Internship Report

# Introduction

I completed my internship at NullClass from 24 February,2025 to 24 May ,2025. The main goal of the internship was to design and develop a feature-rich replica of Twitter. Unlike a simple clone, the project aimed to integrate several additional functionalities tailored to the specific requirements provided by the organization.

Throughout the internship, I worked primarily on backend development using Node.js, Express.js, and MongoDB. I was also responsible for connecting the backend with a React-based frontend, incorporating Firebase for authentication services like Google Sign-In. Key responsibilities included developing secure user authentication, media uploads (image, audio, video), real-time notifications, multilingual support, and optimizing the system for scalability and performance.

This hands-on experience allowed me to understand the architecture of real-world applications and deepen my knowledge in full-stack development.

# Background

I am currently pursuing a Bachelor of Engineering (B.E.) in Computer Science and Engineering with a specialization in Cyber Security. While my academic curriculum focuses on understanding, identifying, and mitigating digital threats, I have developed a deep interest and strong passion for full-stack web development. This interest began when I started experimenting with frontend technologies like HTML, CSS, and JavaScript, and gradually evolved into a more serious pursuit as I explored backend technologies and realized the potential of building complete web applications.

Despite my specialization in Cyber Security, I have consistently taken the initiative to learn and practice full-stack development on my own. I have dedicated time to building personal projects, following structured learning paths, and experimenting with frameworks like React, Node.js, and Express. My goal has always been to become a well-rounded developer who understands both application development and system security — a combination that is highly valuable in today’s digital landscape.

This internship offered an ideal opportunity to gain real-world experience in full-stack development. It allowed me to apply my self-taught skills to professional-grade projects, collaborate with other developers, and deepen my understanding of the complete software development lifecycle.

# Learning Objectives

During the course of this internship, I aimed to strengthen my understanding of full-stack development by focusing on both backend and frontend technologies. My learning objectives were designed to gain deep practical knowledge of tools, frameworks, and libraries that are commonly used in professional web development.

* **Backend Development with Node.js and Express:** I set out to build a solid foundation in backend development by working extensively with Node.js and the Express.js framework. This included setting up APIs, managing routing and middleware, handling asynchronous operations, and ensuring performance and scalability.
* **Authentication Systems:** A significant part of my learning involved implementing secure user authentication systems. I worked with both OTP-based verification and third-party authentication using **Firebase Google Sign-In**, managing token flows, session control, and user validation.
* **Email Integration with Nodemailer:** I gained hands-on experience in using Nodemailer to send emails for OTP verification and notifications. This helped me understand SMTP, secure email delivery, and dynamic templating.
* **Media Upload and Cloud Storage:** I learned how to handle various types of media (images, audio, and video) using **Multer** for in-memory uploads and **Cloudinary** for secure cloud storage and URL retrieval.
* **Real-Time Features with Socket.io:** I explored how to build real-time communication using Socket.io, which enabled me to implement features like instant notifications, enhancing the user experience and responsiveness of the application.
* **API Communication with Axios:** On the frontend, I worked with Axios to efficiently communicate with RESTful APIs. I learned how to manage requests, handle errors, and use interceptors for token management and re-authentication flows.
* **Database Design with MongoDB:** I developed a practical understanding of schema design, indexing, data relationships, and query optimization in MongoDB, as well as best practices for storing and retrieving user-generated content.
* **Frontend Development with React:** I improved my skills in using JSX for writing component-based UI and managing React state efficiently. I also gained insight into **React DOM** rendering flow and how to manipulate the virtual DOM for better performance and interactivity.
* **Frontend-Backend Integration:** One of the key objectives was to successfully integrate the backend APIs with the frontend using REST principles, ensuring seamless data flow, error handling, and dynamic UI updates.

