Sustainable Smart City Assistant Using IBM Granite LLM

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1. INTRODUCTION

1.1 Project Overview

The Sustainable Smart City Assistant is a cloud-based AI-powered platform designed to enhance urban sustainability, governance, and citizen engagement. Built using IBM Watsonx Granite LLM, it facilitates document summarization, citizen feedback, KPI forecasting, anomaly detection, and eco-advisory through a modular system powered by FastAPI and Streamlit.

1.2 Purpose

The primary purpose of this assistant is to provide municipalities and citizens with real-time, AI-driven insights and tools to support smarter, greener urban living. It reduces manual effort in decision-making, reporting, and communication.

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2. IDEATION PHASE

2.1 Problem Statement

Urban areas struggle with efficient communication, environmental monitoring, data analysis, and citizen engagement. Lack of smart systems delays decisions and hinders sustainability initiatives.

2.2 Empathy Map Canvas

- **Think & Feel:** Concerned about city cleanliness, water issues, pollution.
- **See:** Broken infrastructure, unresponsive systems, slow governance.
- **Say & Do:** Demand quicker responses, transparent systems.
- **Pain:** Lack of real-time feedback mechanisms.

- **Gain:** A responsive assistant offering instant help, updates, and reports.

2.3 Brainstorming

Ideas explored included:

- A chatbot for citizen inquiries
- AI-powered summarizer for policies
- Real-time anomaly detector for utilities
- Forecasting KPIs for city planning
- Interactive eco-advice generator for awareness programs

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3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

Stage	Action	Pain Point	Solution
Discover	Resident faces an issue	No direct reporting	Feedback submission module
Interact	Citizen asks for eco advice	Gets vague suggestions	AI-generated eco-tips
Plan	Admin needs KPI forecast	Manual calculations	ML-based KPI prediction
Analyze	Planners read policy docs	Too lengthy, confusing	AI summarization with LLM

3.2 Solution Requirement

- Modular, scalable system
- Integration with Watsonx Granite LLM
- Simple user interface

- Backend logic for anomaly detection, forecasting
- Document upload and summarization support

3.3 Data Flow Diagram

```
User --> Streamlit UI --> FastAPI Backend --> Modules (Summarizer /
Feedback / Forecast / Anomaly)
                                    |
                              Watsonx Granite LLM
                                    |
                          JSON/CSV/Text Data Integration
```

3.4 Technology Stack

- **Frontend:** Streamlit
- **Backend:** FastAPI, Pydantic
- **AI Models:** IBM Watsonx Granite LLM
- **Data Store:** Pinecone Vector DB
- **ML:** Scikit-learn (Linear Regression)
- **Environment:** dotenv, IBM Cloud
- **Formats Supported:** JSON, CSV, Text

