SMART HOME TEST SCENARIOS - CLIMATE

This document contains all the test scenarios that I have used to test the climate module for the Smart Home system. Some testing notes are included below:

- To put the system into the desired state, we can change the desired temperature control on the GUI.
- The logic to update the temperature was included in the framework code and our temperature control state machine should operate correctly, regardless of how this was implemented. For example, even if the temperature continued to rise when we were in the COOLING mode, our code may still be correct. If the cooling unit and fan are activated in this state, and continue to operate until the temperature drops beneath the desired temperature, then our state machine is still operating as specified.
- For my test cases, we assume that the GUI will prevent bad data from coming into the system. Therefore, I avoid test cases dealing with bad inputs. In a real-world system, we would usually be testing a validation component along with my implementation.
- This document contains test cases for the climate subsystem only. The coffee, blinds, security, chemical detection, and front door / mailbox alert functionality is not covered here.
- Typically, test cases such as these are denoted as black box tests. And in my case, that is roughly true. This entire suite of tests can be executed by someone that does not have access to anything but our provided GUI. However, you will note that I have provided the "Temperature Control State" value in the display. When testing a state machine, knowing the internal state is incredibly convenient. However, in a typical system, this information would typically not be available without looking at other system output (such as log files). Fortunately, all the other state machine behavior can be verified without it.
- This document contains test cases that are derived from use cases and meant to be executed manually. In most cases, when creating a state machine such as this, I would want to test it in an automated way, like with JUnit. This improves the repeatability of the tests and allows them to be executed more frequently (hopefully every time there is a build).

Table of Contents

Test – Case 1   System is operating without heating or cooling enabled.

Description:	Verify that the system operates as expected in the OFF mode.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is OFF and the current temperature is less than or equal to the desired temperature.	• All heating and cooling units, as well as the fan, are off. • The temperature control state of the system is "Off".	Pass	
2	Allow the temperature to rise about the desired temperature.	• All heating and cooling units, as well as the fan, remain off. • The temperature control state of the system remains "Off".	Pass	
3	Allow the temperature to fall back beneath the desired temperature.	• All heating and cooling units, as well as the fan, remain off. • The temperature control state of the system remains "Off".	Pass	

Test Case 2   User turns the temperature control off while heating units are active.

Description:	Verify that the system will stop successfully when the user updates the system mode from HEATING to OFF.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is HEATING and the current temperature is less than the desired temperature.	• The fan is on. • The primary heating unit is on. • The cooling unit is off. • The temperature control state of the system is either "BasicHeating" or "EmergencyHeating".	Pass	The backup heating unit can be either off or on for this step.
2	Change the system mode to OFF.	• The fan is turned off. • The primary heating unit is turned off. • If the backup heating unit was turned on, it is turned off. • The cooling unit remains off. • The temperature control state of the system is changed to "Off".	Pass	
3	Continue monitoring the system for another 10 seconds.	• All system components remain off. • The temperature control state of the system remains "Off" (it does not transition back to "BasicHeating" or "EmergencyHeating").	Pass	

Case 3   User turns the temperature control off while the cooling unit is active.

Description:	Verify that the system will stop successfully when the user updates the system mode from COOLING to OFF.
Pre-Conditions:	✓ Climate system is initialized and active.

Test   –

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is COOLING and the current temperature is greater than the desired temperature.	• The fan is on. • Both heating units (primary and backup) are off. • The cooling unit is on. • The temperature control state of the system is "BasicCooling".	Pass	
2	Change the system mode to OFF.	• The fan is turned off. • The heating units remain off. • The cooling unit is turned off. • The temperature control state of the system is changed to "Off".	Pass	

Test Case 4 — User changes the temperature control to heating mode to increase the temperature.

