Project Design Phase-II

Technology Stack (Architecture & Stack)

Date	27 June 2025
Team ID	LTVIP2025TMID31710
Project Name	Sustainable Smart City AI Assistant with IBM Granite LLM
Maximum Marks	4 Marks

Table 1 – Component-wise Stack

Category	**Tools / Technologies Used**	**Purpose / Description**
Frontend & UI	Streamlit	Lightweight Python framework to build interactive dashboards and web apps
Data Visualization	Plotly	For generating interactive line charts, metrics, and forecast visualizations
APIs	OpenWeatherMap, TomTom, IBM Granite	To fetch real-time weather, pollution, traffic, energy data, and use LLM services
AI / LLM	IBM Watsonx Granite LLM	For chatbot interaction and document summarization in natural language
Machine Learning	Prophet, scikit-learn	Prophet: 5-year KPI forecasting; scikit-learn: anomaly detection
Data Processing	Pandas, NumPy	Handling CSV uploads, data cleaning, transformation, and analysis
File Handling	PyPDF2, python-docx	Extracting text from uploaded PDF/DOCX files for summarization
Environment Management	python-dotenv, Streamlit Secrets	Securely managing API keys using env locally and secrets on deployment

Category	Tools / Technologies Used	Purpose / Description
Cloud Deployment	Streamlit Cloud	Hosting the app publicly with version control through GitHub
Version Control	GitHub	Managing code versions, collaboration, and CI/CD integration

Table 2 – Application Characteristics

S.No	Characteristic	Description	Technology
1	**Open-Source Frameworks**	**Streamlit, pandas, NumPy, Plotly, Prophet, scikit-learn**	**Python OSS stack**
2	**Security Implementations**	**API keys stored in .env and in security keys while deploying on streamlit cloud**	**Streamlit Secrets**
3	**Scalable Architecture**	**Stateless Streamlit containers; modular API calls; cloud auto-scale**	**Streamlit Cloud container pool**
4	**Availability**	**24/7 hosting with automatic restart and health checks**	**Streamlit Cloud uptime, GitHub CI/CD**

Key References

1. **Streamlit documentation – https://docs.streamlit.io/**
2. **IBM Watsonx AI / Granite – https://dataplatform.cloud.ibm.com/docs/content/wsj/analyze-data/fm-models.html**
3. **OpenWeatherMap API – https://openweathermap.org/api**
4. **TomTom Traffic API – https://developer.tomtom.com**

   Prophet forecasting library – https://facebook.github.io/prophet/
5. **scikit-learn Isolation Forest – https://scikit-learn.org/stable/modules/outlier_detection.html#isolation-forest**
6. **Streamlit Cloud deployment guide – https://docs.streamlit.io/streamlit-community-cloud**