Home Air Monitor

A cleaner, healthier home

System Test Plan for

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Issued Date:

November 22, 2014

Revision:

1.1

System Test Plan

This document will outline the breakdown of testing procedures for the Home Air Monitor. Testing will be broken down into the hardware component, software component, and finally the integrated testing.

Hardware Test Plan

To test the hardware portion of this system, the individual pieces that make up the system will each need to be tested to ensure each component is reliable. Integrated testing of all hardware components working together will be done afterwards.

Particle Sensor

Test Purpose	Procedure	Pass/Fail
Supply voltage of 5V-7V	Ensure sensor can turn on, use DMM to test if voltage applied is in required range.	
Connections	Connect six sensor wires to PCB as documented in data sheet, ensure all wires have a good connection.	
Sensor sensitivity	Expose sensor to different sizes of particles to ensure it has a sensitivity of $0.5V/0.1mg/m^3$	

Carbon Monoxide Sensor

Test Purpose	Procedure	Pass/Fail
Supply voltage of 1.4V-5V	Ensure sensor can turn on, use DMM to test if voltage applied is in required range during high and lows cycles.	
Connections	Connect sensor wires to PCB as documented in data sheet, ensure all wires have a good connection.	
Sensor sensitivity	Expose sensor to carbon monoxide gas concentrations from 20-2000ppm.	
Resistance	Circuit functions with recommended 10KΩ load resistor	

Humidity/Temperature Sensor

Test Purpose	Procedure	Pass/Fail
Supply voltage of 3.3V-6V	Ensure sensor can turn on, use DMM to test if voltage applied is in required range.	
Connections	Connect sensor wires to PCB as documented in data sheet, ensure all wires have a good connection.	
Functions with 1mA-1.5mA of current	Ensure sensor can turn on, use DMM to test if current applied is in required range.	
Sensor detection	Expose sensor to various levels of humidity to test range.	
Temperature detection	Ensure the temperature readings are accurate and update accordingly to changes.	

Microcontroller Testing:

Test Purpose	Procedure	Pass/Fail
Supply voltage of 5V	Supply a stable voltage of 5V through microcontroller using an external power adapter, use DMM to test if voltage applied is in required range.	
Ground pin functionality	Test functionality of ground pin on microcontroller with DMM.	
Output pin functionality	Test functionality of 5V output pins on microcontroller with DMM.	
Analog and digital pins	Confirm analog A0 pin and digital D8 pin are working by sending High and Low signals to each. (These will be the ones used by the sensor)	
WiFi capability	Verify WiFi capability of microcontroller by demonstrating connection to Arduino program through WiFi.	

Output of pins	Confirm that the pins are able to output a 5 V voltage, and a maximum of 40 mA when stable.	
Readability and code future	Ensure written code on the Arduino Software Program for HAM is clean and concise. Compile and load time should be less than 30 seconds.	

Communication

Test Purpose	Procedure	Pass/Fail
Wifi stability	Ensure WiFi network that the microcontroller and mobile device will be connected to is stable and open.	
Open communication channels	Add microcontroller and mobile device to the network separately, ensure that communication is possible.	
Data collection communicated accurately	Test server setup on microcontroller by running Arduino Bridge setup code in the Arduino IDE and checking for data on a specific Arduino pin denoted in Arduino code using terminal software such as telnet or hyperterminal.	
Accurate communication from hardware to software	Test network communication on mobile application by calling REST style URL calls to a specific pin to get data	

Software test plan

The HAM system will have an algorithm that will be uploaded to the Microcontroller and be able to compute the data collected from the optical sensor. The algorithm will be able to compare the level of dust particles, humidity, and carbon monoxide around the optical sensor to a given pre-programmed threshold given the area of the sample area. The threshold values will be determined based on rigorous testing during the development cycle to see the ratio between particles and surrounding area. Different threshold values will be used when testing our algorithm to make sure the results are consistent with the expected results such that a bigger sample area will have a higher threshold and higher tolerance to the pollutant level, and vice-versa.

To test the mobile application of our system, we will be using different mobile devices to make sure we do not have any compatibility issues and be able to support up to android 4.4.4. We will sanity test the application by repeating closing, relaunching, uninstalling and reinstalling it on multiple devices to make sure we do not have any issues during the setup process.

Mobile Application

Test Purpose	Procedure	Pass/Fail
Compatibility with devices	Ensure written code on Android ADT can compile and be loaded onto devices with API 19 or higher.	
Memory restraints	Mobile application should not take up large amounts of memory on mobile device.	
Mobile application limits background processes	Mobile application should be able to launch and close without leaving any background processes.	
Clean user interface	All pages on mobile application should flow logically with clear navigation buttons. User should not have difficulty reaching the three main pages which are the Main, Edit, and Details page.	
Algorithm	Data from all three sensors are received and thresholds are calculated for each of them. The threshold value should also reflect researched upon values for ideal air quality.	
Logo	Clean Space logo can be seen in place of default Android app logo.	

Integrated Test Plans

Upon completion of testing the individual components, the integrated test plan will be executed in a room temperature environment to simulate a normal living space.

The first part of the integrated test will involve just one sensor and microcontroller. Testing just these two components will ensure that the sensor is accurately returning the results

needed for further calculations to the microcontroller. Here, we will be able to experiment with the each sensor sensitivity, as well as calculate the threshold for an ideal living space.

The second part of the integrated test will involve the communication between the microcontroller and our mobile application. Testing the two way communication between the server and sockets is crucial since we want to allow the user to control the system from their mobile device. We will then test the stability of the application by adding and deleting multiple HAM devices to the application by syncing the devices through the local Wifi network. The mobile application will then be tested with the HAM devices to ensure the status of the monitor will be reflected on the application. When the HAM device detects a large quantity of pollutants, the application will indicate a “need attention” status on the specified monitor. This indicator will be tested to meet all the reliability requirements of the application.

Finally, the full system will be tested with HAM in a test box environment. Air will flow freely into the box through a vent and be out through exhaust holes. On the software side, when the returned sensor data passes the threshold, an alert should be sent to the mobile application. The user should then be able to interact with HAM by informing the system when an area has been cleaned to prompt for another reading. Throughout the testing process, varying levels of particles will be introduced such as dust, carbon monoxide and humidity. This will provide a realistic simulation of a living space at various points of its usage life.