Description:	Verify that the system will begin heating successfully when the user updates the system mode from OFF to HEATING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	Pass
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is OFF and the current temperature is less than the desired temperature.	• All heating and cooling units, as well as the fan, are off. • The temperature control state of the system is "Off".	Pass	
2	Change the system mode to HEATING	• The primary heating unit is turned on. • The fan is turned on. • The cooling unit and the backup heating unit remain off. • The temperature control state of the system is updated to "BasicHeating".	Pass	
3	Allow the temperature to rise.	• The primary heating unit and the fan remain on. • The backup heating unit may come off and on intermittently as the temperature rises. In this case, the temperature control state will continue to switch between "BasicHeating" and "EmergencyHeating".	Pass	The full functionality of the backup heating unit is tested in a later test case.
4	Allow the temperature to continue to rise and become equal to the desired temperature.	• The primary heating unit and the fan are turned off. • If the backup heating unit was on, it is turned off. • The temperature control state is set to "IdleHeating"	Pass	

Test   –

5	Allow the temperature to fall back below the desired temperature.	• The primary heating unit is turned on. • The fan is turned on. • The cooling unit and the backup heating unit remain off. • The temperature control state of the system is updated to "BasicHeating".	Pass	

Case 5 User increases the desired temperature while the system is heating.

Description:	Verify that the system will respond to an updated value for the desired temperature when the system mode is HEATING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is HEATING and the current temperature is greater than or equal to the desired temperature.	• All heating and cooling units, as well as the fan, are off. • The temperature control state of the system is "IdleHeating".	Pass	
2	Update the desired temperature so that the new value is at least 15 degrees greater than the current temperature.	• The primary heating unit is turned on. • The fan is turned on. • The cooling unit and the backup heating unit remain off. • The temperature control state of the system is updated to "BasicHeating".	Pass	
3	Wait for 5 seconds.	• The primary heating unit and the fan remain on. • The backup heating unit will turn on after 5 seconds. • The temperature control state will be updated to "EmergencyHeating".	Pass	This time value is configurable. 5 seconds is simply the value that we chose for our implementation.

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4	Wait for an additional 3 seconds	• The backup heating unit is turned off. • The primary heating unit and the fan will remain on. • The temperature control state is set back to "BasicHeating".	Pass	Again, this time value is configurable. 3 seconds is simply the value that we chose for our implementation.
5	Allow the temperature to continue to rise.	• The primary heating unit and the fan remain on. • The backup heating unit will continue to be turned off for 5 seconds and then come back on again for 3 seconds. The temperature control state will continue to switch between "BasicHeating" and "EmergencyHeating" as this occurs.	Pass	

Step #	Step Description	Expected Result	Pass/Fail	Comments
6	Allow the temperature to continue to rise and become equal to the desired temperature.	• The primary heating unit and the fan are turned off. • If the backup heating unit was on, it is turned off. • The temperature control state is set to "IdleHeating"	Pass	

Test   –
    Case 6   User changes the temperature control to from cooling
mode to heating mode.

Description:	Verify that the system will transition successfully when the user updates the system mode from COOLING to HEATING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is COOLING and the current temperature is greater than the desired temperature.	• The cooling unit is on. • The fan is on. • Both heating units (primary and backup) are off. • The temperature control state of the system is "BasicCooling".	Pass	
2	Change the system mode to HEATING	• The cooling unit is turned off. • The fan is turned off. • Both heating units (primary and backup) remain off. • The temperature control state of the system is updated to "IdleHeating".	Pass	
3	Continue to monitor the system for another 10 seconds and verify that the temperature remains above the desired temperature.	• All heating and cooling units, as well as the fan, remain off. • The temperature control state of the system is still "IdleHeating".	Pass	

Case 7 User changes the desired temperature while the system is heating.

Description:	Verify that the system will respond to an updated value for the desired temperature when the system mode is HEATING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**

Test   –

	Date Test Executed:		December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is HEATING and the current temperature is less than the desired temperature.	• The fan is on. • The primary heating unit is on. • The cooling unit is off. • The temperature control state of the system is either "BasicHeating" or "EmergencyHeating".	Pass	The backup heating unit can be either off or on for this step.
2	Change the desired temperature so that the new value is greater than the original desired temperature.	• The fan and primary heating unit remain on. • If the backup heating unit was turned on, it remains on. Otherwise, it remains off. • The cooling unit remains off. • The temperature control state of the system is not changed.	Pass	
3	Change the desired temperature so that the new value is less than the current temperature.	• The fan is turned off. • The primary heating unit is turned off. • If the backup heating unit was turned on, it is turned off. • The cooling unit remains off. • The temperature control state of the system is changed to "IdleHeating".	Pass	
4	Continue monitoring the system for another 10 seconds. Make sure that the temperature remains above the desired temperature.	• All system components remain off. • The temperature control state of the system remains "IdleHeating" (it does not transition back to "BasicHeating" or "EmergencyHeating").	Pass	

Case 8   User changes the temperature control to cooling mode to decrease the temperature.

