Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon-423603

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

NAAC 'A' Grade Accredited

Department of Information Technology

(UG program, NBA Accredited)

HOCO291:Mathematical Foundations for Artificial Intelligence and Machine Learning

"Energy Optimization in Smart Buildings using AI"

Course incharge

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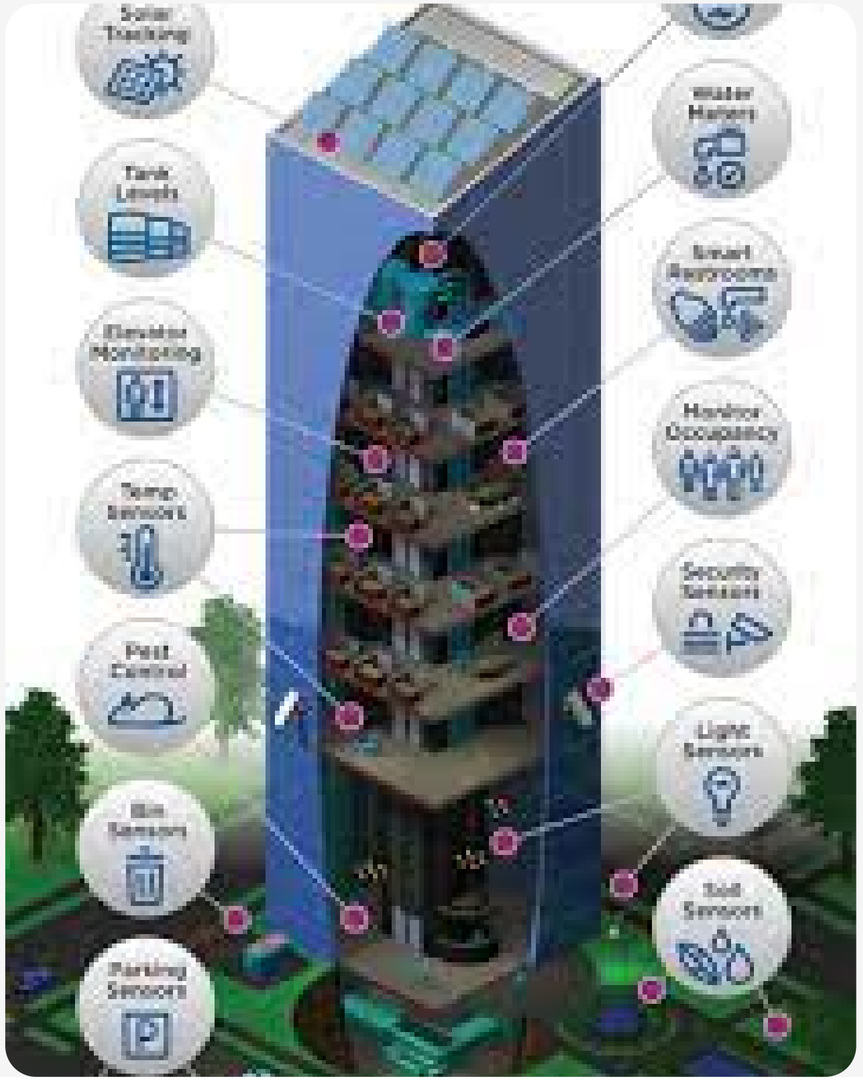
Introduction:

Smart buildings aim to reduce energy consumption while maintaining comfort and efficiency.

This project focuses on developing an AI model that intelligently manages electricity usage.

By using convex optimization techniques, the system ensures optimal energy distribution.

The goal is to minimize energy waste and lower operational costs in real time.



Problem Statement

Inefficient energy management in smart buildings leads to higher costs and energy wastage.

Traditional systems lack real-time adaptability and optimization.

This project aims to use AI and convex optimization to dynamically allocate energy, reducing consumption and costs.

