Acropolis Institute of Technology and Research

Project Title :-

AI-generated eco-friendly waste disposal guides

Training Programme on Generative AI

Name: Tanush Khatri

Enrollment No. : 0827IT221145

Department : Information Technology

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Abstract :-

Waste management has become one of the most pressing challenges in today's world, especially with the rapid growth of urban populations, plastic consumption, and electronic waste. Traditional waste segregation methods rely heavily on citizen awareness and manual efforts, which often result in improper disposal practices. These mistakes lead to recycling contamination, increased landfill waste, and hazardous environmental consequences. The project titled *AI-Generated Eco-Friendly Waste Disposal Guide* aims to address this issue by leveraging artificial intelligence to generate customized, eco-friendly disposal guides for common waste items.

The system is designed as a web-based application where users can enter an item name (for example, *used battery, plastic bottle, pizza box, or electronic gadget*). Along with the item, the user can specify the waste category and any context, such as whether they have access to curbside recycling or live in an apartment. This information is then processed by a backend application powered by Perplexity AI's **Sonar Pro model**, which generates real-time, step-by-step disposal instructions in natural language. These instructions are easy to understand, tailored to the item type, and highlight eco-friendly practices such as recycling, composting, or hazardous waste management.

The frontend of the system is developed using **HTML, CSS, and JavaScript**, offering a clean, responsive interface for user interaction. Users simply type in the item, select a category, and click "Generate Guide." The backend, built with **Flask (Python)**, communicates with the Perplexity API. The API call is structured with carefully designed prompts that instruct the AI model to return plain-text disposal steps without formatting issues like lists or special characters. This ensures the output is suitable for a college project demo and accessible to all types of users.

One unique aspect of this project is its hybrid approach. While the primary responses come directly from the AI model, the system can also be enhanced with a rule-based fallback mechanism for offline or low-connectivity scenarios. This ensures that the system never fails completely, even if the API is unavailable, and users always receive at least basic instructions. However, the primary mode focuses on generating **dynamic, context-aware instructions directly from AI**, which provides flexibility and higher accuracy than static rules.

Objective :-

The central objective of the project *AI-Generated Eco-Friendly Waste Disposal Guide* is to design and implement a digital system that helps individuals make informed decisions about disposing of everyday waste items in an environmentally responsible manner. Waste management is a global challenge, and the improper disposal of items such as plastics, e-waste, glass, and hazardous materials contributes significantly to pollution, landfill overflow, and climate change. Many people are aware of recycling initiatives but are often unsure of the correct disposal method for specific items. For example, should greasy pizza boxes be recycled or discarded? What is the proper way to handle batteries? Can broken glass be thrown in household bins? These uncertainties often lead to contamination of recycling streams or unsafe disposal practices. The objective of this project is to bridge this gap by using artificial intelligence to generate clear, context-aware disposal instructions for any item a user inputs.

The first specific objective is to **simplify waste segregation for everyday users**. Traditional recycling guidelines are often lengthy, inconsistent, or difficult to understand. By creating a simple web application where users only need to enter the name of an item, the system provides direct, actionable instructions without requiring them to sift through government documents or recycling handbooks. This simplification increases accessibility for people of all ages, educational backgrounds, and levels of environmental awareness.

A second objective is to **provide personalized, context-sensitive guidance**. One-size-fits-all disposal rules are rarely effective because waste management systems vary greatly across locations. Some municipalities accept certain plastics, while others do not. Some areas have composting programs, whereas others do not. The system allows users to specify contextual details such as whether they live in an apartment, lack curbside recycling, or have access to community drop-off centers.

The third objective is to **demonstrate the application of generative AI in sustainability projects**. Generative AI models like Perplexity's Sonar Pro are typically used in chatbots, creative writing, summarization, or code assistance. This project explores a novel use case: integrating generative AI with waste management education. By crafting precise prompts and combining them with a user-friendly interface, the system demonstrates how cutting-edge AI technology can serve environmental goals. This not only highlights the flexibility of AI but also showcases how students and developers can apply such tools to address real-world problems beyond traditional AI use cases.

