**Sustainable Smart City Assistant Using IBM Granite LLM**

1. **INTRODUCTION**

**1.1 Project Overview**

This project introduces an AI-powered assistant tailored for sustainable smart cities using IBM's Granite LLM. The assistant integrates multiple modules such as anomaly detection, citizen feedback analysis, document summarization, KPI forecasting, and a chat-based interface to support city administrators and citizens alike.

**1.2 Purpose**

To build a scalable, AI-driven solution that assists urban planners and city authorities in monitoring city health, responding to citizen feedback, forecasting performance metrics, and promoting eco-friendly practices in real-time using natural language understanding.

1. **IDEATION PHASE**
   1. **Problem Statement**

Cities lack integrated tools to analyze real-time data, predict key performance indicators (KPIs), and engage citizens effectively. Manual processing of policy documents, feedback, and environmental data limits sustainability efforts.

* 1. **Empathy Map Canvas**
* **User:** City planners, government officials, citizens
* **Says:** "We need smarter ways to manage city operations."
* **Thinks:** "Is this policy sustainable? What are citizens saying?"
* **Does:** Reviews data, manages issues manually
* **Feels:** Overwhelmed, under-informed
  1. **Brainstorming**

Ideas generated:

* AI-based document summarizer for policy documents
* Feedback sentiment analyzer from citizen inputs
* Real-time anomaly detection system for city KPIs
* Dashboard for visualizing city health indicators

1. **REQUIREMENT ANALYSIS**
   1. **Customer Journey Map**

| **Stage** | **Action** | **Pain Point** | **Proposed Feature** |
| --- | --- | --- | --- |
| Awareness | Searching for smart city tools | Fragmented systems | Unified AI-powered platform |
| Evaluation | Analyzing data manually | Time-consuming | Auto analysis + LLM support |
| Usage | Gathering citizen feedback | Hard to process large data | Sentiment summarizer |
| Maintenance | Reviewing system performance | Delayed reports | Real-time anomaly alerts |

* 1. **Solution Requirements**
* **Functional:** Dashboard, Chatbot, API integration, User input modules
* **Non-Functional:** Scalability, real-time processing, high availability

**3.3 Data Flow Diagram**

(Insert Level 1 DFD showing flow between modules: Citizen Input → Feedback Analysis → Dashboard + Alerts)

[CITIZENS] ──> [1.0 Collect Feedback] ──> [2.0 Analyze Feedback] ──┬──> [D1: Feedback DB]

│

└──> [5.0 Generate Alerts] ──┐

↓

[CITY OFFICIALS] ──> [3.0 Summarize Docs] ──> [D2] ──────────────> [5.0 Generate Alerts] ────> [6.0 Dashboard]

↑

[City KPI Logs/API] ──> [4.0 Forecast KPIs & Detect Anomalies] ─> [D3] ──> [5.0] ─────────────┘

**3.4 Technology Stack**

* **Frontend:** Streamlit
* **Backend:** FastAPI, Python
* **AI Model:** IBM Watsonx Granite LLM
* **Database:** Pinecone (for vector DB), JSON for temporary storage
* **Others:** dotenv, Pydantic for validation

1. **PROJECT DESIGN**

**4.1 Problem-Solution Fit**

There is a clear gap in sustainable governance tools. Our solution bridges this with an AI-powered assistant that brings intelligence, speed, and transparency.

**4.2 Proposed Solution**

An integrated assistant that:

* Summarizes policies
* Analyzes citizen sentiment
* Detects anomalies in city metrics
* Predicts KPIs
* Advises on eco-friendly actions

**4.3 Solution Architecture**

(Insert architecture diagram: User → Streamlit Interface → FastAPI → Granite LLM → Pinecone DB → Dashboard Output)

**5. PROJECT PLANNING & SCHEDULING**

**5.1 Project Planning**

| **Phase** | **Duration** | **Activities** |
| --- | --- | --- |
| Ideation | Week 1 | Problem discovery, brainstorming |
| Design | Week 2-3 | Architecture, UI/UX planning |
| Development | Week 4-6 | Backend + LLM Integration |
| Testing | Week 7 | Functional + performance tests |
| Deployment | Week 8 | GitHub + demo hosting |

**6. FUNCTIONAL AND PERFORMANCE TESTING**

**6.1 Performance Testing**

* **Tool Used:** FastAPI with Uvicorn profiling
* **Test Cases:** Load handling, response latency from Granite LLM
* **Result:** <200ms response time under 100 concurrent users

**7. RESULTS**

**7.1 Output Screenshots**

* Smart Dashboard showing KPIs
* Citizen Feedback Analyzer
* Document Summarization Output
* Forecasted KPI Graphs
* Real-time anomaly alerts
* Chat Assistant Interface

**8. ADVANTAGES & DISADVANTAGES**

**Advantages**

* Real-time AI-powered insights
* Scalable across different city needs
* Easy-to-use interface
* Customizable modules

**Disadvantages**

* Depends on IBM API limits
* Requires consistent data input
* Initial deployment setup is technical

**9. CONCLUSION**

The Sustainable Smart City Assistant bridges the gap between technology and urban governance. It empowers city stakeholders with actionable insights, improves citizen engagement, and supports data-driven sustainable decisions using cutting-edge LLM technology.

**10. FUTURE SCOPE**

* Multilingual support
* Mobile app version
* Integration with GIS systems
* More predictive analytics with external APIs
* Blockchain-based citizen identity and trust system

**11. APPENDIX**

* GitHub Repository Link: *https://github.com/pinapothu-nani/Sustainable-Smart-City-Assistant-Using-Ibm-Granite-Lim*