# Activities and Tasks

The primary task assigned to me during the internship was to develop a Twitter replica with additional real-world, advanced features as specified by the organization. This was a full-stack development challenge that involved implementing several custom functionalities using Node.js, Express.js, MongoDB, React, Firebase, and various third-party tools and APIs. Below are the major activities and tasks I undertook as part of this project:

1. **Responsive Web Design:**  
   I ensured that the entire platform was responsive across various devices by adding advanced CSS styling and media queries. I adapted certain UI components to behave differently on smaller screens (such as mobiles and tablets) while maintaining consistency on desktop.
2. **Advanced Notification System:**I integrated the browser’s native Notification API to implement a real-time notification system. If any tweet contained the keywords "cricket" or "science," a pop-up notification would appear displaying the entire tweet. Users were given the ability to toggle these notifications on or off through the settings on their profile page.
3. **Public Space and Tweet Restrictions:**  
   I implemented custom tweet-posting rules based on user engagement:

* Users following 2 people could post only 2 tweets/day.
* Users with over 10 friends could post multiple tweets/day.
* If a user did not follow anyone, they could post only once between 10:00 AM and 10:30 AM IST.

1. **Audio Tweeting Feature with OTP Verification:**  
   I created a voice-recording feature where users could record and upload their voice as tweets. Before uploading audio, users were required to verify via OTP sent to their email. Additional constraints included:

* Maximum audio length: 5 minutes
* Maximum audio size: 100 MB
* Audio upload allowed only between 2:00 PM to 7:00 PM IST

1. **Multi-Language Support with OTP Validation:**  
   I added multilingual support for six languages: Spanish, Hindi, Portuguese, Chinese, French, and English. The entire website content could be translated based on user preference. For additional security:

* If a user switched to French, an OTP was sent to their email.
* For all other languages (except English), OTP verification was done via mobile number.

1. **Custom Video Player with Gesture Controls:**  
   I developed and integrated a custom video player with advanced gesture-based controls:

* Double-tap right: Seek forward 10 seconds
* Double-tap left: Seek backward 10 seconds
* Single-tap center: Pause playback
* Triple-tap center: Move to next video
* Triple-tap right: Close the website
* Triple-tap left: Open the comment section

1. **Subscription System with Time-Limited Payment Gateway:**  
   I implemented a subscription model using Stripe/Razorpay, offering users different plans to control tweet limits:

* Free Plan: 1 tweet/day
* Bronze Plan: ₹100/month for 3 tweets/day
* Silver Plan: ₹300/month for 5 tweets/day
* Gold Plan: ₹1000/month for unlimited tweets

The payment gateway was designed to work only between 10:00 AM and 11:00 AM IST. Any payment attempt outside this time window was blocked. Upon successful payment, an email was triggered to the user with the plan details and invoice.

# Skills and Competencies

During the internship, I significantly enhanced both my technical and soft skills by working on a complex, full-stack project that involved real-world challenges, strict constraints, and modern development tools. Below is a detailed overview of the competencies I developed:

**Technical Skills**

* **Node.js & Express.js:**  
  Developed secure and scalable backend APIs. Gained hands-on experience with routing, middleware, request handling, authentication, and performance optimization using asynchronous programming in Node.js.
* **MongoDB:**  
  Learned schema design, document modeling, aggregation pipelines, and real-time query optimization. Implemented dynamic conditions (e.g., tweet restrictions) using MongoDB queries efficiently.
* **Firebase:**  
  Integrated Google Sign-In authentication, email verification, and managed user sessions securely. Used Firebase as an identity provider in combination with custom backend logic.
* **Cloudinary & Multer:**  
  Managed media uploads (images, videos, audio) using Multer for in-memory processing and Cloudinary for secure cloud storage, transformation, and retrieval.
* **Socket.io:**  
  Implemented real-time notification features based on tweet content using Socket.io, enabling push-based user engagement similar to professional social platforms.
* **Nodemailer:**  
  Automated transactional email services like OTP delivery and invoice sending after subscription payments using Nodemailer and SMTP services.
* **Axios:**  
  Used Axios for efficient frontend-backend communication, with token-based authentication, error interceptors, and data management.
* **React & JSX:**  
  Built interactive frontend components using JSX. Understood the React rendering lifecycle and DOM manipulation, improving UI responsiveness and interactivity.
* **React DOM & Browser APIs:**  
  Integrated the Notification API, gesture events for custom video player, and conditional rendering logic using DOM-based state updates and React hooks.
* **Bootstrap & Media Queries:**  
  Designed responsive interfaces using Bootstrap 5 and custom media queries to ensure usability across devices with different screen sizes.
* **RESTful API Integration:**  
  Built and consumed REST APIs effectively with full understanding of request-response cycles, CORS handling, and async/await flow.
* **Stripe/Razorpay Integration:**  
  Integrated payment gateways for subscription models with real-time invoice generation, conditional access logic, and time-restricted transaction rules.

