International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 04 Issue: 01 January 2026
Page No: 141-147
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2026.0019

Social Network for Educational Institutions

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Abstract

One of the most crucial aspects of college is networking. It provides students with updates, mentorship, opportunities, guidance, and social connections, and it provides faculty with ease of communication and collaboration. There are so many platforms for connecting with people all over the world, even in a professional setting. But a dedicated social networking site(SNS) for a particular educational institution fosters a sense of community among the students as well as the faculty. Using modular architecture, each of its features can be implemented independently. MERN stack, with JavaScript as the primary programming language, is employed. AWS is utilized for cloud infrastructure. RESTful APIs are used to facilitate communication between the client and server.

Keywords: *networking; SNS; modular architecture; MERN stack; cloud infrastructure.*

1. Introduction

Networking is a significant facet of any career. Social media has revolutionized the way we connect. An essential component of modern communication is digital networking through social media. [3] provides deep insight into the statistics of the use of SNS among students. Its major findings included that around 80% of students spend significant time on SNSs. The benefits, as outlined in [1], include establishing a collaborative environment, enhancing the learning environment and peer engagements and improving every aspect of the social life of students. An SNS-based platform provides a dynamic and interactive environment for the members of the institute. Digitising the community provides the opportunity for worldwide connectivity with alumni, making the alumni more approachable for the students. Furthermore, we can go beyond the traditional classrooms to form online clubs and communities to socialize, learn, and share resources. Hence, it makes knowledge more accessible for its students. Faculty will be able to provide up-to-date information, reminders, and engage in group discussion forums with students. All these increase the academic reach and effectiveness, making it easier for students and faculty members to fulfil their scholastic obligations. However, as mentioned in [2], it is not free of its demerits. It raises concerns regarding distractions, privacy, and misinformation. To combat them, digital literacy and online safety must be prioritized. Most educational institutions rely on public platforms or messaging apps for communication, which often leads to distractions and privacy issues. Current systems fail to provide an academically oriented functionality such as course groups, assignment sharing, and faculty announcements. Additionally, managing user access and data security becomes challenging when external applications are used for internal purposes. Social Network for College provides a structured environment where users are categorized as students, faculty, or administrators. Each user type has specific access permissions and capabilities. Students can post updates, view announcements, and interact with peers. Faculty members can manage academic

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groups, upload learning materials, and communicate with students. The admin oversees platform moderation to ensure a secure and productive experience.

2. Related Work

There is a multitude of existing works that put forward various methods to form and develop an SNS. Those can be tweaked and used for an academic setting. [4] leveraged MERN stack for real-time social media communication. It discusses how the MERN stack can be properly utilized to efficiently conduct front-end and back-end development to present an intuitive interface, strong user authentication, dynamic content sharing, and real-time interactions. Spamming of media is a notable issue faced in social media applications. [5] gives a comprehensive review of the current network-based spam detection techniques. It examines the strengths and limitations of each method and analyses the performance along with the use of machine learning and deep learning for enhanced detection. In [6], two types of spam filtering techniques are proposed: the first is based on machine learning (ML), created using support vector machine (SVM), artificial neural network (ANN) and Naive Bayes classifier, reaching around 95% accuracy. Second, a novel approach has been proposed using the content recommendation model. To make the college social network an inclusive and safe space for all, it is vital to curb hate speech that may circulate on the site. [7] designed a zero-shot prompt and a CoT prompt to detect hate speech. Sharing of videos is an essential feature, whether it be lectures, informational videos, or the individual's feed. [8] developed a simple yet effective model to simulate the video propagation process. It captures the randomness of a video's popularity and the skewed video popularity distribution. [9] shows the characteristics of video sharing propagation in SNS.

3. Proposed Methodology

The proposed methodology for a college social network is to divide the SNS based on its different use cases of its respective users, such as students, faculty, or administrators. Each of these has specific permissions, privileges, and functional requirements which can be implemented as separate features of the social network. For example, students view the announcement boards, post messages, and interact with their peers. Faculty members manage the academic groups, upload learning materials, and communicate with students. The admin is in charge of controlling the overall functioning of the SNS to ensure a secure and smooth experience for all members involved. We have made use of the Firebase platform for the development of the application. It is a Backend-as-a-Service (BaaS) offered by Google. Traditionally, in most social media architectures, a load balancer is used to distribute the incoming client requests to the services on the backend side. In our proposed system architecture, this functionality is not required, as it is managed by Firebase Hosting and Firestore, which automatically scales to handle the user traffic without the need for explicit load balancing. API Gateway acts as a central point of entry for all client requests and routes them to their respective service servers. It is also the authorization layer of Firebase, providing security and ensuring only authorized access is granted to valid users according to their assigned privileges. Next, we have the read and write servers, which are components of Firestone's real-time database engine. It is a flexible, scalable NoSQL document database, part of Firebase. It performs live data updates across clients, works without internet, syncing later and has Powerful querying capabilities. Firebase can trigger background events, which are depicted conceptually by the Notification Queue in the diagram. The User DB is stored in the Firestore. It is the collection of all the user's data, including login credentials, role information, profile data, etc Shown in Figure 1.

