Inspiration - University of Maryland Solar Decathlon Entry: WaterShed
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System Objective

• The system object is to: develop a system to model the effect of different technologies on the temperature within a room
• This model will include the different constructions of window and wall material, the effects of an automated HVAC system, and the side effects from common heat generating appliances.
• Considerations will need to be given to the weather conditions.
Non-Functional Requirements

User must be able to set:
1. Desired Interior Ambient Temperature
2. Wall properties
3. Window properties
4. Appliance properties
5. Weather time frame
6. Simulation time frame
Functional Requirements

1. System should model and follow equations for heat flux and black-body radiation$^{1,2}$
2. System should follow a set weather condition based on weather time frame parameter
3. HVAC is activated when a difference of 2 degrees from Desired Temperature is present
4. Minimum Ventilation standard is at 75 CFM$^3$
List of Assumptions

1. Exterior Ambient Temperature is an infinite source/sink
2. Interior Ambient Temperature experiences no diffusion (i.e. heat in is automatically evenly distributed throughout the space)
3. Interior Airflow is negligible
4. HVAC system operates at 100% efficiency
5. ERV is constantly working
6. 80% of heat used for Appliances is released back into interior space
7. No heat is absorbed in mediums (perfect conduction)
8. House is Wx2W sized plan with one window facing South
9. Threshold for HVAC system is +/- 2 degrees from Desired Int Amb Temp
10. R value is proportional to k/d in conduction equation
11. Each simulation starts with Int Amb Temp at Desired Amb Temp
Goals and Scenarios

Goals 1. Allow homeowner to adjust conditioned space temperature
- Scenario 1.1: Summer, Day
- Scenario 1.2: Fall, Day
- Scenario 1.3: Winter, Day
- Scenario 1.4: Spring, Day
- Scenario 1.5: Summer, Night
- Scenario 1.6: Fall, Night
- Scenario 1.7: Winter, Night
- Scenario 1.8: Spring, Night

Goals 2. Show the effect of changing the wall material on the temperature of a room
- Scenario 2.1: Low R Value
- Scenario 2.2: Medium R Value
- Scenario 2.3: High R Value
Goals and Scenarios

**Goals 3.** Show the effect of changing the window material on the temperature of a room

- Scenario 3.1: Single Pane, Low SHGC
- Scenario 3.2: Single Pane, High SHGC
- Scenario 3.3: Double Pane, Low SHGC
- Scenario 3.4: Double Pane, High SHGC
- Scenario 3.5: Triple Pane, Low SHGC
- Scenario 3.6: Triple Pane, High SHGC

**Goals 4.** Show the effect of appliance type on the temperature of a room

- Scenario 4.1: High Efficiency Appliances
- Scenario 4.2: Standard Appliances
Structure Diagram

- **<system> Simulation**
  - **<subsystem> HVAC**
    - **<block> ERV**
    - **<block> Mini-Split**
  - **<subsystem> Weather**
    - **<block> Ext Amb Temp**
    - **<block> Sunlight Radiation**
  - **<subsystem> Conditioned Space**
    - **<block> Int Amb Temp**
    - **<block> Appliances**
  - **<subsystem> Structure**
    - **<block> Windows**
    - **<block> Walls**
Sequence Diagram

1. Prompt User for Parameters
   2. Return Parameters
   3. Query Database for Temperature-Based Parameters
   4. Return Diff Amb Temp

5. Begin Ventilation(Diff Amb Temp, Int Amb Temp, Flow Rate)

7. Begin Modeling Heat Transfer(Diff Amb Temp, Int Amb Temp, Area, SHGC, Number of Panels)
8. Begin Modeling Heat Transfer(Diff Amb Temp, Decoded Int Amb Temp, P Value, Width)

9. Check Int Amb Temp(Diff Amb Temp, Desired Int Amb Temp)
10. Hall Functioning
11. Check Current Time
12. Else Appliances
13. Above Threshold
14. Below Threshold
Sources

1. http://hyperphysics.phy-astr.gsu.edu/hbase/mod6.html
2. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html