

Computer Science and Engineering Department

NATIONAL INSTITUTE OF TECHNOLOGY

DELHI



Session (2024-2025)

Project Report

“Theory of App Development”

(CSBB 352)

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ABSTRACT

The project titled ***AlumNITD – Alumni-Student Interaction App*** is developed to establish a dedicated digital space for meaningful engagement between the alumni and current students of the institute. The app is designed to promote mentorship, professional networking, collaboration, and knowledge sharing — all within a single, intuitive platform.

Developed using React Native for cross-platform mobile compatibility, and powered by Node.js, Express, Firebase and Socket.io for a robust and scalable backend, AlumNITD delivers real-time, dynamic, and secure interaction.

Key features of the app include:

- **User authentication**, with support for both traditional email-password login and Google Sign-In, along with a forgot password feature for account recovery.
- **Discussion forums** and topic-based feeds where students and alumni can interact on academic, career, or social topics.
- **Real-time chat** using Socket.io for both one-on-one conversations.
- **Event hosting and participation**, enabling organization of webinars, meetups, and alumni talks.
- **Image sharing** across chats and events for improved interaction and engagement.
- **Donation module**, allowing alumni to financially support initiatives, events, and scholarships through a transparent process involving QR-based donation and transaction verification.
- A unique **Time Capsule** feature, enabling users to write messages, share memories, or upload media that can be scheduled to unlock at a future date — preserving legacy and building nostalgia over time.

This report captures the complete development journey, including system design, feature planning, frontend-backend integration, real-time architecture, security considerations, and user experience optimization.

OBJECTIVE

The primary objective of the AlumNITD App is to design and develop a centralized, real-time mobile platform that strengthens the bond between alumni and current students of the institute by facilitating seamless communication, mentorship, and collaboration.

The key goals of the project are:

- To enable meaningful interactions between alumni and students through real-time chat, forums, and discussion spaces.
- To create opportunities for mentorship and guidance, helping students benefit from the experiences and insights of alumni.
- To simplify event creation and participation, allowing users to host and attend webinars, reunions, and other interactive sessions.
- To support chat-messaging and image sharing for a more engaging and personalized interaction experience.
- To provide a secure and transparent donation system, enabling alumni to contribute towards institutional causes and student support initiatives.
- To introduce a Time Capsule feature, allowing users to preserve and unlock messages and media in the future — adding a nostalgic and legacy-oriented dimension.
- To ensure secure user authentication, including Google Sign-In and password recovery options, for a user-friendly onboarding experience.
- To build a scalable and mobile-friendly application using modern technologies like React Native, Node.js, Express, Firebase and Socket.io.

AlumNITD demonstrates the effective use of full-stack development in addressing the need for sustained alumni-student engagement and community building. It is a scalable and extensible solution with real-world impact and institutional value. The ultimate aim is to bridge the gap between past and present members of the institute, fostering a stronger, more connected, and supportive academic community.

BACKGROUND AND SIGNIFICANCE

Alumni are a powerful resource for any educational institution, serving as mentors, motivators, and connectors to the professional world. However, our institution faces challenge in maintaining consistent and impactful communication between alumni and current students due to a lack of dedicated platforms tailored to academic and career-based interaction.

In an era dominated by digital connectivity, there is a pressing need for a centralized, real-time solution that goes beyond generic social media platforms. AlumNITD is developed to address this gap — providing a mobile-first, scalable application that empowers alumni and students of our esteemed institution NIT Delhi to connect, collaborate, and contribute.

The significance of this project lies in its ability to:

- Foster strong alumni-student relationships through structured forums, real-time chats, and personalized profiles.
- Encourage knowledge exchange, career guidance, and mentorship, allowing students to learn from the real-world experiences of their seniors.
- Enable alumni to share internship opportunities and job referrals, helping students gain early exposure and valuable career boosts.
- Facilitate event hosting, such as webinars, reunions, or industry talks, directly through the platform.
- Allow users to share messages, images and emojis, enhancing engagement during chats, events, and community discussions.
- Support a secure donation system, making it easy for alumni to contribute towards scholarships, events, or development initiatives.
- Introduce a unique Time Capsule feature, where users can preserve messages and media to be unlocked in the future — strengthening the legacy and emotional bond with the institution.
- Offer secure authentication via Google Sign-In and traditional email-password login, along with a forgot password feature for smooth account recovery.

AlumNITD leverages a powerful and modern tech stack—React Native, Node.js, Express, Firebase and Socket.io—to overcome the inefficiencies of traditional alumni engagement methods and create a dynamic, scalable, and future-ready platform.

By integrating these technologies, *AlumNITD* transcends the limitations of outdated alumni portals (such as static directories or infrequent email newsletters) and instead delivers a smart, interactive ecosystem. Alumni can network effortlessly, mentor current students, collaborate on research or career opportunities, and participate in institutional growth.

Beyond connectivity, the platform enhances institutional value by strengthening alumni-student relationships, driving mentorship programs, and facilitating knowledge-sharing. This continuous engagement not only benefits students through career guidance and industry insights but also elevates the institute's reputation by fostering a lifelong community.

With its scalable architecture and real-time capabilities, *AlumNITD* is designed to evolve alongside technological advancements, ensuring it remains a cornerstone of alumni engagement for years to come.

TECHNOLOGY USED

Frontend:

- **React Native:** Utilized for building high-performance, cross-platform mobile applications with native capabilities.

