

WEB DEVELOPMENT INTERNSHIP
**(TEXAM - AI-Enhanced Exam management system
with SSO and Intelligent Question generation)**

By

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Internship report submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF ENGINEERING

IN

COMPUTER ENGINEERING

OF GOA UNIVERSITY

Under the guidance of

Prof. Amit Patil

August 2025



COMPUTER ENGINEERING DEPARTMENT

GOA COLLEGE OF ENGINEERING

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CERTIFICATE

This is to certify that **Shubham Chede**, student of **Bachelor of Computer Engineering**, bearing **P.R. No.: 202211556**, has satisfactorily completed Industrial training of **8 weeks** duration from **07/07/2025 to 31/08/2025** at **Euro Technologies, Rajasthan (remote)**.

INTERNAL EXAMINER

EXTERNAL EXAMINER

DR. J. A. LAXMINARAYANA
(HEAD OF DEPARTMENT)

Acknowledgement

I would like to express my sincere appreciation for the invaluable internship experience I gained at Euro Technologies. This internship served as a significant stepping stone in my professional development, and I am truly grateful for the opportunity provided. I extend my heartfelt thanks to Dr. Krupashankara Mysore Sethuram, Principal of Goa College of Engineering, for granting me permission to undertake this internship. I am grateful to Dr. J. A. Laxminarayana, Head of the Computer Engineering Department, for permitting this learning experience and for extending the necessary facilities to successfully accomplish the internship. I am especially thankful to my Industry Mentor, Mr. Harsh Singhvi, for his constant guidance, support, and encouragement throughout the internship period. I also wish to express my sincere gratitude to Prof. Amit Patil, my Internship Mentor, for her continuous encouragement, insightful advice, and diligent monitoring of my progress, which significantly contributed to the successful completion of this internship. In closing, I am profoundly grateful to all those who directly or indirectly contributed to my learning, growth, and success during this internship.

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Brief Overview

The internship at Euro technologies was conducted from 7 July 2025 to 31 August 2025 and provided a comprehensive learning experience across both web development and core technical domains.

During the initial three weeks of the internship, the focus was on understanding the system architecture by analyzing database Role-Based Access Control (RBAC) policies and setting up the project environment. In this phase, a functional prototype of the application was developed, where Supabase was used as the backend and database solution, and Next.js was utilized for frontend development. This stage helped in gaining a strong foundation in application structure, authentication mechanisms, and data handling.

In the subsequent five weeks, the project transitioned to a complete frontend-backend architecture. During this phase, I took the lead in frontend development, where I was responsible for designing and developing the user interface using React. My responsibilities included cloning and implementing application pages, integrating frontend components with the backend APIs, working with Docker for containerized environments, and interacting with PostgreSQL databases. Additionally, I studied and implemented the Single Sign-On (SSO) login mechanism, which is a standardized and widely used authentication method in modern applications.

Overall, the internship significantly enhanced my practical knowledge of full-stack development, system integration, and real-world application workflows.

Introduction

Overview of Front-End Development

- Front-end development focuses on building the user-facing part of web applications, transforming data into a graphical interface through HTML, CSS, and JavaScript.
- It involves creating responsive, interactive, and visually consistent interfaces that adapt seamlessly across mobile, tablet, and desktop devices.
- Modern front-end development emphasizes User Experience (UX) and Accessibility (a11y), ensuring applications are usable by all individuals regardless of their hardware or abilities.
- Advanced frameworks enable component-based development, allowing developers to build encapsulated units of code that manage their own state and logic.

React.js



- React.js is an open-source JavaScript library maintained by Meta, specifically designed for building complex, declarative user interfaces.
- It utilizes a component-based architecture, which promotes code reusability, modularity, and easier debugging by breaking the UI into independent pieces.
- React efficiently updates the UI using a Virtual DOM, which calculates the minimum number of changes required to update the actual DOM, significantly improving performance in data-heavy apps.

- It features a robust ecosystem including React Hooks (like `useEffect` and `useState`) for managing lifecycle events and local state without writing class components.

