e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 11, November 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711006

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

EcoEnergix Optimizer: An AI Approach for Industrial and Commercial Sustainability

Ms Monica Lakshmi R ,Ajay Abishek A, Dwarakanath D, Harini T, Leela Darshni M

Faculty, Department of Computer Science and Business Systems, R.M.D. Engineering College, Chennai, India

U.G. Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Chennai, India

U.G. Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Chennai, India

U.G. Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Chennai, India

U.G. Student, Department of Computer Science and Business Systems, R.M.D. Engineering College, Chennai, India

ABSTRACT: EcoEnergix Optimizer presents an innovative solution for enhancing energy efficiency and sustainability through an integrated energy saving hardware device. The increasing demand for energy efficiency in industrial and commercial sectors necessitates innovative solutions to manage consumption effectively. This project presents an AI-driven energy management system designed to revolutionize energy utilization, minimize waste, and enhance sustainability. By integrating advanced machine learning algorithms and real-time data analytics, the system monitors energy usage patterns and identifies opportunities for optimization. It utilizes predictive analytics to forecast energy demands, enabling facilities to adjust consumption proactively based on anticipated usage and peak periods. Additionally, the system incorporates automation features that facilitate dynamic load management, allowing for real-time adjustments in response to changing operational conditions. By promoting energy-efficient practices, this AI-powered solution aims to significantly reduce operational costs while contributing to environmental sustainability.

KEYWORDS: AI (Artificial Intelligence), Predictive Analysis, Real-time data, Machine Learning.

I. INTRODUCTION

Energy consumption in industrial and commercial facilities represents a significant operational cost, accounting for a substantial portion of overall expenditures. Furthermore, the environmental implications of high energy usage cannot be overstated, as businesses contribute to greenhouse gas emissions and other forms of pollution through their energy consumption practices. Despite the increasing awareness of the need for sustainable energy management, many organizations still grapple with a lack of visibility and control over their energy usage. This gap complicates efforts to manage energy costs effectively and hampers initiatives aimed at reducing carbon footprints.

Traditional energy management systems have been employed to monitor and control energy consumption; however, they often fall short in terms of accuracy and scalability. These systems frequently rely on manual processes, which can lead to delays and inefficiencies in responding to energy demand fluctuations. This reliance on outdated methodologies not only complicates energy management but also impedes the identification of potential savings and efficiency improvements. As a result, many businesses find it challenging to adopt a proactive approach to energy management, limiting their potential for cost savings and environmental stewardship.

The primary goal of developing an AI-powered energy management system is to empower businesses to significantly reduce their energy costs, enhance operational efficiency, and minimize their environmental impact. By optimizing energy consumption, this system not only offers financial benefits but also promotes sustainable practices that are essential in today’s environmentally conscious marketplace. As industries continue to evolve, adopting cutting-edge energy management solutions will be vital in driving sustainability and fostering a greener future.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

II. EXISTING SYSTEM

Before proposing a energy optimizer, it's essential to understand the limitations of existing systems. Traditional energy management systems have predominantly relied on manual methods and basic technologies, which present significant limitations in optimizing energy consumption in industrial and commercial settings. These systems typically utilize analog meters for tracking energy usage, which provides limited data visibility and fails to offer real-time insights. Consequently, facility managers often rely on historical data and periodic audits to assess energy performance, leading to delayed responses to inefficiencies and increased costs. Furthermore, traditional systems lack the integration capabilities required to communicate across various operational platforms, making it challenging to identify patterns and anomalies in energy consumption. Maintenance and operational adjustments are often conducted manually, requiring significant human intervention and increasing the likelihood of errors. One of the most significant drawbacks is the absence of real-time monitoring capabilities. Without continuous data access, facilities struggle to identify inefficiencies promptly and implement corrective measures. While traditional energy management systems have laid the groundwork for energy monitoring in industrial and commercial facilities, their limitations make them inadequate for addressing the complexities of modern energy management. As the demand for efficient energy use grows, there is a pressing need for more advanced systems that leverage technology, such as artificial intelligence and data analytics, to provide real-time insights and optimize energy consumption.

