EffluX: Power Management System

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Background/Project Goal

There is an ongoing problem of overconsumption of energy and with a user being able to easily access information on what devices they are using everyday consume “x” amount of energy, it gives manufacturers as well as consumers an idea of where their energy is going and gives them an incentive to better manage it and shows them where they may start saving. The goal of our project is to develop a system that monitors energy consumption and performance for high energy usage/high waste devices in commercial environments. This power management system addresses power usage by devices with high energy consumption. It will provide power analysis to make the user aware of how much energy the device is consuming and providing the user and device with appropriate corrective action.

System and Device

Figure 1: Coffee machine with the EffluX system installed

Components/Materials Needed

- Hardware
  - LCD display to show status and collected energy usage data of the device
  - Temp, time of day, and motion sensors to help monitor device usage
  - High energy consumption device (i.e. coffee maker)
  - Actuators: Relay heating, solenoid
- Software
  - Back-end uses encrypted MQTT to monitor and control the device interaction, as well as saves and performs quick analysis and display of collected data that will be stored in a SQL database
  - Simple front-end web application to show energy management performance and action logs
  - Wifi Portal to connect device to personal wifi
- Firmware
  - Integrate sensors and communication with MQTT

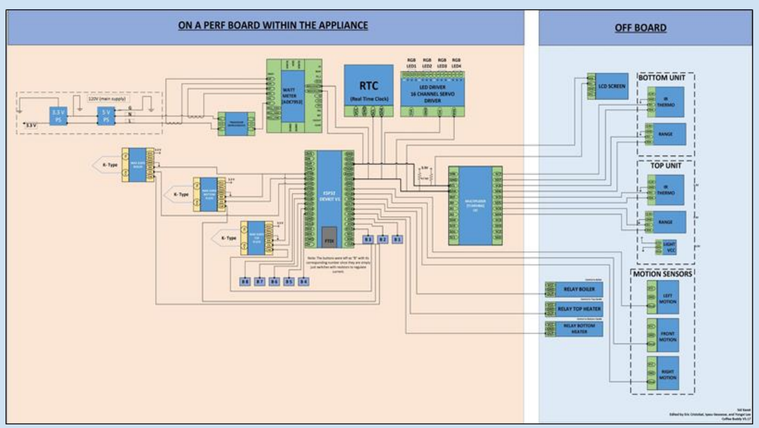

Figure 2: Electronic diagram for EffluX system in a commercial coffee machine[2]

Progress/Milestones

MQTT communication has been successfully established between the database server, the website, and the ESP32 device with the cloud broker. Goals for this quarter include the completion of populating the PCB boards for our system. Once the hardware system is ready, we will begin testing each component and adjusting the design as necessary. On the software side, we will continue to develop the user interface of the website to allow a user to pull and view their personal device’s energy data. In terms of firmware, we will begin implementing a rudimentary energy saving mode with sensing, as well as an interface to control basic functions of the device using physical controls.

Challenges Faced

Mounting the interface board was difficult due to the limited space near the interface portion of the coffee machine. We fixed this by making a surface mount and fitting the measurements of the device and board down to the millimeter. Another challenge was creating the WiFi access point for the ESP32 as the code provided to us was for an older model of the ESP, so we adjusted the code using the ESP32 library.

References

[1] M. Klopfer, L. Xia, J. Pixley, C. Rapier, and G.P. Li, “Intelligent control of domestic and commercial point of use water heating and cooling applications,” *California Plug Load Research Center (CalPlug), University of California, Irvine (UC Irvine)*

[2] P. Higgins, J. Hira, Z. Su, B. Hzu, S. Wong Eiffel, and N. Bozmoon. “Improving Energy Management in Coffee Makers with Intelligent Controls,” *California Plug Loader Research Center (CalPlug), University of California, Irvine (UC Irvine)*, 2019

[3] L. Xia, M. Klopfer, J. Guo, Y. Zhang, L. Wang, U. Kazmi, S. Gago, J. Pixley, M. Levorato and G.P. Li. “Behavior Adaptive Scalable Energy Management for Electronics – a demonstration in Home Appliances and Displays,” *California Plug Load Research Center (CalPlug), University of California, Irvine (UC Irvine)*