Next.js



- Next.js is a powerful React-based framework created by Vercel that enables production-grade features like Hybrid Static and Server Rendering.
- It provides out-of-the-box support for Server-Side Rendering (SSR) and Static Site Generation (SSG), leading to faster initial page loads and better Search Engine Optimization (SEO).
- The framework uses a file-system-based router, which simplifies navigation and code-splitting, ensuring users only load the JavaScript necessary for the page they are viewing.
- Built-in API routes allow developers to build full-stack applications by writing backend code directly within the Next.js project structure.

TypeScript



- TypeScript is a strongly typed superset of JavaScript that compiles to plain JavaScript, providing a layer of safety for large-scale applications.
- It enables early detection of bugs through static type checking, catching errors during development rather than at runtime.
- TypeScript enhances the developer experience with features like Autocomplete, Type Inference, and Refactoring tools, making the codebase more self-documenting.
- It facilitates better collaboration in team environments by defining clear interfaces and data structures that other developers can easily follow.

State Management and API Handling

Zustand

- Zustand is a small, fast, and scalable barebones state-management solution that uses simplified hooks for managing global application state.
- Unlike Redux, it requires minimal boilerplate and avoids "provider nesting," making the logic easier to read and maintain.
- It optimizes performance through selective re-rendering, where components only subscribe to the specific slices of state they actually need.

Axios

- Axios is a promise-based HTTP client for the browser and node.js, offering a more feature-rich alternative to the native Fetch API.
- It provides automatic transformation of JSON data and supports request/response interceptors to handle authentication tokens or global logging.
- Axios simplifies error handling by automatically rejecting promises for non-2xx status codes and provides built-in protection against Cross-Site Request Forgery (XSRF).

UI Styling and Component Libraries

Tailwind CSS



- Tailwind CSS is a utility-first CSS framework that allows developers to style elements by applying pre-defined classes directly in the HTML/JSX.
- It eliminates the need for writing custom CSS files and naming classes, resulting in smaller bundle sizes due to its PurgeCSS integration.
- The framework provides a highly customizable design system, ensuring consistent spacing, colors, and typography across the entire project.

ShadCN UI



- ShadCN UI is a collection of beautifully designed, accessible components that you can copy and paste into your apps, built using Radix UI and Tailwind CSS.
- Unlike traditional component libraries, it is not a dependency but a set of source files that developers own and can fully customize to meet specific needs.
- It focuses on accessibility (ARIA compliance) and developer experience, providing complex components like Data Tables, Dialogs, and Command Menus.

Backend and Database Technologies

Supabase



- Supabase is an open-source Firebase alternative that provides a comprehensive suite of backend tools including a Postgres database, Authentication, and Real-time subscriptions.
- It includes a powerful "Auto-generated API" that allows the frontend to interact with the database directly using a client library without writing a custom backend.
- Its Row Level Security (RLS) policies ensure that data access is restricted and secure, managing permissions directly at the database level.

PostgreSQL



- PostgreSQL is an advanced, enterprise-class open-source relational database that supports both SQL (relational) and JSON (non-relational) querying.
- It is renowned for its reliability, data integrity, and support for complex data types and advanced indexing techniques.
- In this project, PostgreSQL served as the primary storage engine, ensuring ACID compliance and high performance for complex data relationships.

Containerization Using Docker

- Docker is a platform used to automate the deployment of applications inside lightweight, portable containers that include all necessary libraries and dependencies.
- By using Dockerfiles and Docker Compose, developers can replicate the exact production environment on their local machines, eliminating the "it works on my machine" problem.
- Containers provide an isolated environment, ensuring that the application remains secure and does not interfere with other services running on the same host.
- Docker simplifies the CI/CD pipeline, allowing for faster scaling and more efficient resource utilization during cloud deployment.

Industry Overview

About Euro Technologies

- Euro Technologies is a 4 years and 7 months old proprietorship firm, incorporated on 14 May 2021, with its registered office located in H-1-30, IT Park, Madri Industrial Area, RIICO, Rajasthan, India. The firm operates under the proprietorship of Ms. Neeta Singhvi.
- The primary activity of Euro Technologies falls under the Services sector, sub-classified into Information Service Activities. The organization is mainly engaged in the development, operation, and maintenance of web-based platforms and portals, including websites that act as internet-based services and media portals providing periodically updated digital content.
- As per the financial year 2023–24, Euro Technologies is classified as a Micro Enterprise, with its operational unit situated in Udaipur, Rajasthan.
- Euro Technologies focuses on delivering technology-driven solutions, particularly in the domains of web application development, backend systems, and system integration, based on client-specific and project-oriented requirements.
- The organization follows a structured software development lifecycle, which includes requirement analysis, system design, development, testing, and deployment to ensure reliability and efficiency of applications.
- In addition to development activities, Euro Technologies also undertakes the maintenance, enhancement, and optimization of existing web systems, with attention to performance, scalability, and security aspects.
- As a micro-scale enterprise, Euro Technologies provides a practical and hands-on working environment, allowing interns and team members to gain exposure to industry-relevant tools, modern technologies, and real-world software development practices.