III. APPROACH AND PROPOSED METHODOLOGY

The proposed energy optimizer aims to create a comprehensive energy management solution that integrates various hardware components, including sensors, smart thermostats, and energy meters, into a single device. This innovative approach seeks to enhance energy efficiency in industrial and commercial facilities by actively monitoring, analyzing, and optimizing energy consumption.

Daily Energy Consumption Monitoring: The device will continuously track energy consumption levels throughout the day and determine if usage exceeds predetermined thresholds.

Energy Optimization Through Sensor Utilization: The integration of occupancy and lux sensors will allow for dynamic adjustments to energy usage based on real-time occupancy and ambient light levels.

Device Design and Integration: The first phase involves designing the energy optimizer device, which will house the various sensors, smart thermostats, and energy meters. The integration of these components into a single unit will allow for streamlined data collection and analysis.

Energy Consumption Detection: The device will be programmed to monitor energy consumption continuously throughout the day. Using built-in energy meters, it will assess real-time energy usage and compare it against a predefined limit set by facility management. When consumption exceeds this limit, the device will trigger alerts, enabling immediate corrective actions.

Machine Learning Analysis: The K-NN algorithm will be employed to analyze historical energy data and correlate it with current consumption patterns. This algorithm will identify similarities in usage patterns and provide predictions about future energy consumption. The conclusions drawn from this analysis will guide operational decisions, helping facility managers to understand peak usage times and optimize energy allocation accordingly.

Renewable Energy Integration: The system will incorporate mechanisms to facilitate the transition from traditional electrical energy to renewable sources. This includes connecting solar panels and wind turbines to the energy grid managed by the device. The optimizer will assess energy production from these sources and intelligently switch between conventional and renewable energy based on availability and cost-effectiveness.

Sensor Optimization: Occupancy sensors will detect the presence of individuals in a given space, allowing the system to adjust lighting and HVAC settings accordingly. For instance, if a room is unoccupied, the optimizer can reduce energy output by dimming lights or adjusting temperature settings. Lux sensors will measure ambient light levels,

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

enabling the system to optimize artificial lighting, ensuring that lighting levels are appropriate while minimizing energy waste.

Smart Thermostat Functionality: The optimizer will include smart thermostat capabilities to enhance HVAC efficiency. By monitoring external weather conditions and internal occupancy, the system can adjust heating and cooling settings in real time. The integration of HVAC filters will ensure optimal airflow, while voltage regulators will stabilize energy supply, protecting sensitive equipment from power fluctuations.

The proposed energy optimizer aims at providing a hardware device that focuses on optimizing energy consumed by industries. The solution for enhancing energy efficiency and sustainability through an integrated energy saving hardware device. Combining sensors and smart thermostats into a single, user-friendly device, this system empowers users to manage energy consumption effectively and maintain a comfortable working environment .The system is implemented using AI , machine learning. The device helps save energy by replacing non-renewable energy with renewable energy sources like solar energy. This begins with designing a compact unit that continuously monitors real-time energy consumption and compares it against predefined limits, generating alerts when usage exceeds those thresholds. Sensors integrated into the device continuously monitor environmental conditions and occupancy patterns, enabling precise energy usage control. Data from these sensors ensures that energy is allocated only where and when needed, reducing wastage. Smart thermostats within the system enable remote HVAC control, adapting temperature settings based on user preferences, occupancy, and external weather conditions, thus ensuring energy-efficient operation. The device therefore offers real-time monitoring, automation, control of energy-consumption ,thereby saving energy usage. Through this methodology, businesses can optimize their energy consumption effectively, promoting a more sustainable and economically viable future.

IV. RESULTS AND DISCUSSION

The implementation of the smart energy optimizer is anticipated to yield significant improvements in energy management, cost reduction, and sustainability for industrial and commercial facilities. The following are listed:

Energy Consumption Reduction: Preliminary assessments indicate that facilities utilizing the smart energy optimizer could achieve an energy consumption reduction of 15-30% within the first year of implementation. This reduction is primarily attributed to the continuous monitoring and real-time adjustments made possible by the integration of occupancy and lux sensors, which ensure that energy is only used when necessary.This significant decrease in energy usage not only translates into lower utility bills but also contributes to enhanced operational efficiency. Furthermore, by optimizing energy use, businesses can allocate resources more effectively, potentially directing savings into other critical areas of operation.

