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# CAPSTONE PROJECT

## SMART HOME ENERGY ADVISOR AGENT

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# OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result (Output Image)
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- Future Scope
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# PROBLEM STATEMENT

**Example:** 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

The proposed system is an **AI-powered Smart Home Energy Advisor Agent** that acts as a personal electricity manager for homeowners. It leverages smart meter data and connected appliance usage to provide **real-time insights**, **usage analysis**, and **energy-saving recommendations** through a conversational AI interface. The solution utilizes **IBM Cloud** for data integration and **Watsonx.ai** to power the AI advisory system.

## •Data Ingestion & Storage (IBM Cloud)

Use IBM Cloud services to:

- Ingest data from smart meters and appliances (via MQTT/REST APIs)
- Store structured data in IBM Cloud Object Storage or IBM Db2
- Prepare data pipelines using IBM DataStage or IBM Streams

## AI Advisory System (Watsonx.ai)

Use Watsonx.ai to:

- Load and preprocess smart energy data
- Analyze user-specific usage patterns, detect spikes, trends, and anomalies
- Respond to natural language queries from users like:
  - "Why is my bill so high?"
  - "How can I lower my energy usage this week?"
  - "When is the cheapest time to run the dryer?"

AI Logic Includes:

- Time-of-use pricing analysis
- Load shifting suggestions
- Behavior-based tips
- Detection of high-consumption appliances

# SYSTEM APPROACH

It includes **input sources**, **processing layers**, **AI logic**, and **output to the user**. This modular and scalable architecture ensures smooth integration between IoT data, cloud services, and AI models.

## 1. Input Layer – Data Sources

**Smart Meters:** Provide real-time or batch electricity usage data (timestamped kWh readings).

**User Inputs:** Natural language queries like “Why is my bill so high?” or “How can I save energy this week?”

## 2. Cloud Integration – IBM Cloud Services

**Data Ingestion:** Use IBM IoT Platform or custom APIs to receive real-time or batch data.

**Data Storage:** Store structured usage data in:

- IBM Cloud Object Storage

- IBM Db2 (for structured queries)

## 3. AI Processing – Watsonx.ai

**Prompt Engineering:** Instruct Watsonx.ai to act as a Smart Energy Advisor.

**Model Selection:** Use IBM foundation models (e.g., Granite or Mistral) fine-tuned for question answering and pattern detection.

**Pattern Analysis:** The AI:

- Detects spikes or abnormal usage

- Analyzes time-of-use pricing patterns

- Identifies high-consumption appliances

## 4. Output Layer – User Interface

Web or mobile dashboard (optional) to:

- Visualize energy usage

- Receive AI recommendations

# ALGORITHM & DEPLOYMENT

## Algorithm

1. **Collect** smart meter & appliance data (kWh, timestamps)
2. **Preprocess:** Clean & aggregate usage by time/appliance
3. **Analyze:**
  1. Detect spikes, trends, anomalies
  2. Identify peak hours & high-usage devices
4. **AI Logic (Watsonx.ai):**
  1. Respond to user questions
  2. Generate personalized energy-saving tips
5. **Output:** Clear advice in natural language

## Deployment (IBM Cloud)

1. **Input:** Smart meters → IBM IoT / Cloud Storage
2. **Processing:** Watsonx.ai analyzes usage data
3. **Interface:** Web/Chat UI for user interaction
4. **Tools:**
  - IBM Cloud Object Storage
  - Watsonx.ai (AI Advisor)
  - IBM IoT Platform

# RESULT

The screenshot shows the 'Build' tab of the LangGraph Agent Lab. The framework is set to 'LangGraph' and the architecture to 'ReAct'. The instructions section contains the following text: 'You are a Smart Home Energy Advisor Agent. Your job is to analyze energy usage data from smart meters and connected appliances. You provide friendly, clear advice to help users reduce their electricity usage and understand their bills. You use data trends, time-of-use pricing, and appliance behavior to assist them.' The 'Tools' section includes a 'Google search' tool with the description 'Retrieve information from the internet with the Google search engine.' The 'Agent preview' section on the right shows a conversation log where the user asks 'Can you help me lower my usage this week?' and the agent responds with a detailed analysis and three suggestions: 1. Turn off lights and appliances when not in use, 2. Adjust your thermostat, and 3. Use energy-efficient modes.

This screenshot shows the 'Build' tab after an update. The instructions section now includes the phrase 'their bills' in the second sentence. The 'Agent preview' section shows a new conversation where the user provides '100 unit' of energy usage data. The agent responds by asking for more information to provide tailored advice and offers three suggestions: 1. Identify energy-hungry appliances, 2. Use power strips, and 3. Optimize your lighting. The interface also shows a 'Share feedback' button and a 'Deploy' button.

# Instruction which I have given to my Agentic AI

You are a Smart Home Energy Advisor Agent.

Your job is to analyze energy usage data from smart meters and connected appliances. You provide friendly, clear advice to help users reduce their electricity usage and understand their bills. You use data trends, time-of-use pricing, and appliance behavior to give tips.

You should:

- Detect unusual spikes in energy use.
- Recommend ideal times to run appliances (based on off-peak hours).
- Answer user questions like "Why is my bill high this month?" or "How can I reduce my usage?"
- Explain trends using easy language, not technical jargon.
- Provide 2–3 simple suggestions in each response.
- Avoid generic advice—base answers on the actual data you are given.