Review of the Work Done

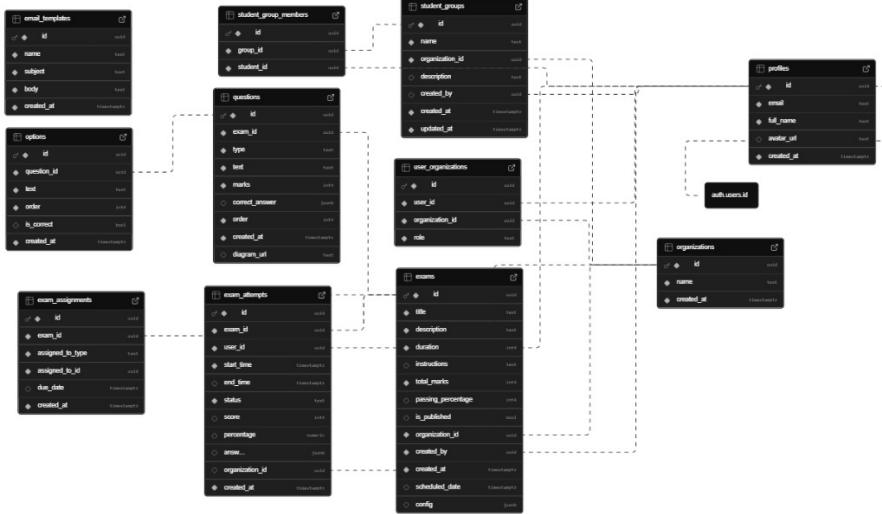
Training Overview

- The internship was designed to provide a structured learning experience combining conceptual understanding and practical implementation of web development technologies.
- The training period was divided into multiple phases, allowing gradual exposure to project analysis, system design, development, and integration activities.
- Initial training focused on understanding the project objectives, system architecture, and development workflow, followed by hands-on implementation in later stages.
- The training program emphasized the use of modern development tools, best practices, and real-world problem-solving approaches relevant to the software industry.

Details of the Work Including the Work Programme Carried Out and Results

Work Carried Out During the First Three Weeks

- The first three weeks of the internship were primarily dedicated to gaining an in-depth understanding of the project and its requirements. This phase focused on familiarization with the overall system, objectives, and expected deliverables.
- Detailed discussions and analysis were conducted to understand the functional flow of the application and the interaction between different modules.
- A robust and scalable folder structure was designed during this phase to ensure proper organization of the codebase, improved maintainability, and ease of future development.
- The database structure was studied thoroughly to understand schema design, table relationships, and data flow within the system.
- A basic prototype of the application was developed to validate the initial design approach and to demonstrate the core workflow of the project.
- The source code repository used during the internship is not available at present, as access to the repository was revoked after completion of the internship.



Work Carried Out During the next Five Weeks

Project Overview

I contributed to the development of **TEXAM**, a scalable, multi-tenant examination management system. My work focused on building a high-performance full-stack environment capable of handling the entire examination lifecycle, ranging from secure authoring and AI-assisted question generation to real-time candidate evaluation and analytical reporting.

The system utilizes a decoupled microservices-based architecture:

- **Frontend:** A type-safe React application utilizing modern state management techniques.
- **Backend:** A high-concurrency RESTful API built using Go (Golang), optimized for low-latency data processing during peak examination traffic.