Cost Savings: The anticipated cost savings from reduced energy consumption can range from 20% to 40%, depending on the facility's size, energy usage patterns, and existing inefficiencies. Additionally, integrating renewable energy sources is expected to lower dependence on grid energy and further reduce costs associated with energy purchases. These financial benefits can significantly enhance a company’s profitability. By leveraging renewable energy, businesses not only mitigate the impacts of fluctuating energy prices but also position themselves as environmentally responsible entities.

Improved Operational Efficiency: The smart energy optimizer is expected to streamline operations by automating energy management processes, allowing for a more responsive and adaptive environment. Facilities that adopt this system may report improved comfort levels among occupants due to optimized HVAC settings and lighting adjustments based on real-time data. Enhanced comfort and efficiency can lead to increased productivity among employees, as a well-managed environment has been shown to correlate with higher satisfaction and performance levels.

Sustainability and Environmental Impact: The shift to renewable energy sources and the reduction in overall energy consumption are expected to decrease the carbon footprint of participating facilities significantly. Initial projections suggest that facilities could reduce their greenhouse gas emissions by up to 25% as a direct result of using the smart

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711006

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

energy optimizer. This reduction in emissions aligns with global sustainability goals and can enhance corporate social responsibility (CSR) efforts.

Long-Term Benefits and Scalability: The scalability of the smart energy optimizer allows it to be implemented across multiple facilities within a company, amplifying the benefits observed in pilot locations. Facilities that adopt the optimizer can expect to see cumulative savings and efficiency improvements as the system learns and adapts to varying energy needs over time

