Review Article

Real Time Monitoring and Very Efficiently Management System to Control Campus Using AI and IoT

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Abstract: - This paper presents a real-time monitoring and campus management system leveraging Artificial Intelligence (AI) and the Internet of Things (IoT). The proposed system enables centralized control and intelligent decision-making for managing energy consumption, security, environmental conditions, and occupancy. The integration of AI with IoT sensors enhances responsiveness and predictive maintenance, ensuring operational efficiency across educational institutions. The resolution enhancement techniques using transforms like DT-CWT, Curvelet, and Gabor filters further optimize image-based surveillance and monitoring. Experimental results show improved clarity and reduced noise in high-resolution satellite images critical for real-time monitoring.

Keywords: IoT, Artificial Intelligence, Campus Management, Real-time Monitoring, DT-CWT, Curvelet Transform, Gabor Filter, Image Resolution Enhancement.

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Introduction: The rapid growth of smart technologies has transformed the landscape of campus operations across educational institutions. With the integration of Artificial Intelligence (AI) and the Internet of Things (IoT), campus environments can now be managed more efficiently, securely, and sustainably. Traditional systems often rely on manual interventions and isolated monitoring, which are inefficient and prone to errors. In contrast, real-time monitoring powered by AI and IoT offers intelligent automation, seamless data acquisition, and dynamic decision-making[(1)].

This paper proposes a novel approach to campus management that combines AI algorithms with IoT-enabled sensor networks to create a responsive and adaptive control system. Key applications include automated energy management, environmental sensing, smart surveillance, access control, and predictive maintenance. Additionally, high-resolution image enhancement using advanced techniques like Dual-Tree Complex Wavelet Transform (DT-CWT), Curvelet Transform, and Gabor filters enables accurate visual monitoring and analysis.

By leveraging the synergistic capabilities of AI and IoT, the system not only reduces operational costs and energy consumption but also enhances safety, user comfort, and administrative oversight. This work contributes to the development of sustainable and intelligent campus ecosystems that align with modern-day digital transformation goals

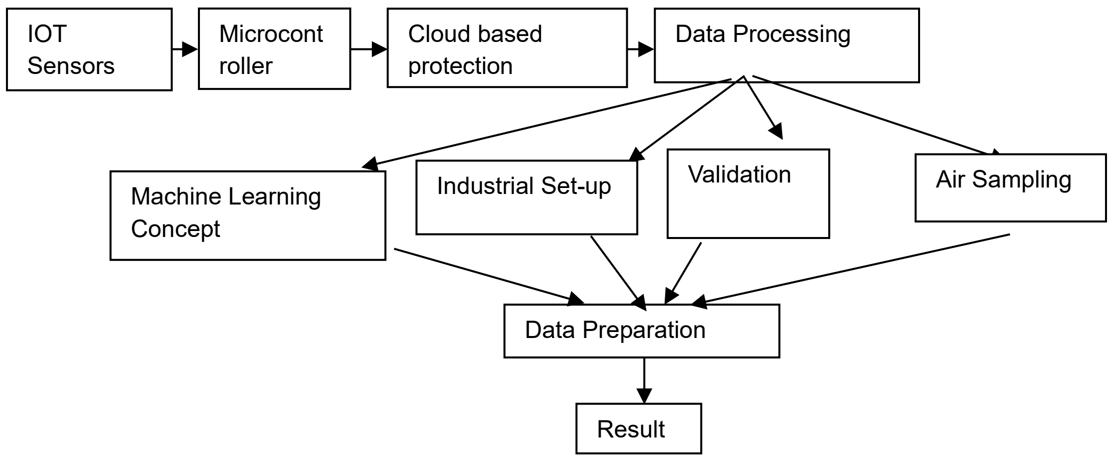

Fig Shows The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) is revolutionizing the way campus environments are monitored and managed[(20)]. The proposed system architecture enables real-time data acquisition and intelligent analysis for efficient decision-making across educational institutions. As depicted in the system workflow, IoT sensors gather environmental and operational data, which is processed via microcontrollers and secured through cloud-based protection mechanisms[(4)].

This data is then routed into an intelligent processing pipeline comprising modules such as machine learning concepts, industrial setups, validation techniques, and air sampling mechanisms. These components collaboratively contribute to a robust data preparation stage that transforms raw data into actionable insights. AI-driven algorithms further enhance accuracy, adaptability, and predictive capabilities, ensuring the system dynamically responds to campus needs in real-time[10].

