**Smart Thermostat**

**Test Plan**

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**Version: 1.0**

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**Introduction:**

This project aims to maintain the temperature within a part or division of a building enclosed by walls, floor, and ceiling between a specific range.

* Temperature controller will perform one function under two modes.

1. Auto mode - keep room temperature within a predefined range
2. User mode - keep room temperature within a user defined range

**Following actions will be available to user under the 2 modes**

|  |  |
| --- | --- |
| **Auto** | **User** |
| Turn off auto/switch to user mode | Turn on auto/switch to auto mode |
| Adjust LCD brightness | Adjust desired room temperature range |
|  | Adjust LCD brightness |

**Function Description:**

|  |  |
| --- | --- |
| Turn on/off auto | A switch the enables user to toggle between auto mode and user mode |
| Adjust desired room temperature range | A knob that enables user to adjust room temperature in user mode |
| Adjust LCD brightness | A knob that allows user to adjust LCD screen brightness for visual purposes in user and auto mode |

* Temperature reading will be accurate within +- 3 degrees fahrenheit.
* Action to change temperature will occur within 1 minute of temperature change.
* In User Mode, adjustment to desired temperature will immediately result in action to adjust temperature accordingly.

This test plan will enable developers of the Smart Thermostat project to efficiently build version 1.0 of the Smart Thermostat PCB.

1.a. Objectives

This test plan outlines the testing process and defines each of the individual test cases to be performed. The tests conducted are to be consistent with Product Requirements document, version 1.1 dated 11/30/2017.

1.b. Scope

The purpose of the test plan is to facilitate the quick and efficient development of the smart thermostat PCB and all of its components. Once the functionality individual units of the smart thermostat has been confirmed, the connections between modules will be tested. After the connections between all the modules has been confirmed, the smart thermostat software will be tested. Finally, after all of the parts, connections and software have been confirmed functional and adherent to the design, the system will be tested by users to confirm that it meets our marketing requirements. For this version of the test plan, the objective is to have a single board built for a demonstration.

1.c. Testing Strategy

Testing will begin by checking that each component is functional. For the Power Jack, Voltage regulator, potentiometers, switch, temperature sensor, fan, heating element, and transistors, this simply involves connecting the part to their required voltage(s) and checking their output. LCD and Microcontroller have test code to test unit functionality. Once the unit functionality has been determined for each part, the connections between the units will be tested. The Power Jack will connect to the voltage regulator and convert 9 V to 5V. The voltage regulator will supply 5 V to the Microcontroller, LCD, Potentiometers, switch, heating element, fan and temperature sensor modules. Once power has been confirmed available to the units, software will be uploaded to test the connections between the microprocessor and the different components. After all interconnections are confirmed, the smart thermostat system control software will be uploaded and the board will be tested to confirm that the design specifications have been met.

1.d. Revision History:

|  |  |  |
| --- | --- | --- |
| Revision | Changes | Date |
| 1.0 | Initial Draft | 11/30/17 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Pretest Preparation:**

2.a. Test Equipment

1. Tektronix DMM 4020 5-½ Digit Multimeter
   1. Used to check node voltages.
2. GW INSTEK GPS-3303 Laboratory DC Power Supply
   1. Supply DC power for unit testing.
   2. Used to check current usage.
3. Heat source: Blow dryer
   1. Used to increase temperature sensor input temperature
4. Temperature sensor
   1. Used to compare reading of temperature sensor
5. Stopwatch
   1. Used to measure time taken to initiate temperature change

2.b. Test Setup

1. Microcontroller Output Test Code
   * 1. Used to test if output signals from microcontroller is sent correctly to fan and heater
     2. Used to test if fan and heater work when they receive a signal from microcontroller
     3. Used to test if control works correctly
        + Fan turned on if a need to reduce room temperature
        + Heat turned on if a need to increase room temperature
2. LCD Test Code
   * 1. Used to test if LCD is connected properly and prints what is sent to the LCD from the microcontroller
3. A/D Converter Test Code
   * 1. Used to test if A/D converter on the chip reads in the correct value and converts it using the specified modes -
        + 10 bit single conversion mode - input voltage is converted into a 10 bit digital value and a “conversion start” command concludes after a single conversion
        + 8 bit single conversion mode - input voltage is converted into an 8 bit digital value and a “conversion start” command concludes after one conversion

**System Tests:**

3.a. Unit Testing

1. Functional
   * Power Jack
   * Voltage Regulator
   * Potentiometers
   * Switch
   * LCD
   * MicroController
   * Temperature Sensor
   * Transistors
   * Heating element
   * Fan
2. Parametric
   * Test temperature range between 40 degrees and 100 degrees fahrenheit.