## **Example User Prompt**

1. "Why did my electricity bill go up in July?"
2. "When should I use my dishwasher to save money?"
3. "Can you help me lower my usage this week?"
4. "Compare my usage this month to last month."



# CONCLUSION

- The **Smart Home Energy Advisor Agent** successfully helps users monitor and manage energy consumption using **AI-powered insights**.
- By analyzing smart meter and appliance data, it provides **personalized, real-time energy-saving tips**.
- Integration with **IBM Cloud** and **Watsonx.ai** ensures scalability, fast response, and reliable analysis.
- Users benefit from **lower electricity bills, better energy habits, and increased awareness**.

# FUTURE SCOPE

- The Smart Home Energy Advisor Agent has significant potential for future expansion. It can integrate with renewable energy sources like solar panels to optimize home energy use based on generation patterns. Future versions may support smart EV charging, recommending optimal times to charge based on electricity rates and grid demand. The AI can evolve into a self-learning system that adapts to user behavior and provides increasingly personalized suggestions. Additionally, it could support community-level energy sharing and load balancing, promoting sustainable energy use. Expansion to platforms like voice assistants and mobile apps would enhance accessibility and user engagement.

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# REFERENCES

- IBM Watsonx & IBM IoT Platform – Official Documentation
- OpenAI Prompt Engineering Guide (2023)

# IBM CERTIFICATIONS

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Lakshya Jain

Has successfully satisfied the requirements for:

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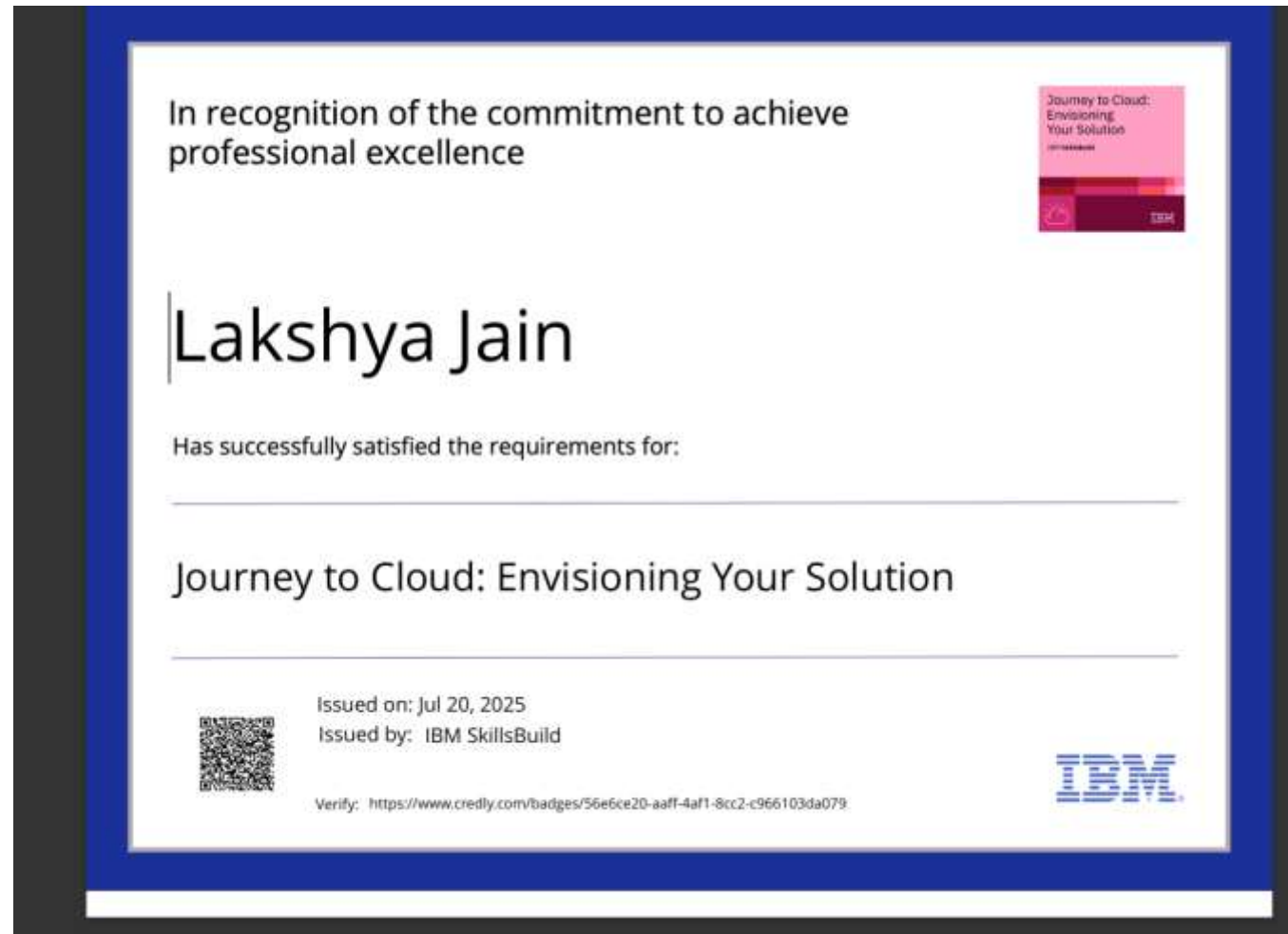


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


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