AUTOMATED FLAT LOAD PROFILE CONTROLLER

FINAL REPORT

TEAM ECE - 07

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Abstract

Currently, many commercial power-conserving devices and techniques rely on past power consumption data or past load profiles to perform the necessary optimizations. The aim of this project was to design a real-time controller that does not use a pre-determined load profile, but uses a utility specified desired load profile. This design will allow the consumer to specify settings for comfortable temperature range and optimize the individual load responses considering building time constants. This helps the power company to evenly distribute available power, hence reducing generation side strains.

The final result was to obtain this controller and demonstrate its capabilities through software simulation and scaled down replica in a laboratory setting. The completed Graphical User Interface (GUI), House/Heater models (in LabVIEW), and the control and optimization algorithm (using MATLAB) have been the major accomplishments of this project. Integrating all the aspects of this project at the end took some time because of the incompatibility between the Simulink, MATLAB and LabVIEW interfaces combined. As a result, all the work completed in Simulink had to be transferred to LabVIEW to maintain a more manageable and streamline interface running just LabVIEW and MATLAB. Also, as was mentioned previously, obtaining the physical controller design was deemed unfeasible because of the complexity of the controller algorithm, which utilizes an exhaustive search method. The physical controller, was hence, taken out of the deliverables.

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Problem Description

Most power-curbing and energy saving devices available on the market today are only capable of forecasting and scheduling which will adjust loads in buildings based upon predetermined values. However, these forecasted values may not be accurate as a particular building load may vary greatly on a daily basis. Thus, the need for a real-time and dynamic load-controlling device is necessary. The aim of this project is to design such a device in the form of a controller that can manage multiple building loads. If given a certain demand (desired power consumption) from the electrical service provider or power dispatcher, the controller would be able to adjust the load, mainly the heating and air conditioning, in each of these houses to meet that demand. In addition, the controller will respect the user specified settings at each of the houses such as a given comfortable temperature range.

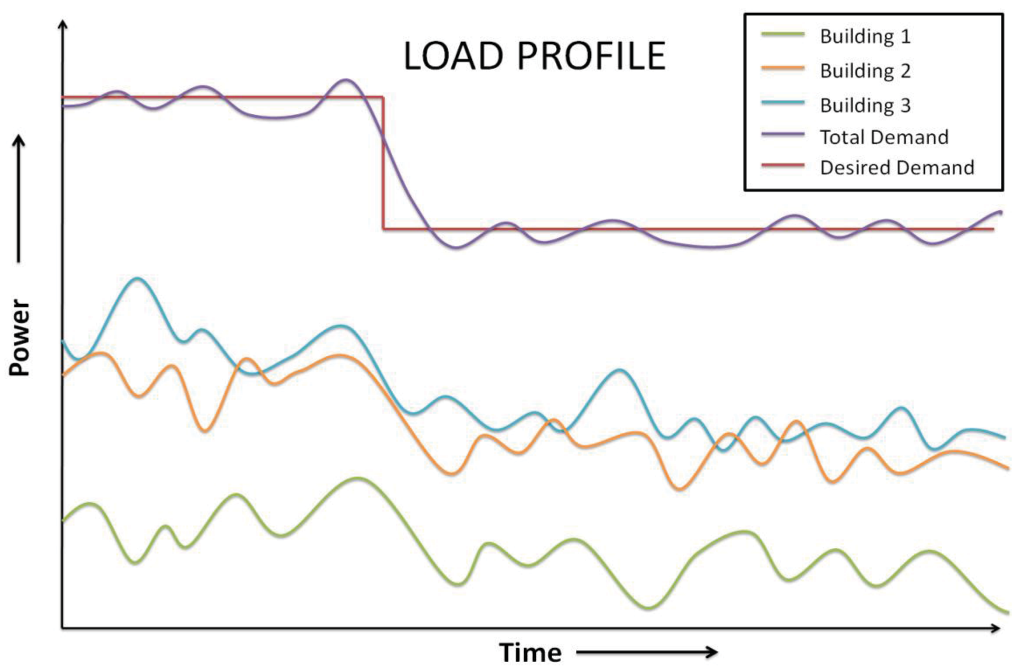

Figure 1: Individual building and total load profiles when controller is acting

It is acknowledged that the controller may not always be able to achieve the desired demand due to temperature constraints and other building parameters, but should be able to keep a flat load profile wherever possible. A flat load will ensure that there is little change in the power and that there is less fluctuations on power generation requirements. Thus, by keeping the load as flat as possible, as specified by the utility side, one can reduce the energy consumption [1].

In the end, the desire is to design the controller and demonstrate its capabilities through both software and physical simulation. As such, the following deliverables were established:

- Simulated Building – Physical laboratory replica using resistor/capacitor bank and controllable load and software simulation done in LabVIEW.
- Simulated Controller – A control and optimization algorithm that switches the loads on/off to maintain a flat load profile that meets the desired demand.
- Graphical User Interface (GUI) and Control – Main Interface allowing user to enter desired power and temperature range and display individual building loads as well as total load.

A system level diagram encompassing the entire setup is shown below:

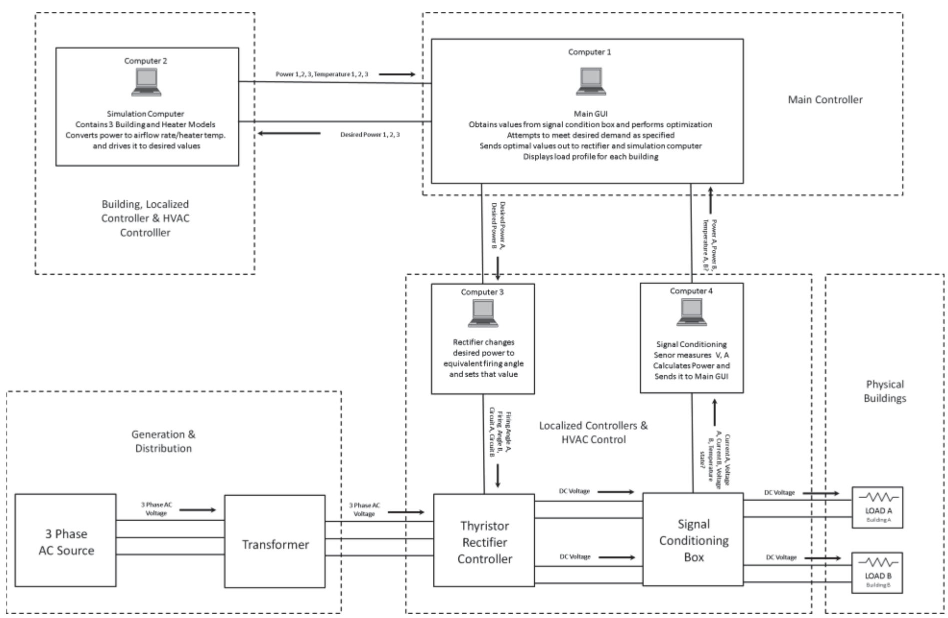

Figure 2. Schematic of the entire setup encompassing all deliverables