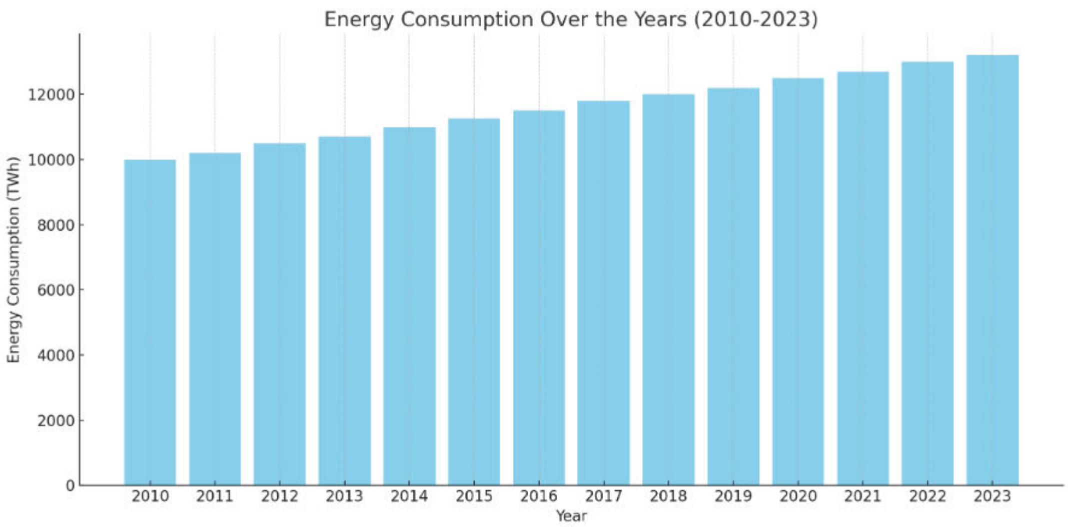

Fig. 1 Energy Consumption

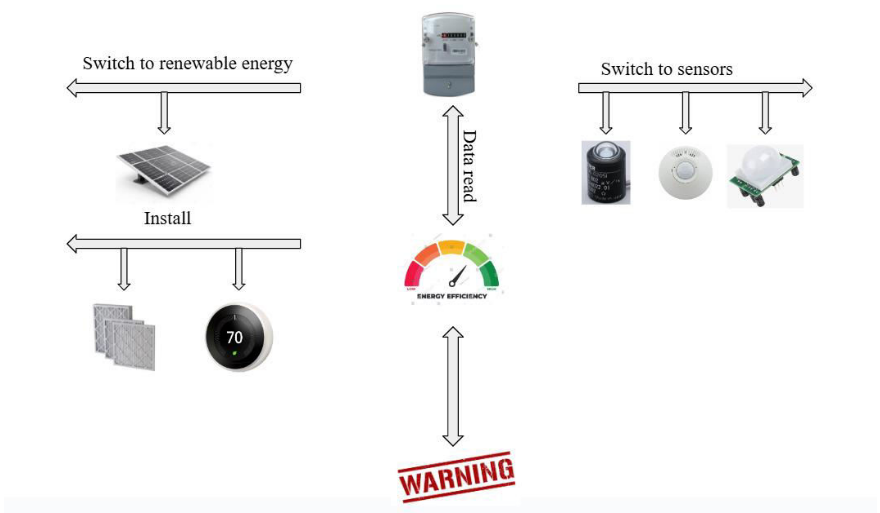

Fig. 2 Block diagram

© 2024 IJMRSET | Volume 7, Issue 11, November 2024| DOI: 10.15680/IJMRSET.2024.0711006

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig .3 LUX Sensor , Occupancy Sensor and Motion Sensor

Fig .4 HVAC filters , Smart Thermostat and Energy Meter

V. CONCLUSION

In conclusion, the smart energy optimizer represents a transformative solution for energy management in industrial and commercial facilities. Through continuous monitoring, machine learning analysis, and the integration of renewable energy, the optimizer is poised to deliver substantial energy savings, cost reductions, improved operational efficiency, and significant environmental benefits. The results highlight the optimizer's potential to not only enhance individual facility performance but also contribute to broader sustainability initiatives, positioning organizations for success in an increasingly energy-conscious world.

REFERENCES

1. H. Zhao et al., "Thermal-Sensor-Based occupancy detection for smart buildings using machine-learning methods", ACM Trans. Design Autom. Electron. Syst., vol. 23, no. 4, pp. 1-21, Jun. 2018.
2. Sivill L, Manninen J, Hippinen I, Ahtila P. Success factors of energy management in energy-intensive industries: development priority of energy performance measurement. International Journal of Energy Research. 2013;
3. Alimi, O., & Ouahada, K. (2018). Smart home appliances scheduling to manage energy usage. In 2018 IEEE 7th International Conference on Adaptive Science & Technology (ICAST) (pp. 1–5). IEEE.
4. Han T, Muhammad K, Hussain T, Lloret J, Baik SW. An Efficient Deep Learning Framework for Intelligent Energy Management in IoT Networks. IEEE Internet of Things Journal. 2020
5. Rathor SK, Saxena D. Energy management system for smart grid: an overview and key issues. International Journal of Energy Research. 2020; 44: 4067-4109.
6. Fiorini, L., & Aiello, M. (2022). Automatic optimal multi-energy management of smart homes. Energy Informatics, 1–20. https://doi.org/10.1186/s42162-022-00253-0
7. Lin, Y. H., Tang, H. S., Shen, T. Y., & Hsia, C. H. (2022). A smart home energy management system utilizing neurocomputing-based time-series load modeling and forecasting facilitated by energy decomposition for smart home automation.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

8. Tang L, Wang X, Wang X, Shao C, Liu S, Tian S. Long-term electricity consumption forecasting based on expert prediction and fuzzy Bayesian theory. Energy. 2019;
9. L. Yu, T. Jiang and Y. Cao, "Energy cost minimization for distributed internet data centers in smart microgrids considering power outages", IEEE Trans. Parallel Distrib. Syst., vol. 26, no. 1, pp. 120-130, Jan. 2015.
10. M. Krarti, "Evaluation of occupancy-based temperature controls on energy performance of KSA residential buildings", Energy Buildings, vol. 220, Aug. 2020.
11. K. Akkaya, I. Guvenc, R. Aygun, N. Pala and A. Kadri, "IoT-based occupancy monitoring techniques for energy-efficient smart buildings", Proc. IEEE Wireless Commun. Netw. Conf. Workshops (WCNCW), pp. 58-63, Mar. 2015.

INTERNATIONAL JOURNAL OF
MULTIDISCIPLINARY RESEARCH
IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com