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Gamified Coding Platform: An Interactive EdTech Concept

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Abstract: Programming concepts are often challenging for beginners because they are abstract and difficult to visualize using traditional teaching methods. This paper presents a gamified coding learning platform that introduces programming fundamentals through interactive gameplay and visual feedback. The platform features a game called "King vs Monster," which explains the for loop concept by allowing learners to write loop syntax in an input console. Each loop iteration is visually represented through animations where a King attacks an Error Monster, while personalized output messages display step-by-step execution details. User-submitted code is executed securely in isolated environments to ensure safety and reliability. By combining hands-on coding with visualization and gamification, the platform enhances learner engagement, improves conceptual understanding, and builds confidence in beginner-level programming.

I. INTRODUCTION

Programming has become an essential skill in the modern digital era; however, beginners often struggle with fundamental concepts such as loops due to their abstract execution flow. Traditional teaching methods rely on theoretical explanations and static examples, which fail to clearly demonstrate real-time code execution, leading to confusion and reduced learner engagement.

To overcome this challenge, this project proposes a gamified coding learning platform that teaches programming concepts through interactive games and visual feedback. Learners actively write code and observe its execution through animations. A key game, "King vs Monster," focuses on explaining the **for loop** concept by visualizing each iteration as an attack by a King on an Error Monster, accompanied by step-by-step output messages. This approach simplifies loop execution and enhances conceptual understanding for beginners.

II. PROBLEM STATEMENT

Many beginners find programming difficult because core concepts like loops are abstract and poorly visualized in traditional teaching methods. Most learning approaches focus on theory and provide limited hands-on practice, making it hard for students to understand how code executes step by step. This often leads to confusion, loss of interest, and low confidence in programming.

To address this issue, there is a need for a learning approach that combines real coding practice with clear visual feedback. While existing platforms offer coding exercises, they lack effective execution visualization. Hence, a secure and gamified learning system is required to help beginners intuitively understand programming loops through interactive gameplay and immediate feedback.

III. LITERATURE SURVEY

Gamification has been widely adopted to improve engagement and learning outcomes in programming education. Studies such as *Code Play* [1] and *Code Realm* [2] demonstrate that story-based and level-driven gamified platforms significantly enhance the motivation and coding skills of beginners, although their evaluations are conducted on limited sample sizes. Socially driven platforms such as *Asemble* [3] further integrate collaboration and competitive elements to sustain learner interest, while gamified learning management systems like *Learnify* [4] report improved engagement and understanding of introductory programming concepts. Review-based research in [5] confirms the positive short-term impact of gamification on learner motivation, while also highlighting the lack of extensive experimental validation.

Further studies emphasize the effectiveness of gamification in online and self-directed learning environments. Research presented in [6] and [7] reports increased learner motivation, retention, and autonomy through game-based programming instruction. However, findings in [8] indicate that while gamification enhances motivation and learner satisfaction, its influence on academic achievement may vary.

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Systematic studies in [9] and early gamified platform designs in [10] underscore the overall benefits of gamification in computer science education, while emphasizing the need for well-designed instructional strategies and clear visualization of code execution. These identified gaps motivate the proposed platform, which focuses on interactive gameplay combined with real-time code execution visualization to improve conceptual understanding among beginners.

IV. METHODOLOGY AND IMPLEMENTATION

The gamified coding platform was developed using a design-and-development approach. The system uses a React frontend, a Java backend with REST APIs, and a DynamoDB database for storing platform data.

Docker containers were used to run the user code to isolate backend services from code injection attacks. Development followed modular implementation and its testing. Ethical practices were maintained by anonymizing user data and restricting it to academic, user-specific content and platform-improvement purposes.

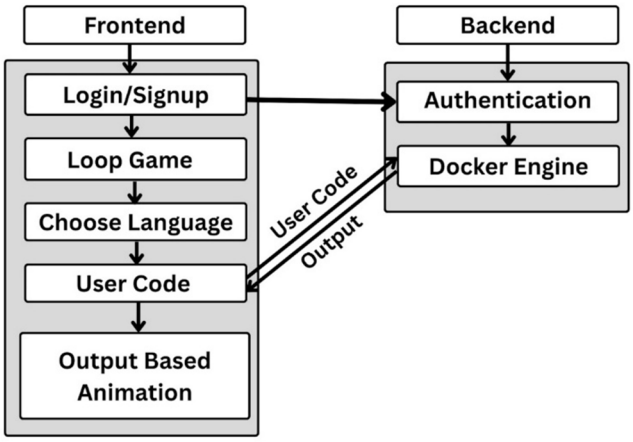


Fig 1: Platform Architecture

The flowchart represents the working process of the proposed system. Users interact with the frontend to log in, select a programming language, and write code within the game environment. The user code is securely sent to the backend, where it is executed using Docker-based isolation. The execution output is returned to the frontend and converted into visual animations, helping learners understand code execution step by step.

