Sustainable Smart City Assistant Using IBM Granite LLM



# TEAM MEMBERS

**TEAM LEADER:** P.KEERTHIKA

**TEAM MEMBER:** G.KIRUBHALINI

**TEAM MEMBER :** M.PRABAVATHI

# INTRODUCTION

The \*Sustainable Smart City Assistant\* is an AI-powered framework designed to optimize urban living by leveraging IBM Granite LLM. It integrates sustainability principles with advanced AI capabilities to support decision-making, improve citizen engagement, and enhance city management. The assistant provides real-time insights and recommendations across domains such as energy, transportation, waste management, and urban planning, ensuring a more eco-friendly and resilient urban ecosystem.

# PROJECT OVERVIEW

This project aims to revolutionize smart city management by embedding IBM Granite LLM into core city operations. The assistant acts as a central AI-driven hub that enables sustainable policy enforcement, predictive resource allocation, and intelligent citizen interaction.

## Key Features:

* + Conversational Interface – AI-driven natural interactions between citizens, officials, and city services.
  + Sustainability Policy Summarization – Simplifies government policies for citizens and ensures compliance.
  + Resource Forecasting – Predicts energy, water, and waste consumption trends for optimized allocation.
  + Eco-Advisor – Suggests green practices for households, businesses, and government departments.
  + Citizen Feedback Loop – Provides participatory governance through real-time citizen reporting and feedback.
  + KPI Forecasting – Tracks environmental, social, and governance (ESG) indicators for smart cities.
  + Anomaly Detection – Detects unusual events (e.g., pollution spikes, traffic congestion, power outages).
  + Multimodal Input Support – Accepts text, voice, images, and sensor data for decision-making.
  + AI-Powered Dashboard – Provides real-time monitoring of city performance metrics.

# ARCHITECTURE

The architecture of the Sustainable Smart City Assistant consists of two core components:

**Front-end:** Interactive multimodal interface for city officials, citizens, and IoT dashboards. **Back-end:** Cloud-based infrastructure powered by IBM Granite LLM, integrated with IoT sensors, databases, and APIs.

## Key Components:

* + IBM Granite LLM Integration – Core reasoning engine for policy analysis, sustainability recommendations, and citizen interaction.
  + IoT & Sensor Data Pipeline – Real-time integration of traffic, air quality, water, and energy usage data.
  + Vector Store – Maintains city knowledge base for quick retrieval and recommendations.
  + ML Modules – Specialized AI models for traffic prediction, waste optimization, and renewable energy forecasting.

# SETUP INSTRUCTIONS

## Prerequisites:

* + Python 3.9+ installation
  + IBM Granite LLM access (API / fine-tuned model)
  + Streamlit / Gradio for UI
  + TensorFlow / PyTorch for ML models
  + Vector database (FAISS, Pinecone, Weaviate)
  + IoT data connectors (MQTT, Kafka, REST APIs)

## Installation Steps:

1. Install Python 3.9+
2. Install dependencies: pip install -r requirements.txt
3. Configure IBM Granite LLM API keys and IoT data sources
4. Set up vector database for city knowledge embeddings
5. Run backend server and launch frontend UI

# AUTHENTICATION

The system employs secure role-based authentication to ensure safe access for city administrators, businesses, and citizens. Data encryption, API tokens, and blockchain-based audit trails safeguard sensitive urban data.

# USER INTERFACE

The assistant features an interactive dashboard with sustainability KPIs, maps, and alerts. Citizens can interact through a chatbot, while city officials use analytical dashboards for decision-making. Accessibility, multilingual support, and mobile compatibility ensure wide usability.

# TESTING

AI-driven testing is applied to validate data accuracy, monitor system resilience, and evaluate policy simulations. The assistant undergoes performance testing with IoT data streams and citizen feedback loops to ensure reliability and scalability.

# KNOWN ISSUES

* + Occasional response delays for large IoT datasets.
  + AI recommendations may require expert validation.
  + Sensor data inconsistencies can affect predictions.
  + Internet/cloud dependency impacts performance.

# FUTURE ENHANCEMENTS

* + Real-time multi-city integration for comparative insights.
  + Support for advanced multimodal inputs (video, satellite images).
  + Enhanced predictive analytics for disaster risk management.
  + Automated sustainability reporting for ESG compliance.
  + Integration with blockchain for transparent governance.

# PROJECT SCREENSHOT

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