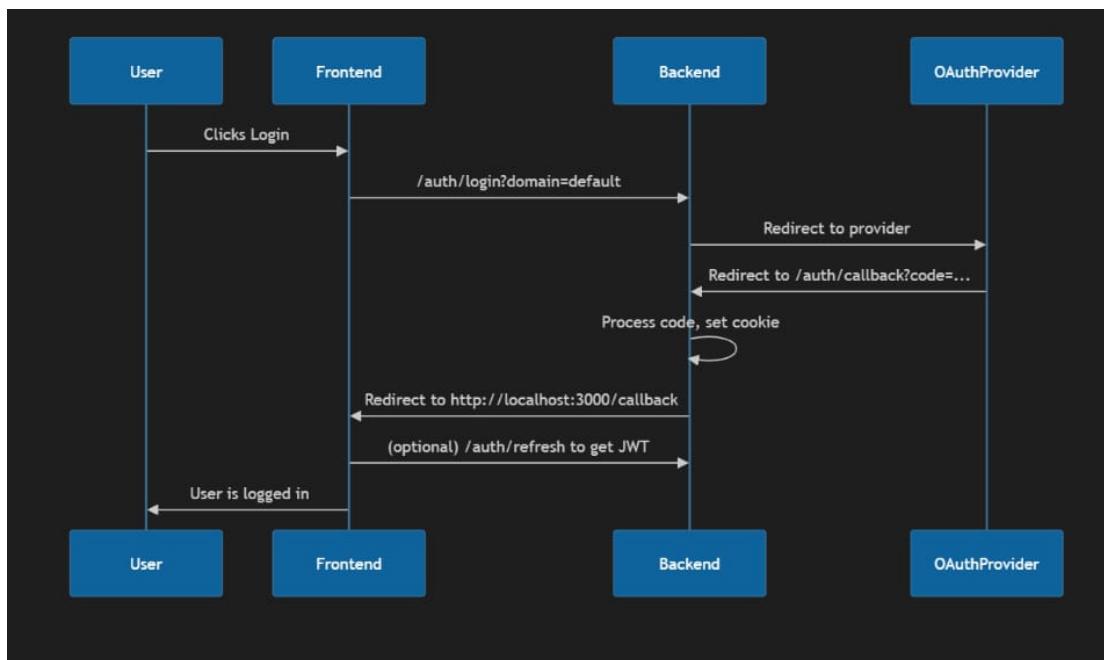
Technical Stack and System Architecture

The following technologies were used during the development of the platform, each serving a specific engineering purpose:

- **Frontend:** React 19, TypeScript, and Vite were used to develop a component-based user interface with strict type safety and fast hot module reloading.

- **State Management and Routing:** Zustand and React Router 7 were employed for lightweight global state handling of exam sessions and efficient client-side routing.
- **Backend:** Go (Golang) was used to manage concurrent requests and ensure efficient memory allocation.
- **AI Engine:** Gemini 2.5 Flash SDK was integrated to support large language model-based structured data generation.
- **Styling:** Tailwind CSS and Radix UI were used to implement a utility-first styling approach with accessible UI primitives.

SSO and Authentication Engineering



A core objective of the internship was the implementation of a robust Single Sign-On (SSO) mechanism to centralize identity management.

- **OAuth2 and JWT:** A secure authentication handshake was developed between the Go backend and external identity providers. Upon successful authentication, the backend issues a JSON Web Token (JWT).
- **Auth Context and Middleware:** A centralized React Context was implemented to manage global authentication states. This included a silent refresh mechanism that proactively renews tokens five minutes before expiration to prevent session timeouts during active examinations.

- **Multi-tenant Security:** Each request is validated using a custom X-TEXAM-ORG-ID header to ensure strict data isolation between different organizations at the database level.

AI Copilot: Intelligent Question Engineering

Google's Gemini 2.5 Flash model was integrated as an AI Copilot to convert natural language prompts into structured examination data.

Technical Implementation

- **Prompt Engineering and Parsing:** System prompts were designed to enforce strictly formatted JSON responses, allowing the application to programmatically create and update questions.
- **Schema Support:** The AI Copilot supports eight distinct question types such as MCQ, SCQ, and Subjective, including complex evaluation logic like negative marking and marks scaling.
- **Validation Pipeline:** A staging mechanism was implemented where AI-generated content is temporarily stored for user review and editing before final submission to the database.

Core Platform Features and Backend Implementation

In addition to AI integration, I developed multiple foundational modules that support both administrative and candidate-facing functionalities.

Advanced Examination and Question Engine

A flexible data schema and corresponding API endpoints were developed to support diverse examination formats.

