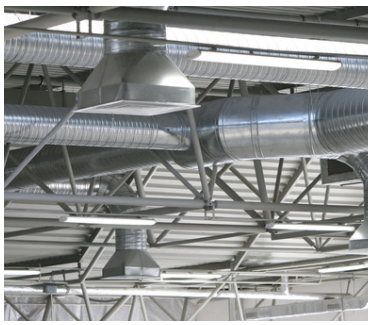
HARVARD
CENTER FOR GREEN
BUILDINGS AND CITIES

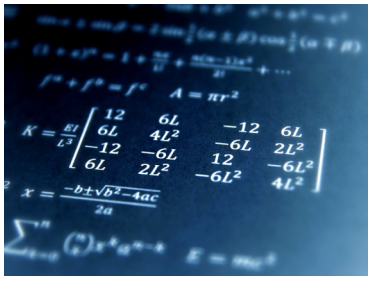
Research and development of an open platform for automated HVAC fault detection and smart building applications

PROBLEM

Few buildings perform as intended. It is reported that around 20% of the energy consumption in buildings is wasted due to system degradation and faults. A growing awareness of the inefficiencies in heating, ventilation and air conditioning (HVAC) systems has expanded the research in fault detection and diagnostics (FDD). It is estimated that more than 10 billion US dollars can be saved through FDD for HVAC systems every year.

As more and more sensors and smart devices merge within buildings, various smart building applications to increase energy efficiency, provide better comfort, and allow for more occupant interactions become possible and relevant. An integrated platform connecting various smart devices with different protocols, the existing building automation system (BAS), and external systems (e.g., utility's demand response automation server) is essential to realize the full potential of a smart building.





GUIDING QUESTIONS

This project explores how to integrate machine learning techniques and big data analytics into FDD algorithms. The project also seeks to use advanced IT technologies to integrate with various devices in a building, better visualize sensor data, present faults and solutions, and interact with users.

Can integrating physics models, rule-based methods and Bayesian networks improve FDD algorithm performance?

Can new building management technology improve user experience and open access?

PROJECT DESCRIPTION

This project includes two parts—developing FDD algorithms and building an open platform for FDD and other smart building applications. The FDD algorithms will be an integration of physics models, rule-based methods and machine learning techniques including Bayesian networks and Gaussian processes. The open platform features a novel decentralized communication system architecture and modern IT technologies. Through this project, we will implement a prototype system and deploy it in a building test-bed to perform FDD as a sample application.

IMPACT

The project will provide an open web-based platform that will allow building managers to improve energy efficiency of the systems. Researchers will be able to embed their own FDD algorithms into this open platform. The platform has the potential to integrate various functionalities, for example, monitoring, fault detection, control and interaction with occupants.

Develop an open platform for FDD and other emerging smart building applications.

Collect, analyze and visualize building energy system operation data interactively.

Improve energy efficiency in buildings through automated FDD and cost-effectiveness analysis

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CONTACT

20 Sumner Road
Cambridge, MA 02138
tel. 617-495-8807
fax. 617-496-4408
email: cgbc@gsd.harvard.edu