SUSTAINABLE SMART CITY ASSISTANT
Project Documentation

INTRODUCTION

- Project Title : Sustainable Smart City Assistant
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PROJECT OVERVIEW

1.Purpose :

The purpose of a Sustainable Smart City Assistant is to empower cities and their residents to thrive in a more eco-conscious and connected urban environment. By leveraging AI and real-time data, the assistant helps optimize essential resources like energy, water, and waste, while also guiding sustainable behaviors among citizens through personalized tips and services. For city officials, it serves as a decision- making partner—offering clear insights, forecasting tools, and summarizations of complex policies to support strategic planning. Ultimately, this assistant bridges technology, governance, and community engagement to foster greener cities that are more efficient, inclusive, and resilient.

2.Features:

Conversational Interface

- Key Point: Natural language interaction
- Functionality: Allows citizens and officials to ask questions, get updates, and receive guidance in plain language

Policy Summarization

- Key Point: Simplified policy understanding
- Functionality: Converts lengthy government documents into concise, actionable summaries.

Resource Forecasting

- Key Point: Predictive analytics
- Functionality: Estimates future energy, water, and waste usage using historical and real-time data.

Eco-Tip Generator

- Key Point: Personalized sustainability advice
- Functionality: Recommends daily actions to reduce

environmental impact based on user behavior.

Citizen Feedback Loop

- Key Point: Community engagement
- Functionality: Collects and analyzes public input to inform city planning and service improvements.

KPI Forecasting

- Key Point: Strategic planning support
- Functionality: Projects key performance indicators to help officials track progress and plan ahead.

Multimodal Input Support

- Key Point: Flexible data handling
- Functionality: Accepts text, PDFs, and CSVs for document analysis and forecasting.

Gradio UI

- Key Point: User-friendly interface
- Functionality: Provides an intuitive dashboard for both citizens and city officials to interact with the assistant.

3.Architecture:

- **Backend (Fast API):**

  Fast API serves as the backend REST framework that powers API endpoints for document processing, chat interactions, eco tip generation, report creation. It is optimized for asynchronous performance and easy Swagger integration.

- **LLM Integration (IBM Granite):**

  Granite LLM models from IBM are used for natural language understanding and generation. Prompts are carefully designed to generate summaries, sustainability tips, and reports.

4. Setup Instructions:

- **Prerequisites:**
  - Python 3.9 or later
  - pip and virtual environment tools
  - Internet access to access cloud services
- **Installation Process:**
  - Clone the repository
  - Install dependencies from requirements.txt
  - Run the backend server using Fast API

- Upload data and interact with the modules

5. Folder Structure:

- app/ – Contains all Fast API backend logic including routers, models, and integration modules.
- Smart City Assistant.py – Handles all communication with IBM Granite model including summarization and chat.
- report_generator.py – Constructs AI-generated sustainability reports.

6. Running the Application

To start the project:

- Launch the FastAPI server to expose backend endpoints.
- Navigate through pages via the sidebar.
- Upload documents or CSVs, interact with the chat assistant, and view outputs like reports, summaries, and predictions.

7. API Documentation Backend

APIs available include:

- POST /chat/ask – Accepts a user query and responds with an AI-generated message
- POST /upload-doc – Uploads and embeds documents in Pinecone GET /search-docs – Returns semantically similar policies to the input query
- GET /get-eco-tips – Provides sustainability tips for selected topics like energy, water, or waste
- POST /submit-feedback – Stores citizen feedback for later review or analytics Each endpoint is tested and documented in Swagger UI for quick inspection and trial during development.

8. Authentication

Each endpoint is tested and documented in Swagger UI for quick inspection and trial during development.

This version of the project runs in an open environment for demonstration. However, secure deployments can integrate:

- Token-based authentication (JWT or API keys)
- OAuth2 with IBM Cloud credentials
- Role-based access (admin, citizen, researcher)
- Planned enhancements include user sessions and history tracking.

9. User Interface

The interface is minimalist and functional, focusing on accessibility for non technical users. It includes:

- Sidebar with navigation
- KPI visualizations with summary cards

- Tabbed layouts for chat, eco tips, and forecasting
- Real-time form handling
- PDF report download capability

The design prioritizes clarity, speed, and user guidance with help texts and intuitive flows.