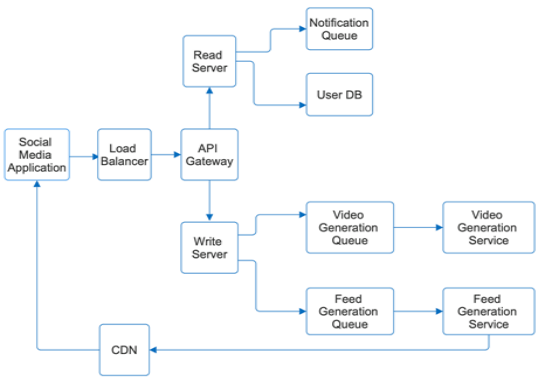

Figure 1 System Architecture of the Proposed Model

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3.1. Registration and Login Module

The Firebase Authentication is the primary user identity management system and controls the login mechanisms. Instead of open account creation, a controlled one is employed through Firebase. This ensures that only the legitimate people belonging to the institution are allowed access to the SNS, and no outsider is verified. The administrator is tasked with creating the user accounts for students and faculty members by providing them with the login credentials. All account creations are handled by the verified administrators of the application, and a mapping of the user credentials and user roles is maintained by them. After the registration of the user accounts is done, they receive a unique Firebase UI. This acts as a key for their verification to gain the required access to the SNS. For a user to log in, they enter their administrator-issued credentials into the app UI. The Firebase client-side SDK collects the credentials and sends them to the Firebase backend servers for validation against the associated authentication provider. The passwords are hashed and compared with the stored hashes. If the credentials are invalid, access is denied. If they are found to be authentic, Firebase generates two tokens, an ID token and a refresh token. These tokens are taken by the client-side SDK and stored locally to manage the session of user. The ID token is short-lived and expires quickly. It is used for the user to gain access to the application and to retrieve the user's data and profile. The user identity is made available across all the components, while the underlying details of the authorization are kept hidden by storing the authorization results in the application locally through the React Context API. Once logged in, the refresh token ensures the user is logged in across all the pages it navigates to or after the app restart. This is done by the refresh token, producing new tokens as needed and expires when the user signs out. After the user is validated and the session is established, the application dynamically loads the features based on the user's role. For example, if it's a student logging in, they are displayed with the options to view announcements, make blogs and interact with the learning material, etc. However, if it's a professor logging in, then they are given the option to make virtual learning environments and post the lecture materials, etc. If the logged-in user is an admin, they are provided with exclusive access to management features such as onboarding new users, granting permissions, etc. All internal navigation throughout the platform is protected using route-level access control, implemented using React Router. Every primary route in the application is wrapped inside a protection layer that checks whether a valid Firebase session exists before rendering any internal page. If authentication is not present, the user is automatically redirected to the login screen. The overall authentication flow ensures a trusted and role-aware access experience throughout the system. The combination of Firebase Authentication for login, Firestore for user profile storage, and React's Context API for session state creates a secure boundary around user login. This prevents unauthorized access, eliminates the possibility of anonymous users participating in the platform, and ensures that all communication within PDA Connect is tied to a verified identity that has been issued by the institution.

3.2. Posts and Interaction Module

One of the most crucial features is that of feed generation and interactions with the posts. The posts and interaction module in PDA Connect allows the users to make posts, form discussion forums, create groups and communities to share content and announcements. It enables the students and faculty members to engage with events, share content, and carry out internal communications regarding the college and its activities. The provision for making posts is available on the homepage itself, so it does not require long submission processes. Users can post images, announcements, opinions, and updates through the lightweight, interactive interface of the application. Once the posts are uploaded by the user, they appear in reverse chronological order, with the latest uploaded posts being shown at the topmost position on the feed. This ensures that all the information is updated in real time and fresh updates are provided. This is carried out by React without a page refresh to give a real-time, dynamic experience, making the feed seem natural and conversational. Hence, a clean and minimal interface is maintained, letting students share thoughts and experiences

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instantly. In addition to generating posts, the home page can also display announcements and bulletins. The faculty members, as well as the administrators, can post academic information, important notices and campus instructions. These are visible to all students, making college-wide communications and information distribution easier and effortless. It removes the need for physical bulletin boards and reduces the dependency on physical medium and word-of-mouth propagation of information, which isn't always as reliable. It also ensures all students receive the important information timely and in real-time, through notifications of the application. This creates a unified information flow where informal student posts and official announcements co-exist in the same interface but are separated logically according to permissions. Students can react to posts by responding through follow-up blog entries or by initiating personal conversations using the integrated chat system, thereby enhancing the overall engagement model of the application.

