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# Code Learning Platform

Stalin Murugan[1], Vaishnavi Vinnu[2], Poonam Malchimane[3], Usha Rani[4], T Anusha[5]

[1]Department of Computer Science and Engineering, Visvesvaraya Technological University, Belgavi, India.

[2,3,4]Navodaya Institute of Technology, Raichur, India.

**Abstract:** The increasing demand for software development skills has led to a proliferation of e-learning resources. However, many existing platforms lack interactive environments and gamified progression, leading to low completion rates. This paper introduces a comprehensive "Code Learning Platform" developed using the MERN stack (MongoDB, Express.js, React.js, and Node.js) and Tailwind CSS. The platform employs a task-based learning methodology where users must complete nine incremental coding challenges in a built-in command editor before unlocking a final project. Upon successful completion, the system awards achievement cards and points, impacting the user's rank on a global leader board. Furthermore, the platform integrates an AI-driven chatbot powered by the Gemini API to provide realtime technical assistance. Administrative features allow for the dynamic management of programming languages and user data, resulting in a scalable and engaging ecosystem for modern programming education.

The proposed system focuses on the design and implementation of a task-oriented code learning platform that combines gamification features and AI-based assistance to enhance practical programming education.

**Keywords**—Gamified Learning, MERN Stack, Code Editor, Gemini API, Leader Board, Web Development.

## 1. INTRODUCTION

In the digital age, proficiency in programming has transitioned from a specialized skill to a foundational literacy. While online tutorials and video courses are abundant, they often suffer from a "passive learning" trap where students watch content without practical application. To master coding, learners require a hands-on environment that provides immediate feedback and a structured path to follow. Gamification has proven to be a powerful tool in sustaining learner motivation and engagement.

This paper presents an interactive Code Learning Platform designed to solve the engagement gap. By leveraging the MERN stack for full-stack development and Tailwind CSS for a modern user interface, the platform offers a seamless experience. The core innovation lies in its "10-Task Challenge" system: users progress through nine coding tasks, executing code in a custom-built command editor, culminating in a tenth project-based task.

Unlike conventional platforms that primarily rely on video-based instruction, the proposed system emphasizes active problem-solving, project-based learning, and gamified elements. The objective of this work is to design and implement an interactive learning platform suitable for academic and practical skill development.

## 2. LITERATURE SURVEY

The evolution of online programming education has shifted from static learning materials to interactive web-based platforms. Smith (2023) analyzed the impact of gamification techniques such as task progression, points, and achievement indicators in computer science education and reported improved learner motivation. However, the study did not focus on structured coding challenges with project-level assessment.

Johnson (2024) discussed the application of full-stack web technologies in developing educational platforms and identified the MERN stack as an effective solution for building interactive and scalable web applications. The study mainly emphasized system architecture and did not include challenge-based learning workflows.

Recent advancements in AI-assisted learning environments highlight the importance of conversational agents in supporting learners. According to the Gemini API documentation (2025), AI-based chatbots can provide contextual explanations and guidance. The proposed system incorporates this capability to assist users during coding challenges.

Based on the observations from existing studies, the proposed Code Learning Platform integrates task-based learning, gamification elements, and AI-assisted interaction within a single web-based system.

## 3. SYSTEM ARCHITECTURE

The platform architecture is built on the MERN stack, offering a scalable and robust infrastructure. The primary components include:

- Frontend Layer: Developed using React.js and Tailwind CSS to ensure a responsive, utility-first design. It manages state using React hooks and provides an interactive command-line interface (CLI) emulator for real-time code execution.

- Backend Layer: Powered by Node.js and Express.js to handle RESTful API requests, secure user authentication via JSON Web Tokens (JWT), and logical validation of code snippets.

- Database Layer: MongoDB serves as the NoSQL data store, maintaining user profiles, course progress, point tallies, and global rankings in a high-performance BSON format.

- AI Assistant Integration: The Gemini API is implemented via a secure backend proxy to act as a virtual mentor, offering debugging hints and explanatory text for complex concepts.