Description:	Verify that the system will begin cooling successfully when the user updates the system mode from OFF to COOLING.
Pre-Conditions:	✓ Climate system is initialized and active.

Test   –

Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is OFF and the current temperature is greater than the desired temperature.	• All heating and cooling units, as well as the fan, are off. • The temperature control state of the system is "Off".	Pass	
2	Change the system mode to COOLING	• The cooling unit is turned on. • The fan is turned on. • Both heating units (primary and backup) remain off. • The temperature control state of the system is updated to "BasicCooling".	Pass	
3	Allow the temperature to fall.	• The cooling unit and the fan remain on. • The temperature control state will remain "BasicCooling".	Pass	
4	Allow the temperature to continue to fall and become equal to the desired temperature.	• The cooling unit and the fan are turned off. • The temperature control state is set to "IdleCooling"	Pass	
5	Allow the temperature to rise back above the desired temperature.	• The cooling unit is turned on. • The fan is turned on. • Both heating units (primary and backup) remain off. • The temperature control state of the system is updated to "BasicCooling".	Pass	

Case 9   User decreases the desired temperature while the system is cooling.

Description:	Verify that the system will respond to an updated value for the desired temperature when the system mode is COOLING.
Pre-Conditions:	✓ Climate system is initialized and active.

Test   –

Post-Conditions:	✓ Climate system remains active.
	✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is COOLING and the current temperature is less than or equal to the desired temperature.	• All heating and cooling units, as well as the fan, are off. • The temperature control state of the system is "IdleCooling".	Pass	
2	Update the desired temperature so that the new value is less than the current temperature.	• The cooling unit is turned on. • The fan is turned on. • Both heating units (primary and backup) remain off. • The temperature control state of the system is updated to "BasicCooling".	Pass	
3	Allow the temperature to continue to drop and become equal to the desired temperature.	• The cooling unit and the fan are turned off. • Both heating units (primary and backup) remain off. • The temperature control state is set to "IdleCooling"	Pass	

Test

Case 10 – User changes the temperature control from heating mode to cooling mode.

Description:	Verify that the system will transition successfully when the user updates the system mode from HEATING to COOLING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	**Pass**
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is HEATING and the current temperature is less than the desired temperature.	• The fan is on. • The primary heating unit is on. • The cooling unit is off. • The temperature control state of the system is either "BasicHeating" or "EmergencyHeating".	Pass	The backup heating unit can be either off or on for this step.
2	Change the system mode to COOLING	• The fan is turned off. • The primary heating unit is turned off. • If the backup heating unit was turned on, it is turned off. • The cooling unit remains off. • The temperature control state of the system is changed to "Off".	Pass	
3	Continue to monitor the system for another 10 seconds and verify that the temperature remains below the desired temperature.	• All heating and cooling units, as well as the fan, remain off. • The temperature control state of the system is still "IdleHeating".	Pass	

Test
Case 11 – User changes the desired temperature while the system is cooling.

Description:	Verify that the system will respond to an updated value for the desired temperature when the system mode is COOLING.
Pre-Conditions:	✓ Climate system is initialized and active.
Post-Conditions:	✓ Climate system remains active. ✓ No errors were logged during the scenario.
Combined Test Result (Pass/Fail):	Pass
Date Test Executed:	December 9th, 2016

Step #	Step Description	Expected Result	Pass/Fail	Comments
1	Initialize the climate system such that the system mode is COOLING and the current temperature is greater than the desired temperature.	• The fan is on. • The cooling unit is on. • Both heating units (primary and backup) are off. • The temperature control state of the system is "BasicCooling".	Pass	
2	Change the desired temperature so that the new value is less than the original desired temperature.	• The fan and cooling unit remain on. • Both heating units (primary and backup) remain off. • The temperature control state of the system remains "BasicCooling".		
3	Change the desired temperature so that the new value is greater than the current temperature.	• The fan is turned off. • The cooling unit is turned off. • Both heating units (primary and backup) remain off. • The temperature control state of the system is changed to "IdleCooling".	Pass	

Test

4	Continue monitoring the system for another 10 seconds. Make sure that the temperature remains below the desired temperature.	• All system components remain off. • The temperature control state of the system remains "IdleCooling".	Pass	