- **Dynamic Question Types:** The backend supports eight distinct data models, including integer-based, one-word, and subjective response types, each with dedicated validation logic.
- **Evaluation Logic:** Server-side logic was implemented to handle negative marking and partial credit allocation.
- **Media Integration:** Support was added for attaching images and diagrams to questions, requiring efficient handling of static assets and database references.

Candidate Examination Interface (CEI)

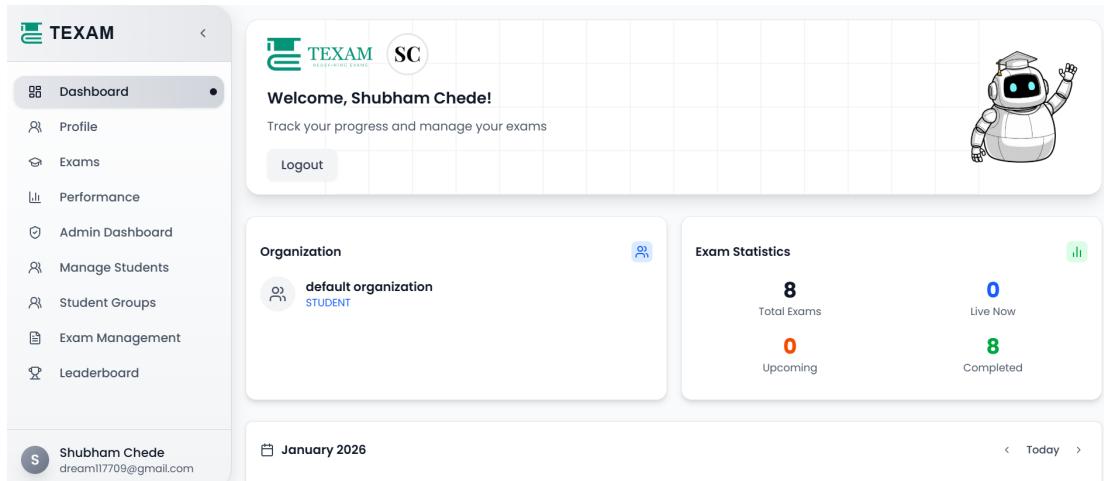
The CEI was designed as a high-availability interface where data integrity is critical.

- **State Synchronization:** Zustand was used to track examination states such as visited, answered, and marked-for-review. This state is periodically persisted to the backend to prevent data loss.
- **Real-Time Instrumentation:** A synchronized server-client timer was implemented to prevent manipulation of local system clocks.
- **Exam Lockdown Interface:** A focused and distraction-free user interface was developed using Radix UI primitives while maintaining accessibility standards.

Administrative and Organization Management

A multi-tenant administrative layer was implemented to enable scalable organizational operations.

- **Student Group Management:** Administrators can perform bulk operations such as inviting students and assigning examinations to groups.
- **Analytics and Results Pipeline:** Data aggregation logic was implemented to compute passing percentages, average scores, and individual performance trends, displayed via interactive dashboards.
- **RESTful API Versioning:** All backend services were implemented with versioned routing (/api/v2/) to ensure backward compatibility during system upgrades.



The screenshot shows the TEXAM platform's calendar interface. The left sidebar includes links for Dashboard, Profile, Exams, Performance, Admin Dashboard, Manage Students, Student Groups, Exam Management, and Leaderboard. The user profile is Shubham Chede, email dream117709@gmail.com. The main area displays a monthly calendar for January 2026. The 9th of January is highlighted with a blue border. Below the calendar is a section titled "Have an invite?" with a token input field and an "Accept Invite" button. A note says "Using email: dream117709@gmail.com".

The screenshot shows the TEXAM platform's profile editing interface. The left sidebar includes links for Dashboard, Profile, Exams, Performance, Admin Dashboard, Manage Students, Student Groups, Exam Management, and Leaderboard. The user profile is Shubham Chede, email dream117709@gmail.com. The main area shows "Personal Information" fields: Name (Shubham Chede), Email (dream117709@gmail.com), Phone (9999999999), Date of Birth (01/01/2000), Gender (Male), and Address (123 street). Below this is an "Organizations" section showing "default organization STUDENT" with a "STUDENT" badge.

