
CAPSTONE PROJECT

Smart Home Energy Advisor Agent

Presented By:

1. Ashwini Panicker- MVLU- IT (graduated)

OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

A Smart Home Energy Advisor Agent acts like your personal electricity manager.

It takes information from your smart meter and appliances, analyzes power usage, and gives you tips to save energy. The agent can answer questions like "Why is my bill so high this month?" or "What time should I run the washing machine to save money?". It uses AI to understand consumption patterns and provide simple recommendations.

PROPOSED SOLUTION

- To support energy conservation and provide personalized energy management, this project proposes a **Smart Home Energy Advisor chatbot** using AI and IBM Cloud services. The chatbot analyzes household energy usage data and provides actionable insights to reduce electricity costs and improve consumption behavior.
- **Data Collection:**
 - Simulate or collect smart meter data including total kWh usage, appliance-wise consumption, and time-of-day usage.
 - Use realistic patterns to reflect seasonal changes, peak/off-peak usage, and appliance behavior.
- **Data Preprocessing:**
 - Clean and structure the usage data for analysis.
 - Segment usage by appliance and time window (peak/off-peak) to enable meaningful insights.
- **AI Model Integration:**
 - Use the **IBM Watsonx Granite model** for natural language understanding and generating responses.
 - Embed a system prompt to enable the model to act as an energy advisor.
- **Response Logic & Evaluation:**
 - Test the chatbot with queries like *“Why is my bill high?”* or *“When should I run the washing machine?”*
 - Evaluate whether the responses are personalized, helpful, and data-aware.
- **Result Interpretation:**
 - Highlight the chatbot’s ability to identify high-usage appliances, peak-hour habits, and inefficient patterns.
 - Use example outputs to visualize how users can save energy and reduce bills.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the rental bike prediction system. Here's a suggested structure for this section:

- **System requirements:**
 - **Platform:** IBM Cloud
 - **Tools:** Watsonx.ai Studio (Granite AI model), IBM Cloud Object Storage
 - **Interface:** AI Chatbot Agent

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**

- We used the **IBM Watsonx Granite AI model**, a large language model (LLM), ideal for understanding user queries and generating personalized energy-saving responses. It was selected for its ability to interpret natural language and analyze contextual data.

- **Data Input:**

The agent uses user-provided data such as:

- Total energy usage (kWh)
- Appliance-wise consumption
- Peak vs off-peak usage times
- Monthly usage comparisons
- **Training Process:**
 - The LLM is pre-trained by IBM; no custom training was required.
 - We used **prompt engineering** to guide the AI's behavior and simulate data-based reasoning.
- **Prediction Process:**
 - When a user inputs their data and a question (e.g., "Why is my bill high?"), the AI analyzes patterns, compares past and present usage, and outputs energy-saving tips or appliance-level insights.

RESULT

We successfully built a Smart Energy Advisor chatbot using **IBM Watsonx Granite AI**.

The agent analyzes user-provided energy data (like total kWh, appliance usage, and peak hours) and gives **personalized responses** to questions such as:

“Why is my bill high?” and **“When should I run the washing machine?”**

The chatbot responds intelligently using prompt-based reasoning and helps users make better energy decisions.

RESULT

Framework

LangGraph



Architecture

ReAct



Instructions

[Advanced configuration](#)

You are a Smart Home Energy Advisor. Analyze energy usage data to explain why the user's electricity bill is high. Compare current and previous consumption, identify appliances with increased usage, and provide specific, actionable tips. If no data is given, respond with general reasons and ask for data. If specific off-peak time data isn't available, assume that off-peak hours are from 10 PM to 6 AM and base suggestions on that. Mention that actual times may vary.

Knowledge



Tools



RESULT



You: 02:54 PM

Why is my bill high this month?



watsonx Agent 02:54 PM

I'm sorry for the inconvenience. To provide an accurate analysis, I would need to review your energy usage data. Could you please share your current and previous months' consumption details? This should include the total kilowatt-hours (kWh) used and the corresponding costs. With this information, I can identify any appliances with increased usage and provide specific, actionable tips to help reduce your electricity bill.

► How did I get this answer?

RESULT



You: 02:55 PM

Total energy usage this month: 480 kWh Last month: 320 kWh Air Conditioner: 200 kWh Washing Machine: 70 kWh Peak hour usage: 280 kWh Off-peak usage: 150 kWh



watsonx Agent 02:55 PM

Thank you for providing the data. Your energy consumption has increased by 160 kWh this month compared to last month, leading to a higher bill. The significant increase is primarily due to your air conditioner, which has used 200 kWh this month, a 130 kWh increase.

Air conditioners are notorious for high energy consumption, especially during peak hours. Since you've used 280 kWh during peak hours, I recommend shifting some of your air conditioner usage to off-peak hours.

Additionally, consider the following tips:

1. **Air Conditioner Optimization:** Set your thermostat a few degrees higher when you're not home or sleeping. For every degree higher, you could save around 6-8% on cooling costs.
2. **Washing Machine Efficiency:** Try to run your washing machine only when you have a full load. Also, consider switching to cold water washes when possible, as heating water accounts for nearly 90% of the energy used by washing machines.
3. **Off-Peak Usage:** Utilize off-peak hours (10 PM to 6 AM, assuming this is your off-peak period) for running high-energy appliances like your washing machine and air conditioner if possible.
4. **Regular Maintenance:** Ensure your appliances are regularly maintained. A well-maintained air conditioner operates more efficiently, saving energy and money.
5. **Energy-Efficient Appliances:** If your current appliances are old, consider upgrading to energy-efficient models. They can significantly reduce your energy consumption.

Please note that off-peak hours can vary based on your utility provider, so it's best to confirm these times with them.

RESULT



You: 02:55 PM

What is the best time to use the washing machine?



watsonx Agent 02:55 PM

Based on the standard off-peak hours (10 PM to 6 AM), this would be the most energy-efficient time to operate your washing machine. During these hours, the electricity rate is typically lower, which can help reduce your overall energy costs. However, please confirm these off-peak hours with your specific utility provider as they can vary.

Also, consider running your washing machine overnight when you're less likely to be at home to maximize efficiency.

► How did I get this answer?

CONCLUSION

- The Smart Home Energy Advisor demonstrates how AI can help users understand and manage their electricity usage.

By leveraging IBM Watsonx Granite AI, the chatbot provides personalized, data-driven advice to reduce energy costs and promote efficient consumption.

This solution supports sustainable living through intelligent home automation.

FUTURE SCOPE

- **Real-time Smart Meter Integration:** Connect with IoT-based smart meters for live energy monitoring.
- **Voice Assistant Support:** Integrate with Alexa, Google Assistant for voice-based energy advice.
- **Dynamic Tariff Alerts:** Notify users about peak/off-peak pricing changes from utility providers.
- **Mobile App Deployment:** Offer a user-friendly mobile app for on-the-go energy insights.
- **Personalized Energy Goals:** Set and track monthly consumption targets for sustainable living.

REFERENCES

- IBM, “watsonx.ai – Build, Tune, and Deploy Foundation Models,” IBM. [Online]. Available: <https://www.ibm.com/products/watsonx-ai>
(Used for building the AI agent with Granite model)
- IBM, “Granite Foundation Models,” IBM Blog. [Online]. Available: <https://www.ibm.com/blog/announcing-granite-models>
(Describes the AI model you used for natural language responses)
- IBM, “IBM Cloud Lite,” IBM. [Online]. Available: <https://www.ibm.com/cloud/free>
(Used as the platform to host your project)
- IBM Documentation – Watsonx.ai Studio
(Used to develop, test, and run the chatbot interface)

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