V. RESULT

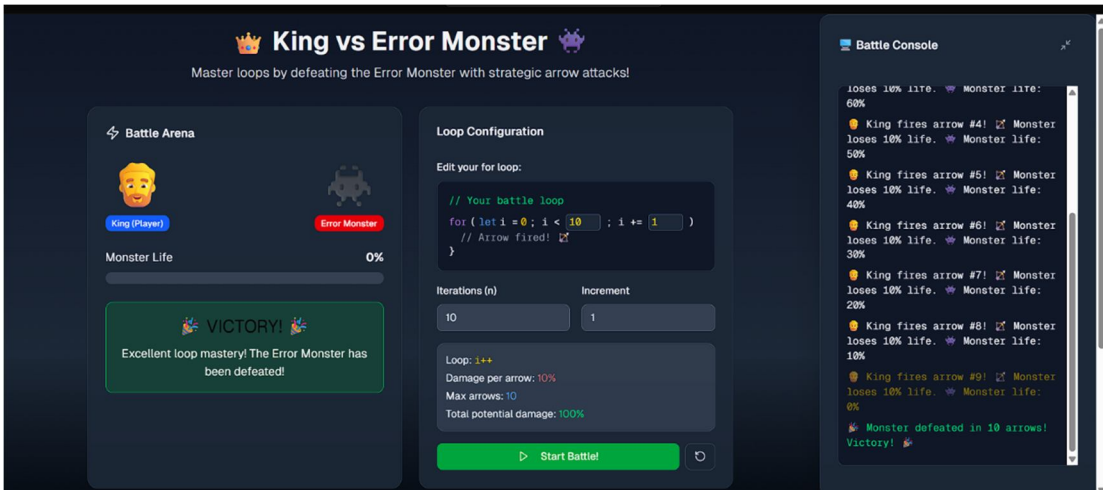


Fig 2: King vs Error Monster game

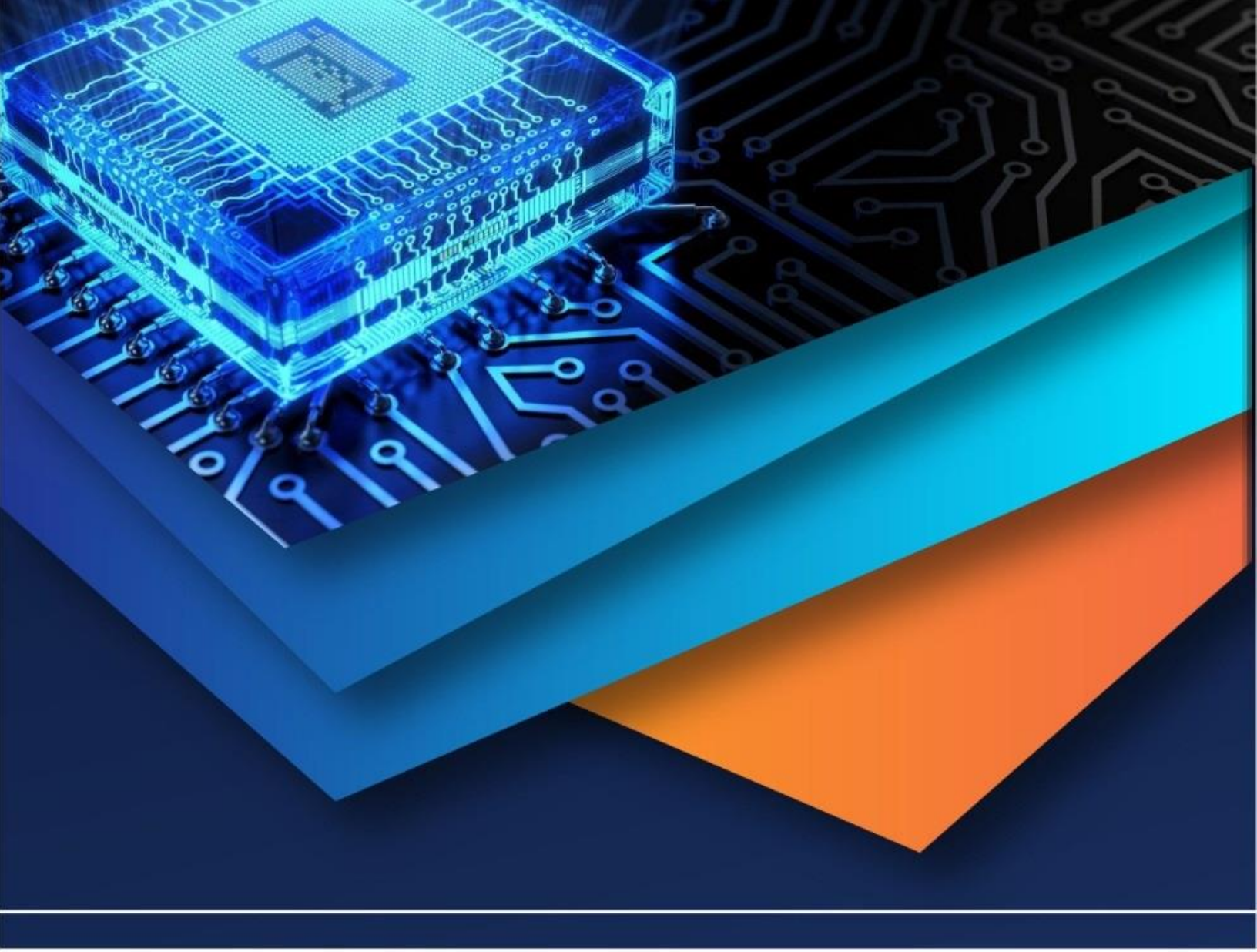
VI. CONCLUSION

This paper introduces a gamified learning platform that helps beginners understand programming concepts through interactive visuals and gameplay. The “King vs Monster” game explains for-loop execution by showing each iteration as a simple visual action, making abstract logic easier to follow. By combining hands-on coding, real-time feedback, and secure execution, the platform increases learner engagement and improves conceptual understanding. The approach is effective for introductory programming and can be expanded to cover more concepts in future versions.

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