SUSTAINABLE SMART CITY ASSISTANT USING IBM GRANITE LLM

Project Documentation

1.Introduction:

- **Project title:** Sustainable smart city assistant using IBM GRANITE LLM
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2.Project Overview:

Purpose:

The purpose of this application is to use artificial intelligence to promote environmental awareness and simplify the process of analyzing environmental policies. The system provides users with practical eco-friendly tips and an easy-to-use tool for summarizing complex policy documents. This improves access to information on sustainability and makes it easier for individuals and organizations to understand and act on environmental issues.

Features:

Eco Tips Generator:

- The application takes keywords related to environmental problems (e.g., plastic waste, water conservation).
- It generates practical and actionable tips for sustainable living.

Policy Summarization:

- Users can upload a policy document in PDF format or paste the text directly.
- The system summarizes the key points, provisions, and implications of the document.

User interface:

The interface is simple to use with two main tabs: one for generating eco tips and one for policy summarization.

Customizable:

The application allows users to input their own keywords and policy documents, making the output highly relevant to their specific needs.

Saves time:

It helps in quickly finding eco-friendly solutions and rapidly analyzing large policy documents, significantly reducing manual effort.

3. Architecture:

Frontend (Gradio):

The frontend is built with Gradio, which provides a simple and interactive web-based interface. The UI is divided into two main tabs for different functionalities. Gradio handles the user input (text boxes, file uploads) and displays the AI-generated output.

Backend (Python):

The backend runs on Google Colab and uses Python. It manages the core logic of the application, including model loading, input processing, and interaction with the AI model.

LLM Integration (IBM Granite):

The project integrates the IBM Granite 3.2-2B-Instruct LLM from Hugging Face for natural language understanding and generation. The model is responsible for generating eco tips from keywords and summarizing the content of policy documents.

PDF Processing (PyPDF2):

The system uses PyPDF2 to extract plain text from uploaded PDF documents. This extracted text is then passed to the Granite model for summarization.

4. Setup Instructions:

Prerequisites:

- Google account to access Google Colab.
- A stable internet connection to install the libraries and download the model.
- A Hugging Face account is recommended to manage API access.

Installation process:

- Open Google Colab.
- Create a new notebook.
- Change the runtime to T4-GPU for faster performance.
- In the first cell, install the necessary Python libraries using pip.
- Copy and paste the provided code into the next cell and run it.

5. Folder Structure:

Since the project is run within a single Google Colab notebook, the folder structure is simple, with one main file.

Structure:

```
project/
        sustainablesmartcity.ipynb
```

6. Running The Application:

- Run the code cell in Google Colab.
- The app.launch(share=True) command will generate a public Gradio link.
- A URL will be displayed in the terminal output (e.g., https://xxxxxx.gradio.live).
- Click this link to open the web application in a new browser tab.
- The application is now ready to use. Users can switch between the Eco Tips Generator and Policy Summarization tabs to access the functionalities.

7. API Documentation:

This application's functionality is accessed through its web interface, not through traditional REST API endpoints. The core logic is contained in the following Python functions:

- ***eco_tips_generator(problem_keywords):*** - This function takes a string of keywords and generates eco-friendly tips using the LLM.
- ***policy_summarization(pdf_file, policy_text):*** - This function processes either an uploaded PDF file or pasted text and uses the LLM to create a summary of the content.

Each function leverages the IBM Granite model to perform its task, which is hosted and accessed via the transformers library.

8.User Interface:

- **Tabs:** The interface is organized into two tabs: "Eco Tips Generator" and "Policy Summarization."
- **Inputs:** Users interact with text boxes and a file upload component (gr.File) to provide their inputs.
- **Buttons:** "Generate Eco Tips" and "Summarize Policy" buttons trigger the AI models.
- **Textboxes for Input/Output:** Simple text areas are used for both user input and displaying the final results.
- **Public/Local Link:** Gradio's share=True option provides a publicly accessible URL, allowing the interface to be used from any device with a browser.

9. Testing:

- **Function Testing:** Verify that both the Eco Tips and Policy Summarization functions produce correct and relevant output based on their inputs.
- **PDF Handling:** Test the policy summarization function with different types of PDFs (e.g., multi-page documents, single-page files) to ensure text extraction is robust.
- **Model Response Check:** Confirm that the generated responses are coherent, readable, and do not cause the application to crash.

- **Cross-Device Access:** Check that the public Gradio link works correctly on both desktop and mobile browsers.

10. Known Issues:

- **Performance:** The application may run slowly on a weak internet connection or if the GPU runtime is not enabled.
- **Inaccuracy:** The LLM may occasionally generate inaccurate or incomplete tips or summaries.
- **Security:** The current setup lacks authentication. Anyone with the public Gradio link can access the application.
- **Offline Use:** The application requires Google Colab to run, so it cannot be used offline.