Objectives

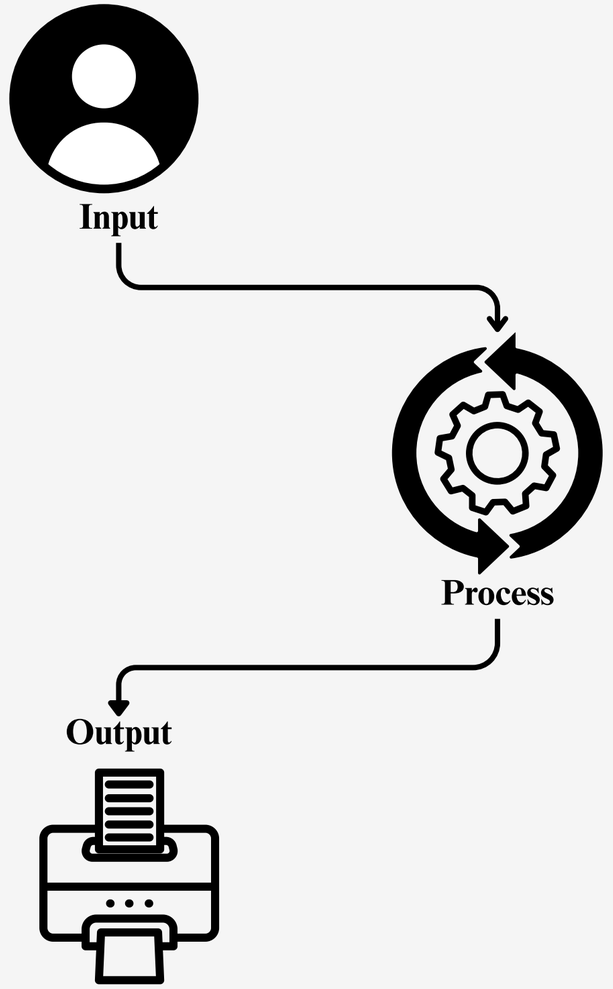
- Develop an interactive software tool to optimize energy usage across various electrical devices in a smart building.
- Minimize overall energy consumption while ensuring that critical devices receive adequate power.
- Use AI and convex optimization techniques to make smart, cost-effective energy decisions in real time.
- Provide clear visual feedback to help users understand energy distribution across devices.

Tools & Technologies

- Python – Core programming language.
- Tkinter – For GUI development.
- NumPy – For numerical computation and predictive modeling.
- Matplotlib – For plotting real-time traffic visualizations.
- (Optional if used) Pandas, Scikit-learn – For data processing and ML models.

System Architecture

- Input: User provides device count, energy limits, and cost.
- Processing: cvxpy optimizes energy allocation based on constraints.
- Output: Displays optimized energy usage and cost, visualized with Matplotlib.



Benefits

Benefits:

- Reduced Energy Costs: Optimizes energy usage, lowering electricity bills.
- Enhanced Efficiency: Ensures that devices use only the necessary power, reducing waste.
- Real-Time Optimization: Adapts to changing conditions for better energy management.
- User-Friendly Interface: Provides visual feedback to users for better understanding and control.

