Project Title

Sustainability Smart City Assist ant using IBM Granite LLM

Project Documentation

1. Introduction
Project Title: Sustainability Smart City

Team Members:

- Team leader : Asiba.J
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2. Project Overview

Purpose:
The Sustainability Smart City project aims to integrate advanced technologies, data-driven governance, and eco-friendly practices to build cities that are resource-efficient, resilient, and citizen-centric. By optimizing energy, transport, waste, and water systems, the project addresses pressing urban challenges while ensuring sustainable growth.

Features:

Smart Energy Management – Real-time monitoring and renewable integration.

Green Mobility – Electric vehicle infrastructure, shared transport, and traffic optimization.

Waste & Water Optimization – Smart bins, recycling analytics, water reuse systems.

Citizen Engagement Platform – Mobile and web apps for reporting issues, feedback, and eco-awareness.

Urban IoT & AI Forecasting – Predictive analytics for air quality, energy demand, and disaster management.

Policy Insights – Simplification of sustainability guidelines and compliance tracking.

3. Architecture:

Frontend (Web & Mobile App): Interactive dashboards, eco-friendly design, and multilingual support.

Backend (API Framework): FastAPI/Django for secure communication and modular services.

IoT Integration: Smart meters, sensors, and real-time data collection.

AI & ML Models: Forecasting energy demand, traffic flow, and environmental metrics.

Cloud Integration: Scalable storage and compute on hybrid cloud.

Data Visualization: Dashboards showing KPIs, alerts, and predictive trends.

4. Setup Instructions
Prerequisites:

Python 3.9+

Cloud service APIs (Azure/AWS/IBM Cloud)

IoT Sensor Integration SDK

Docker & Kubernetes for deployment

Installation Process:

Clone repository

Install dependencies (requirements.txt)

Configure .env with API keys and credentials

Start backend server

Launch frontend application

Connect IoT devices or load sample datasets

5. Folder Structure

app/ – Backend logic (APIs, models, integrations)

ui/ – Frontend components (dashboards, forms, charts)

iot_modules/ – Sensor integration and data ingestion scripts

ml_models/ – Forecasting and anomaly detection scripts

reports/ – Sustainability reports and analytics

6. Running the Application
Start backend server

Launch frontend dashboard

Upload datasets / connect IoT feeds

Access modules: energy, water, waste, transport

Generate reports and forecasts

7. API Documentation

POST /upload-data – Upload sensor or city datasets

GET /eco-tips – Generate sustainability tips

GET /forecast-kpi – Predict future urban metrics

POST /feedback – Citizen input and suggestions

GET /policy-summary – Simplified sustainability policy

8. Authentication

JWT token-based security

Role-based access: Citizen, City Official, Administrator

OAuth2 integration with city services

9. User Interface
Navigation Sidebar

KPI Dashboards (Energy, Water, Waste, Mobility)

Interactive maps for pollution and traffic hotspots

Citizen eco-engagement apps

Downloadable reports and visual insights

10. Testing

Unit Testing: Data ingestion, ML models, APIs

Integration Testing: IoT sensors with backend services

UI Testing: Dashboard usability

Edge Case Handling: Missing/large data, invalid credentials

11. Screenshots
[Placeholder for dashboard and mobile UI images]

12. Known Issues

Limited IoT device compatibility

High dependency on cloud resources

13. Future Enhancements

Blockchain-based carbon credit tracking

AI-driven disaster response system

5G integration for faster IoT data transfer

Smart agriculture module

14. Key components:

14.1 Renewable Energy Integration:

- Solar rooftop programs.
- Smart grids with AI-driven energy distribution.
- Wind and biomass energy pilot projects.

14.2 Smart Mobility:

- Electric vehicle (EV) charging infrastructure.

- Public transport with real-time tracking apps.
- Bicycle-sharing and pedestrian-friendly pathways.

14.3 Water & Waste Management:

- IoT-enabled smart water meters.
- Rainwater harvesting and water recycling plants.
- Waste segregation at source and waste-to-energy conversion.

14.4 Digital Infrastructure:

- High-speed fiber internet for e-governance and smart services.
- AI-powered city dashboards for real-time monitoring.
- Smart lighting and surveillance for security and efficiency.

14.5 Green & Sustainable Living:

- Net-zero energy buildings.
- Urban farming and rooftop gardens.
- Tree plantation and biodiversity conservation zones.

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15 . Implementation Plan:

| Phase | Timeline | Activities |
|---|---|---|
| Phase 1 | Year 1–2 | Feasibility study, stakeholder consultations, land-use planning |
| Phase 2 | Year 3–5 | Infrastructure development (energy, water, transport, digital) |
| Phase 3 | Year 6–8 | Smart service integration, community participation |
| Phase 4 | Year 9–10 | Monitoring, performance evaluation, scaling-up |

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## 16 . Financial Model:

- Estimated budget: USD 1.5 Billion (over 10 years)
- Funding Sources:
    - Government smart city mission grants.
    - Public-private partnerships (PPPs).
    - Green bonds and international climate funds.
    - Revenue from smart services (waste-to-energy, solar power sales).

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## 17. Sustainability Impact:

- Environmental: 40% reduction in $CO_2$ emissions, 30% increase in green cover.
- Economi2s :20,000+ green jobs created.
- Social **:** Improved public health, reduced commute time, enhanced digital literacy.

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## 18. Monitoring & Evaluation:

- Use of Key Performance Indicators (KPIs):
    - % renewable energy in grid.
    - Air quality index (AQI) improvement.
    - % reduction in non-recyclable waste.
    - % population using public transport.
- Annual review reports and real-time dashboards for transparency.