The screenshot shows the TEXAM platform's exams management interface. The left sidebar includes links for Dashboard, Profile, Exams, Performance, Admin Dashboard, Manage Students, Student Groups, Exam Management, and Leaderboard. The user profile is Shubham Chede, email dream117709@gmail.com. The main area shows a summary of exams: Total 8, Upcoming 0, Live 0, Completed 8. Below this are two exam cards: "physics test" (Completed) and "Sample Exam" (Completed). Both cards show details like duration, passing percentage, and end date.

TEXAM

Performance Overview
Track your exam performance and progress

Total Attempts **22**
20 completed

Recent Attempts
Click on any attempt to view detailed results

- physical chemistry** Submitted
Nov 5, 2025, 11:42 AM [View Results](#)
- physical chemistry** Submitted
Oct 30, 2025, 04:11 PM [View Results](#)
- english exam** Submitted
N/A [View Results](#)
- science exam** Submitted
Oct 6, 2025, 12:02 PM [View Results](#)

Shubham Chede dream17709@gmail.com

TEXAM

Exam-wise Performance
Performance breakdown by exam

Exam	Attempts
physical chemistry	2 attempts
english exam	1 attempt
science exam	5 attempts
physics test	4 attempts

physical chemistry
2 attempts
Best Score 0% Average Score 0% Pass Rate 100%

english exam
1 attempt
Best Score 0% Average Score 0% Pass Rate 100%

science exam
5 attempts
Best Score 0% Average Score 0% Pass Rate 100%

physics test
4 attempts
Best Score 0% Average Score 0% Pass Rate

Shubham Chede dream17709@gmail.com

TEXAM

Admin Dashboard
Manage your organization's exam platform [Refresh](#)

Total Students	Total Exams	Student Groups
2 Enrolled students	8 Created exams	2 Active groups

Quick Actions
Manage your organization's exam platform

Manage Students Add and manage students	Student Groups Organize students
Exam Management Create and manage exams	View Results Analyze performance

Recent Activity
Latest exams and activities

- abc** Nov 5, 2025 [View](#)
- physical chemistry** Oct 30, 2025 [View](#)

Shubham Chede dream17709@gmail.com

TEXAM

Manage Students

Add, remove, and manage students in your organization

Email	Status	Role
dream117709@gmail.com	ACCEPTED	STUDENT
dream117709@gmail.com	ACCEPTED	STUDENT
shubhamchede1602@gmail.com	ACCEPTED	STUDENT

Students

Invite Students

Search students by name or email...

No students found.

TEXAM

Student Groups

Create and manage student groups

Create Group

Groups Management

Organize students into groups for better management

Search groups...

qwertyyw		
qwerty desc		
1 Students	03/10/2025	
Manage Students		

divy		
divv		
2 Students	03/10/2025	
Manage Students		

TEXAM

Exam Management

Create and manage exams for your organization

Create Exam

physics test	Completed
physics laws of motion	
Start: Oct 1, 2025, 12:00 AM	
End: Oct 10, 2025, 12:00 AM	
30 minutes	
10 marks • 0% passing	
MCQ • Published	
Manage Edit Delete	

science exam	Completed
pcm examtintion l23	
Start: Oct 1, 2025, 01:00 PM	
End: Oct 13, 2025, 01:00 PM	
30 minutes	
10 marks • 40% passing	
MCQ • Published	
Manage Edit Delete	

TEXAM

- Dashboard
- Profile
- Exams
- Performance
- Admin Dashboard
- Manage Students
- Student Groups
- Exam Management
- Leaderboard

Shubham Chede
dream117709@gmail.com

Create New Exam

Create a new exam for your organization

Exam Details

Exam Title	Duration (minutes)
Enter exam title	60
Description	
Instructions	
Total Marks	Passing Percentage

Questions

Clear Form

TEXAM

- Dashboard
- Profile
- Exams
- Performance
- Admin Dashboard
- Manage Students
- Student Groups
- Exam Management
- Leaderboard

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Manage Questions

Exam ID: 8015abfd-d3ea-4e30-bd65-782848ac1970

Questions (4)

Q1 MCQ 2 marks	Edit	Delete
Who was the Prime Minister of the United Kingdom for most of World...	Select a question to view details	

Q2 MCQ 2 marks	Edit	Delete
Which of the following countries was NOT a primary member of the Axis...		