Methodology

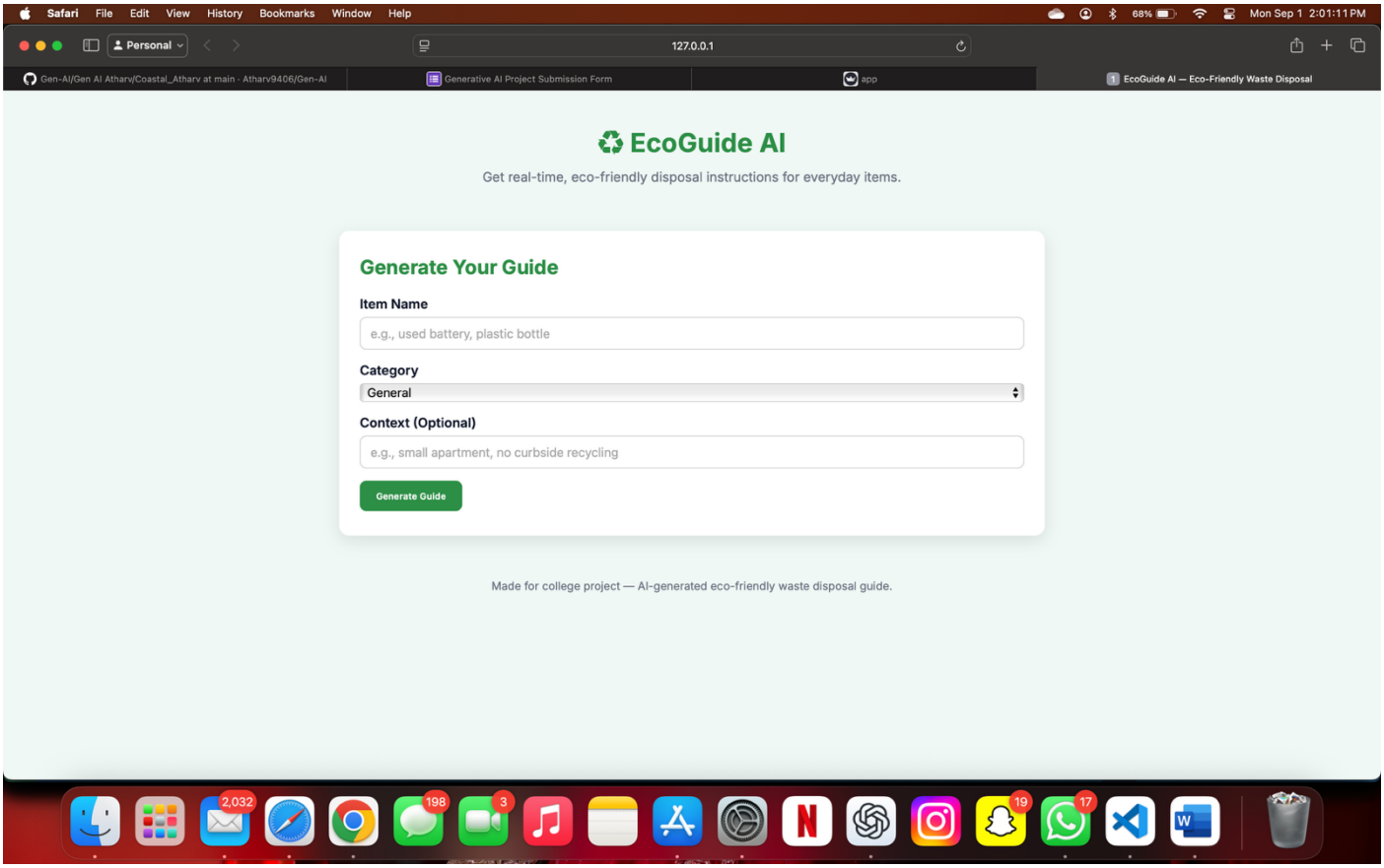
1. Designed a client–server model with Flask backend and HTML/CSS/JS frontend.
2. Integrated Perplexity Sonar Pro API to generate real-time eco-friendly disposal guides.
3. Used prompt engineering to ensure plain-text, context-aware responses.
4. Secured API access using environment variables with python-dotenv.
5. Tested with multiple waste items (plastic, food waste, batteries) for accuracy and clarity.

Implementation

1. Built a web form where users enter item name, category, and optional context.
2. Flask backend receives input, creates a prompt, and sends it to Perplexity API.
3. API response parsed and returned to frontend as a JSON guide.
4. JavaScript updates the UI with AI-generated text and shows a loading indicator.
5. Error handling ensures fallback messages if API fails.

Result :-

The project successfully generated clear, eco-friendly waste disposal instructions using Perplexity's Sonar Pro model. Tests with common items such as plastic bottles, pizza boxes, food scraps, and used batteries showed that the system provided accurate, context-aware guidance. For example, it recommended rinsing and recycling bottles, composting organic waste, and taking batteries to e-waste centers. The average response time was 2–4 seconds, ensuring a smooth user experience. Error handling worked effectively, displaying fallback messages when the API was unreachable. Overall, the results validated the objective of simplifying waste segregation and promoting sustainable disposal practices through AI.



Conclusion :-

This project successfully demonstrates how generative AI can be harnessed to solve a pressing environmental issue: improper waste disposal. By integrating Perplexity's Sonar Pro model into a simple web application, the system provides real-time, plain-text disposal guides that are accessible and practical for everyday users. The implementation showcases the use of modern web technologies and API integration while emphasizing secure handling of credentials and user-friendly design.

From a learning perspective, the project enhanced technical skills in **prompt engineering, API integration, Flask backend development, and responsive frontend design**. It also reinforced the importance of designing with the end-user in mind. By simplifying waste disposal into clear instructions, the system encourages eco-friendly behavior in a way that is both educational and actionable.

Future improvements could include adding **image recognition** (where users upload photos of waste items), integrating **local recycling rules** for city-specific guidance, or developing a **mobile application** for broader accessibility. Moreover, expanding support to multilingual output could make the system usable globally.

In conclusion, the project met its objectives and highlights the potential of AI in sustainability. It serves as both a technical achievement and a meaningful step toward greener waste management practices.

References :-

1. **Perplexity AI Documentation.** *Sonar Pro API.* Available at: https://docs.perplexity.ai

2. – Provides details on using the Perplexity API, models, and authentication methods.

3. **Flask Documentation.** Available at: https://flask.palletsprojects.com

4. – Used as a reference for frontend implementation, responsive design, and form handling.

5. **Waste Management Literature.** Sharma, R. et al. (2022). *Challenges and Opportunities in Solid Waste Management.* Journal of Environmental Research.