- Admin Control Panel: A dedicated dashboard for administrators to perform CRUD operations on curriculum content and oversee user engagement metrics.


Figure 1: System architecture of the Code Learning Platform.

## 4. METHODOLOGY

The methodology follows a structured gamification framework aimed at reducing cognitive load while maximizing hands-on practice:

- User Onboarding: Users register or log in to the system and are redirected to a user dashboard displaying available programming language courses. After selecting a course, the learner proceeds through a predefined sequence of coding tasks.

- Interactive Challenge Loop: Learning is divided into language-specific modules. Each module contains 9 incremental tasks that require code input within the integrated command editor.

- Execution and Validation: Code is sent to a sandboxed validation engine that executes the logic and compares the output against expected results to ensure task mastery.

- Capstone Project Phase: The 10th task is a comprehensive project module that integrates all concepts learned in the previous tasks, serving as a final evaluation.

- Gamified Rewards: After completing all assigned tasks and the final project, the system generates an achievement card and assigns completion points to indicate successful course completion.

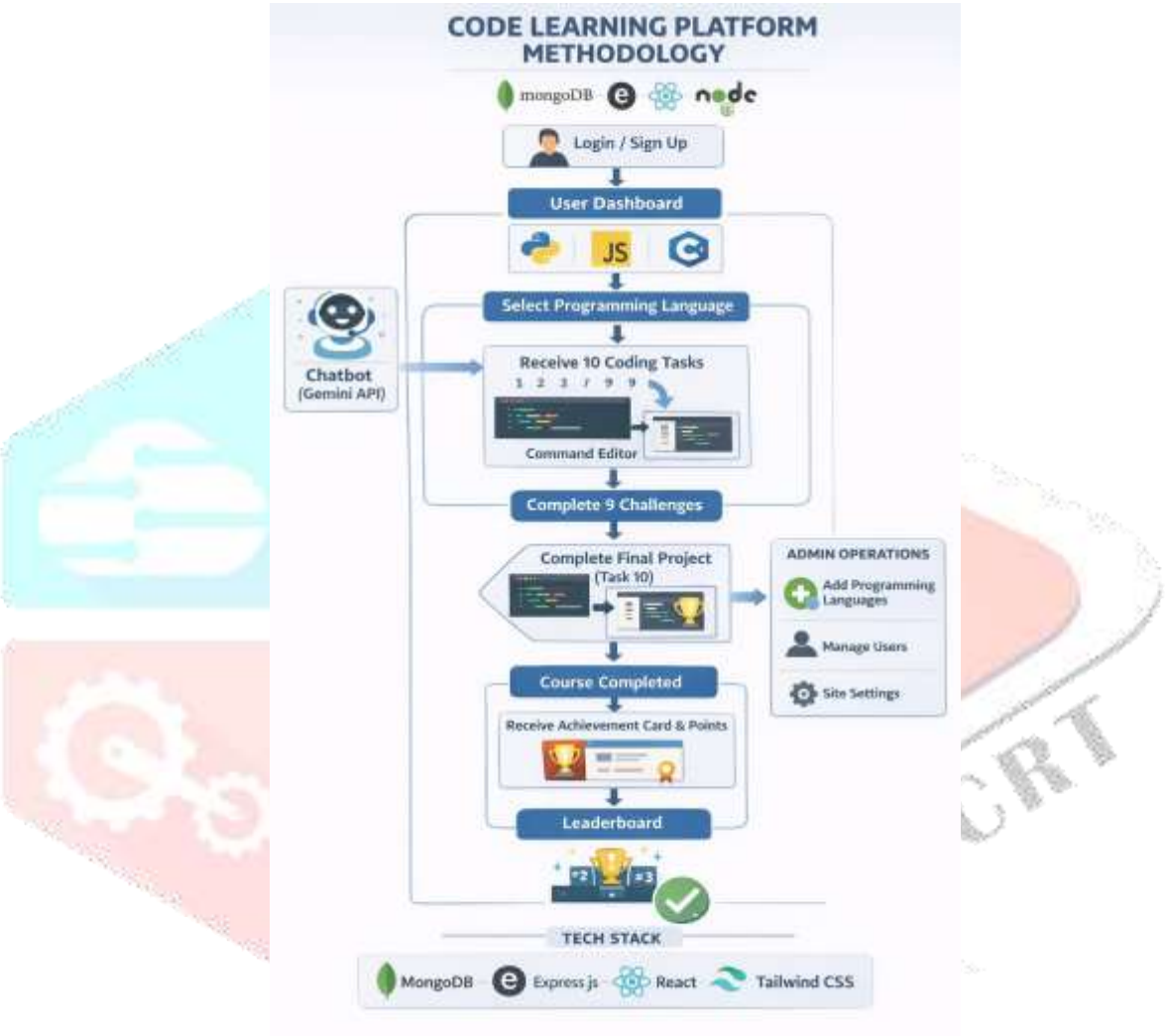


Figure 2: The operational flowchart of the platform methodology.

## 5. RESULTS AND DISCUSSION

The implementation demonstrates the functional flow of user authentication, course selection, task execution, project submission, and AI chatbot interaction. The system effectively supports structured learning through progressive challenges and project-based evaluation.

The implementation of the MERN stack allowed for a highly responsive environment. Initial testing suggests that the "Project Unlock" requirement (completing 9 tasks first) creates a sense of achievement and ensures users are adequately prepared for the final project. Below are the visual representations of the system:


Figure 3: landing page interface.


Figure 4: user dashboard overview.

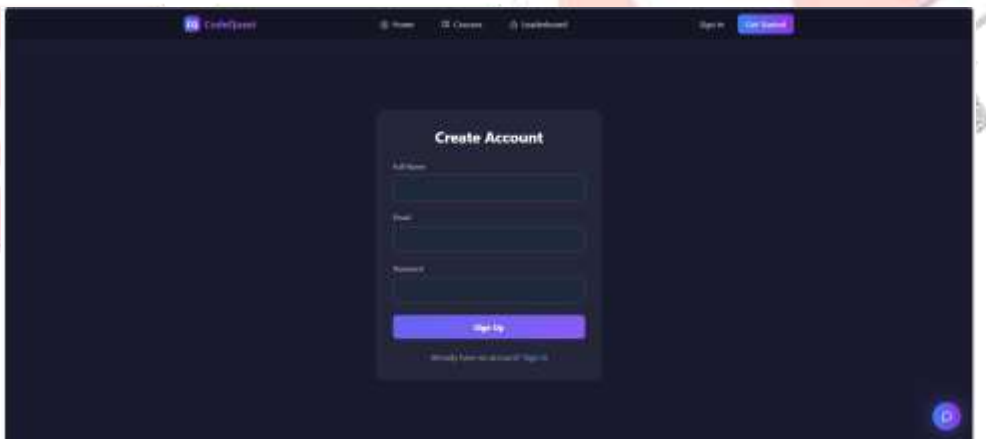


Figure 5: create account registration interface.


Figure 6: course selection dashboard.

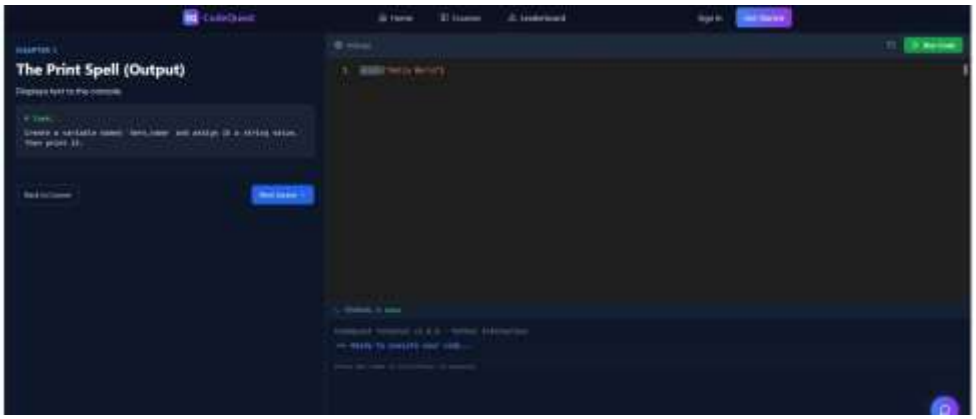


Figure 7: course page with challenge and command editor.

