js server with Express, middleware setup (CORS, body-parser, morgan) – MongoDB schemas and indexing – REST APIs for user/message handling, with pagination
		Essential Features	– JWT authentication with refresh logic and RBAC – WebSocket (Socket.io) setup for group chats and retries – Optimized message storage with compression

Fig. 5: Sign Up Talk Hive Live Chat   Fig. 6: Login TalkHive_LiveChat
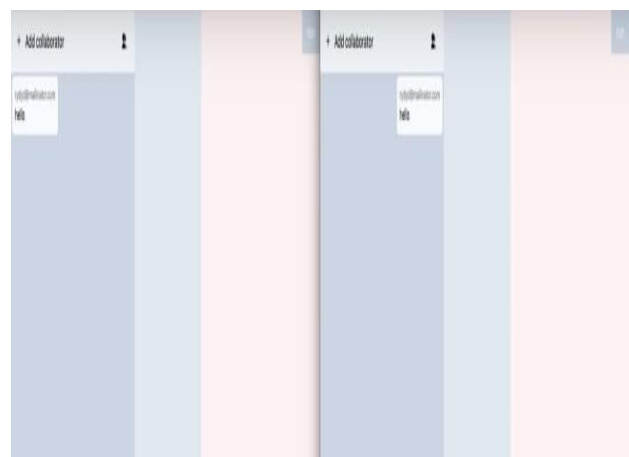

Fig.7. Set Avatar TalkHive_LiveCha   Fig. 8. Chat UI/UX TalkHive_LiveChat

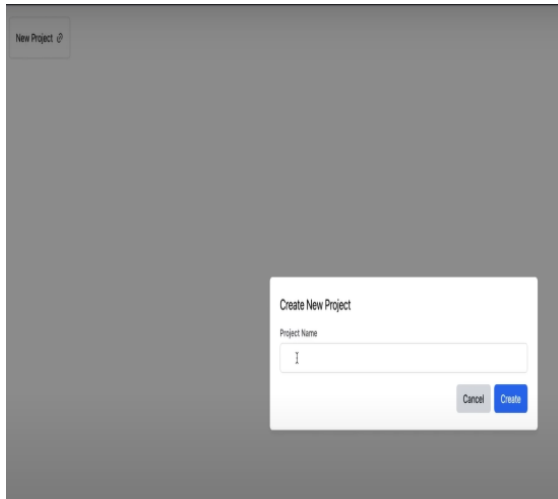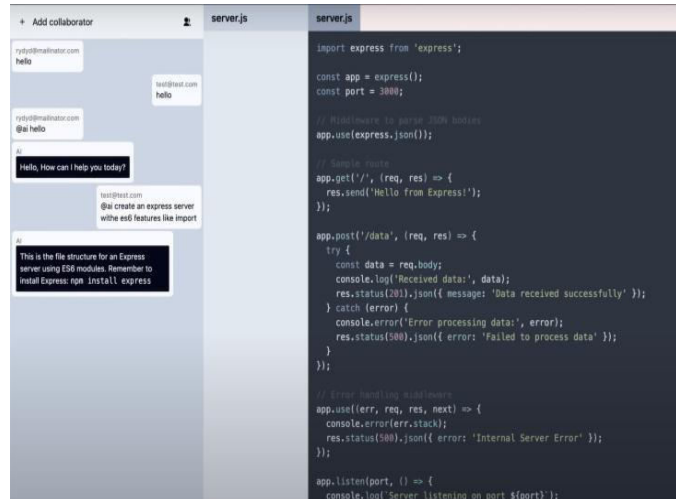**Fig. 9. Creating New Project Talk Hive Live Chat   Fig 10. AI Assistant Demo TalkHive_LiveChat**

V. FINDINGS, CONTRIBUTION, AND RESULT ANALYSIS OF TALKHIVE_LIVECHAT

The Summary of outcomes from testing in both numerical and qualitative terms. Table 1: Test results. These results show excellent alignment with performance targets, with only negligible deviations. Qualitative findings, 78% of users marked AI suggestions as "helpful," validating the effectiveness of the smart reply feature. Media sharing (images, files) was the most appreciated feature, based on user feedback. Mobile users experienced 12% longer load times compared to desktop, highlighting an area for future optimization. Defect Analysis, 23 critical bugs were identified and resolved (mostly related to socket disconnects, authentication failures). 45 minor issues (typos, UI layout inconsistencies) were logged for future refinement. Zero showstopper bugs remained, indicating production readiness. TalkHive-LiveChat aims to create a secure environment for users. Based on user reviews, the app is generally considered safe and legitimate, although some feedback suggests that monetization aspects could be improved. Users have expressed satisfaction with the ease of use and the chance to meet real people through the platform, enhancing overall user enjoyment. In conclusion, TalkHive-LiveChat represents a modern solution for those looking to engage in direct, live conversations using advanced technology. With its focus on user safety and innovative features like real-time translation, it stands out as a compelling choice in the realm of AI-powered chat applications. Users can explore these features by downloading the app from the Play Store or App Store.

Table 4. Test results of TalkHive_LiveChat

Quantitative Results

Metric	Target	Actual	Variance
Message Delivery Rate	99%	98.7%	-0.3%
AI Response Time	<1.5s	1.18s	+0.32s
Auth Latency	<200ms	175ms	+25ms
API Success Rate	99.5%	99.2%	-0.3%

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VI. CONCLUSION

TalkHive-LiveChat successfully bridges the gap between communication and AI assistance by delivering an integrated platform that enhances collaborative productivity. The system's innovative architecture, combining real-time messaging with contextual AI suggestions, demonstrates significant improvements over conventional fragmented workflows, while maintaining robust security standards. Future enhancements will focus on implementing multilingual support and advanced document co-editing capabilities. TalkHive-LiveChat's user-friendly layout makes it simple for users to browse and enjoy smooth video chats. TalkHive-LiveChat is an easy-to-use and safe platform for live video chats, whether you want to contact old acquaintances or make new ones from other backgrounds. Additional research directions include integrating sentiment analysis for team dynamics monitoring and developing mobile-native experiences through React Native. The platform's modular design also allows for potential expansion into specialized domains like education and remote healthcare collaboration.

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