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Smart Quiz AI: Development of an Intelligent Mobile Application for Interactive Learning and Assessment

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Abstract

Conventional quiz systems often offer limited engagement, delayed feedback, and a high preparation burden for instructors. This paper presents SmartQuiz AI, an Android-based mobile application developed to automate quiz creation, digitize notes using optical character recognition (OCR), support teacher-led live quizzes, and deliver gamified analytics. A modular architecture integrating Firebase services and AI-based text processing was implemented. Testing indicated satisfactory OCR accuracy for clear printed text, relevant generated questions, and near-real-time synchronization, showing that the system can support interactive and data-driven learning.

Keywords: mobile learning, automated question generation, OCR, gamification, learning analytics

1. Introduction

Mobile learning has become an important channel for instructional access, enabling study beyond the classroom and supporting frequent formative assessment. However, many quiz platforms remain static and provide delayed feedback. Such limitations can weaken learner motivation and prevent instructors from using timely evidence to improve teaching. In parallel, advances in natural language processing (NLP), optical character recognition (OCR), and cloud synchronization have created practical opportunities for automated assessment and rapid content digitization.

Despite the growth of educational applications, conventional quiz delivery still depends largely on repetitive question banks and manual preparation. Engagement is often limited because progress indicators, ranking, and immediate reinforcement are absent. Students also rely heavily on printed notes and handwritten material, which are difficult to convert into structured digital practice resources. As a result, learning often remains fragmented, and feedback loops stay slow.

To address these concerns, SmartQuiz AI was developed as an Android application that combines automated quiz generation, Scan & Learn content digitization, teacher-led live quizzes, gamified learning modes, and analytics-based feedback. The main objective was to reduce manual workload, improve learner participation, and provide immediate performance evidence for both students and teachers. The system was designed as a deployable classroom tool rather than a conceptual prototype.

2. Literature Review

Previous studies have investigated mobile-assisted learning, interactive educational applications, and intelligent tutoring systems. Rodríguez-Arancón et al. [1] reported that many mobile-assisted language learning applications lacked strong pedagogical alignment and stable interactivity. Anohah et al. [2] proposed a smart mobile learning environment with adaptivity and context awareness; however, the work remained largely conceptual. Al Rekhawi and Abu-Naser [3] introduced automated problem generation within an intelligent tutoring setting, although the validation scope was limited.

Research on interactive learning has also demonstrated benefits from app-based instruction and gamification. Falode et al. [4] reported improved achievement through an interactive mobile learning intervention, but the deployment was localized and short term. These studies suggest that mobile tools can improve learning outcomes; however, most systems still lack integrated support for content digitization, live assessment, and analytics-driven feedback.

Ref.	Work (Year)	Technique / Approach	Application Area	Key Strength	Limitation	Gap Addressed in SmartQuiz AI
[1]	Rodríguez-Arancón et al. (2013)	App evaluation rubric	Mobile-assisted language learning	Structured evaluation	Limited adaptivity	Interactive assessment with synchronization
[2]	Anohah et al. (2018)	Mixed-method; SMLE model	Programming education	Context-awareness concept	Mostly theoretical	Implemented adaptivity and analytics
[3]	Al Rekhawi & Abu-Naser (2018)	Intelligent tutoring system	Android tutoring	Automated problem generation	Small-scale validation	Multi-source input and live assessment
[4]	Falode et al. (2022)	ADDIE; pre/post testing	Educational technology	Improved achievement	Localized study	Gamified classroom workflow

Table 1: Literature Comparison

3. Methodology

SmartQuiz AI was developed as a modular Android application using Kotlin/Java and the Android SDK. A layered architecture was adopted to separate the presentation layer, service layer, and intelligence layer. Firebase Authentication was used for user sign-in, while role-based access control distinguished students from teachers. Quiz content, responses, and performance logs were synchronized through Firebase Realtime Database or Firestore, and scanned images were stored in Firebase Cloud Storage. This structure supported secure communication and simplified maintenance.

The Scan & Learn module captured page images and applied preprocessing, including denoising and contrast enhancement, before OCR processing by ML Kit or a comparable service. The extracted text was cleaned and stored for later use. In the AI quiz-generation pipeline, tokenization, stop-word removal, keyword extraction, and sentence ranking were used to identify key concepts. Multiple-choice and short-answer items were then generated with answers and distractors. The same content pipeline was used for teacher-uploaded text and scanned materials.

Live quizzes were managed through session-based synchronization. Teachers created sessions and generated unique identifiers, after which students joined in real time and submitted answers concurrently. The scoring engine validated responses immediately and updated the leaderboard with low latency. The analytics module aggregated attempt histories to compute accuracy, topic-level proficiency, and progress trends, which were displayed through charting components. A lightweight adaptation rule adjusted recommended practice according to repeated weak-topic performance. Transport security and database rules were applied to protect user data.

