DYNAMIC LOAD MONITORING SYSTEM FOR A SET OF COMPLEX DEVICES

ELECTRICAL & COMPUTER ENGINEERING

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PROBLEM STATEMENT

Contemporary industrial environments consume exorbitant amounts of energy. The depletion of non-renewable primary sources of energy in the past decade has significantly increased the cost of electricity. This has majorly impacted the cost of running an industrial space, impacting millions of businesses around the world.

INTRODUCTION

- Our system measures and samples real time voltage and current for different electrical sources and creates power signatures in order to recognize the events in the system.

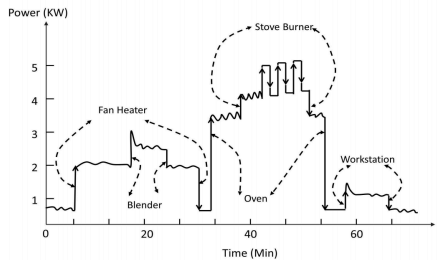


Figure 1 An Example of Load De-Aggregation

- The system would allow utilities to track and manage industrial energy consumption and use this information to implement a machine learning module that could detect parasitic energy consumption.

SYSTEM OVERVIEW

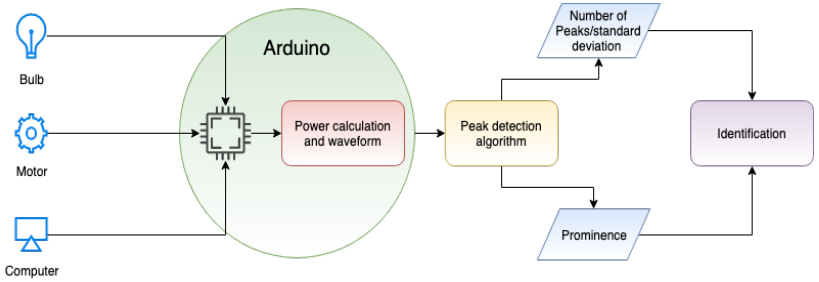


Figure 2 Diagram of the System

SYSTEM REQUIREMENTS

- Identify 3 complex loads using NILM
- Software and hardware package to analyze load signals
- Safe to handle high voltage from the wall
- GUI interface for monitoring system for commercial and industrial use

IMPLEMENTATION

HARDWARE

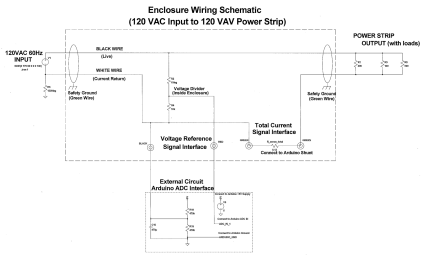


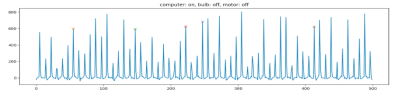
Figure 3 The Hardware Setup Schematic

- The hardware circuitry contains a high voltage circuitry enclosure
- The external circuit consists of a voltage divider and filtering capacitor connected to the Arduino.
- Combination of three different loads

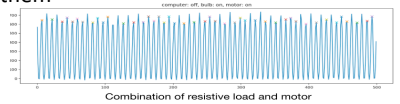
Figure 4 The Three Loads

PYTHON

- Peak detection algorithm returns peaks identified & their prominence
- For special cases, std of peaks values is used to identify the case



- For similar waveforms, specific prominence ranges are set to differentiate them



- A different prominence range leads to different peaks detection result.

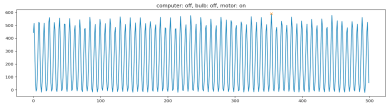


Figure 5 A, B & C Graphs of the Peak Detection Algorithm

MACHINE LEARNING

- Utilized Linux device to acquire data
- Used edge analyzer and training data in Falkonry SW to help identify loads
- Alternative and more accurate method for load identification

DATA ACQUISITION

- The Analog to Digital Conversion (ADC) feature of the Arduino is used to monitor the total current & voltage.
- An algorithm is implemented to take the real time data values and calculate the power consumption.

RESULTS

- Graphical User Interface (GUI)

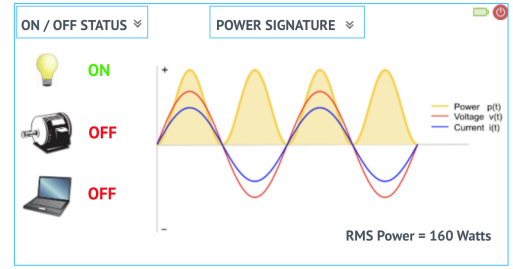


Figure 6 The designed Graphical User Interface for the System

- Hardware Implementation

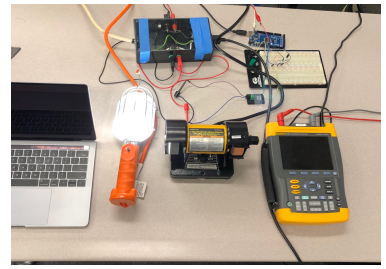


Figure 7 The Implemented Hardware Setup and the Loads

- Load De-Aggregation: Successful detection of all configurations

Parameters | Loads							
ON/OFF Status	Complete	Complete	Complete	Complete	Complete	Complete	In-Progress
Real Power GUI	Complete	Complete	Complete	Complete	Complete	Complete	Complete
Fault Analysis	Complete	Complete	Complete	In-Progress	In-Progress	Pending	Pending

Figure 8 The Table Displaying the Teams Progress in Achieving the set Milestones

FUTURE WORK/ DISCUSSION

- Validate and finish machine learning using Falkonry
- Identification for any type of load & complex power calculations