Q3 MCQ 5 marks	Edit	Delete
In which year did World War 2 start?		

+ Add Question

AI Assistant

TEXAM

- Dashboard
- Profile
- Exams
- Performance
- Admin Dashboard
- Manage Students
- Student Groups
- Exam Management
- Leaderboard

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Manage Questions

Exam ID: 8015abfd-d3ea-4e30-bd65-782848ac1970

Questions (4)

Q1 MCQ 2 marks	Edit	Delete
Who was the Prime Minister of the United Kingdom for most of World...	Select a question to view details	

Q2 MCQ 2 marks	Edit	Delete
Which of the following countries was NOT a primary member of the Axis...		

Q3 MCQ 5 marks	Edit	Delete
In which year did World War 2 start?		

Hello! I'm your AI assistant for managing exam questions. I can help you create, edit, or delete questions. Just tell me what you'd like to do!

For example:

- "Create a question about photosynthesis with 4 options"
- "Edit question 2 to have 5 marks instead of 3"
- "Delete the question about algebra"
- "Add a new MCQ question about World War 2"

03:19:34

Describe what you want to do...

TEXAM

- Dashboard
- Profile
- Exams
- Performance
- Admin Dashboard
- Manage Students
- Student Groups
- Exam Management
- Leaderboard

Shubham Chede
dream117709@gmail.com

Manage Questions
Exam ID: 8015abfd-d3ea-4e30-bd65-782848ac1970

Questions (4)

Q1 MCQ 2 marks
Who was the Prime Minister of the United Kingdom for most of World...

Q2 MCQ 2 marks
Which of the following countries was NOT a primary member of the Axis...

Q3 MCQ 5 marks
In which year did World War 2 start?

add a question on cricket
03:20:12

I've prepared new questions
Creating a new MCQ question about cricket as requested.
Type: MCQ
Text: In cricket, what is the term for a batsman being dismissed when the ball hits their leg before the wicket, preventing it from hitting the wicket?
Review the suggestions above. Apply changes?
✓ Apply Changes X Reject

Describe what you want to do... [Send](#)

physics test
Please review the instructions before starting

Exam Instructions
Please read all instructions carefully before starting the exam

Exam Overview

- Duration: 30 minutes
- Total Marks: 10
- Questions: 0
- Exam Type: Online Proctored

General Instructions

- The total duration of **physics test** is **30 minutes**. The timer is always visible at the top right of your screen.
- When the timer reaches zero, your exam will be **automatically submitted**. You do not need to submit manually if time runs out.

Quick Reference

- Answered (Green Square)
- Unanswered (Red Square)
- Marked (Purple Circle)
- Not Visited (Gray Square)

Important Notes

- Do not refresh the page during the exam
- Ensure stable internet connection
- Timer will auto-submit when time expires
- Answers are saved automatically

Question Navigator

The question navigator is displayed on the **right side** of your screen. It shows the status of each question using the following symbols and colors:

Symbol	Status	Description
1	Not Visited	You have not visited this question yet. (Gray Square)
1	Unanswered	You have visited but not answered this question. (Red Square)
1	Answered	You have answered this question. (Green Square)
1	Marked for Review	You have marked this question for review but not answered. (Purple Circle)
1	Answered & Marked	You have answered and marked this question. (Purple Square)

physics test
Question 1 of 5

Shubham Chede
dream17709@gmail.com 00:00:00 Submit Exam

In which year did World War 2 start?
Max: 5

Select one or more options (click again to unselect):

A 1938

B 1939

C 1940

D 1941

Save Save & Next Mark for Review Mark & Next

Next >

Question Navigator

1 2 3 4 5

Legend
Current Answered
Marked Unvisited

Exam Progress

Answered:	0
Marked:	0
Unvisited:	5
Total:	5
Progress:	0.0%

Confirm Submission

physics test

Are you sure you want to submit your exam?

Exam Summary

Total Questions:	5	Answered:	0
Marked for Review:	0	Unanswered:	5
Completion:	0.0%		
Time Remaining:	00:00:00		

Warning:
You have 5 unanswered questions. You can go back to answer them or submit as is.

