



Predicting Miscellaneous Electrical Loads (MELs) in Commercial Buildings: A Time Series Analysis

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Significance

- Buildings on the whole represent approximately **33%** of the globe's total energy consumption.
- Commercial buildings account for **12%** of global energy use and **21%** of the U.S.'s total energy use.
- Due to higher energy use intensity (E/SQF/Y) in commercial buildings, even a slight energy savings would have a significant impact.
- MELs account for more than **20%** of the primary energy used in commercial buildings, a number that is projected to **increase by 40%** in the next **20 years**.

Significance

Reducing plug-load consumption in commercial buildings offers an excellent opportunity for achieving *net-zero energy buildings*.

Knowledge Gap

- Previous studies did not consider occupants' individual energy-use behavior to provide well-timed, personalized, and targeted energy efficiency feedback to induce further energy efficiency.
- Sustainable behavioral change is a challenge which has not yet been thoroughly addressed.

Research Objectives

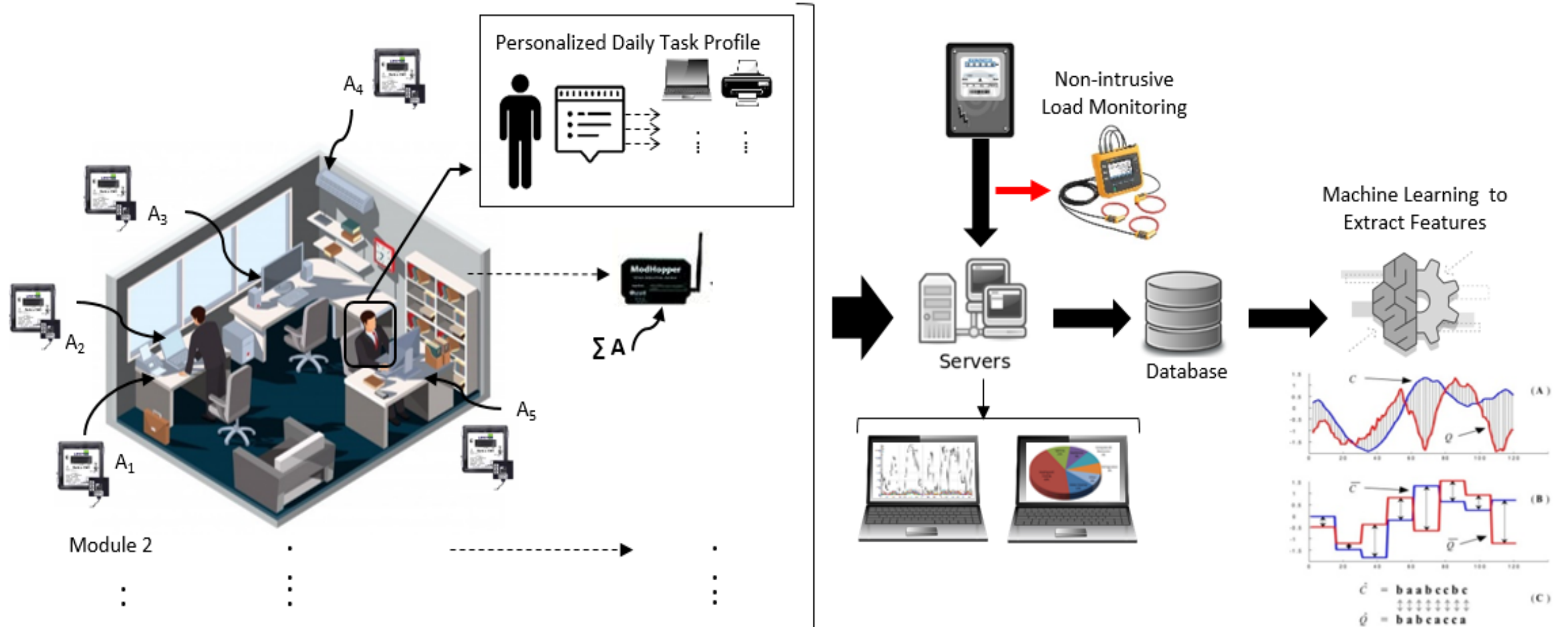
- To determine effective interventions that will reduce energy consumption in commercial buildings:
 1. Track MELs' energy use and apply MLA to subsequently predict individual energy consumption;
 2. Build and validate a new, NILM technique for measuring individual plug loads from a single point using time-series analysis;
 3. Create an infrastructure to collect MELs' energy use in Volgenau School of Engineering for at least 5 years.

Research Methods

- Volgenau School of Engineering building (5 story, 185,000 SQF):
 - ✓ 10 faculty offices,
 - ✓ 1 administrative office (ENG 1300),
 - ✓ 1 computer lab (ENG 1505), and
 - ✓ 3 office spaces designated for teaching and research graduate assistants (ENG 1202; 2249; 4603).

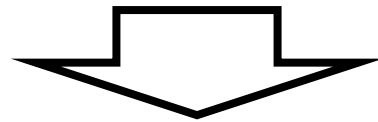


Research Framework



Research Methods

- Using SVM and k means clustering techniques to construct individual energy-use profiles;
- Develop a set of predictive models to forecast energy consumption based upon a limited set of features; and
- Using Symbolic Aggregate approximation (SAX) to disaggregate and identify appliances and their operational states.



- The results of this analysis will help us to more accurately determine MLE's energy consumption using NIEL techniques.
- Feedbacks will be provided to change behavior of occupants to reduce energy consumption.

Contributions

- Our success will lay the foundation for several ***solutions*** and ***interventions*** for occupant-level energy-efficiency programs such as *automated energy-efficiency notifications and cell-phone based feedback.*

Contributions

- Users will be able to predict broader energy consumption via MELs' energy use;
- Facility managers and building owners will be able to provide feedback to building occupants and will support the implementation of strategies to reduce energy use;
- Utilities will be able to manage existing electricity supply chains more efficiently;
- Building designers will be able to alter their designs based on more precise predictions of energy consumption; and
- The database of MELs energy use developed in this study can be later used as a benchmark or input for simulation models.



ANY QUESTIONS?

Thanks for your Time and Attention!