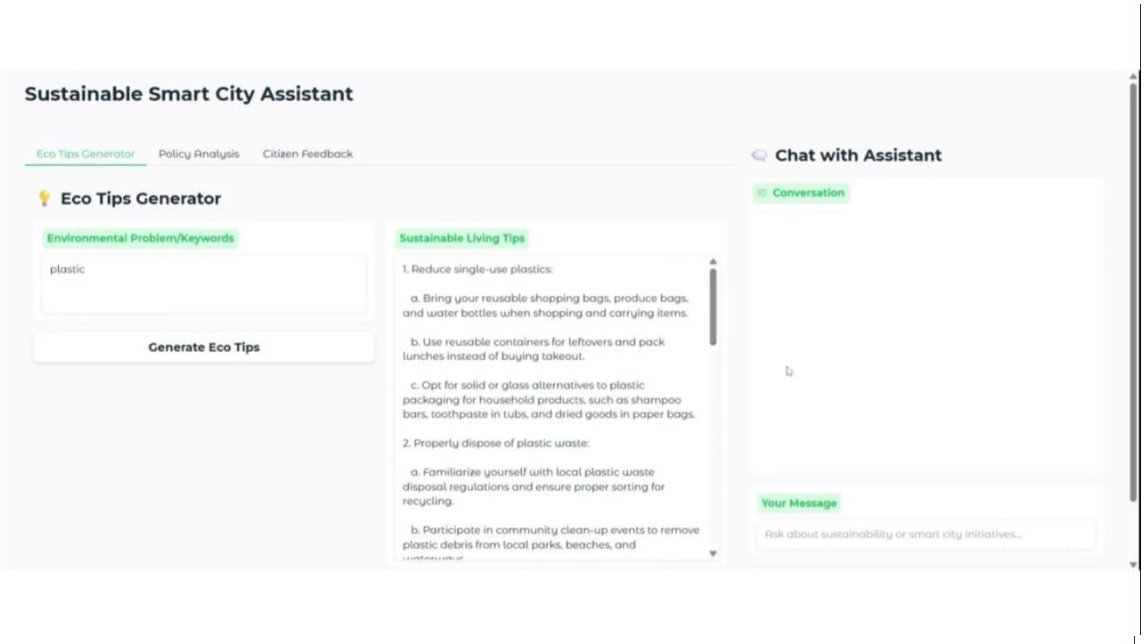
10. Testing

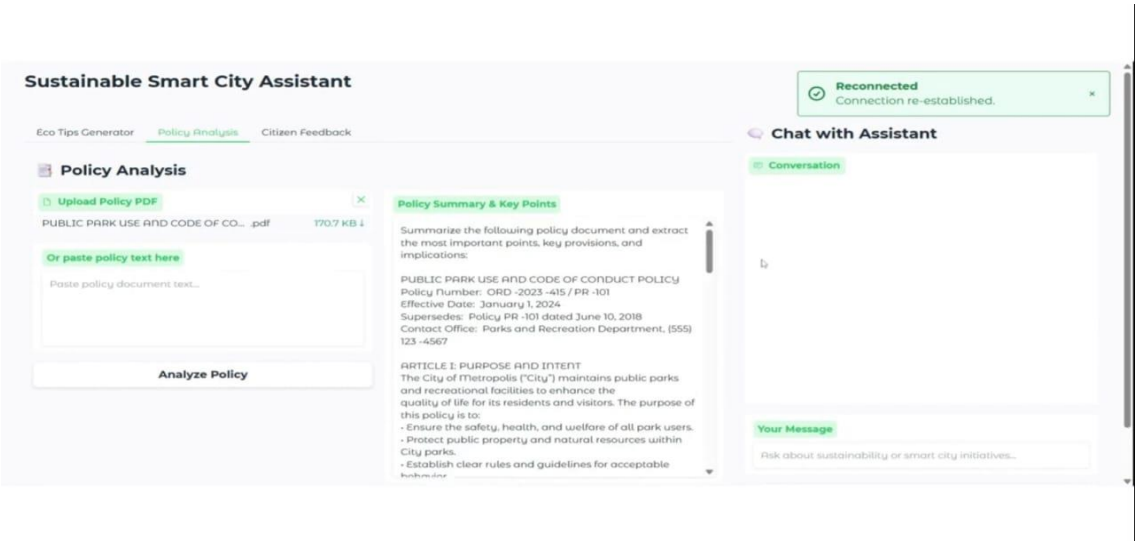
Testing was done in multiple phases:

