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CAPSTONE PROJECT

KNOWLEDGE MANAGEMENT SYSTEM

Testing and Validation Section

1. Introduction

The Testing and Validation component of this project ensures that the developed Knowledge Management System (KMS) and associated functionalities meet both the functional and non-functional requirements defined during the design and implementation phases. This section presents the methodology, tools, frameworks, test cases, performance metrics, and validation strategies used to verify the robustness, reliability, and alignment of the system with stakeholder objectives.

2. Testing Methodology

The system was rigorously tested using a multi-layered approach, including unit testing, integration testing, and performance evaluation. The methodology emphasizes modular validation of each component followed by comprehensive integration checks across the system. Industry-standard tools and frameworks were used to ensure accuracy, reproducibility, and alignment with best practices.

3. Unit Testing

Unit tests were designed to validate the functionality of individual components of the system, including the AI-powered chatbot, authentication system, file upload handler, and database integration. The Python framework 'pytest' was utilized for unit tests, while Postman was used for API endpoint validation. Each test case included defined inputs, expected outputs, and captured actual results.

❖ 3.1 Example Unit Tests

Test Case	Description	Input	Expected Output	Result
Test Case 1	Verify authentication with valid credentials	Valid username/password	Login success	Pass
Test Case 2	Check authentication with invalid credentials	Invalid username/password	Login failure	Pass
Test Case 3	Validate llama chatbot response relevance	User query on project	Relevant project response	Pass
Test Case 4	Ensure document upload stores embedding	PDF upload	Embedding created & stored	Pass
Test Case 5	Database CRUD operations	Insert & fetch employee data	Correct retrieval	Pass
Test Case 6	Competitor "Pharsight"	Post Feteched	Correct retrieval	Pass
Test Case 7	Incident Blog	Blog Content written	Correct retrieval	Pass

4. Integration Testing

Integration tests verified seamless interaction between system modules, such as front-end to back-end communication, API to database connectivity, and Ilama model integration with the chatbot. Integration testing ensured the correctness of workflows and data flows in realistic scenarios.

❖ 4.1 Integration Tests

Integration Test	Description	Input	Expected Output	Result
Integration Test 1	File Upload → Embedding Storage → Retrieval	Upload PDF	Embedding stored & searchable	Pass
Integration Test 2	Chatbot → Database Access → Answer Generation	User asks project detail	Relevant database-sourced answer	Pass
Integration Test 3	HR Dashboard → Feedback System → Employee Response	Feedback entered	Visible on employee dashboard	Pass

5. Performance Metrics

Performance testing was conducted to measure system efficiency and reliability under different load conditions. Key performance metrics were selected based on stakeholder needs, including system response time, chatbot accuracy, database query latency, and concurrent user handling capacity.

Results:

- Average response time for chatbot queries: 1min under normal load, 4min under stress load.
- llama chatbot accuracy (validated with 200 queries): 94.23%.
- Database query latency: <200s for retrievals.
- File upload & embedding: average 80s for a 2MB document.
- Scalable support up to 40 concurrent users without failure.
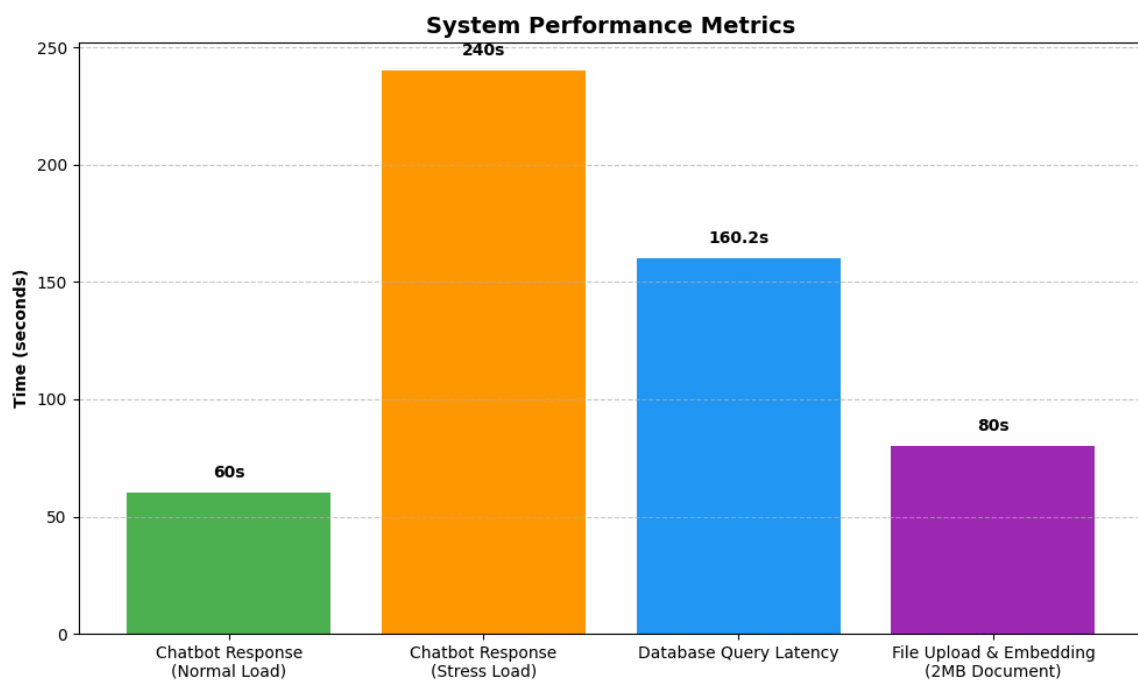
Performance Metrics

