

# Smartbridge

**Team ID:** NM2025TMID00578

**Team Leader:** Bala Chandran s

**Team Member 1:** bala Aravinth k

**Team Member 2:** Akash s

**Team Member 3:** Aasik T

# Sustainable Smart City Assistant – Project Report

---

## 1. INTRODUCTION

### 1.1 Project Overview

Sustainable Smart City Assistant is an AI-powered dashboard designed to enhance sustainability efforts in urban environments. It leverages IBM Watsonx LLM, FastAPI, Streamlit, and machine learning to support data-driven decision-making in areas like anomaly detection, KPI monitoring, policy assistance, and eco-friendly citizen engagement.

### 1.2 Purpose

The primary goal is to empower citizens, city administrators, and sustainability officers with intelligent tools to understand, monitor, and improve urban sustainability metrics effectively.

---

## 2. IDEATION PHASE

### 2.1 Problem Statement

Urban cities face challenges in efficiently managing environmental data, detecting anomalies in utilities, and communicating policies clearly to citizens. Lack of centralization and AI tools makes it harder to achieve sustainability targets.

### 2.2 Empathy Map Canvas

Who: Citizens, City Administrators

Think & Feel: Want clean cities, transparency, eco-solutions

See: Fragmented data, unresponsive systems

Hear: Complaints about pollution, waste, and poor infrastructure

Do & Say: Demand better feedback mechanisms and guidance

### 2.3 Brainstorming

We explored problems like poor air quality tracking, lack of anomaly alerts in water/electricity usage, and the absence of AI-based sustainability chat. The idea evolved into a central dashboard assistant for smart cities.

---

## 3. REQUIREMENT ANALYSIS

### 3.1 Customer Journey Map

User → Enters dashboard → Uploads KPI → Gets insights → Asks policy questions → Receives responses → Gives feedback

### 3.2 Solution Requirements

- Real-time anomaly detection

- Natural language chat assistant
- User-friendly data upload & dashboard
- Feedback collection and eco-suggestions
- Vector-based smart search

### 3.3 Data Flow Diagram

User → Streamlit Frontend → FastAPI Backend →

|→ Watsonx Granite (LLM)

|→ ML Model (Anomaly Detection)

|→ Pinecone (Smart Search Vector DB)

### 3.4 Technology Stack

- Frontend: Streamlit
- Backend: FastAPI
- LLM: IBM Watsonx Granite
- ML: Scikit-learn
- Vector DB: Pinecone
- Embeddings: Sentence Transformers
- Others: Pandas, NumPy, Uvicorn

---

## 4. PROJECT DESIGN

### 4.1 Problem-Solu on Fit

We observed the need for a single platform combining AI, sustainability insights, and interactivity. Our solution provides all-in-one capability to handle KPIs, generate insights, and interact with city data.

### 4.2 Proposed Solu on

A unified assistant that allows:

- CSV upload for KPIs
- Auto anomaly detection
- Feedback collection
- Eco p display
- AI chat with LLM

- Smart semantic search on documents

### 4.3 Solution Architecture

Frontend (Streamlit)

↓

Backend (FastAPI with routers: /chat, /feedback, /eco, /anomaly, /kpi, /vector) ↓

External APIs/Models: IBM Watsonx LLM, Pinecone Vector DB, ML models

---

## 5. PROJECT PLANNING & SCHEDULING

### 5.1 Project Planning

Phase Timeline

Tasks

Week 1 Idea on & UI design Empathy map, wireframes

Week 2 Backend setup FastAPI routes, ML model

Week 3 Frontend integration on Streamlit components

Week 4 Testing & Debugging Unit and performance tests

Week 5 Final deployment GitHub, documentation, screenshots

---

## 6. FUNCTIONAL AND PERFORMANCE TESTING

### 6.1 Performance Testing

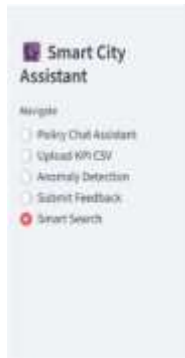
- Response time for chat and anomaly endpoints: < 2s
- Streamlit UI tested across browsers
- API tested using Swagger for correctness

---

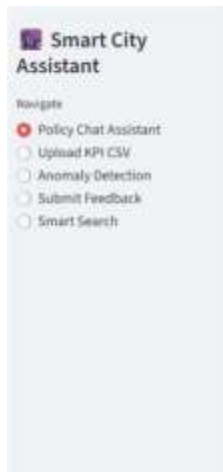
## 7. RESULTS

### 7.1 Output Screenshots

- Home/Dashboard



- Policy Chat Interface



### Policy Chat Assistant

Ask a question about sustainability:

What are the key policies for improving air quality in smart cities?

