SERB-TARE SCHEME PROJECT DETAILS

Project Title: Achieving Decarbonisation and Power Load Management through Smart Building Energy Management System: A model-free approach

Principal Investigator & Parent Institute	**Mentor & Host Institute**
	
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Funding: Research fellowship of Rs. 60,000/- per year and Research grant of Rs. 5 lakhs per annum (50% each to host and parent institution) and overheads (as per SERB norms) will be provided	
Duration: 3 years	

Project Summary:

With the use of information and communication technologies (ICT), building processes and management have been automated, resulting in a new radical shift known as Smart Buildings, that can enhance the customer's comfort and productivity while using less energy than that of a typical building. Smart buildings may also communicate with the electric grid, which is becoming highly significant for utilities load management systems that require exact forecasts of smart building power usage. The ability to estimate electricity usage in a building is crucial for identifying energy-saving opportunities as part of the automation of the building design. Buildings must be more adaptive and robust while requiring less electricity and preserving customer comfort, which helps to alleviate the impacts of climate change. Peak energy consumption can be predicted using historical data and information, allowing consumers to instantly manage their energy use while also delivering a load-side management response approach to utilities for real-time control and actuation. In view of this, the proposal highlights the usefulness of data-driven approaches in forecasting the electricity demand of a smart building in a model-free environment.

Building management systems (BMS) are vital for the effective management of smart building architecture, technology, and subsystems. It serves as the smart building core monitoring and operating entity. The most apparent flaw in this is that BMS fails to incorporate data management, analytics, computing, and control systems for complicated settings. Flexibility, multi-sensor integration, predictive analysis, and dynamic optimization are only a few of the features and functions that are lacking. As a result, in this proposal, the artificial intelligence (AI) field, big data analytics, and various data-driven approaches introduce new methodologies for the development of intelligent BMSs to construct valuable information such as occupancy behavior, fault or weather forecasting, energy consumption patterns, etc. to address user comfort while ensuring maximum efficiency and minimizing carbon footprints.

Keywords:
Smart Building, Decarbonisation, Data-driven approaches, Artificial Intelligence, Big-data Analytics, Building Management System

Objective:

- To provide a novel framework about the utilization of artificial intelligence (AI) techniques for energy management in smart buildings, considering recent AI-based concepts like autonomous computation and prediction via deep learning.
- To track user energy consumption and develop an accurate load forecasting model using deep learning algorithms.
- To integrate digital ecosystems into the proposed framework, exchange data for gaining new insights, and develop innovative solutions to solve efficiency and sustainability issues.
- To meet decarbonisation targets and abate the electricity demand-supply mismatch by implementing the model on a larger scale.

Expected output and outcome of the proposal:

The transition of the energy systems is leading to a strong investment in smart grid technologies to minimize the overall energy cost. Smart grid technologies can reduce energy consumption, increase the efficiency of the electricity network, and manage electricity generation from renewable technologies. One of the main elements of smart buildings is the BMS, which must seek energy efficiency and its integration with smart grid technologies. BMS must implement key energy management tasks, such as monitoring of energy supply information, and supervision of energy costs. A model-free techniques based framework is proposed for load forecasting of smart buildings that results in energy optimization. It can be adopted for thermal

control to minimize the overall cost by jointly considering the energy consumption of the HVAC system and amending the mismatch of energy related to the smart grid.

The proposal intends to provide a novel framework for incorporating the utilization of AI techniques for resource optimization with smart building management systems.

1. By incorporating digital ecosystems into the proposed framework, the exchange of data for gaining new insights, developing innovative solutions to efficiency and sustainability issues can be achieved.
2. AI-based concepts like autonomous computation and prediction via deep learning, can help in organizing the information and its applications.
3. The proposed model-free approach also helps in developing accurate load forecasting data that further enables the functioning of smart building ecosystems along with smart grids resulting in higher energy efficiency.
4. The model will also minimize the electrical demand-supply mismatch up to a greater extent. From an environmental point of view, CO2 emissions can be drastically eliminated if the proposed model is implemented on a global scale.

The decarbonization process will result in:

1. Resource optimization with smart building management systems, energy performance contracting, etc.
2. Reduction in fossil fuel consumption, the adaptation of EVs, renewable energy, etc.
3. Energy management with performance tracking and analytics buildings.

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