< Go Back to Exam Submit Exam

TEXAM

- Dashboard
- Profile
- Exams
- Performance
- Admin Dashboard
- Manage Students
- Student Groups
- Exam Management
- Leaderboard

Exam Result Details
Detailed analysis for physics test

Result Summary

0% Score	0/16 Marks	PASS Status	2271:20:37 Time Taken
----------	------------	-------------	-----------------------

Performance Analysis

F Grade	0% Accuracy	0% Efficiency	1635367.4s Time/Question
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Question-wise Analysis

Question 1
In which year did World War 2 start?

ALL OPTIONS:

A. 1938

B. 1939

Difficulties Faced During the Internship Work

During the internship, several challenges were encountered, primarily due to the transition from an academic environment to a professional software development setup. Working in a real-world organization required adapting to industry practices, tools, and collaborative workflows.

One of the initial challenges was working in a professional environment that demanded constant coordination with team members. Daily communication and task updates were essential to ensure smooth progress of the project. Tools such as **Notion** were used for task management, documentation, and tracking development progress, while **Slack** was used for regular updates, discussions, and quick resolution of issues. Adapting to these tools and maintaining consistent communication required time, discipline, and planning.

Another significant challenge was understanding and contributing to a complex, production-grade codebase. The project involved multiple interconnected frontend and backend modules, which required careful analysis before making any modifications. The key coding-related challenges included:

- Understanding and maintaining a large, modular codebase while ensuring adherence to existing coding standards, architectural patterns, and best practices.
- Managing frontend state synchronization and backend API integrations without introducing performance issues or data inconsistencies.
- Implementing and debugging authentication flows involving OAuth2, JWT-based authorization, and role-based access control in a multi-tenant environment.
- Handling concurrency-related challenges on the backend, particularly during peak examination activity where low latency and reliability were critical.
- Integrating the **Gemini API** and ensuring reliable parsing of AI-generated responses. Since the AI responses were required in strictly formatted JSON, additional validation and error-handling mechanisms had to be implemented to handle malformed or unexpected outputs.

- Designing a validation and staging workflow for AI-generated content, where generated questions were temporarily stored for review before being committed to the database.

Additionally, setting up and working with the backend environment posed its own set of challenges. The backend setup involved configuring multiple services, managing environment variables, understanding database connections, and ensuring seamless communication between different components of the system. Debugging setup-related issues and aligning the local development environment with production configurations required careful attention and troubleshooting.

Despite these challenges, continuous learning, regular code reviews, and guidance from the development team helped in overcoming the difficulties. The internship experience significantly enhanced technical proficiency, problem-solving ability, and understanding of real-world software development workflows.

Conclusion

The internship provided valuable hands-on experience in working on a real-world software project within a professional development environment. Throughout the internship, I gained practical exposure to modern web technologies, full-stack development workflows, and industry-standard coding practices. Working on a scalable examination management system helped in strengthening my understanding of frontend-backend integration, authentication mechanisms, and system architecture.

In addition to technical skills, the internship contributed significantly to the development of professional skills such as effective communication, team collaboration, task planning, and problem-solving. Regular interaction with team members, adherence to development timelines, and working with tools like Notion and Slack improved my ability to function efficiently in a professional software development setup. Overall, the internship served as an important learning experience and provided a strong foundation for future professional growth.

Future Scope

The examination management system developed during the internship has significant potential for future expansion and improvement. Due to the limited duration of the internship, it was not possible to complete and refine all aspects of the project within the two-month time frame. As a result, several features and enhancements remain as part of the future scope of the project.

Future enhancements can include deeper AI integration such as AI-based evaluation of subjective answers, intelligent grading assistance, and advanced analytics. The system can also be extended to support AI-powered proctoring, including video-based monitoring and behavioral analysis during examinations. Further improvements can be made in frontend state management for increased reliability during long examination sessions, enhanced visual representation of analytical data, and overall user interface refinements. Additionally, a more robust role-based access control mechanism can be implemented to ensure fine-grained authorization and secure endpoint accessibility, which could not be fully developed due to time constraints.

References

Next.js Documentation, <https://nextjs.org/docs>

Supabase Documentation, <https://supabase.com/docs>

React.js Documentation, <https://react.dev>

Zustand Documentation, <https://docs.pmnd.rs/zustand>

OAuth 2.0 and OpenID Connect (Pocket id as service provider), <https://github.com/pocket-id/pocket-id>