World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:14, No:06, 2020

Designing Energy Efficient Buildings for Seasonal Climates Using Machine Learning Techniques

Authors : Kishor T. Zingre, Seshadhri Srinivasan

Abstract : Energy consumption by the building sector is increasing at an alarming rate throughout the world and leading to more building-related CO_2 emissions into the environment. In buildings, the main contributors to energy consumption are heating, ventilation, and air-conditioning (HVAC) systems, lighting, and electrical appliances. It is hypothesised that the energy efficiency in buildings can be achieved by implementing sustainable technologies such as i) enhancing the thermal resistance of fabric materials for reducing heat gain (in hotter climates) and heat loss (in colder climates), ii) enhancing daylight and lighting system, iii) HVAC system and iv) occupant localization. Energy performance of various sustainable technologies is highly dependent on climatic conditions. This paper investigated the use of machine learning techniques for accurate prediction of air-conditioning energy in seasonal climates. The data required to train the machine learning techniques is obtained using the computational simulations performed on a 3-story commercial building using EnergyPlus program plugged-in with OpenStudio and Google SketchUp. The EnergyPlus model was calibrated against experimental measurements of surface temperatures and heat flux prior to employing for the simulations. It has been observed from the simulations that the performance of sustainable fabric materials (for walls, roof, and windows) such as phase change materials, insulation, cool roof, etc. vary with the climate conditions. Various renewable technologies were also used for the building flat roofs in various climates to investigate the potential for electricity generation. It has been observed that the proposed technique overcomes the shortcomings of existing approaches, such as local linearization or over-simplifying assumptions. In addition, the proposed method can be used for real-time estimation of building air-conditioning energy.

Keywords : building energy efficiency, energyplus, machine learning techniques, seasonal climates
Conference Title : ICEEB 2020 : International Conference on Energy Efficiency in Buildings
Conference Location : Vienna, Austria
Conference Dates : June 18-19, 2020