Backend:

- **Node.js:** Server-side runtime used to develop scalable backend services with JavaScript.
- **Express.js:** Lightweight Node.js framework used for building RESTful APIs.
- **Socket.IO:** Enabled real-time, low-latency, bi-directional communication for interactive features such as live discussion forums.

Authentication & Database:

- **Firebase Authentication:** Secured authentication using email, phone, and social logins, integrated seamlessly with Firebase.
- **Firebase Firestore:** A NoSQL cloud database used for real-time, scalable data storage and complex querying.
- **Firebase Realtime Database:** Enabled real-time synchronization of data for chat and forum updates.
- **Firebase Cloud Messaging:** Delivered rich push notifications across platforms using React Native Notifee.
- **MongoDB:** Used as the primary database for structured and unstructured data storage, supporting complex queries and integration with the backend services.

Notifications:

- **React Native Notifee:** Used for advanced notification handling and customization on React Native apps.

Deployment & Infrastructure:

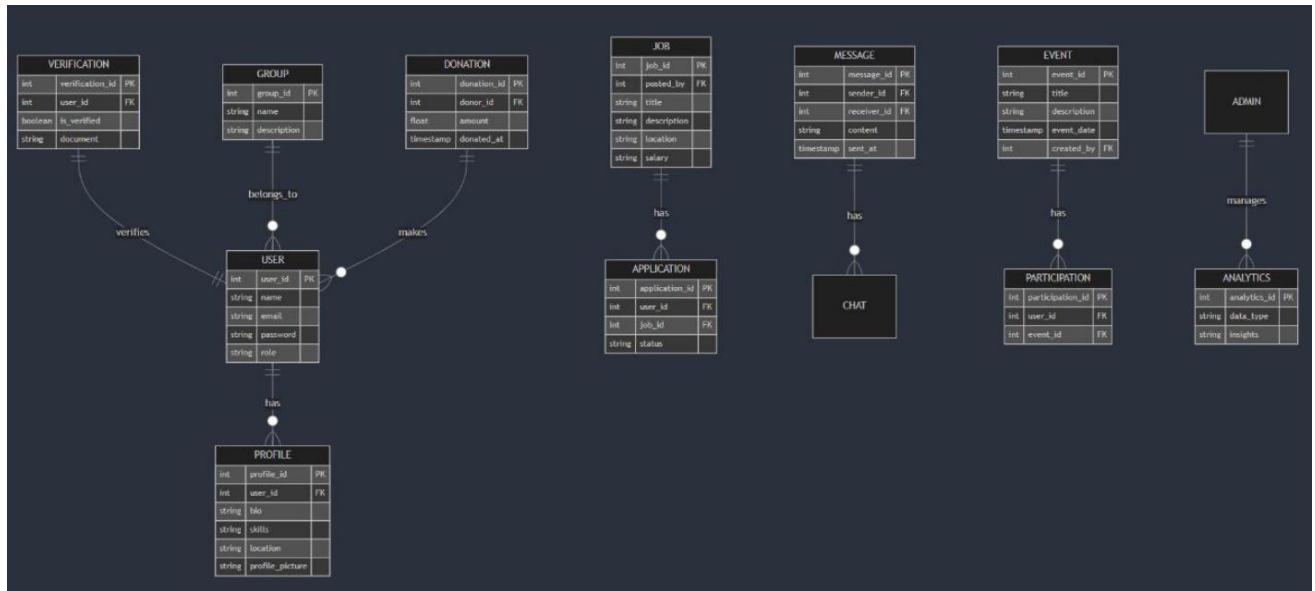
- **GitHub Actions:** Used for setting up automated CI/CD pipelines for seamless deployment.

Maps Integration:

- **MapTiler:** A privacy-focused and customizable map service used to display alumni locations effectively.

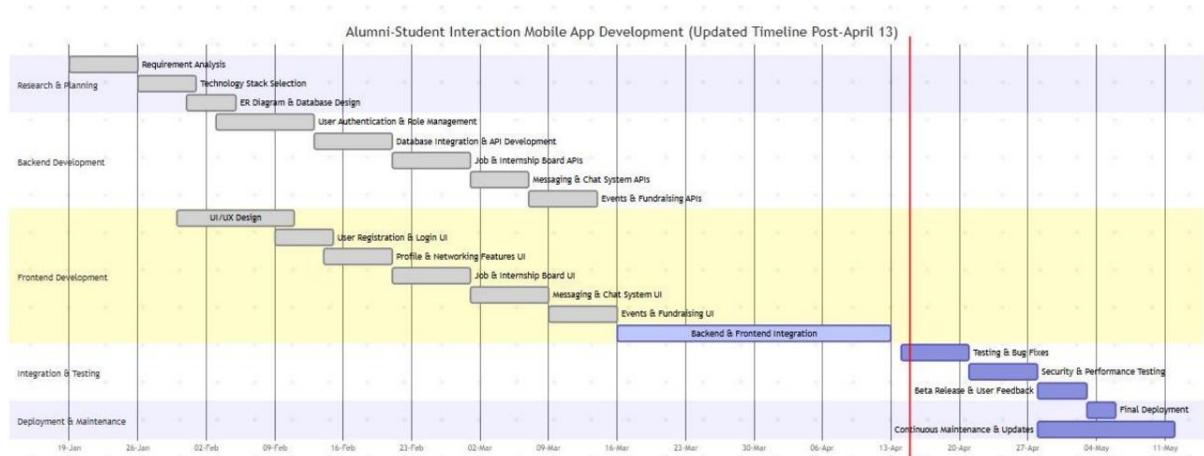
WORKFLOW DIAGRAM

ER DIAGRAM:



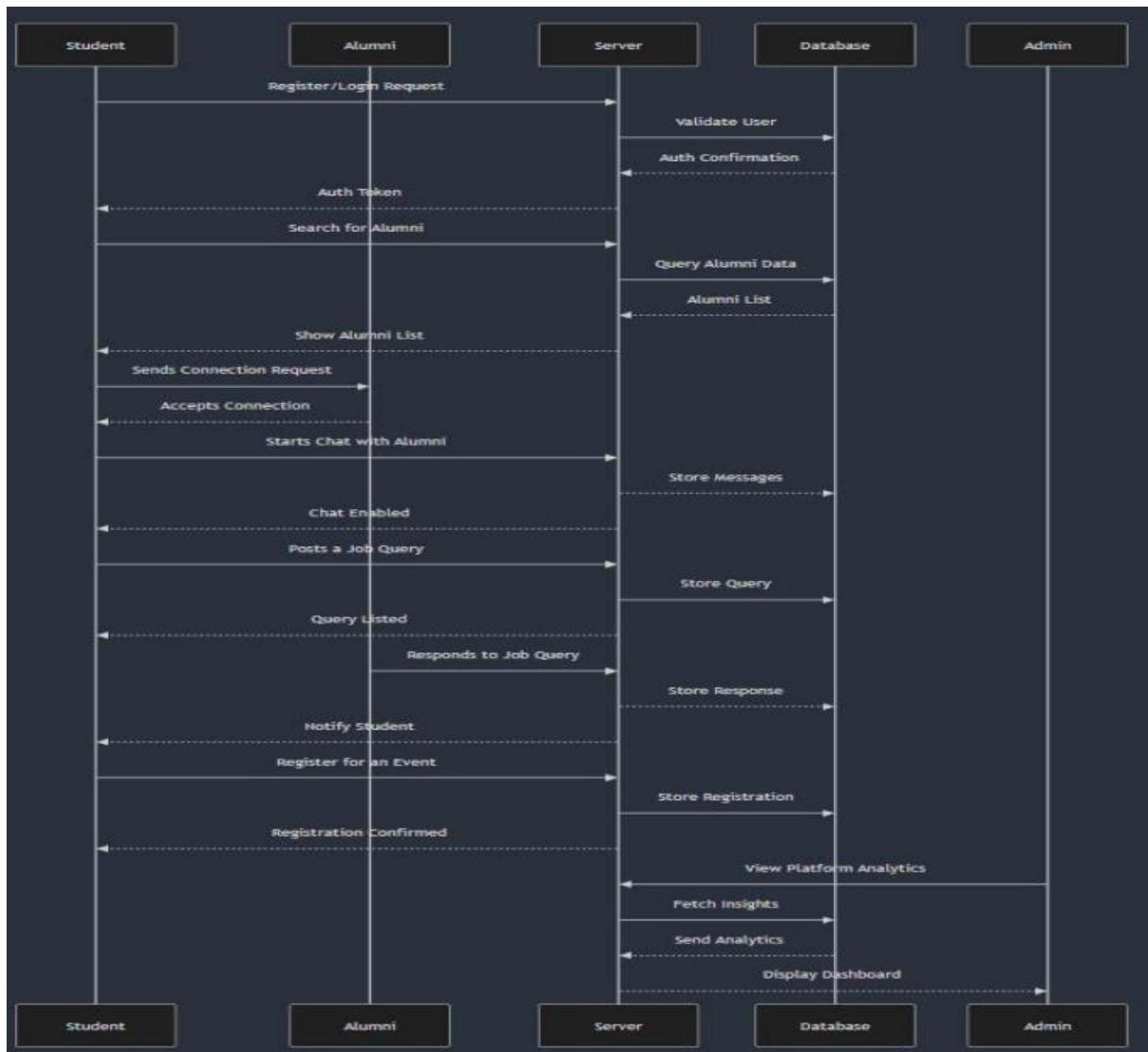
(Figure 1)

GANTT CHART:



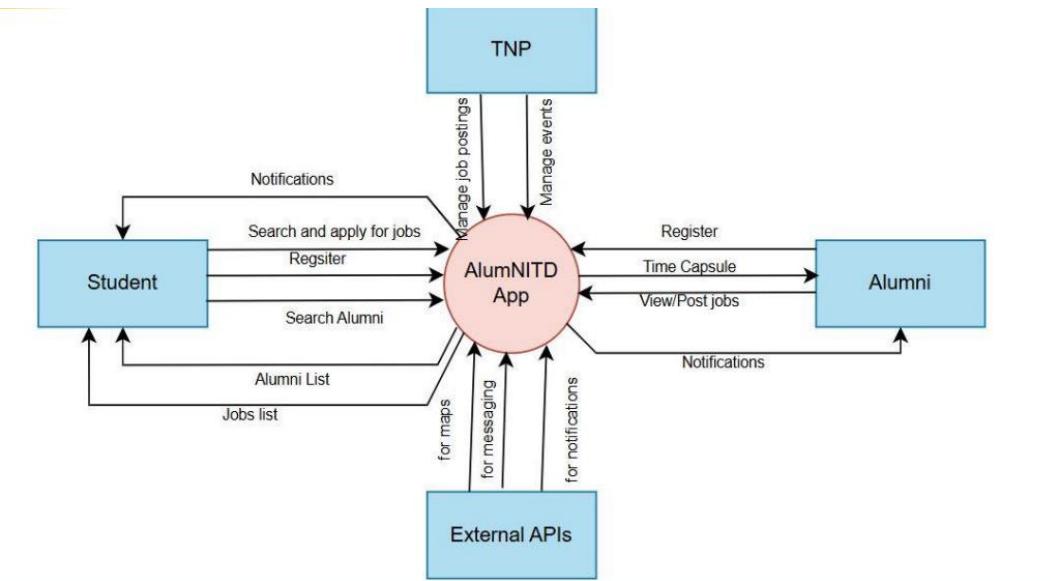
(Figure 2)