3.3. Chat Module

Any social networking app is incomplete without a chatting feature since it is one of the most fundamental aspects of any SNS. The chat module in PDA Connect is designed to provide chat communication in many diverse forms, whether it be among students or faculty, individually or in a group setting. Students can converse one-on-one with their professors to ask doubts, clear concepts, and seek guidance. This makes communication with professors more accessible and less intimidating for students. The teachers can also form groups to easily communicate with a large number of students at a time. Students can also make such study groups or other college groups and reach out to one another. This makes collaboration smooth and convenient. This feature makes reaching out and getting help simpler. A lightweight data schema of the Firestore is used to model the conversations by associating each chat thread with its members, message history and metadata, such as the last exchanged message and its timestamp. When a user selects a chat, the application retrieves its thread from the database and continuously listens for updates using real-time listeners. Any update made is instantaneously reflected for all involved users of the corresponding conversation. This design enables seamless message synchronization without requiring page refreshes, and ensures a responsive experience where new messages appear instantly as they are sent. React is used for the implementation of the interactive layer. Modular components are developed, such as the chat sidebar displaying the chatlist of a user and the chat window where the messages are shown. To distinguish the messages based on the sender's role, the text bubbles are dynamically styled. The interface supports continuous message flow, timestamps, and sender names, which creates clarity and context in discussions. The module also leverages Firebase Authentication to validate sender identity and enforce access control, ensuring that only registered users can participate in conversations. Together, the combination of structured database modelling, real-time listeners, and a responsive UI results in a robust chat environment that supports academic collaboration, informal student communication, and direct interaction with faculty while maintaining the privacy and authenticity of user exchanges.

3.4. Notification Module

The notification module in PDA Connect is developed to ensure that users receive timely updates about academic activities, announcements, and interactions within the platform. The operation of notifications is based on the real-time database capability provided by Firebase, where any changes in central collections (announcements, posts and messages) are automatically detected. Whenever a new announcement has been posted by a Professor or Administrator, the feed for all users can be automatically updated, eliminating the need to manually refresh the announcements. This instantaneous notification stream guarantees that immediate, higher-priority campus announcements (eg, exam schedules, event updates, or administrative directives) are efficiently communicated to all authenticated individuals. Such a user interface embedded announcement system through the home page develops messages that do not need external messaging mechanisms or information dissemination tools such as email. Internal notifications, which concern user-related events (such as when a new message arrives or when a conversation has been updated while already in

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use), are also accessible from the scene. The chat section listens to new message events via Firestore listeners and provides a visual reflection of activity via changes in the UI state so that users are still kept informed about communication. Currently, notifications are presented within the app, but the module was built considering the ability to add push notifications and alerts for mobile devices, making them more accessible. With the integration of notification logic into the current interface, additional interruptions of the notification are eliminated, making the experience feel more complete, ensuring that timely notifications are contextualized to the user and helping them engage more with campus discussions and activities.

3.5. Implementation Setup

We have named our developed application as PDA Connect and will be referring to it as such. For the experimental setup, we have employed a web-based environment utilizing modern front-end architecture and cloud-hosted backend services. The front-end interface was built using React.js and Tailwind CSS. It provided a component-driven layout and responsive user experience suitable for interactive web applications. A local server environment, configured through the React development toolchain, was used for the initial testing and iterative development since it makes it possible to stimulate the user interface and evaluate each component's behaviour before integrating them and the external services and deploying. The system was deployed in a development environment using Visual Studio Code as the primary IDE, with Node.js running locally to support dependency management, module bundling, and compilation. A local server environment, configured through the React development toolchain, was used for the initial testing and iterative development since it makes it possible to stimulate the user interface and evaluate each component's behaviour before integrating them and the external services and deployment. Firebase was used for authentication and data storage. It is a cloud-based services suite provided by Google. Firebase Authentication was configured to register the users and validate them when they log in. It was configured to give only the administrators the privilege to create user accounts manually based on their respective roles to maintain controlled access. Firestone was used to store the user and their interaction data.Experimental validation was conducted by stimulating the application experience and creating various accounts to check the behaviour of each of the user types and ensure their intended features are operating seamlessly. This included creating multiple admin, student and professor accounts and assessing the role-based features such as announcement making, uploading lecture material, making posts and chatting, etc. Browser-based debugging tools were used to monitor request flow, database reads and writes, and authentication token behaviour. The system was finally hosted on Firebase Hosting for real-time testing, enabling evaluation of the application in a live cloud setting with authentic network latency, database synchronization timing, and multi-user interactions.