11.Future Enhancements:

1. Better Security and Privacy:

- Add a login system so only registered users can access the app.
- Track usage to prevent misuse and see which features are most popular.

2. More Features:

- Handle more file types like Word documents (.docx) and plain text (.txt) for policy summaries.
- Add a download button to save generated content.
- Make it a chatbot for a more interactive and conversational experience.
- Allow multiple users to work on the same task together.

3. Improved User Experience:

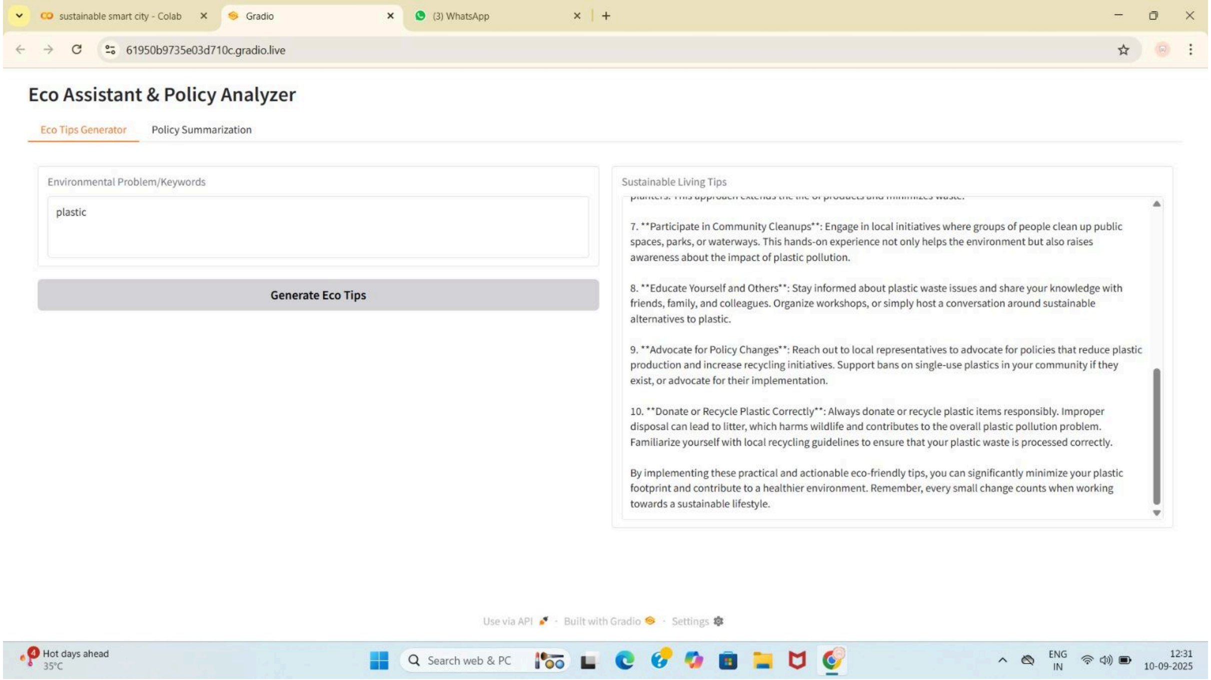
- Give it a better look with different themes and colors.
- Make it phone-friendly so it works on any device.
- Add loading animations to show that the app is working on a request.

4. A Stronger App:

- Run it on a server instead of Google Colab so it's always available.
- Create simple "building blocks" (APIs) so other developers can use the app's functions in their own projects.

12. Screenshot:

Output:



Eco Assistant & Policy Analyzer

Environmental Problem/Keywords

plastic

Sustainable Living Tips

planters. This approach extends the life of products and minimizes waste.

7. **Participate in Community Cleanups**: Engage in local initiatives where groups of people clean up public spaces, parks, or waterways. This hands-on experience not only helps the environment but also raises awareness about the impact of plastic pollution.

8. **Educate Yourself and Others**: Stay informed about plastic waste issues and share your knowledge with friends, family, and colleagues. Organize workshops, or simply host a conversation around sustainable alternatives to plastic.

9. **Advocate for Policy Changes**: Reach out to local representatives to advocate for policies that reduce plastic production and increase recycling initiatives. Support bans on single-use plastics in your community if they exist, or advocate for their implementation.

10. **Donate or Recycle Plastic Correctly**: Always donate or recycle plastic items responsibly. Improper disposal can lead to litter, which harms wildlife and contributes to the overall plastic pollution problem. Familiarize yourself with local recycling guidelines to ensure that your plastic waste is processed correctly.

By implementing these practical and actionable eco-friendly tips, you can significantly minimize your plastic footprint and contribute to a healthier environment. Remember, every small change counts when working towards a sustainable lifestyle.