SEQUENTIAL DIAGRAM:



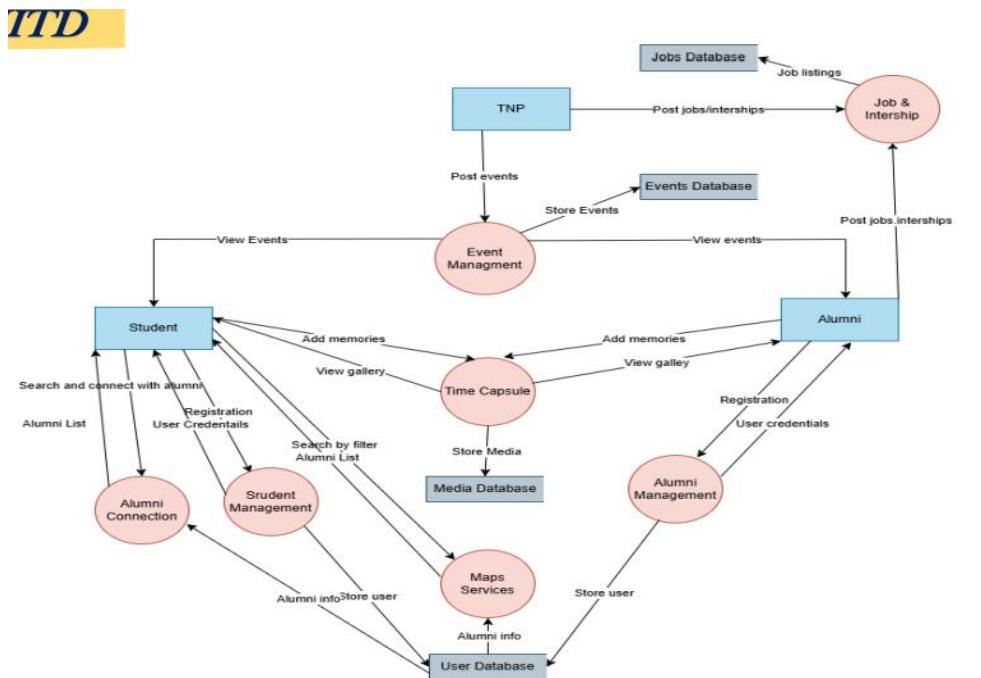
(Figure 3)

DATA FLOW DIAGRAM (LEVEL 0):



(Figure 4)

DATA FLOW DIAGRAM (LEVEL 1):



(Figure 5)

KEY FEATURES (FUNCTIONALITIES)

1. User Management & Access Control

This module ensures secure and organized access to the platform, offering:

- **User Registration & Login:**

1. Email and Password Authentication: Built using Firebase Authentication for secure, scalable login systems. Users can sign up using a valid email address and password, which are securely stored and encrypted by Firebase. Upon registration: A verification email is sent to ensure the authenticity of the user. Only verified users are allowed access to community features such as messaging, forums, and job boards. Password reset functionality is also integrated to allow users to recover their accounts easily.

2. Google Sign-In (OAuth 2.0): Integrated Google OAuth Sign-In to allow users to register or log in using their Google account. Benefits: Seamless, one-click login experience without the need to remember new credentials. Verified identity through Google's secure system reduces the risk of spam or fake profiles. Once authenticated via Google, users are redirected to the platform and a corresponding profile is automatically created in the database.

- **Verification-System:**

Implements a verification process to ensure only genuine alumni and students gain access, enhancing platform integrity and trust. Users with NIT email can only login and register on the app. The email should end with @nitdelhi.ac.in.

- **Profile-Management:**

Enables users to create, update, and manage their profiles with personal, professional, and academic details.

2. Networking & Community Building

This section fosters meaningful connections and interactions within the alumni and student community:

- **Advanced Search & Filters:** The Alumni Search & Connect feature is a powerful discovery engine that enables students and alumni to find, filter, and network with the right professionals in seconds. Unlike basic directory listings, this tool offers smart search algorithms, advanced filters, and personalized recommendations to build meaningful connections based on career goals and expertise,
- **Nearby Alumni Map:** The Alumni Nearby feature leverages geolocation technology and MapTiler's mapping solutions to help users discover and connect with fellow alumni in their geographic vicinity. This functionality transforms passive alumni data into active networking opportunities by visualizing alumni concentrations worldwide and enabling location-based interactions.
- **Direct Messaging & Chat:** The Real-Time Chat system enables secure, instant messaging between alumni and students using Socket.IO for live communication. Users can exchange text messages, images, and emojis while maintaining full control over their conversations with message deletion capabilities and showing them their message timestamps.
- **Alumni Forums:** The Alumni Forums serve as a structured discussion hub within AlumNITD, enabling alumni and students to engage in meaningful conversations based on shared interests, academic fields, and professional domains. Unlike generic social media groups, this feature provides topic-specific, moderated, and searchable threads to facilitate productive networking, mentorship, and collaborative problem-solving.
Tagging & Filtering: Users can filter discussions by tags (#InternshipAdvice, #StartupIdeas, #GATEPreparation). Pinned threads for important announcements (e.g., alumni job referrals).
- **Time Capsule Section:** The Time Capsule is a dedicated digital space within AlumNITD where alumni can relive, share, and archive their cherished college memories. This feature serves as a virtual scrapbook, allowing users to upload photos, videos, stories, and mementos from their time at NIT Delhi. It fosters nostalgia, strengthens emotional connections, and preserves the institution's heritage for future generations.