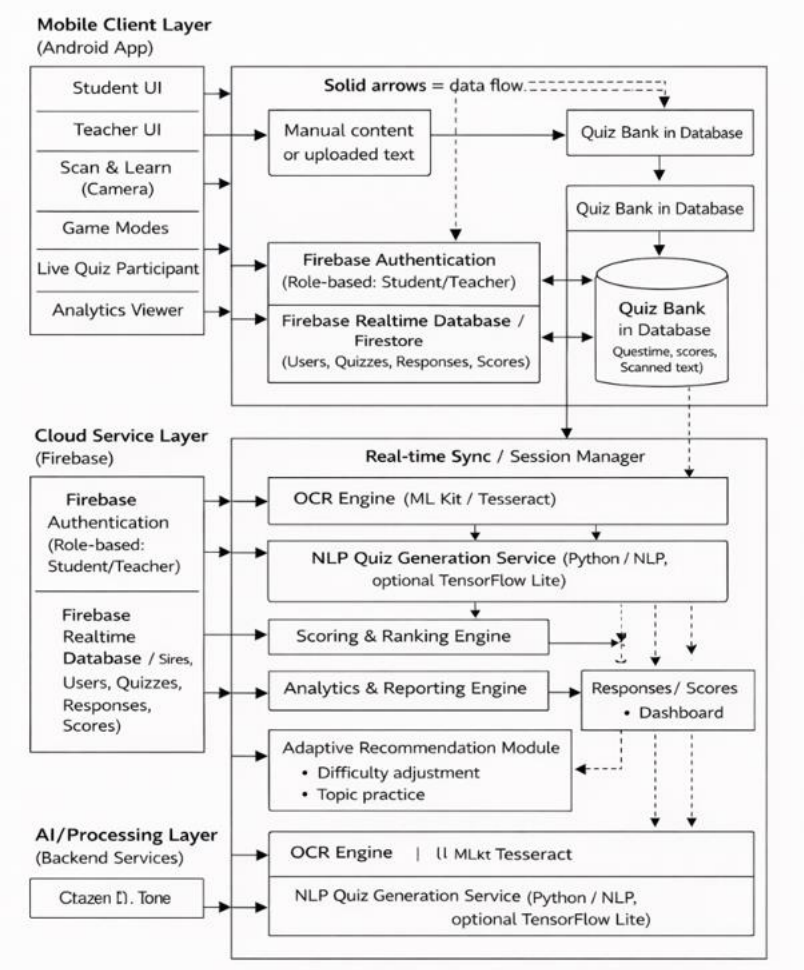

Fig 1: System Architecture Diagram

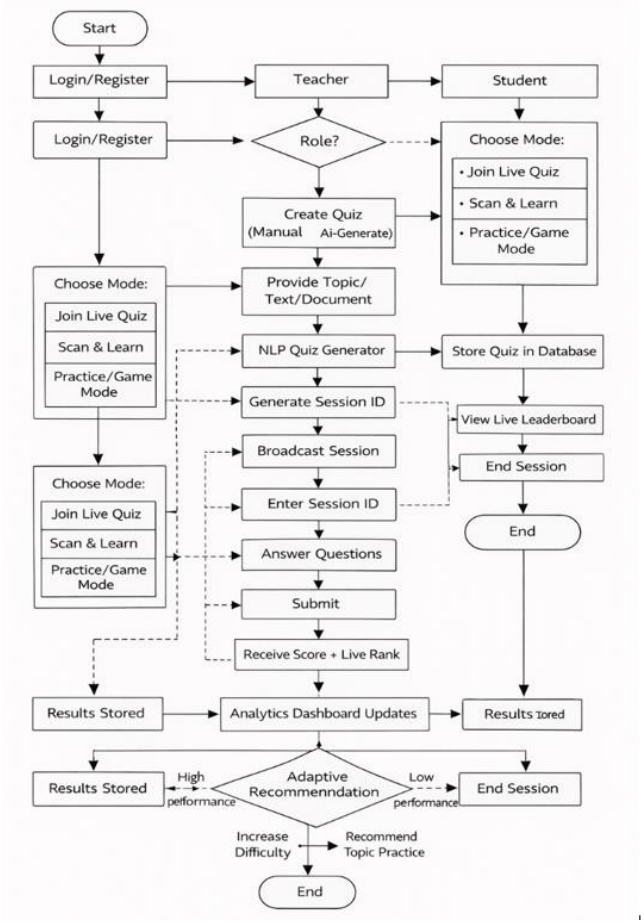

Fig 2: Workflow Diagram

4. Results and Discussion

The system was evaluated through unit, integration, and system testing, followed by limited beta use by students and teachers. Unit tests verified the correctness of quiz generation, OCR extraction, scoring, leaderboard ordering, and analytics calculations. Integration testing confirmed the Scan & Learn to quiz-generation flow as well as the live quiz to scoring and logging flow. System testing showed stable operation across multiple Android devices and consistent role-specific behavior.

