World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:19, No:10, 2025

Evaluation of Server Performance Under Various Indoor Thermal Conditions Through Field Surveys

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Abstract : The increasing demand for efficient small-scale enterprise data centers necessitates a comprehensive understanding of the interactions between environmental conditions and server operations. While large-scale data centers have been extensively studied, research focusing on enterprise data centers within constrained environments remains limited, leaving a significant gap in understanding their unique challenges. This study aims to analyze the effects of indoor thermal conditions, specifically air temperature, on server performance and operational stability while considering relative humidity as a crucial parameter for ensuring equipment safety in alignment with ASHRAE guidelines. The research involves conducting a field survey with a laptop acting as a simulated server placed in an active lab environment designed primarily for people. Benchmarking tools such as Cinebench are used to evaluate computational performance, while HWMonitor records CPU temperature and power-related metrics. Air temperature and relative humidity are measured using the TR-76Ui sensor under varying room cooling conditions, including free running, cooling, and heating, determined by the season during data collection. Measurements are conducted with reference to ASHRAE-recommended ranges to maintain operational reliability and prevent equipment damage. In addition, fan noise levels are monitored to evaluate the impact of thermal conditions on the noise generated, providing insights into how these factors influence workplace comfort alongside server performance. Preliminary findings suggest that higher ambient air temperatures lead to significant increases in CPU temperature, resulting in potential thermal throttling and reduced computational performance. Relative humidity outside the ASHRAE-recommended range could pose risks to equipment safety. Future analysis will identify critical environmental thresholds and propose applicable solutions for enhancing server operational stability while minimizing disruptions in shared environments designed for human activity. This research provides valuable insights into designing and operating efficient enterprise data centers, emphasizing the importance of environmental analysis in optimizing performance, equipment safety, and workplace comfort.

Keywords : enterprise data center, Indoor thermal conditions, Server performance, field survey, ASHRAE standards
Conference Title : ICENS 2025 : International Conference on Engineering and Natural Sciences
Conference Location : Bali, Indonesia
Conference Dates : October 25-26, 2025