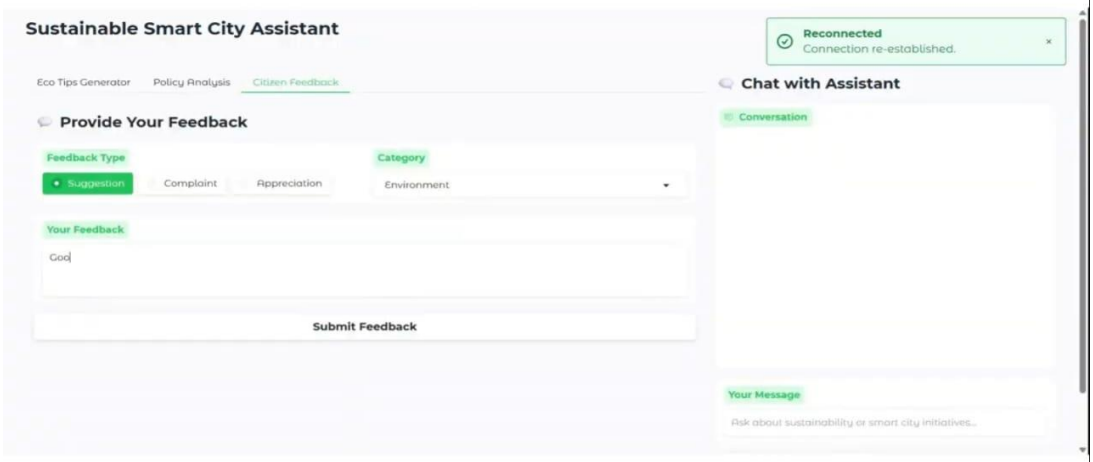
- Unit Testing: For prompt engineering functions and utility scripts
- API Testing: Via Swagger UI, Postman, and test scripts
- Manual Testing: For file uploads, chat responses, and output consistency
- Edge Case Handling: Malformed inputs, large files, invalid API keys
- Each function was validated to ensure reliability in both offline and API connected modes.

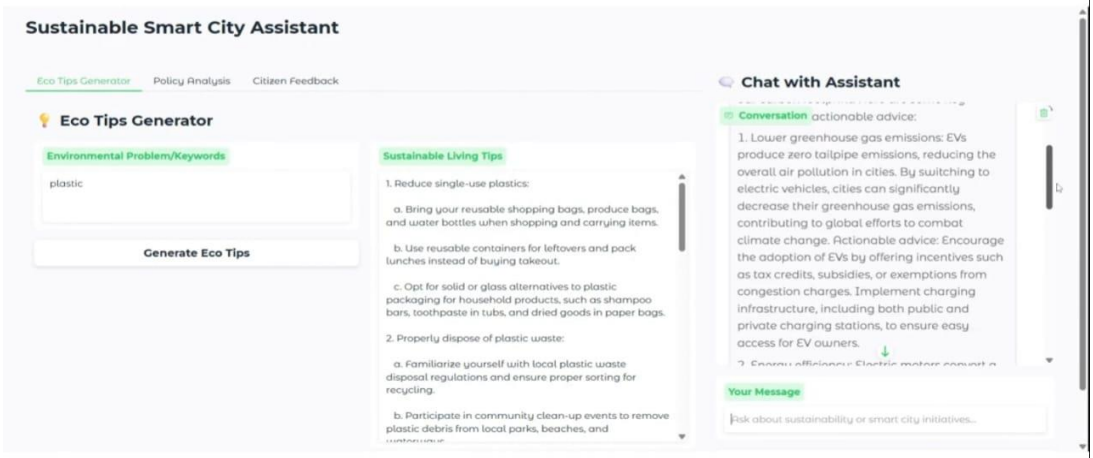
11.Screen shots

ECO TIP GENERATOR






Sustainable Smart City Assistant
Reconnected
Connection re-established.
Eco Tips Generator
Policy Analysis
Citizen Feedback
Provide Your Feedback
Feedback Type
Suggestion
Complaint
Appreciation
Category
Environment
Your Feedback
Goo
Submit Feedback
Chat with Assistant
Conversation
Your Message
Ask about sustainability or smart city initiatives...


Sustainable Smart City Assistant
Eco Tips Generator
Policy Analysis
Citizen Feedback
Eco Tips Generator
Environmental Problem/Keywords
plastic
Generate Eco Tips
Sustainable Living Tips
1. Reduce single-use plastics:
a. Bring your reusable shopping bags, produce bags, and water bottles when shopping and carrying items.
b. Use reusable containers for leftovers and pack lunches instead of buying takeout.
c. Opt for solid or glass alternatives to plastic packaging for household products, such as shampoo bars, toothpaste in tubs, and dried goods in paper bags.
2. Properly dispose of plastic waste:
a. Familiarize yourself with local plastic waste disposal regulations and ensure proper sorting for recycling.
b. Participate in community clean-up events to remove plastic debris from local parks, beaches, and
Chat with Assistant
Conversation
actionable advice:
1. Lower greenhouse gas emissions: EVs produce zero tailpipe emissions, reducing the overall air pollution in cities. By switching to electric vehicles, cities can significantly decrease their greenhouse gas emissions, contributing to global efforts to combat climate change. Actionable advice: Encourage the adoption of EVs by offering incentives such as tax credits, subsidies, or exemptions from congestion charges. Implement charging infrastructure, including both public and private charging stations, to ensure easy access for EV owners.
Your Message
Ask about sustainability or smart city initiatives...