4. Results and Discussions

The use of cloud-native platforms for the development of applications has made the process much easier and hassle-free. A functional, scalable, real-time social media platform had been successfully implemented. The application has effectively been built, tailored to the needs of the academic institutions. Features like authentication, user role management, content posting, announcements, and real-time messaging are integrated into a unified interface designed for students, faculty, and administrators. One of the key strengths in providing the feasibility in the development has been the utility of Firebase services, which include authentication, cloud firebase, storage, real-time database, hosting, etc. It efficaciously abstracts the complexities of backend development while ensuring high performance, reliability and security. Since no dedicated servers are required, such as database administrators, load-balancing mechanisms, etc, this model makes it highly attractive to institutions with limited technical resources and monetary restrictions. The screen shown in Figure 2 prompts the user to enter a college-assigned ID and password, reflecting the system’s controlled registration mechanism, where only institution-verified credentials are permitted. This ensures secure access and prevents unauthorized sign-ups. The design features a centred login card

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with rounded edges, a dark theme panel, and a gradient background, providing a visually appealing and professional experience. Below the input fields, a prominent "Login" button initiates the authentication flow through Firebase Authentication. Additionally, a note at the bottom of the interface informs users that IDs are issued by the college and self-registration is not allowed, reinforcing the system's focus on identity verification and role-based access.

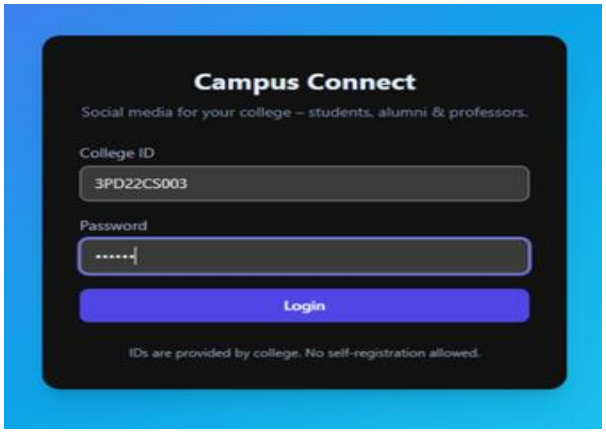

Figure 2 Login Page

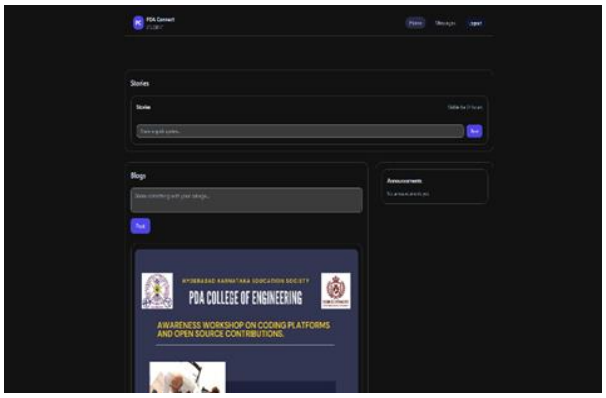

Figure 3 Home Page

Figure 3 displays the Home Page of the PDA Connect application, which acts as the central hub for student interaction, updates, and campus communication. At the top, the navigation bar shows the user's profile name and status, along with quick access to the Home, Messages, and Logout options. The page is organized into clean, card-based sections that maintain a minimalist and user-friendly interface. The Stories section allows users to share quick updates visible for 24 hours, mimicking modern social media behaviour. Below it, the Blogs module enables users to post detailed content such as event posters, campus news, or general updates, with newly added posts appearing instantly through local state rendering. On the right, the Announcements panel displays institutional notifications, ensuring that important messages from faculty or administration remain visible and accessible. Overall, the Home Page consolidates academic communication, student engagement, and content sharing into a unified and intuitive interface. It also highlights the importance of modularity and role-based access control (RBAC). By assigning defined roles such as student, professor, and administrator, the platform ensures that sensitive actions—like posting official announcements or adding new users—are performed only by authorized personnel. This aligns with institutional requirements for information integrity and controlled communication. Moreover, the architecture is highly extensible; features such as push notifications, file uploads, automated event reminders, or integration with institutional systems can be incorporated with minimal architectural changes due to the flexible, component-based structure of the application.

Conclusion

A social media platform enhances the college experience for all. Students can learn better, connect with more people and build their network, and stay up-to-date and manage their college obligations. They are able to expand what college is to foster stronger connections and become well-rounded in a better environment. Teachers can also elevate their teaching practices by leveraging the digital tools available. The application can build a collaborative and interactive community of students, faculty, and alumni. A structured application developed with agile methods, providing security measures and seamless operations, supplements the academic life, going beyond classrooms and campuses.

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