Smart Bikes: Dynamic Optimization of Bike-Sharing Systems

Phase 1 - Waterfall Model Project Plan using GenAI Virtual Agents

Group 28

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Project Overview

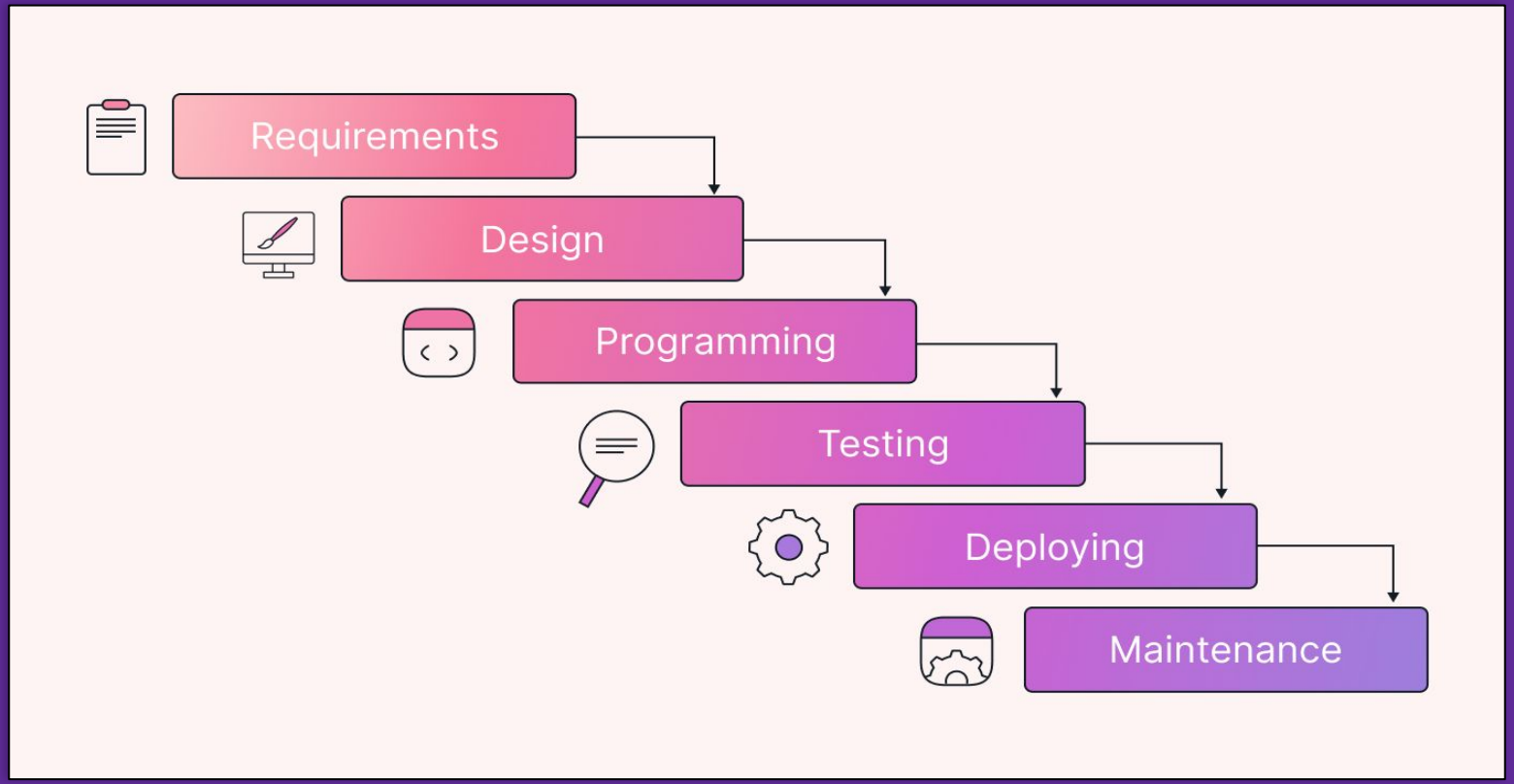
The project mainly focuses on:

Dynamic Fleet Management: A system that uses real-time data to monitor and rebalance bike availability across the city, ensuring efficient fleet distribution.

Predictive Analytics: Utilizes machine learning models to forecast user demand and automate bike reallocation, reducing the need for manual intervention.

Optimized Operations: Enhances user satisfaction, minimizes operational costs, and supports seamless city-wide mobility.

Waterfall Model Overview



GenAI frameworks

Langchain

- A framework that integrates language models into applications.
- Enables dynamic generation, management, and execution of workflows by chaining AI models and tools for complex tasks.

AutoGen

- An AI-powered framework that automates the generation of project plans and processes.
- Streamlines tasks like project management, resource allocation, and task prioritization.

Virtual Agents

Customer: Communicates user needs and preferences for bike availability and fleet management.

Project Manager: Oversees the timeline and coordination of the dynamic rebalancing system, ensuring smooth implementation.

