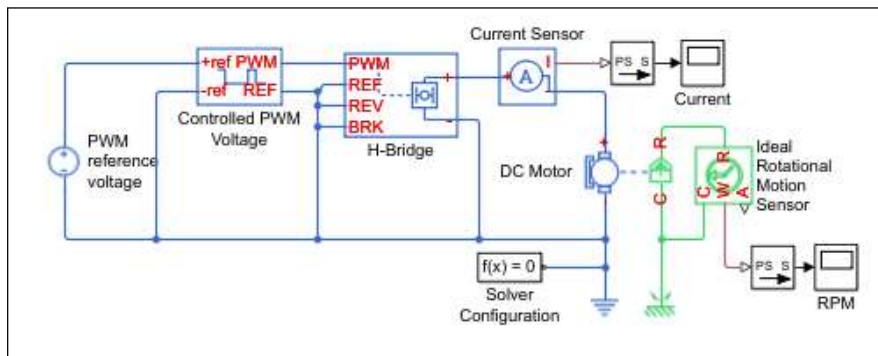


# Subsystem Level Functional Requirements

## Block Diagram



## Outline

- 1 Introduction
- 2 Background Study
  - Literature
  - Prior Work
  - Challenges
- 3 Subsystem Level Functional Requirements
  - Block Diagram
  - **Specifications**
- 4 Engineering Efforts
  - Simulation
- 5 Subsystem Level Functional Requirements
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  - Specifications
- 6 Engineering Efforts
  - Simulation
  - Design
  - Experimental Activities

## Subsystem Level Functional Requirements

### Specifications

#### Motor Requirements

- The simulation must be modeled based on the real system in the lab
- The model must be run by a PWM signal and H-bridge to allow for feedback control later
- The model must produce a power calculation to be used later for the machine learning algorithm

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# Engineering Efforts

Simulation

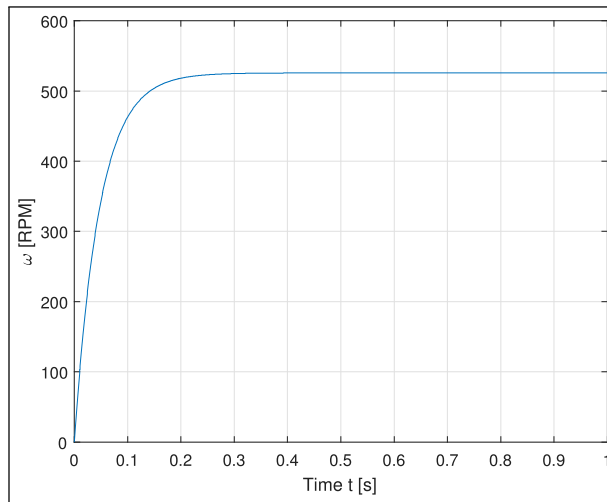


Figure: Motor Simulation Results

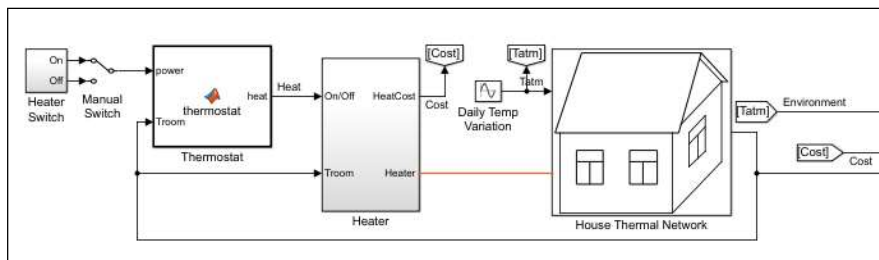


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# Subsystem Level Functional Requirements

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## Subsystem Level Functional Requirements

### Specifications

#### House Requirements

- The model must give a realistic thermal behavior of a room
- Modeled after work done by a previous work, the system is modeled after the system of equations:

$$\frac{d\mathbf{T}^e}{dt} = \begin{bmatrix} \dot{T}_1^e \\ \dot{T}_2^e \end{bmatrix} = \begin{bmatrix} -\frac{U_{cc}A_{cc}}{M_{cc}C_v} & \frac{Q_w\rho_w C_{pw}}{M_{cc}C_v} \\ 0 & -\frac{Q_w\rho_w C_{pw} + U_t A_t}{V_t\rho_w C_{pw}} \end{bmatrix} \begin{bmatrix} T_1^e \\ T_2^e \end{bmatrix} + \begin{bmatrix} \frac{U_{cc}A_{cc}}{M_{cc}C_v} T_{amb} - \frac{Q_w\rho_w C_{pw}}{M_{cc}C_v} T_{wo} \\ \frac{U_t A_t}{V_t\rho_w C_{pw}} T_{amb} + \frac{Q_w\rho_w C_{pw}}{V_t\rho_w C_{pw}} T_{wo} \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{15000}{V_t\rho_w C_{pw}} \end{bmatrix} \chi + \begin{bmatrix} \left(\frac{\rho_a C_{pa}}{M_{cc}C_v} Q_{a1} - \frac{U_{cc}A_{cc}}{M_{cc}C_v}\right) \\ 0 \end{bmatrix}$$

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# Engineering Efforts

Simulation

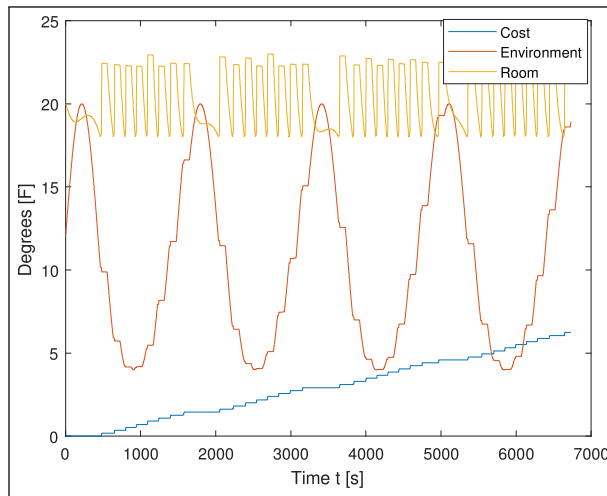


Figure: House Simulation Results using on/off control