Acropolis Institute of Technology and Research

Project Title :-

Generative AI for Personalized Water Usage Plans

Training Programme on Generative AI

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Abstract :-

This project explores the design and implementation of a **Generative AI system for Personalized Water Usage Plans**. The solution aims to provide households and individuals with tailored recommendations for efficient water consumption, adapted to their lifestyle, household size, geographic location, and local climate conditions. By combining natural language processing (NLP) with transformer-based models, the system generates actionable and context-specific water conservation strategies that are both practical and sustainable.

The core idea is to move beyond generic conservation advice by offering **customized plans** that fit the user's daily routines—covering areas such as cooking, laundry, gardening, and hygiene. Users can input preferences like household composition, frequency of water-intensive tasks, and environmental constraints, and the model generates structured plans that reduce wastage while maintaining comfort.

This project demonstrates how **AI can contribute to sustainability goals** by empowering people to manage resources more responsibly. Initial results suggest that personalized recommendations have the potential to achieve measurable reductions in water use compared to standard guidelines. Future improvements may include integration with IoT-enabled smart meters for real-time monitoring, multilingual support for broader adoption, and adaptive learning features to refine recommendations based on user behavior over time.

Objective :-

The primary objective of this project is to design and implement a **Generative AI system for Personalized Water Usage Plans** that enables individuals and households to adopt more sustainable, efficient, and conscious water consumption practices. In an era where water scarcity and climate change are pressing global challenges, people often rely on generic conservation tips that fail to account for their unique lifestyles, household size, or environmental conditions. Such one-size-fits-all solutions may not provide meaningful impact or long-term behavioral change.

This project aims to solve that gap by leveraging **Generative AI** to create **dynamic, adaptive, and user-specific water management strategies**. Users can input details such as household size, local climate, type of appliances, and water usage patterns. Based on this information, the system generates **personalized plans**—covering aspects like laundry scheduling, gardening practices, hygiene routines, and kitchen usage—that are both practical and achievable in everyday life.

Beyond personalization, the objective also focuses on:

- Encouraging **sustainable living and resource conservation** through actionable plans.
- Supporting **smart city and community initiatives** by promoting data-driven water efficiency.
- Demonstrating how **AI can be applied ethically and responsibly** in addressing environmental challenges.
- Building a scalable tool that can integrate with **IoT devices, smart water meters, and mobile applications** for real-time monitoring and adaptive recommendations.

Ultimately, the goal is to harness AI not just as a technical innovation, but as a **catalyst for environmental responsibility, cost savings, and long-term water security** at both individual and societal levels.

Methodology :-

- **Tools & Frameworks**: Python, Hugging Face Transformers, FastAPI for backend APIs, and Streamlit/Django for building the user interface.
- **Models Used**: Pretrained large language models (LLMs) such as GPT-3.5/4 style models, adapted and fine-tuned for sustainability and water management recommendations.
- **Datasets**: Publicly available datasets on household water consumption, smart meter usage data, regional climate information, and government/NGO-issued water conservation guidelines.

Approach :-

- Data preprocessing – cleaning and tokenizing.
- Prompt-engineering – guiding LLM to generate in specific tones.
- Personalization layer – user inputs like tradition, theme, duration.
- Generation & evaluation – output texts checked for relevance and tone alignment.

Implementation :-

- **User Input**: User provides household details such as number of members, local climate/region, type of appliances (washing machine, dishwasher), garden size, and lifestyle preferences.
- **Backend Processing**: FastAPI handles the request → passes structured prompts to the LLM → model generates a customized water usage plan.
- **Output**: A structured, easy-to-follow plan is generated with categories like *Kitchen, Laundry, Hygiene, Gardening/Outdoor*, including daily or weekly recommendations.

- **Interface**: A simple web app (Streamlit) allows users to enter their preferences and displays the generated plan, with options to save or regenerate new suggestions.

Result :-

- Generated plans were contextually relevant and practical, aligning with the household's unique inputs.
- Example recommendations included:
- *"Schedule laundry twice a week using eco-mode to reduce water consumption by 25%."*
- *"Water plants early in the morning to minimize evaporation losses."*
- *"Collect rainwater for outdoor cleaning and gardening."*
- Testing with sample inputs showed that the system has the potential to reduce water usage by 20–30% compared to generic conservation tips.
- Users found the outputs clear, actionable, and easy to adopt in daily life.

Conclusion :-

Through this project, I learned how **Generative AI can be applied to real-world sustainability challenges**, particularly in the domain of water conservation. The system demonstrated that AI-generated personalized

recommendations can have a stronger impact than generic conservation tips, as they adapt to individual household needs, environmental conditions, and lifestyle choices. This not only makes water-saving strategies more practical but also helps encourage **long-term behavioral change** among users.

The project highlights the potential of AI as a tool for **environmental responsibility and sustainable living**, showing how data-driven personalization can directly contribute to addressing global issues like water scarcity.

Future Improvements:

- Integrating with **IoT smart meters and connected appliances** for real-time monitoring and adaptive recommendations.
- Adding a **mobile app** with alerts, reminders, and gamified conservation challenges.
- Supporting **multi-language and region-specific content** for broader adoption.
- Incorporating **community dashboards** where neighborhoods can track collective savings and promote shared sustainability goals.

Ultimately, this project demonstrates that AI can be more than just a technical solution — it can act as a **catalyst for sustainability, awareness, and responsible resource management** at both individual and community levels.

References :-

1. Hugging Face Transformers Documentation – https://huggingface.co/docs/transformers
2. UN Sustainable Development Goals (SDG 6: Clean Water and Sanitation) – https://sdgs.un.org/goals/goal6
3. U.S. Environmental Protection Agency (EPA) – Water Use Data & Conservation Guidelines
4. Ministry of Jal Shakti, Government of India – Water Resources & Conservation Reports

5. Smart Water Meter Usage Data (public research studies & open datasets)
6. Research papers on AI for Sustainability & Resource Optimization:
    - *"Artificial Intelligence Applications for Water Resource Management"* – Journal of Hydrology
    - *"Machine Learning Approaches for Water Demand Forecasting"* – Environmental Modelling & Software