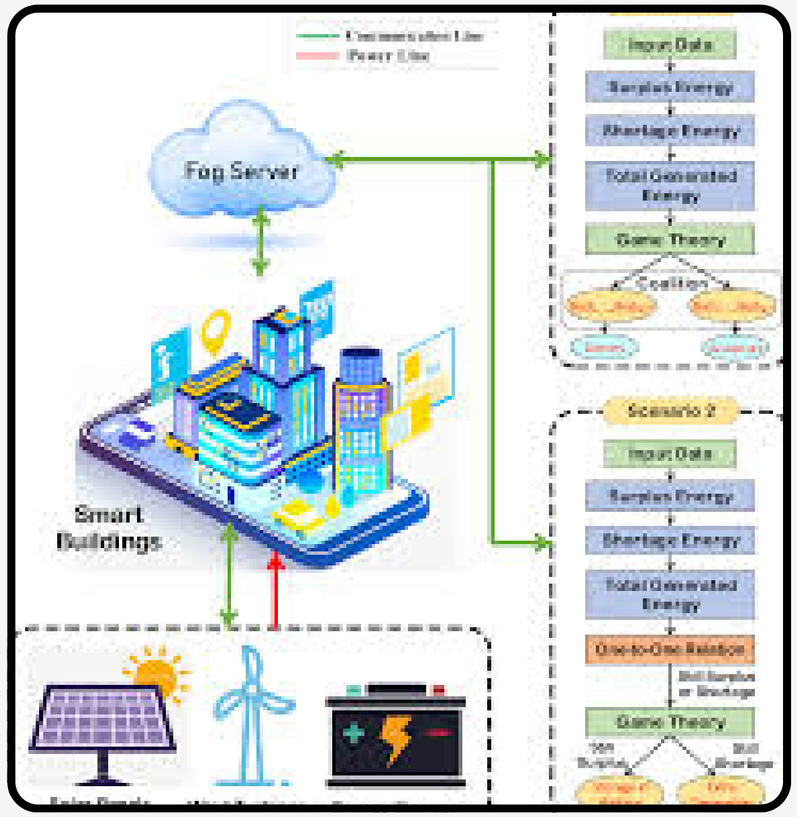
Challenges

- Real-Time Data Processing: Collecting and processing data from multiple devices in real time can be complex.
- Model Accuracy: Ensuring the AI model accurately predicts energy consumption patterns.
- Integration with Existing Systems: Integrating the optimization model with different building management systems can be challenging.
- User Adaptability: Ensuring the system is user-friendly and easily understood by non-technical users.

Future Scope

Future scope:

- Scalability: Expanding the system to optimize energy usage in larger buildings or entire campuses.
- Advanced AI Algorithms: Using machine learning to predict energy consumption trends more accurately.
- IoT Integration: Enabling communication between devices for smarter, automated energy allocation.
- Mobile Application: Developing a mobile app for remote monitoring and control of energy usage.



Conclusion

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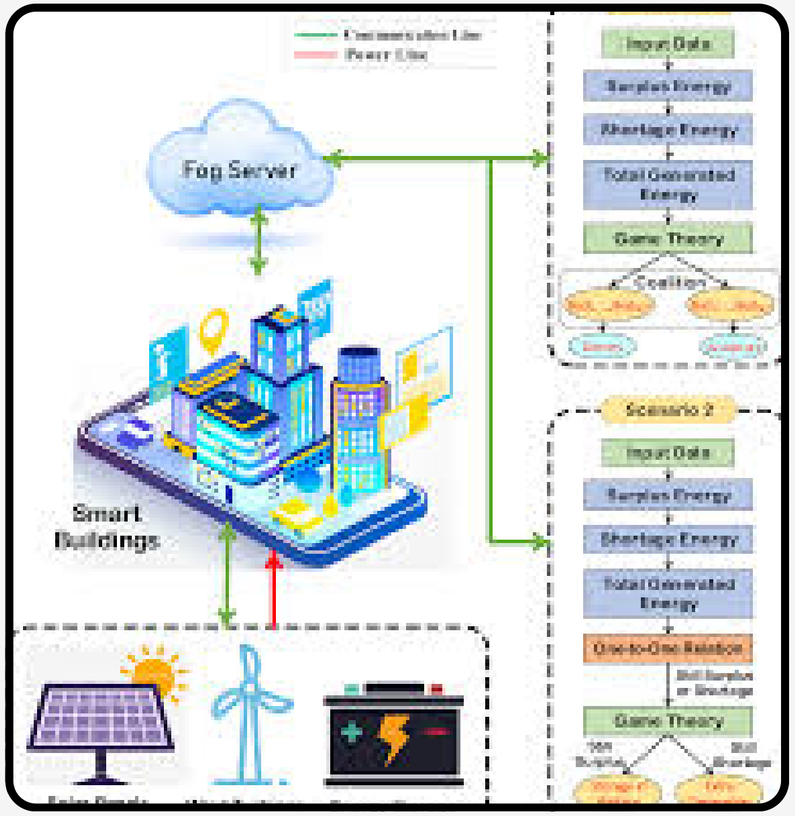
This project shows how AI and convex optimization can significantly improve energy management in smart buildings, helping reduce costs and minimize energy waste.

By intelligently allocating power to devices in real-time, we can make buildings more efficient and contribute to a more sustainable future



Thank you