QURIO: A Real-Time Multiplayer Quiz Battle Platform for Competitive Exam Preparation

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Abstract

In this paper, the design, development, and implementation of an adaptive multiplayer quiz software for the better preparation of students in competitive exams are discussed. Unlike the traditional static quiz websites, the software will dynamically change the difficulty level of the questions depending on the performance, learning patterns, and initial diagnosis test results of the user. After registration, the software will require the user to respond to a series of profiling questions, the answers to which will help the software provide the user with questions tailored specifically to their level of knowledge. There will also be a progressive learning component, where the user will be able to achieve awards for continuous learning by completing a series of escalated difficulty questions. Additionally, the software can be used in multiplayer mode, either two players or four players, with a smart matching algorithm that will help the software automatically pair players of equal skills, ensuring healthy competition. To make learning easier, an integrated chat bot has been included using Google API, giving immediate solutions for incorrect answers and additionally enabling the user to ask subsequent questions. Also, it has been made possible for the user to create more than one profile if they want to prepare for more than one competitive exam. The results confirm that by combining adaptive learning, matchmaking, and AI support in one system, there can be improved performance and motivation for learning.

Keywords— Adaptive learning, Multiplayer quiz system, Competitive exam preparation, Gamification, Skill-based matchmaking, AI chatbot, educational technology, Mobile learning, Real-time assessment, Personalized learning

I. INTRODUCTION

UPSC, SSC, NEET, JEE, Banking, and RRB Competitive Exams have assumed a significant place in shaping the educational as well as employment destiny of millions of youngsters. To prepare for such exams, it is not just necessary to have proper concepts but is also required to practice, test, and be highly motivated. For the purpose of preparation, students have been following traditional methods of preparation involving classes, physical book preparation, and video classes. However, such modes of preparation lack the ability to retain the students.

With the ever-increasing popularity of smartphones as well as internet accessibility, online learning sites have gained popularity as well. There are several online sites as well as software available on android devices related to learning through quizzes. However, the fact is that most sites are limited to static quizzes where all the people taking the quiz are subjected to the same questions despite their level of ability.

Another major challenge with students is the lack of timely feedback and interaction. When students study individually, they often do not know how well they do compared to others. It is thus tough to measure their progress and find out the areas they need to improve. A learning environment in which students can interact, compete, and learn with others will help increase their motivation and effectiveness of learning.

Moreover, most of the learners cannot keep up the consistency in their preparation. Absence of regular motivation with structured practice, students tend to avoid study sessions and lose focus on it. Incentivized learning environments, incorporating rewards, challenges, and achievements, actually motivate everyday practice and long-term engagement.

Hence, there exists a great requirement for an intelligent learning solution that integrates adaptive learning, multiplayer interaction, and smart feedback mechanisms. The proposed Adaptive Multiplayer Quiz System fulfils the requirement by offering a dynamic, competitive, and personalized learning environment for the aspirants of the competitive exams.

II. LITERATURE REVIEW

A. Gamification in Education

Gamification is now a significant technique being employed by the field of educational technology. This process integrates game design mechanics like points, levels, rewards, badges, or leader boards within the learning process. This was proven by the study of Deterding et al. to increase the engagement of participants because the process made learning fun. Gamification of learning systems online helps decrease the dropout rate among learners and motivates them to practice on a steady basis.

B. Adaptive Learning Systems

Adaptive learning systems generate personalized learning content by monitoring the behaviour and performance of the individual learner. Through analysing user responses, these systems adjust difficulty. Research also proves that this increases efficiency in learning since it focuses more on the weak areas of the learner. By generating questions that fall within the ability of a student, adaptive systems will curb frustrations among beginners and bores among advanced learners.

C. Multiplayer and Competitive Learning

Competitive and collaborative learning environments have really been proved to enhance students' performance. As affirmed by Johnson and Johnson, learning based on groups and competition enhances understanding and retention. Multiplayer quiz platforms bring about real-time competition that increases excitement, thus making learners perform better. Competition among students with peers of their skills level brings about increased motivation to participate in the learning.