3. Career & Placement Assistance

Dedicated to supporting students and recent graduates in their career journey with:

- **Job & Internship Board:** A curated space where verified alumni and recruiters can post job/internship opportunities, accessible to students and fresh graduates.
- **Alumni Hiring & Referral System:** Facilitates referral-based hiring processes, where alumni can refer students for roles within their companies or networks. This improves and provides direct referral for Internships as well as Full Time Offers.

4. Events & Engagement

Designed to improve alumni engagement through events and outreach:

- **Event Management System:** Enables organizers to create, manage, and promote events like webinars, reunions, and guest lectures within the platform. It provides a complete suite of tools for alumni relations teams, department heads, and student organizers to plan, execute, and analyse various engagement activities. This integrated solution transforms traditional event coordination by combining scheduling, promotion, and participation tracking into one seamless platform.
- **Donation and Fundraising:** Allows alumni to contribute to college initiatives, scholarships, and infrastructure development via secure transactions. System transforms charitable giving into a verifiable, transparent, and engaging process while maintaining rigorous financial security standards. The QR+verification method particularly addresses common concerns about payment legitimacy in institutional donations.
- **Push Notifications & Alerts:** Uses Firebase Cloud Messaging and Notifee to send real-time alerts and updates about new messages, events, or job postings.

5. Admin Dashboard & Analytics

Empowers the platform Administrators/TNP Head with tools for oversight and data-driven decisions:

- **Centralized Control Panel:** A unified interface for admins to manage user roles, moderate content, approve events, and control platform settings.
- **Data Insights & Analytics:** Provides usage statistics, engagement metrics, and community growth data through dynamic dashboards for better decision-making.

SCREENS

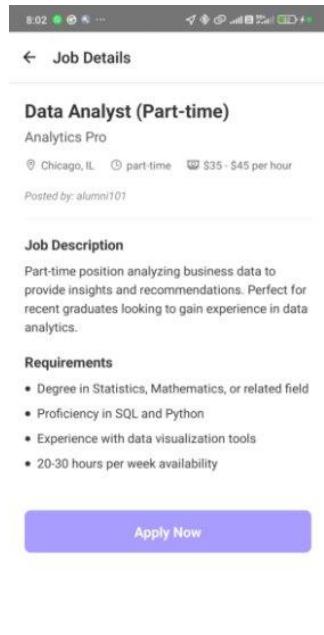
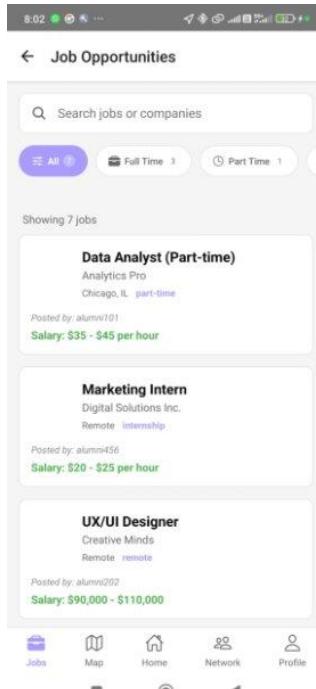
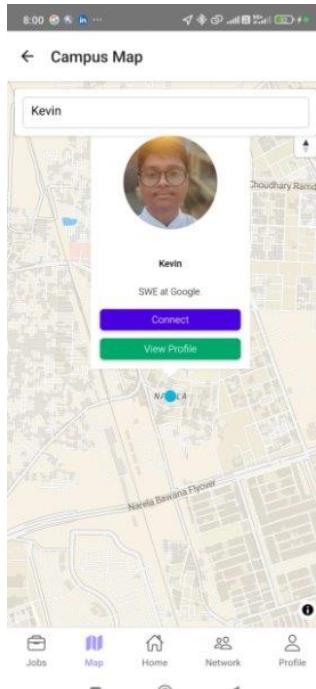
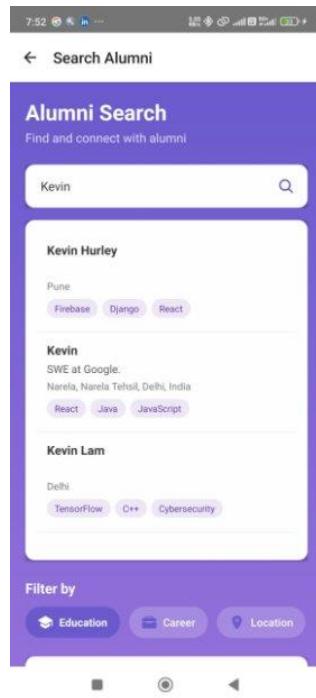
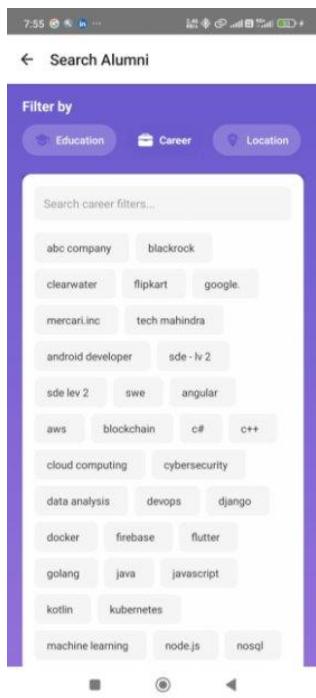
The image displays six screenshots of a mobile application interface for AlumNITD, arranged in two columns of three. The top row shows the login screen, the account creation screen, and the welcome screen. The bottom row shows the profile settings screen, the edit profile screen, and the skills section of the profile.

