Investigating the Potentials of Operational Data Collected from Facilities' Embedded Sensors for Early Detection of HVAC Systems' Failures

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ABSTRACT

HVAC systems are crucial for proper ventilation and air circulation in a building. Current HVAC maintenance methods focus on visualization tools or process monitoring techniques. These conventional techniques are triggered at the onset of system failures, leading to exorbitant maintenance costs. While researchers have utilized the operational data for predictive maintenance of HVAC systems by detecting early failures in HVAC systems, these studies have relied mainly on the data collected from advanced embedded sensors. Moreover, the data collection is mainly based on a lab experiment in a controlled environment. Towards this end, the study aims to assess the feasibility of operational data (e.g., zone humidity, temperature, and airflow) collected from common embedded sensors in the HVAC system for early detection of failures. In this regard, three months of the operational data were recorded from an HVAC system in the Human and Health Development Building at Penn State University. To assess the potential of operational data in detecting failures of HVAC systems, measurable metrics in time-domain and frequency-domain such as mean frequency and kurtosis were calculated both from failure and non-failure data. Pearson product-moment correlation (PPMC) test showed a strong correlation (correlation coefficient greater than 0.6) between the calculated metrics and the working condition of the system. Results demonstrated the feasibility of applying operational data from the embedded sensors to early detect failures in HVAC systems. This potential of the embedded sensors will set the stage for assistive mechanisms whereby the HVAC operators can prognose the faults before they emerge.