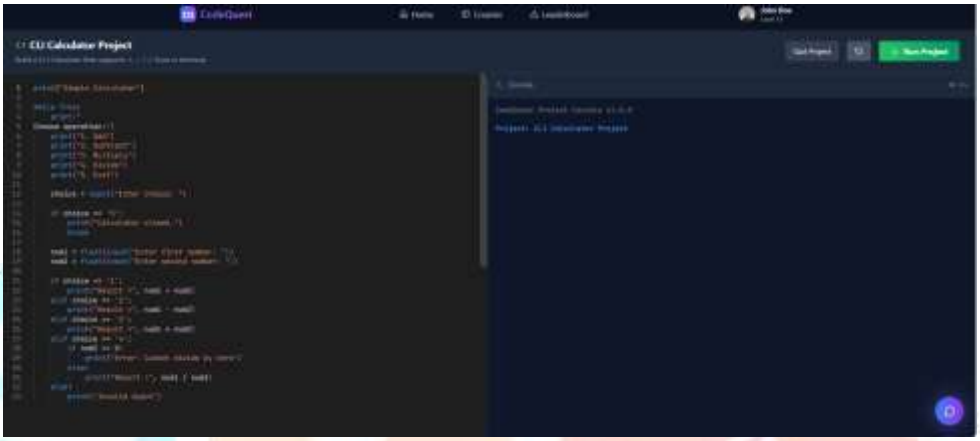

Figure 8: final project screenshot.

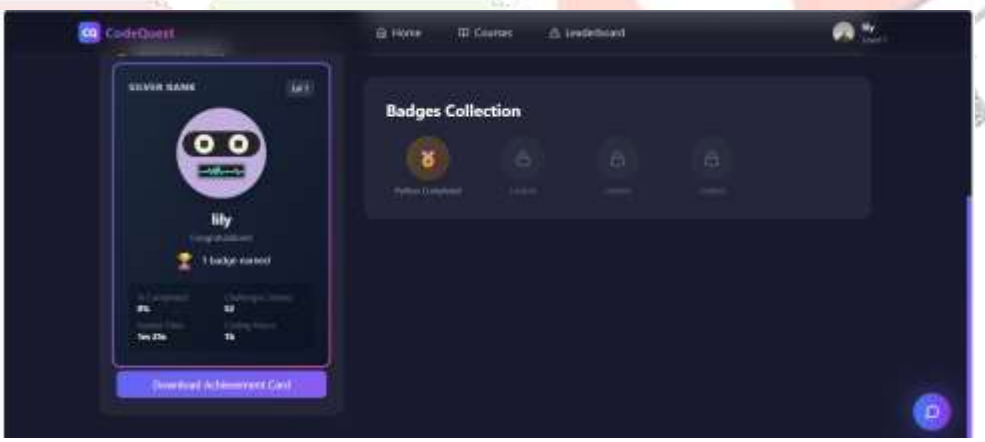


Figure 9: achievement card awarded to the user.


Figure 10: leader board displaying user ranks and points.


Figure 11: admin dashboard for system management.

## 6. CONCLUSION

The Code Learning Platform demonstrates that a combination of gamified tasks and AI assistance can create a superior learning experience. By utilizing the MERN stack and Gemini API, we have developed a scalable, interactive platform that moves beyond passive video watching to active code execution.

## 7. FUTURE SCOPE

In future enhancements, the system can be extended with deployment on cloud platforms, real-time user performance analytics, and advanced gamification features to support a larger learner base.

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