The performance results indicated satisfactory operation for the intended classroom use case. OCR accuracy was acceptable for clear printed pages, while handwriting remained less reliable. AI-generated questions were generally aligned with the source material, although complex passages occasionally required refinement of distractors. Live quiz synchronization operated near real time, which supported classroom interaction. Teachers highlighted the reduction in manual question preparation and the visibility of learner performance as the most valuable features. Students reported that ranking and immediate feedback improved motivation.

The results also showed that overall quality depended on input clarity and network stability. Low-resolution scans, blur, and weak illumination reduced OCR performance. In addition, semantic ambiguity in source text sometimes affected distractor quality. These findings indicate that future work should strengthen handwriting OCR, incorporate semantic validation for question generation, and improve

resilience under variable connectivity. Even with these limitations, the integrated system demonstrated clear practical value as a unified learning and assessment tool.

Metric	Observed Result	Interpretation
OCR text extraction accuracy	85–90%	Suitable for clear printed text; reduced by blur and lighting
AI-generated quiz relevance	80–85%	Mostly aligned; complex passages require refinement
Live-quiz response delay	< 1–2 s	Appropriate for synchronized participation
Scoring consistency	100%	Deterministic tie-breaking remained stable
System success rate	>95%	Failures mainly due to network variability

Table 2: System Performance

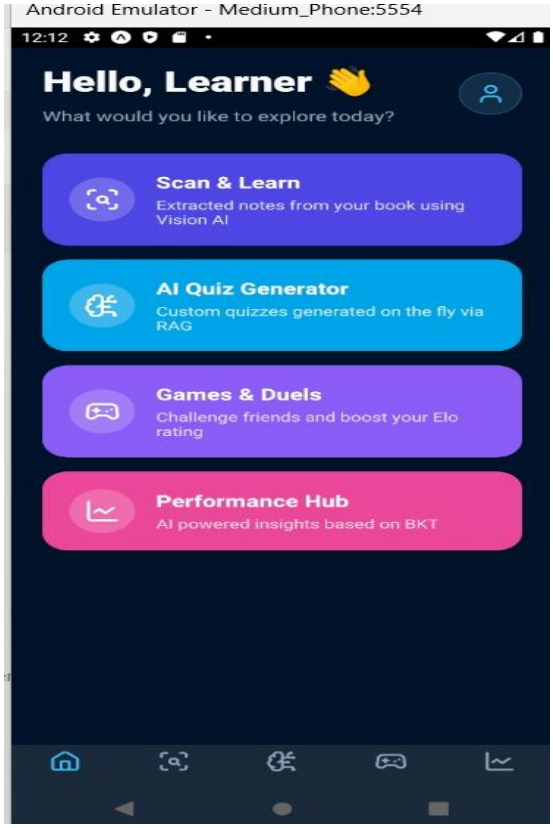

Fig 3: Application Screenshot – Home Page

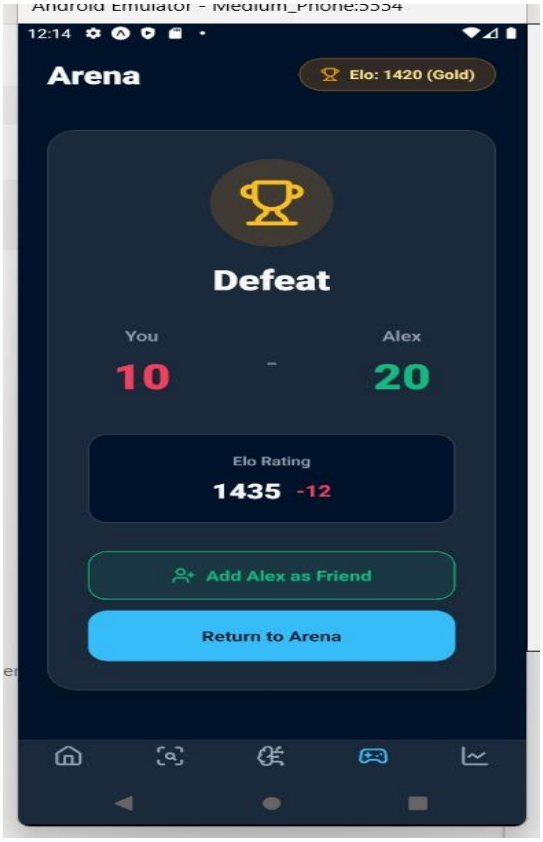

Fig 4: Application Screenshot – Results Page

5. Conclusion

SmartQuiz AI demonstrated that AI-based quiz generation, OCR-enabled note digitization, live quiz synchronization, gamified participation, and analytics can be integrated within a single Android platform for interactive learning and assessment. The evaluated system showed satisfactory OCR performance for clear printed content, relevant generated questions, and low-latency real-time operation. Therefore, the proposed approach is feasible for classroom assessment and self-directed practice. Future work should improve handwriting recognition, expand question formats, and validate long-term learning gains across larger and more diverse student cohorts.

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