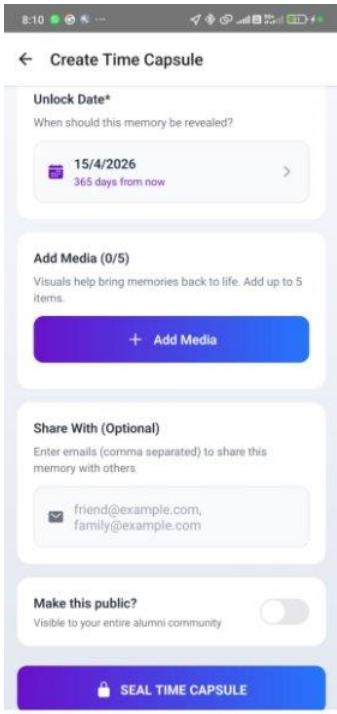
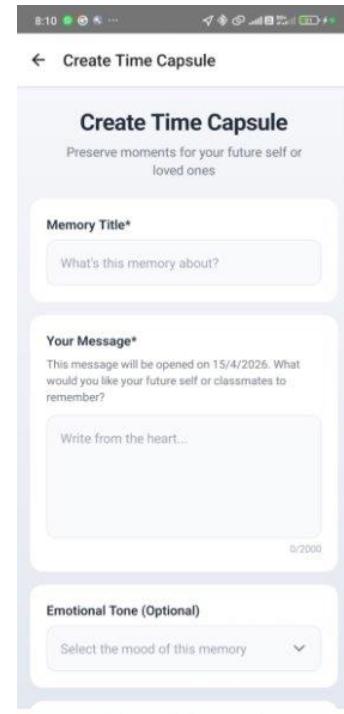
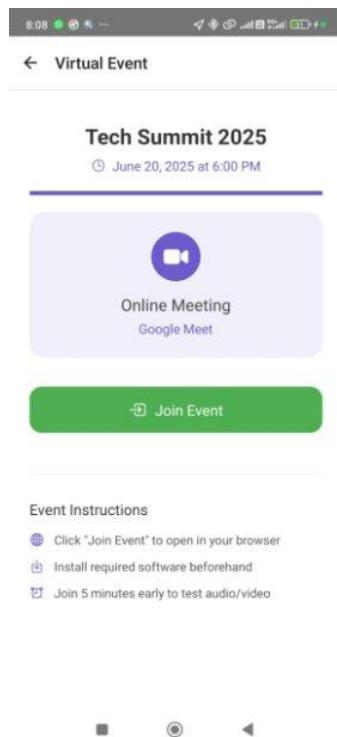
Top Row Screens:

