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An Experimental Machine Learning Analysis on Adaptive Thermal Comfort and Energy Management in Hospitals

Authors : Ibrahim Khan, Waqas Khalid

Abstract : The Healthcare sector is known to consume a higher proportion of total energy consumption in the HVAC market owing to an excessive cooling and heating requirement in maintaining human thermal comfort in indoor conditions, catering to patients undergoing treatment in hospital wards, rooms, and intensive care units. The indoor thermal comfort conditions in selected hospitals of Islamabad, Pakistan, were measured on a real-time basis with the collection of first-hand experimental data using calibrated sensors measuring Ambient Temperature, Wet Bulb Globe Temperature, Relative Humidity, Air Velocity, Light Intensity and CO2 levels. The Experimental data recorded was analyzed in conjunction with the Thermal Comfort Questionnaire Surveys, where the participants, including patients, doctors, nurses, and hospital staff, were assessed based on their thermal sensation, acceptability, preference, and comfort responses. The Recorded Dataset, including experimental and survey-based responses, was further analyzed in the development of a correlation between operative temperature, operative relative humidity, and other measured operative parameters with the predicted mean vote and adaptive predicted mean vote, with the adaptive temperature and adaptive relative humidity estimated using the seasonal data set gathered for both summer – hot and dry, and hot and humid as well as winter – cold and dry, and cold and humid climate conditions. The Machine Learning Logistic Regression Algorithm was incorporated to train the operative experimental data parameters and develop a correlation between patient sensations and the thermal environmental parameters for which a new ML-based adaptive thermal comfort model was proposed and developed in our study. Finally, the accuracy of our model was determined using the K-fold cross-validation.

Keywords : predicted mean vote, thermal comfort, energy management, logistic regression, machine learning
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