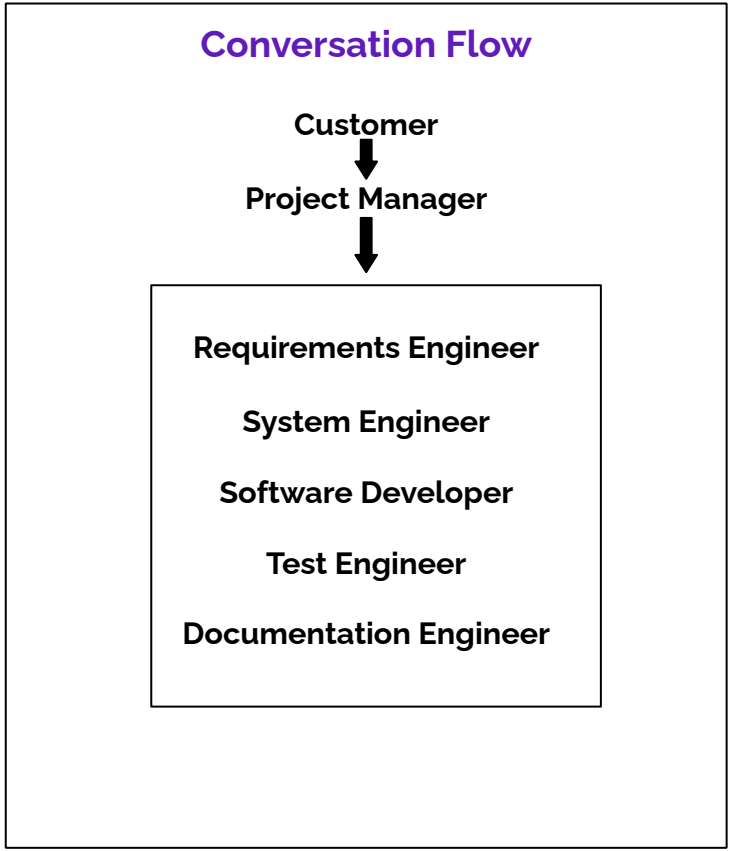
Requirements Engineer: Gathers detailed requirements for fleet management, data sources, and optimization algorithms.

System Engineer: Designs the architecture for real-time data collection, analytics, and fleet optimization.

Software Developer: Writes the code for predictive analytics models and system automation for bike reallocation.

Test Engineer: Ensures system reliability through testing of demand predictions and rebalancing algorithms under various scenarios.

Documentation Engineer: Prepares user manuals and technical documentation for system use, including rebalancing protocols and optimization reports.



Comparative Analysis

Comparison Criteria	LangChain	Autogen
Average Requirements Engineering Effort	18	Approx. 3.6 days
Average System Design Effort	Approx. 9.8 days	Approx. 2.4 days
Average Software Development Effort	90 days	79 days
Average Testing Effort	29 days	9 days
Total Calculated Effort	Approx. 132.4 days	Approx. 93.6 days

Model Run	LangChain	Autogen
Average Number of Requirements	18	18
Average Pages in System Design	49 pages	12 pages
Average SLOC in Software Development	4,500 SLOC	3,950 SLOC
Average Number of Test Cases	58	18
Detail and Precision in Calculations	High	High
Coherence and Organization	Moderate to High	High
Accuracy of Content	High	High

LangChain Output Analysis

1. **Accuracy:**
   - LangChain's outputs show a high degree of accuracy. The detailed inclusion of software development metrics, such as specific numbers of requirements, pages for system design, and lines of code (SLOC), align closely with realistic project planning expectations. This indicates that LangChain is capable of mimicking real-world scenarios effectively, providing outputs that can be directly correlated with typical software development tasks.

2. **Coherence:**
   - The coherence in LangChain's presentations varies from moderate to high. This variation may be attributed to the complexity of the projects being simulated. In some cases, the information is presented with high clarity, following a logical sequence that enhances user comprehension and the practical applicability of the data. However, there are instances where the depth of detail might overwhelm the structural presentation, leading to sections where coherence could be improved.

Autogen Output Analysis

1. **Accuracy:**
    - Autogen also demonstrates a high level of accuracy in its outputs. The experiments consistently offer realistic project management data, similar to LangChain. Autogen's strength lies in its consistent approach across different runs, showing little variation in the accuracy of the content provided. This consistency is crucial for users who rely on predictable and reliable output for planning and analysis.

2. **Coherence:**
    - Autogen's outputs are generally characterized by high coherence. The information is well-organized, making it easy for users to follow and understand. The logical flow of data from one section to the next is clear, and there is an apparent alignment between the stated objectives and the results presented. This high level of coherence in Autogen's outputs makes it an excellent tool for educational purposes or for stakeholders needing clear and straightforward project management simulations.

Conclusion

- The dynamic bike-sharing system optimizes fleet distribution across the city, ensuring efficient bike availability and improved user satisfaction.
- Langchain facilitates intelligent task management, connecting workflows between agents such as project managers, system engineers, and developers.
- AutoGen automates project planning tasks like scheduling, resource allocation, and risk prediction, ensuring efficient execution.
- The AI-driven approach reduces manual intervention, enhances real-time decision-making, and streamlines operations.
- This system can be scalable and holds potential for integration with other urban mobility solutions, contributing to the creation of smarter, more connected cities.

THANK YOU!