D. Artificial Intelligence in Education

Today's modern educational platforms support the learning process using vast amounts of artificial intelligence. AI-based chatbots help students with answers to questions, explanations of concepts, and even immediate feedback. Recommendation systems further suggest suitable content for them based on their performance. These technologies also minimize the dependency on a human instructor, enabling the students to get their queries responded to anytime.

E. Mobile Learning (M-Learning)

Mobile learning has brought a revolution in the education sector by allowing students to access learning resources whenever and wherever they want. Crompton explained how flexibility and convenience offered by mobile applications have helped students preparing for competitive exams. Students can make use of mobile-based learning systems whenever they get free time.

F. Limitations of Existing Systems

Currently available quiz and examination preparation systems are limited to single-player quiz games of varying difficulty levels. These are non-adaptive and lack intelligent feedback. Students are also deprived of facilities to monitor their own performances as well as compare with others. Hence, it is required to have an overall system integrated with gamification aspects, non-adaptive learning activities, multiplayer activities, and AI assistance.

III. PROPOSED SYSTEM / METHODOLOGY
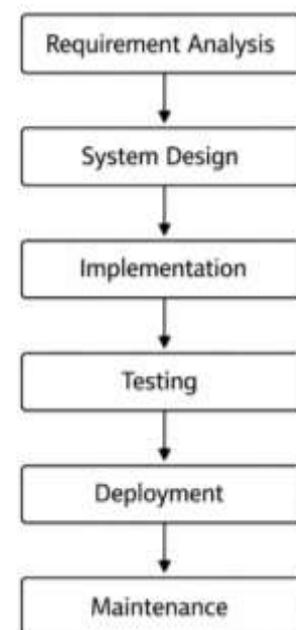
A. Development Methodology

Fig -1: Figure

In developing QURIO, a real-time multi-player quiz platform utilizing the Waterfall System Development Life Cycle (SDLC) Model has been used to create an online quiz platform that is built using sequential steps from one phase completing before moving onto the next phase including: - Requirements analysis; System design; Build (or Implementation); Testing; Deployment; and Maintenance. Before beginning each of these phases, extensive analysis was conducted which has allowed us to create a product that has undergone thorough quality assurance (QA) and includes features like Adaptive Learning, Match Making and AI Chatbot, etc.

B. System Overview

The system developed is QURIO, a real-time multiplayer quiz battle system developed to make competitive study prep a lot more fun and effective. The system creates a learning platform where students preparing for different competitive exams, such as UPSC, SSC, NEET, JEE, RRB, and BANKING EXAMS, can engage with a real-time quiz battle

feature against different students. The system has a capability of supporting a maximum of 2-4 players during a single play session, where participants compete against each other by attempting the same set of questions under a time constraint, which makes learning a lot more fun and exciting.

Every quiz game involves more than 14 subjects of competitive exams, which are selected from a large pool of categorized questions. Every player is given the same set of questions at the same time, and based on those answers, it is assessed immediately. The result is displayed live, which enables players to know how they are performing compared to another player.

QURIO also incorporates advanced gamification elements such as XP points, levelling up, achievement badges, daily tasks, and leader boards. These serve as a motivating factor for the user to regularly practice the skill and also enhance their performance level. Skill-based matchmaking enables users to play against players with equal levels of skills.

Further, an Admin Panel has also been incorporated for dynamic handling of questions, categories, and difficulty levels. This further allows the removal of outdated information and adjustment of difficulty parameters on the basis of performances of learners. Thus, QURIO would remain dynamic and scalable in nature to be used for competitive exams.

B. Frontend Design and User Interface

The frontend of QURIO is developed with Flutter technology, and this makes it possible for the app to run smoothly on Android, iOS, and web platforms with a single code. The design of the interface makes it modern and attractive with ease of navigation in order to facilitate use by different age groups of people. The interface is made in a way that it is able to respond well on different screen sizes such as smartphones, tablets, and web browsers.

The design incorporates a simple and intuitive design layout that makes it easy for the user to switch between various sections of the application. The application incorporates the use of colours, icons, transitions, and loading indicators that help the application have a gaming feel that keeps the user engaged.

B.1 Authentication Interface

The authentication screens comprise Login, Google sign-in, and Guest Login. The feature enables the users to easily access the system. The new and existing users can easily log in and thus continue the learning process.