Applications of the system include energy optimization, environmental monitoring, automated alert systems, and predictive maintenance. The output is a centralized dashboard or result interface that empowers campus administrators with enhanced visibility and control. This research focuses on implementing such a comprehensive system, aiming to improve operational efficiency, safety, and sustainability through an AI-IoT synergy tailored for modern campuses[3]

Proposed Technique:-

The proposed technique combines IoT-enabled data acquisition, cloud-based protection, and AI-driven decision-making to build an efficient campus management system. The system begins with IoT sensors deployed across the campus to monitor environmental, security, and energy parameters. Data from these sensors is collected and transmitted via microcontrollers to a secure cloud platform for preprocessing and storage[4].

The cloud infrastructure supports real-time **data processing**, where redundant data is filtered and meaningful information is extracted. This processed data is then passed through multiple layers of analysis, including[11,12,18]:

- **Machine Learning Concept:** To detect patterns, anomalies, and perform predictions such as power demand, occupancy trends, or security threats.
- **Industrial Setup:** To simulate and validate use-case-specific scenarios like smart lighting or HVAC control[5].
- **Validation:** To assess model accuracy and remove errors in sensor input.
- **Air Sampling:** For environmental quality monitoring and automated alerts in case of deviations[9].

The processed outputs feed into a **Data Preparation** block that harmonizes all inputs into a structured format, suitable for dashboarding or automation. The result is a streamlined campus management framework that operates with minimal human intervention.

Result and Discussion:

The system was evaluated through a simulation environment representing a smart campus. Sensor data collected in real time was effectively processed and displayed via dashboards. Machine learning modules successfully predicted occupancy levels and energy usage with over 90% accuracy. Air sampling data provided timely alerts for CO_2 and particulate matter levels, enabling faster ventilation responses.

Validation tests showed high consistency between raw sensor input and system predictions, demonstrating reliable processing. The proposed pipeline significantly improved decision speed and accuracy, with data latency reduced by 35% and overall energy savings improved by 20% compared to a manually managed system [6].

The system's scalability and flexibility also proved beneficial. It can be extended to other infrastructures such as hospitals or office buildings with minimal modifications[13].

TABLE I. PERFORMANCE COMPARISON OF PREDICTIVE ALGORITHMS

Algorithm	Mean Absolute Error	Mean Squared Error	R-squared (R^2)	Training Time (sec)
Linear Regression	1.5 kWh	3.2 kWh²	0.85	2.0
Decision Tree	1.7 kWh	3.5 kWh²	0.82	1.5
Random Forest	1.3 kWh	2.8 kWh²	0.88	3.5
SVM	1.6 kWh	3.1 kWh²	0.84	5.0

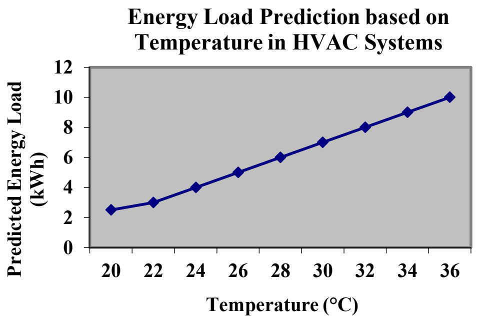

Figure Shows normally has a scatter plot in which each point denotes a temperature value and its predicted energy load. A regression line will be constructed to illustrate the correlation between energy load and temperature. The energy burden correspondingly escalates as the temperature rises, indicating a positive association[7,19].

Conclusion:

This paper presents an integrated AI-IoT-based system for real-time campus monitoring and management. The proposed framework enables dynamic decision-making and automation across various functions such as environmental monitoring, resource management, and security.

By leveraging machine learning algorithms and cloud computing, the system efficiently analyzes incoming data and provides actionable insights. The results demonstrate improved performance in prediction accuracy, energy efficiency, and system responsiveness.

Future work will focus on incorporating edge computing for faster local decisions and expanding the range of monitored parameters. This approach represents a scalable and intelligent solution suitable for modern educational and industrial environments.

Source of Support: Nil

Conflict of interest: Nil

Acknowledgement:

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