**Soft Skills**

* **Time Management:**  
  Handled multiple tasks and deadlines efficiently, especially while implementing complex feature sets under time-based constraints (like limited upload/posting windows).
* **Problem Solving:**  
  Tackled real-world challenges such as conditional media uploads, custom authentication rules, and building gesture-based video control logic.
* **Communication:**  
  Effectively communicated ideas and progress updates, translated business requirements into technical implementations, and documented features clearly.
* **Agile Teamwork:**  
  Followed an iterative approach, collaborated using version control, and responded to feedback actively during feature rollouts and testing phases.
* **Adaptability & Self-learning:**  
  Proactively explored new libraries, tools, and APIs not covered in academics, and implemented them successfully within a production-level system.

# Feedback and Evidence

During the internship, I received continuous feedback from my mentors and peers, which helped me refine my skills and improve the quality of my work. The tasks and objectives outlined for the project were challenging but aligned well with my learning goals, pushing me to adopt new technologies and tools.

To provide evidence of the work completed during the internship:

1. **Live Deployment:**  
   I deployed the entire platform on a cloud server, making it accessible for users to test and interact with. The live deployment showcases the fully functioning **Twitter replica** with the additional features such as the real-time notification system, audio upload restrictions, multi-language support, and custom video player.
2. **GitHub Repository:**  
   I maintained a detailed **GitHub repository** that contains the complete source code, version history, and implementation details of all features. This repository can serve as a reference for anyone interested in the architecture and design of the platform. It includes thorough documentation, explanations of key features, and the processes followed to build and deploy the system.

The feedback received was positive, with mentors appreciating my ability to handle complex tasks, effectively manage my time, and implement innovative features. The evidence of my work is available through the live deployment link and the GitHub repository, both of which reflect my dedication to the project and the quality of my work.

# Challenges and Solutions

Throughout the internship, I encountered various challenges that tested my technical abilities and problem-solving skills. However, each challenge presented an opportunity to learn and apply new techniques. Below are some key challenges I faced and how I successfully overcame them:

1. **Real-Time Notification Feature Implementation:**
   * **Challenge:** One of the primary challenges was implementing the real-time notification system based on tweet content. Specifically, notifications had to trigger if a tweet contained specific keywords like "cricket" or "science." This required real-time communication between the backend and frontend, ensuring that notifications were delivered instantly.
   * **Solution:** I utilized **Socket.io** for real-time communication between the server and the client. The backend would emit notifications when specific keywords were detected in tweets, and the frontend would listen for these events to display the notifications to the user. This solution ensured efficient and real-time updates across users.
2. **OTP Verification for Audio Uploads:**
   * **Challenge:** For the audio upload feature, I had to ensure that users were authenticated via OTP before they could upload audio files. Additionally, I needed to enforce strict validation rules for file size and duration (e.g., no more than 5 minutes and 100 MB).
   * **Solution:** I integrated **Nodemailer** to send OTPs to the user's email for audio upload verification. On the backend, I implemented validation logic to check the file's duration and size. I used **Multer** for in-memory file uploads and stored the metadata of successfully validated audio files in **MongoDB**. This approach ensured secure and efficient handling of user-uploaded audio content.
3. **Multilingual Support with OTP Verification:**
   * **Challenge:** Another significant challenge was implementing multilingual support (Spanish, Hindi, Portuguese, Chinese, French, and English) with OTP verification. This was particularly tricky as switching between languages required different methods of authentication based on the user's region.
   * **Solution:** I implemented the multilingual feature with **i18n** (Internationalization), allowing users to switch between languages. For OTP verification, I added logic to send OTPs to **mobile numbers** or **emails** based on the language selected. For example, if a user switched to **French**, they would receive an OTP via email for verification, whereas for other languages, OTPs would be sent via mobile number. This approach ensured both security and user convenience.
4. **Ensuring Seamless Audio Upload:**
   * **Challenge:** Managing the upload of audio files, particularly handling file size, duration limits, and restricted upload times, was another significant challenge. Users needed to upload audio only within a specific time window (2 PM to 7 PM IST), and the audio file had to meet strict size and duration constraints.
   * **Solution:** I used **Multer** for handling audio file uploads and implemented middleware that checked the audio's duration and size before accepting the file. I also added a time-based condition on the backend to restrict uploads to the designated hours. This ensured compliance with the project requirements and minimized errors.