B.2 Home Screen

The Home Screen is where the user is shown his or her current level, XP points, badges, and daily challenges. In addition, the user can access functions such as playing a quick game,

choose categories for exams, view leader boards, and modify the settings of the user's profile.

B.3 Category Selection Page

This Page enables users to select among more than 14 competitive exam categories, including UPSC, SSC, NEET, and many more. All categories have been displayed with proper icons and tags so that users can easily select their subject of choice.

B.4 Quiz Battle Screen

The Quiz Battle Screen displays the current question being asked, the options in the question in the form of multiple-choice questions, a countdown timer, and the scores of the players competing. Every player sees the same question at the same time.

B.5 Result Screen

The result screen shows the winner of the game, scores, XP points, badges unlocked, and the overall leaderboard rank of the player after each match. This encourages players to play more matches.

B.6 Leaderboard Page

The Leaderboard Page offers global, as well as category-wise, positions, which enable the user to measure their performance compared to other users. The Profile Page includes personal information, game history, achievements, as well as progress statistics.

Nevertheless, taken as a whole, the frontend design of QURIO provides a friendly, competitive, and simple-to-use interactive learning environment which serves as a motivation for users to continue using it.

C. Backend System

The backend of QURIO is developed using Firebase Cloud Firestore. Firebase Cloud Firestore is a robust real-time database solution. Cloud Firestore handles the whole process of storing, syncing, and maintaining data related to users, quiz sessions, questions, scores, as well as leaderboards. This real-time data sync functionality helps update the scoreboard of every player taking part in a quiz battle in real time, which is highly necessary in the case of multiplayer games.

Firebase Authentication is employed for user authentication purposes. Users are able to log in using Google Sign-In or log in as guests. It ensures that every user has their own identity for storing his or her progress securely. Users are given their own identification for storing their XP values.

The backend of the system maintains multiple key operations: matchmaking, quiz room creation, question distribution, answer evaluation, and score calculation. When a player

enters a game, the matchmaking system automatically finds suitable opponents based on skill level and category preferences. Once matched, a game room is created where all player actions and answers are recorded and synchronized.

It also does the heavy lifting on the back end for updating XP, levelling up, ranking in the leaderboard, and achievements when a match is completed. Firestore security rules ensure no cheating or unauthorized access can take place for the modification of a user's data. Real-time listeners to database changes, in every player, ensure that the updates of scores, questions, and results are live and that everything works seamlessly and in sync.

D. Database Design

D.1 Real-Time Database Platform

The database component of this application is hosted on Firebase Firestore, which is a cloud-based NoSQL real-time database solution. In fact, it is ideal when creating multiplayer or interaction forms of applications whereby it enables simultaneous synchronization of data to all users connected. This is important as it enables updates of quiz questions, player points, or game status.

D.2 Collection-Based Data Organization

The database is divided into various collections including the user's collection, game rooms collection, questions collection, leaderboards collection, user statistics collection, and daily challenges collection. Each collection contains unique data essential for the functionality of the system.

D.3 User and Game Room Data

Users represent information about the user, like ID, XP, level, badges, and log in information, as well as their match history. The game rooms contain information about active and completed quizzes, like player IDs, picked questions, answered questions, and the state of the game in progress.

D.4 Question and Performance Data

The questions collection stores all quiz content categorized by types of exams, topics, and difficulty. The records can be amended via the admin panel to insert new ones and delete the outdated ones. The leaderboards and user statistics collection stores the rank information, scores, and performance trends, whereas the daily challenges collection stores time-based tasks for regular engagement.

This structured database design promotes quick data retrieval, dynamic updates, and seamless scalability as the number of users and quiz attempts increases.

E. Benefits of the Proposed System

The proposed system encompasses an engaging and interactive environment for the students to learn in preparation for competitive exams. Quiz battles among multiplayer users in real-time enable an element of excitement and healthy competition among the users to participate and perform better. Gamification elements including XP points, levelling, badges, daily missions, and leaderboards are responsible for ensuring that users are consistent with respect to preparation.

The presence of skill-based matchmaking allows students to play with opponents of a similar level of ability, ensuring that each quiz experience is fair and competitive. The right amount of challenge and no chance of being disappointed or bored help learners of all levels improve and upgrade their skills. Detailed analytics of performance regarding scores, winning and loss records, and subject-wise performance help learners improve areas of weakness.