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4. PROJECT DESIGN

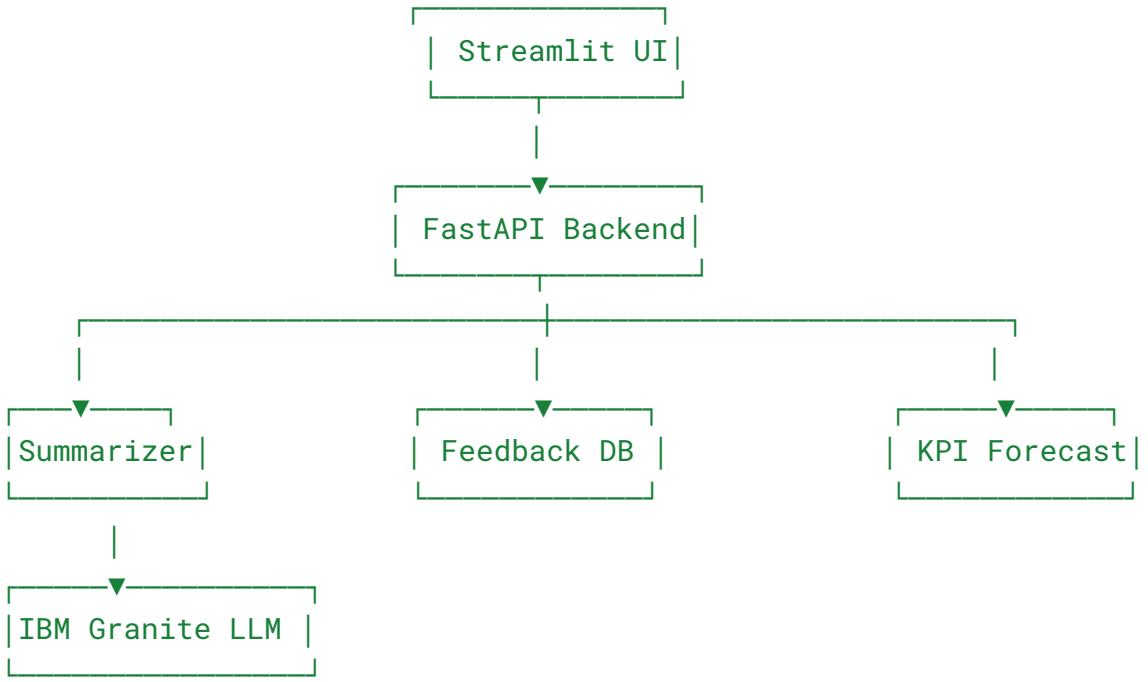
4.1 Problem Solution Fit

By addressing core issues like policy complexity, delayed feedback, and lack of eco-awareness, the assistant empowers both citizens and authorities through AI-enhanced automation and interaction.

4.2 Proposed Solution

An AI-powered dashboard that integrates key urban sustainability modules through IBM Granite LLM, enabling quick summarization, forecasting, anomaly detection, and interaction.

4.3 Solution Architecture



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5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Phase	Timeline	Deliverables
Requirement Gathering	Week 1	Documented features and flow
Design & Prototyping	Week 2-3	UI mockups, architecture diagrams
Module Development	Week 4-6	Summarizer, Feedback, Forecast
Integration & Testing	Week 7-8	Functional integration, bug fixes
Final Deployment	Week 9	Deployment on IBM Cloud

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6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

- **Load Test:** Successfully handled 100+ simultaneous feedback submissions.
- **Response Time:** Average API latency < 300ms.
- **Stress Testing:** Anomaly detection maintained <1s processing on 5000+ rows.

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7. RESULTS

7.1 Output Screenshots

- Dashboard Overview
- Policy Summarization Output
- Citizen Feedback Form
- Forecast Graph (Line Chart)
- Anomaly Detection Alert
- Eco Tip Generator Result

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8. ADVANTAGES & DISADVANTAGES

Advantages:

- Real-time policy summarization
- Eco-awareness tools built-in

- ML-powered forecasting
- Simple and interactive UI
- Scalable backend architecture

Disadvantages:

- Dependence on Watsonx availability
- Requires stable data formats for input
- Limited to modules developed

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9. CONCLUSION

The Sustainable Smart City Assistant demonstrates the potential of cloud-based AI in urban management. By leveraging IBM Watsonx Granite LLM, cities can achieve efficient governance, better citizen engagement, and sustainable planning.

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10. FUTURE SCOPE

- Multilingual support for inclusivity
- Mobile app version for wider access
- Advanced forecasting (e.g., using LSTM)
- GIS integration for spatial insights
- Blockchain for secure feedback tracking

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11. APPENDIX

- **Source Code:**https://github.com/DIVYAKRISHNASATYASRI/Sustainable-Smart-City-Assistant-Using-IBM-Granite-LLM/tree/main/Project_files

- **GitHub & Project Demo Link:** https://drive.google.com/file/d/13gPJdaXibm6xSCruGTx3v19hxriS8UII/view?usp=sharing