

Proposal Initial Choice

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1. What is the project about? Articulate your objectives using absolutely no jargon.

This project is based on the multi-room heating project provided on Brightspace. It aims to simulate a room heating system for a house comprising four rooms, each potentially containing a heater (with a maximum of two overall). The temperature in each room is regulated by the heater (if present) and is influenced by the temperatures of neighboring rooms as well as the outside temperature. Only two rooms can have a heater operational at any given time. The objective is to model and analyze this room heating system, considering various parameters and configurations, to achieve effective and efficient room heating.

2. What is the overall impact of the system you are simulating or analyzing? If you are successful, what difference will it make? Is there a longer-term trajectory of continuing this research beyond the class project?

Success in this project can lead to better control of heating systems, ensuring optimal comfort for inhabitants and potentially improving energy usage. In fact, a more effective heating system can reduce energy bills and environmental impact while also improving life quality. In the long term, this research could be extended to larger buildings,

apartments, or even community heating solutions, making a meaningful contribution to energy conservation and sustainable living.

3. In real-world, how is this done today? If your project does not set up a completely new concept, then can you answer how this work resembles state of the art?

Today, heating systems in most homes operate independently, often lacking the intelligence to consider adjacent room temperatures or effectively manage limited heating resources. Advanced homes might have programmable thermostats, but the dynamic shifting of heaters based on real-time data and interconnected room dynamics has not been widely implemented. Our work seeks to introduce an innovative control model to align modern smart homes with sustainability.

4. What are the midterm and final “exams” to check for success? In short, how will you know you will be able to finish?

Midterm Evaluation: Toward the halfway point of the project, we should have a simple working model of the rooms and heaters. The model should accurately represent temperature changes and heater movement rules.

- Design Python models that represent the room heating system
- Implement a functional controller using Python, likely using one of the state machine libraries, incorporating the specified thermostat-based heater control logic and heater placement rules for the rooms.

Final Evaluation: By the end, we should be able to finish building the model and controller for the multi-room heating system. It should be able to simulate different scenarios and adjust the heater controls accordingly to sustainably maintain room temperature. In fact, our system should be able to maintain desired room temperatures under varying weather conditions. We will present our model in a conference-style paper.

- Execute comprehensive simulations for a significant duration, capturing and analyzing relevant events such as heater movements.
- Analyze the outcome of modifying controller parameters to optimize the model.
- Evaluate if the simulation adheres to the temperature requirement of maintaining each room's temperature between 15 and 20 degrees.
- Submit a detailed report (in a conference paper format), describing the constructed models and controllers, simulation results, and analysis of the system's behavior under various parameter configurations.

5. What concepts from the course are going to be used or demonstrated in the project.

We will leverage the concepts of hybrid and embedded systems learned in the course.

Specifically, the project will involve:

- Safety requirements
- Liveness requirement
- Synchronous/Asynchronous components
- Modeling of dynamic systems/uncertainties
- Controller design

Overall, our model will represent a culmination of the concepts that we have learned in class throughout this semester.