For administrators, there is comprehensive control over question pools, user accounts, and game options. New questions can be entered easily, and obsolete items can be updated, and this will not affect the functionality of the system. In general, the system promotes learning, and students will be well prepared for their exams.

F. DATA FLOW DIAGRAM

Fig -2: Figure

The Data Flow Diagram illustrates the entire information flow in the adaptive multiplayer quiz system environment. It explains how information moves between the users, system, and database during various operations such as login requests, matching, playing, and result processing.

Upon login into the system, the login information is submitted to the user database for verification. After a successful login process, the user selects a quiz topic and proceeds to the matchmaking module, where skill information is obtained from the database for the reason of choosing opponents. Once the players are matched, a quiz room is established, where questions are obtained from the questions database.

During the process of the quiz session, players submit their responses, which are processed instantly. Results, XP points, and the game result are stored in the game session and leaderboard databases. Once the game is completed, the profile, level, or achievements of the user are updated. The

admin module interacts with the database in order to facilitate the deletion, editing, or addition of questions and user data.

This specific data flow helps in the efficient coordination of users, online quiz activities, and storage in the system, ensuring a quick response, accuracy, and efficiency.

IV. IMPLEMENTATION AND RESULTS

The system was developed using Flutter for the UI design, as well as Firebase for backend operations such as authentication, real-time database management, and security. Flutter enabled the development of an app with a single codebase that runs smoothly on Android, iOS, and web browsers. Google Sign-In with guest support was also employed in Firebase Authentication for secure login processes of users into this online platform.

Firebase Firestore was employed for handling real-time data synchronization among players. When the quiz Battle starts, all players are exposed to the same questions at the same time, and the answers are processed immediately. Firestore provided real-time listeners that ensured updates in scores, questions, and game status were reflected at the same time on all devices connected. The syncing delay was maintained below two seconds throughout the testing process of the system, even when more than one player took part in the same quiz Battle.

The matchmaking service was tested with players of varying skill levels, and it was able to connect players within the level range, ensuring a good level of competition. The XP system, level system, badges, and leader boards were able to track player progress accurately, giving instant feedback of player progress every time a player played a game. The admin panel was used to manage over 340 questions in 14 categories of exams, which could continually be updated without affecting the game.

Results showed that the system helped the users engage more with the service compared to traditional single-player quiz games. This could be due to the availability of live competition, graphic rewards, and daily challenges, which provided an incentive for the users to interact with the service. This result highlights the effectiveness of the proposed system in enhancing the motivation, participation, as well as the performance in exam preparations of the learners.

V. CONCLUSION

Highlighted in this paper was a real-time multiplayer quiz battle tool intended for greater efficiency in preparing for competitive exams. With its integration of gamification, adaptive education models, and real-time functionality, the tool upgrades conventional education methods involving quizzes into a querulous process. Students using the tool will be capable of competing against equals, get instant results, as

well as measure progress through XP points, levelling, and achievement unlocked.

The outcome of experiments demonstrates that real multiplayer and reward-based learning feature a substantial impact on engagement compared to a traditional single-player quiz app used in quiz-based learning platforms. The presence of daily challenges and analytics has made it a privilege and challenge for learners to take consistent efforts on a daily basis to prepare and perform at their best on the platform without any limitations of space or size due to scalability features.

For the future enhancement of this system, there could be integration of advanced AI-based tutoring systems, question generators based on adaptation, and smart learning suggestions. All these will further improvise the learning process for better focus on the strengths and weaknesses of the individual learner. With this proposed system, a highly effective digital learning solution will be available for the competitors of the competitive exams.

REFERENCES

1. S. Deterding et al., "From Game Design Elements to Gamefulness," *Proc. ACM Int. Conf.*, 2011.

2. D. Johnson and R. Johnson, "Cooperative Learning Theory," *Educational Researcher*, 1989.

3. H. Ebbinghaus, *Memory: A Contribution to Experimental Psychology*, 1885.

4. H. Crompton, "Mobile Learning in Education," *Journal of Educational Technology*, 2013.

5. Firebase Documentation, Google LLC, 2024.