3.b. Integration Testing

1. Potentiometer is correctly translated by Microprocessor and sent to LCD.
2. Temperature is correctly translated by Microprocessor and sent to LCD.
3. AVR successfully programs Microprocessor.
4. Power Jack connects to voltage regulator.
5. Voltage regulator connects to
   1. Microprocessor
   2. LCD
   3. Fan
   4. Heater
   5. Potentiometers
   6. Temperature sensor
6. Microprocessor successfully turns on Fan.
7. Microprocessor successfully turns on Heating element.
8. Switch successfully send signal to Microprocessor and confirmation is displayed on LCD.

3.c. Acceptance Testing

1. User should be able to set temperature between 50 F and 90 F
   * Set to user mode and adjust knob from lowest possible value (50 F) to highest possible value (90 F)
2. Test that temperature is accurate within 3 degrees fahrenheit.
   * Compare sensor reading with another working temperature sensor
3. Adjust temp within 1 minute after degrees of temperature change
   * Adjust temperature so it stays between 3 degrees of current temperature - expect no change
   * Adjust temperature so it is outside 3 degrees of current temperature - expect fan or heating system to turn on to reach input temperature within a minute
4. In auto mode, current temperature is displayed on LCD.
5. In auto mode, user input is ignored and user input value is not displayed on the LCD.
6. On a button press, the system toggles between auto and user mode.
7. In user mode , action to adjust temperature occurs immediately to user input.
8. In user mode, LCD displays the user input for desired temperature.
9. In both modes, screen brightness can be changed by user.

3.d. Use Testing

* Untrained user should be able to learn how to use smart thermostat within 5 mins.

**Test Cases**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Writer** | | Dawit Amare | | | | | |
| **Test Case Name** | | Circuit Test | | | | **Test ID** | CT-1 |
| **Description** | | Tester will check if circuit power up and voltage regulator takes 9 V(+/- 0.5V) and 5V(+/- 0.5V) is supplied to microcontroller pins. | | | | **Type** | Black Box  White Box X |
| **Tester Information** | | | | | | | |
| **Name of Tester** | |  | | | | **Date** |  |
| **Hardware Version** | |  | | | | **Time** |  |
| **Setup** | | Temperature Controller circuit board needs around 5 V to operate. Outputs (i.e Heat Element and Fan) use external power. 9 V power supply should be used. | | | | | |
| **Additional Equipment** | | Tektronix DMM 4020 (multimeter), GW Instek GPS-­‐3303 (DC supply) | | | | | |
| **Step** | **Action** | **Expected Result** | **Pass** | **Fail** | **N/A** | **Comments** | |
| **1.** | Put multimeter probe on across voltage regulator | Input of voltage regulator should read ~9V. Output of voltage regulator should read ~5 V. |  |  |  |  | |
| **2.** | According to schematic, using multimeter, check all VCC and ground lines | All VCC lines should read ~5 V. All ground lines should read ~0V. |  |  |  |  | |
| **3.** | Use 9V Adaptor to check all VCC and Ground lines | 9 V power adaptor should give ~5 V for VCC and ~0 V for ground |  |  |  |  | |
| **4** | Check if 9V power is reaching Fan port on PCB | 9 Volts should be read on Fan output from mosfet connected to microcontroller to the fan |  |  |  |  | |
| **5** | Check for clicking sound on relay | Relay on daughter board should click with heat signal from microcontroller |  |  |  |  | |
| **Overall Test Results** | | |  |  |  |  | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Writer** | | Dawit Amare | | | | | |
| **Test Case Name** | | Temperature Test | | | | **Test ID** | TT-1 |
| **Description** | | Tester will check if temperature displayed on temperature controller is within 3 degrees of external calibrated thermometer | | | | **Type** | Black Box  White Box X |
| **Tester Information** | | | | | | | |
| **Name of Tester** | |  | | | | **Date** |  |
| **Hardware Version** | |  | | | | **Time** |  |
| **Setup** | | Temperature Controller should display current temperature that is accurate (+/- 3 degrees). | | | | | |
| **Additional Equipment** | | Calibrated thermometer, watch | | | | | |
| **Step** | **Action** | **Expected Result** | **Pass** | **Fail** | **N/A** | **Comments** | |
| **1.** | Observe LCD screen of temperature for current temperature value | Observed result should be around value measured using calibrated thermometer. (+/- 3 degrees) is a pass. |  |  |  |  | |
| **2.** | Touch button on Temperature controller for User mode operation and use knob to increment temperature in steps of 5 degrees (50 - 90). | Confirm if displayed value matches thermometer value. (+/- 3 degrees) is a pass. |  |  |  |  | |
| **3.** | Touch button on Temperature controller for Auto mode operation. | Confirm if displayed value matches thermometer value. (+/- 3 degrees) is a pass. |  |  |  |  | |
| **4** | Every 3 hours in 12 hours period, check temperature displayed in Auto mode. | Confirm if displayed value matches thermometer value. (+/- 3 degrees) is a pass. |  |  |  |  | |
| **Overall Test Results** | | |  |  |  |  | |