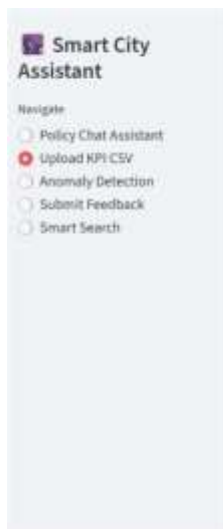
**Ask**

**Chat Response:**

```
{
  "response": "AI says: What are the key policies for improving air quality in smart cities?"
}
```

AI says: What are the key policies for improving air quality in smart cities?

- KPI Upload Form



### Upload KPI CSV

Upload KPI CSV

Drag and drop file here  
Limit: 200MB per file + CSV

**Browse files**

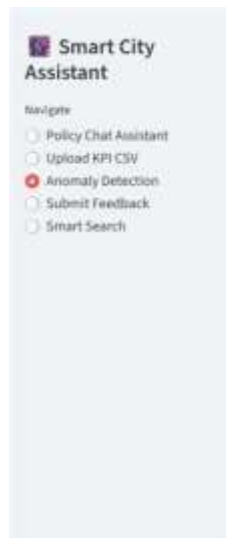
kpi.csv 15.0B

#### CSV Preview

	parameter	value
0	Air Quality	Good
1	Water Consumption	120
2	Energy Usage	455

**Submit**

- Anomaly Detect on Results

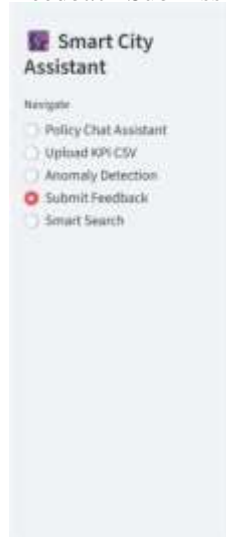


 A form titled 'Anomaly Detection' with a magnifying glass icon. It includes a label 'KPI Metric (e.g., Water Consumption)' above a text input field containing 'Air quality'. Below this is a 'Value' section with a text input field containing '200.00' and minus/plus icons. A 'Check Anomaly' button is positioned below the value field. Underneath is a 'Backend Response:' section with a code block showing a JSON object: 

```
{  "anomaly": true,  "metric": "Air quality"}
```

. At the bottom, a red alert box displays a warning icon and the text 'Anomaly Detected in Air quality!'.

- Feedback Submission Form



 A form titled 'Citizen Feedback' with a speech bubble icon. It includes a 'Your Name' label above a text input field containing 'Madhu'. Below this is a 'Type of Issue' label above a dropdown menu showing 'Garbage'. A 'Describe the Issue' label is above a text area containing 'Please clean'. A 'Submit Feedback' button is located below the text area. At the bottom, a green success message box says 'Thanks for your feedback!'.

---

## 8 ADVANTAGES & DISADVANTAGES

### Advantages

- Integrates LLM, ML, and search in one dashboard
- Interactive and intuitive design
- Customizable for any smart city

### Disadvantages

- Requires internet connectivity
- LLM inference may be costly without free- or APIs
- Limited KPI formats (currently only CSV)

---

## 9. CONCLUSION

The Sustainable Smart City Assistant showcases the effective use of AI and data science in urban development. It simplifies sustainability tracking and promotes actionable insights for citizens and administrators.

---

## 10. FUTURE SCOPE

- Expand data formats (Excel, JSON)
- Add alert notifications via email/SMS
- Enable real- me IoT sensor integra on
- Mul -language chat support
- Admin login and role-based access