

## **AI-Powered Knowledge Quiz Builder - Submission Report**

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### *System Architecture and Technical Decisions*

This project implements a full-stack monorepo architecture using modern web technologies to create an AI-powered quiz generation system. The backend leverages PHP Laravel 11 with a MySQL database, containerized using Docker for consistent deployment. The frontend utilizes Angular 19 with NgRx for state management, providing a reactive and scalable user interface. The system is orchestrated through a Makefile that manages Docker containers for all services, ensuring seamless development and deployment workflows.

The architecture follows a microservices pattern with clear separation of concerns: the Laravel backend handles API endpoints, database operations, and AI integration; the Angular frontend manages user interactions and state; and the MySQL database persists quiz data and results. Key technical decisions include using NgRx for complex state management to handle quiz generation, submission, and review workflows; implementing CORS middleware for cross-origin requests; and creating a robust error handling system with fallback mechanisms. The system also implements Retrieval-Augmented Generation (RAG) by integrating Wikipedia API retrieval to enhance factual accuracy of AI-generated content.

### *AI Tools and Implementation*

The primary AI tool used is OpenAI's GPT-3.5-turbo model, integrated through a custom OpenAIService that handles both quiz generation and explanation generation. The system implements RAG (Retrieval-Augmented Generation) by first retrieving factual context from Wikipedia using a dedicated WikipediaService, then injecting this context into OpenAI prompts to ensure factual accuracy. This approach addresses the requirement for retrieval to improve factual accuracy by grounding AI responses in real-world knowledge sources.

The AI integration serves two main functions: generating educational quiz questions based on user-provided topics with Wikipedia context injection, and creating detailed explanations for incorrect answers that are both educational and encouraging. The system includes robust error handling with fallback mechanisms, ensuring graceful degradation if AI services are unavailable. The implementation demonstrates how modern AI tools can be effectively combined with traditional web technologies to create an engaging, educational platform that maintains high standards of factual accuracy through external knowledge retrieval.