# Outcomes and Impact

The outcome of my work during this internship has had a significant and positive impact on the progress of the project. By taking ownership of core modules such as **user authentication** and **media uploads**, I contributed directly to the key functionalities of the platform. These modules were crucial for the **Twitter replica** to function smoothly, providing users with a secure and seamless experience.

1. **User Authentication and Security Enhancements:**  
   My work on implementing **OTP-based user authentication** and **Google Sign-In** not only secured the platform but also enhanced the overall user experience by simplifying the login process. This laid the foundation for a robust user management system that will scale as the platform grows. By integrating **Firebase** and **Nodemailer**, I ensured secure authentication while also allowing for additional features like email/mobile verification during language switch.
2. **Efficient Media Upload System:**  
   I developed a **media upload system** that supports image, audio, and video uploads, which was a vital part of the platform’s content-sharing capabilities. By utilizing tools like **Cloudinary** and **Multer**, I ensured media was uploaded efficiently and securely. Additionally, the **audio upload feature** with **size and duration restrictions** was crucial in ensuring the platform's content guidelines were adhered to. This feature, combined with OTP verification for added security, helped ensure a safe and organized user experience.
3. **Real-Time Notifications and Custom Features:**  
   My implementation of the **real-time notification system** using **Socket.io** brought the platform closer to its goal of providing engaging and dynamic content for users. Notifications triggered by specific keywords within tweets (like "cricket" and "science") gave users a more interactive experience, similar to popular social media platforms. This feature was crucial for increasing user interaction and engagement.
4. **Multilingual Support and Global Reach:**  
   By adding **multilingual support**, I helped make the platform more accessible to a wider audience. This feature not only allowed users to interact with the platform in their preferred language but also integrated necessary **OTP verification** for language switching, ensuring a seamless and secure transition across regions.

Overall, my contributions helped move the project from the development stage to near deployment. The completion of these features has had a **direct impact** on the **platform's functionality and usability**, bringing it closer to being fully operational and ready for testing and deployment. The work done has set a strong foundation for future modules and has enabled other team members to build on these core features with confidence.

# Conclusion

This internship has been an incredibly valuable and rewarding experience in my journey as a computer science student, particularly with my interest in full-stack development. Throughout the internship, I had the opportunity to work on cutting-edge technologies and implement real-world solutions, which has significantly enhanced my technical skills and understanding of web development.

From building the **Twitter replica** with features like **user authentication, media uploads, multilingual support, real-time notifications**, and **custom video players**, I gained hands-on experience that I had only previously studied in theory. The challenges I faced, such as implementing OTP verification, managing media file uploads, and creating real-time communication between users, pushed me to think critically and improve my problem-solving abilities.

The internship allowed me to not only improve my **backend development** skills using **Node.js**, **Express**, and **MongoDB**, but also sharpen my **frontend development** capabilities with **React**, **JSX**, and **Bootstrap**. Additionally, I developed a deeper understanding of integrating third-party services like **Firebase**, **Cloudinary**, **Razorpay**, and **Socket.io**.

I also learned the importance of effective collaboration, communication, and time management in an agile development environment. The feedback and mentorship I received helped me grow as both a developer and a team player, making me more confident in my abilities to contribute to real-world projects.

The project is now nearing completion and is ready for deployment, which gives me immense satisfaction knowing that my work has played a key role in its development. The skills and knowledge I have gained during this internship are invaluable, and they have laid a strong foundation for my future career in full-stack development. I am grateful for the opportunity and excited to continue applying these skills in future projects and professional endeavors.