Energy Efficiency in smart building

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Problem Statement

- Brief Overview:

Buildings account for nearly 40% of global energy consumption. Improving energy efficiency is essential to achieving sustainability goals. AI-powered systems analyze energy consumption, optimize HVAC (Heating, Ventilation, and Air Conditioning), and provide recommendations to minimize energy usage. These solutions are particularly effective in commercial buildings with high energy demands.

- Key Objectives:

1. Analyze how AI can identify inefficiency in energy consumption
2. Develop a model to predict energy consumption based on occupancy and weather data
3. Suggest additional features to improve model accuracy
4. Recommend step for building manager to reduce energy consumption
5. Explore AI-driven solution for net-zero building

Dataset Overview(Optional)

- The dataset included two years of data on:

•**Building Energy Usage:** Hourly energy consumption records.

•**Occupancy Data:** Number of people present in different areas of the building.

•**Weather Conditions:** Temperature, humidity, and external climate factors affecting HVAC performance.

Data Source: Publicly available smart building energy datasets from online repositories.

Methodology

- Approach:

1. Data collection and preprocessing.
2. Exploratory data analysis (EDA) to identify trends and anomalies.
3. Features engineering to include weather conditions and occupancy data.
4. Model training and evaluation using AI/ML techniques.
5. Validation and deployment of the model for real-time energy optimality.

- Algorithms Used:

1. **Regression Models**: Predict energy consumption trends.
2. **Decision Trees & Random Forests:** Identify patterns in occupancy and climate conditions.
3. **Neural Networks:** Improve prediction accuracy through deep learning.
4. **Clustering Algorithms:** Detect inefficient energy usage patterns.

Conclusion

- Summary:

AI-driven energy management significantly reduces energy costs and improves sustainability in commercial buildings. By leveraging AI and IoT, buildings can dynamically adjust energy consumption based on occupancy and environmental factors.

- Future Work:

1. Integrating renewable energy sources for further efficiency.
2. Enhancing AI models with real-time feedback loops.
3. Expansion to residential and industrial buildings for broader impact.

References

•U.S. Department of Energy. (2023). "Energy Efficiency in Buildings: Strategies and Technologies." Retrieved from https://www.energy.gov

•International Energy Agency (IEA). (2022). "Digitalization and Energy Efficiency in Buildings." Retrieved from https://www.iea.org

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