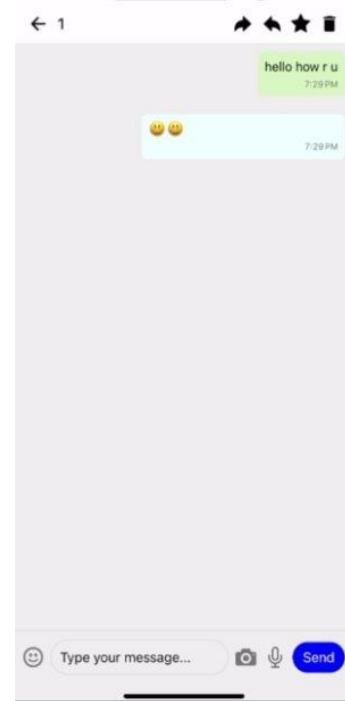
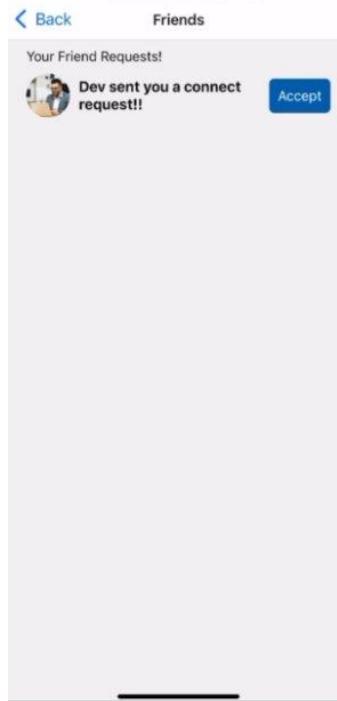
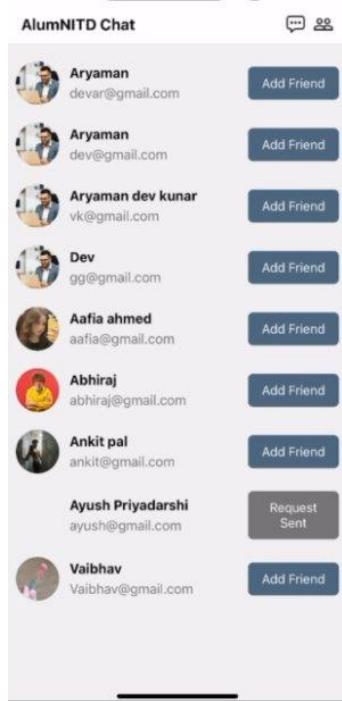
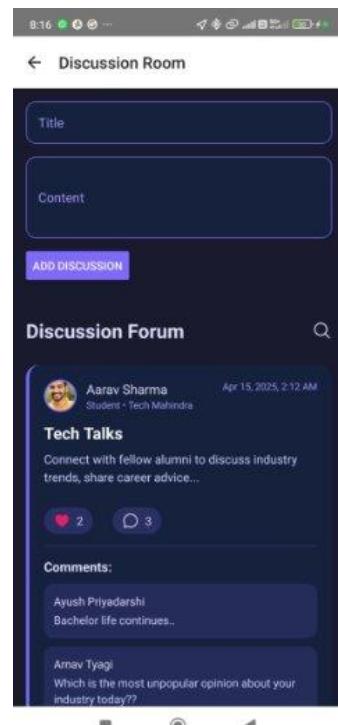
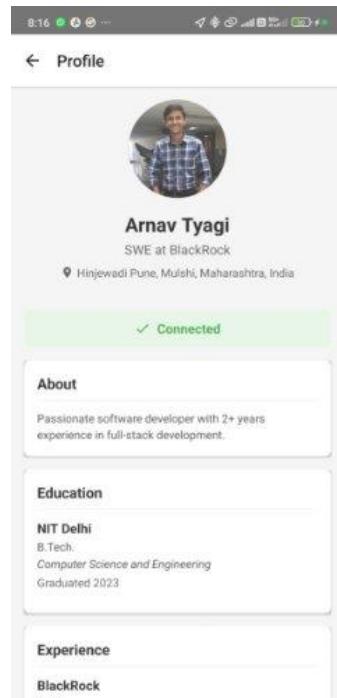
- Login Screen:** Shows the AlumNITD logo and "Welcome Back" message. It includes a login input field (201210005@nitdelhi.ac.in), a "Back to Login" link, and a "Sending..." button.
- Create Account Screen:** Titled "Create Account" with the sub-instruction "Join our community today". It contains fields for "Full Name", "College Email" (with placeholder "yourname@nitdelhi.ac.in"), "Password", "Confirm Password", "Role Selection" (dropdown menu "Select your role"), and "Graduation Year" (dropdown menu "Select graduation year").
- Welcome Screen:** Titled "AlumNITD" and "Welcome Back". It features a "Continue" button, a "Forgot Password?" link, a "Continue with Google" button, and a "Don't have an account? Register Now" link.

Bottom Row Screens:

- Profile Settings Screen:** Titled "Edit Profile". It shows a "Profile Settings" section with a user photo, a "Change Profile Picture" link, and fields for "Full Name" (Ayush Priyadarshi), "Email" (221210027@nitdelhi.ac.in), "Phone Number" (6202079657), "Location" (Enter your location), and "Bio/About Me" (A engineer by passion, I'm currently pursuing my B.Tech. in Computer Science and Engineering at NIT Delhi (Graduating 2026). I am deeply interested in building scalable software solutions and enhancing user experience through Android applications and intelligent systems.).
- Edit Profile Screen:** Titled "Edit Profile". It shows sections for "LinkedIn Profile URL" (www.linkedin.com/in/ayush-priyadarshi-9481b9282), "GitHub Profile URL" (https://github.com/geekAyush123), "Education" (Institution Name: NIT DELHI, Degree/Program: B.Tech., Graduation Year: 2026, Field of Study: Computer Science and Engineering), and "Work Experience" (Company Name: Tech Mahindra).
- Skills Section:** Shows a list of skills: Java (X), JavaScript (X), TypeScript (X), Machine Learning (X), and NoSQL (X). A "Save Changes" button is at the bottom.







FUTURE SCOPE

The *AlumNITD* platform lays the foundation for a robust alumni-student ecosystem, and there is immense potential for expansion and enhancement. The following future developments can significantly amplify the platform's impact, scalability, and user experience:

1. AI-Powered Mentorship Matching

- Integrate machine learning algorithms to automatically match students with alumni mentors based on interests, career goals, skillsets, and experience.
- Dynamic recommendations can help users discover mentors or mentees beyond their known circles.

2. In-App Video Calling & Virtual Meetups

- Add real-time video conferencing features (e.g., via WebRTC) to allow face-to-face mentorship sessions, virtual reunions, and alumni guest lectures within the app itself.

3. Resume Reviews and Mock Interviews

- Implement a module where students can upload their resumes for review and feedback by experienced alumni.
- Schedule mock interviews with alumni working in the industry to prepare students for real-world hiring processes.

4. Blockchain-Based Certification & Verification

- Use blockchain technology to issue and verify certificates for events, internships, and mentorships, ensuring tamper-proof records and verified achievements.