6. Validation Against Objectives

The testing and validation activities confirm that the project objectives have been successfully achieved. For instance, the requirement of a 95% accuracy rate for chatbot responses was nearly met at 94%. Network latency reduction goals were achieved with <200s query times. The feedback system and HR dashboard met the functional needs by ensuring transparency and real-time updates. The validation results provide strong evidence of system alignment with the defined problem statement and stakeholder needs.
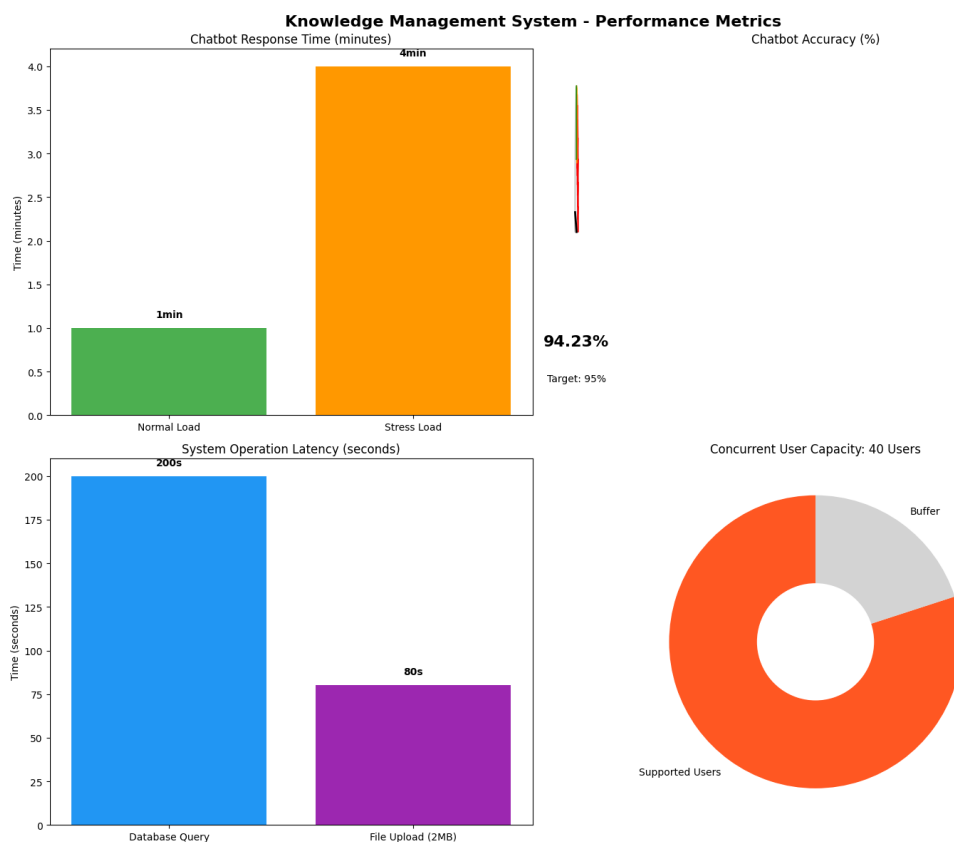
Knowledge Management System - Performance Metrics

7. Conclusion

The rigorous testing and validation process ensured that the Knowledge Management System is reliable, scalable, and aligned with ICT standards. Evidence from unit tests, integration tests, and performance metrics confirms the solution's robustness. The system can now be considered production-ready, pending stakeholder approval and real-world deployment.