Problem Statement: Optimizing systems health management in buildings involves detecting anomalies, diagnosing faults, predicting failures, and mitigating issues. To achieve this, we proposed an integrated framework using active learning and statistical techniques. Our approach includes data preprocessing, active learning model development, statistical event detection, and real-world implementation. The goal is to enhance cost-effectiveness, operational efficiency, and decision-making for building maintenance, ultimately improving performance, and reducing costs.

Specific Aims:

1. Gather relevant data sources including sensor data and energy consumption data. Preprocess the data to handle non-stationarity, missing values, and noise, and synchronize multi-modal data streams.
2. Develop an active learning framework to incorporate human feedback in anomaly detection and contextual event curation. Implement the techniques for speeding up the labeling process while ensuring data quality and informativeness.
3. Utilize statistical approaches for detecting abrupt changes in multi-modal, time-series data streams. Characterize the detected events based on contextual information and annotate them with human input. Train machine learning algorithms using annotated data to accurately detect and curate contextual events.
4. Implement the developed framework and algorithms in a real-world setting, particularly in a building maintenance context. Evaluate the system’s performance in terms of detection accuracy, false positives, and efficiency gains in maintenance operations.

Timeline:

|  |  |  |  |
| --- | --- | --- | --- |
| Tasks | Month1 | Month2 | Month3 |
| T1: Data Preparation and Collection | Gather relevant data sources | Preprocess and clean the data | Synchronize multi-modal data |
| T2: Framework Development | Develop an active learning framework | Implement labeling acceleration | Ensure data quality |
| T3: Event Detection and Curation | Detect abrupt changes in data | Characterize events and annotate | Train machine learning algorithms |
| T4: Implementation and Evaluation | Implement framework and algorithms | Evaluate system performance | Fine-tune algorithms if necessary |

Appendix:

Fayyad, U., & Stolorz, P. (1997). Data mining and KDD: Promise and challenges. Future generation computer systems, 13(2-3), 99-115.