5. Gamification & Engagement Metrics

- Introduce a reward system for participation (e.g., badges, leaderboards, alumni points) to encourage continued involvement and engagement.
- Provide analytics for students to track their networking and learning growth over time.

6. Integration with LinkedIn & GitHub

- Allow users to sync profiles with LinkedIn or GitHub to enrich professional data, showcase projects, and simplify the login process.
- Enable one-click sharing of alumni events or job postings on social media platforms.

7. Mobile-Only Offline Access & Caching

- Enhance offline capabilities using local storage and caching to ensure seamless access to essential features like saved contacts, messages, or forum posts without internet connectivity.

8. Scholarship and Grant Management Portal

- Introduce a financial aid section where alumni can create, sponsor, or contribute to scholarships and grants for deserving students.
- Admins can monitor and distribute these resources transparently.

9. Cross-Institution Collaboration

- Extend the platform for inter-college or inter-NIT alumni networks, enabling broader collaboration, startup incubation, and pan-India networking opportunities.

10. Advanced Analytics for Institutions

- Provide colleges with deep insights through dashboards showing alumni engagement trends, placement stats, and student career paths, aiding in institutional development and accreditation processes.

CHALLENGES AND RESOLUTION

1. Secure and Scalable User Authentication

Challenge:

- Implementing a flexible yet secure login system for both alumni and students using multiple methods (email-password and Google Sign-In).
- Ensuring proper role-based access control and session handling.

Resolution:

- Used Firebase Authentication, which supports email/password login and OAuth 2.0 (Google Sign-In).
- Applied email verification and integrated Firebase's role-based access to ensure users get access to only the allowed sections (e.g., admin panel, event dashboard).
- Sessions managed via secure tokens (JWT) and Firebase's client-side SDK.

2. Real-Time Communication for Chat & Forums

Challenge:

- Implementing low-latency chat and discussion features where users can interact in real time.
- Ensuring the messages sync instantly and persist even on app refresh.

Resolution:

- Integrated Socket.IO with MongoDB Database, allowing real-time, bi-directional communication.
- Used event listeners to instantly update chats and forum posts across all devices.
- Data persists via MongoDB while maintaining real-time event-driven updates via Socket.io.

3. Dynamic Alumni Location Mapping

Challenge:

- Visualizing alumni locations on a map while respecting user privacy and ensuring accuracy.

Resolution:

- Integrated MapTiler, a privacy-focused, open-source mapping platform.
- Only approximate locations are shown on the map, avoiding exact geolocation to preserve privacy.
- Users can voluntarily set or update their location on profile setup.

4. Testing Across Devices (Android Emulator)

Challenge:

- Ensuring the app runs smoothly across various Android devices with different screen sizes and OS versions.

Resolution:

- Used the Android Expo Emulator for consistent, cross-platform testing.
- Implemented responsive design principles and React Native's flexible UI components to ensure proper scaling.
- Also performed physical device testing on different screen sizes to catch edge-case UI issues.

5. Efficient Data Handling and Querying

Challenge:

- Managing a large and growing set of user profiles, chat messages, events, and posts in a performant way.

Resolution:

- Leveraged Firebase Fire store for scalable document-based storage with powerful querying.

- Also integrated MongoDB for certain backend operations where relational-style queries or aggregation pipelines were needed.
- Indexed key fields and used pagination to optimize performance.

6. Maintaining Data Consistency in Chat & Forums

Challenge:

- Preventing data conflicts in real-time messaging scenarios when multiple users edit or send messages at once.

Resolution:

- Used Firestore's real-time sync and offline persistence, which automatically manages conflicts and retries.
- Additionally, message timestamps and user IDs were used to resolve ordering issues and ensure consistency across clients.

7. Engaging UI/UX for Different User Groups

Challenge:

- Designing an interface that is friendly and intuitive for both tech-savvy students and non-technical alumni.

Resolution:

- Created a clean and minimalistic UI using React Native and Tailwind-inspired styles.
- Conducted informal user testing to gather feedback from peers and iterated on the design for improved usability.
- Used conditional rendering to offer customized experiences for different user roles (student, alumni, admin).

CONCLUSION

The *AlumNITD* application serves as a comprehensive digital platform bridging the gap between alumni and students of educational institutions, with a strong focus on community building, mentorship, career support, and event engagement. The app successfully encapsulates the core idea of fostering lifelong connections, professional networking, and collaborative growth among the alumni and current students of NITs and other institutions.

By leveraging modern technologies such as React Native, Node.js, Firebase, MongoDB, and real-time tools like Socket.io and Firebase Cloud Messaging, the application offers a seamless and scalable cross-platform experience. With features like job boards, direct messaging, alumni maps, time capsules, donation management, and centralized admin control, the platform not only enhances student-alumni interaction but also opens doors for future collaboration and opportunities.

The development of *AlumNITD* also brought forward several real-world challenges, including handling real-time communication, ensuring secure authentication, designing an intuitive UI, and deploying scalable backend services—all of which were resolved with efficient tech solutions and architecture.

This project stands as a testament to the potential of technology in strengthening institutional networks, encouraging mentorship, and driving impactful alumni engagement. Moving forward, the platform holds immense scope for integration with AI-based recommendation systems, advanced analytics, and broader institutional deployment across the country.

In essence, *AlumNITD* is not just an app—it's a step towards building a thriving, interconnected alumni ecosystem that empowers both students and graduates for years to come.