EE 41430

SmartLint©

Design Review 1

Group 3: SmartLint
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I. Subsystems

A. Microcontroller Subsystem

1. Microcontroller: ESP32-WROOM-32E - Microcontroller link
2. Function: The ESP32-WROOM-32E is a powerful, generic Wi-Fi + Bluetooth + Bluetooth LE MCU module that targets a wide variety of applications, one of them being low-power sensor networks.
3. Interfaces: SPI, I2C, UART
4. Price:
   a)

QTY	UNIT PRICE	EXT PRICE
1	$3.15000	$3.15

5. Lead Time: In Stock

B. Atmospheric Sensing System

1. Sensor: BME280 - Sensor Link
2. Function: The BME280 sensor measures gas, humidity, temperature, and pressure.
3. Interfaces: I2C, SPI

4. Price:

a)

QTY	UNIT PRICE	EXT PRICE
1	$9.01000	$9.01
5	$7.95000	$39.75

5. Lead Time: In Stock

C. Airflow Sensing Subsystem

1. Sensor: FS3000 Air Velocity Sensor Module - Sensor Link
2. Function: The FS3000 sensor measures air velocity in m/sec, which can be converted to another desired unit of measurement (i.e., mph).
3. Interfaces: I2C
4. Price: $24.99 for one (Digi-Key order link)
5. Lead Time: 3 weeks

D. Communications Subsystem

1. Components: Electronic, Audio, Visual
    a) Web Server (192.168.0.102)
        (1) Need to be connected to same WiFi network to connect
    b) Piezoelectric buzzer (Digi-Key order link)
    c) LED (Digi-Key order link for Red, Green, Blue)
2. Function: Using WiFi capabilities of the ESP32 to send environment data to a webpage. Additionally use a combination of an LED and a buzzer to communicate a simple logic gate to alert users of an issue.
3. Interfaces: Web Server with access from an IP address
4. Price: ~$5
5. Lead Time: 0 weeks (All components in-stock)

E. Power Subsystem

1. Components: Using standard USB wall adapter and microUSB cord.
2. Function: provide power to the microcontroller and other peripheral devices
3. Price: $8, including cord and wall plug
4. Lead Time: 0 weeks

F. Casing Subsystem

1. Components: 3D printed plastic
2. Function: The function of the casing is to contain all of the components related to the microcontroller subsystem together (minus sensors). The casing will feature a clean and accessible interface for the user to interact with.
3. Interface: The interface with the other components is that the casing has to be made so that the other components fit properly and that the outside casing has holes or openings for relevant components (i.e., LED, buzzer).
4. Price: Free; ND 3D printers

G. Pipe Subsystem

1. Components: Circular metal tubing, 4” in diameter, likely more robust than most dryer tube venting, but less robust than steel.
2. Function: Create the connection between the user’s dryer venting tube and the back of their dryer. Our sensors, as relevant, will sit inside of this pipe in locations we determine are optimal for sensing.

3. Interface: Interfaces to the dryer vent on one end, and a dryer venting tube on the other. The Casing Subsystem (and contained microcontroller and other components) will sit likely on top of this, isolated from the metal pipe.
4. Price: ~5-10 at Lowe's

II. Essential Connections

A. I2C or SPI from microcontroller to BME280:

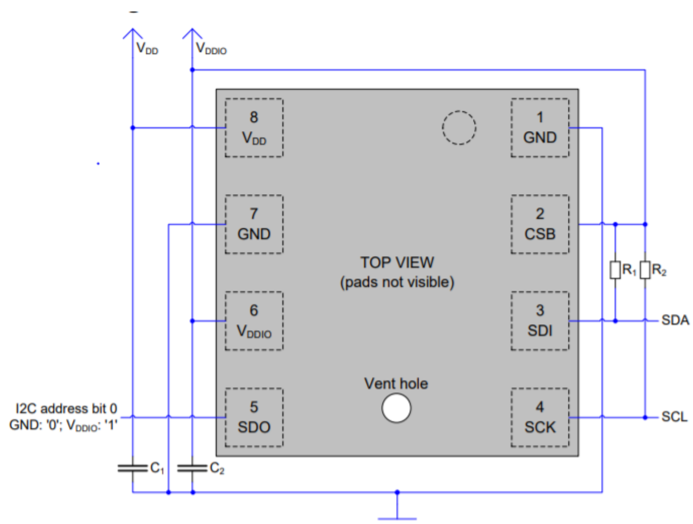
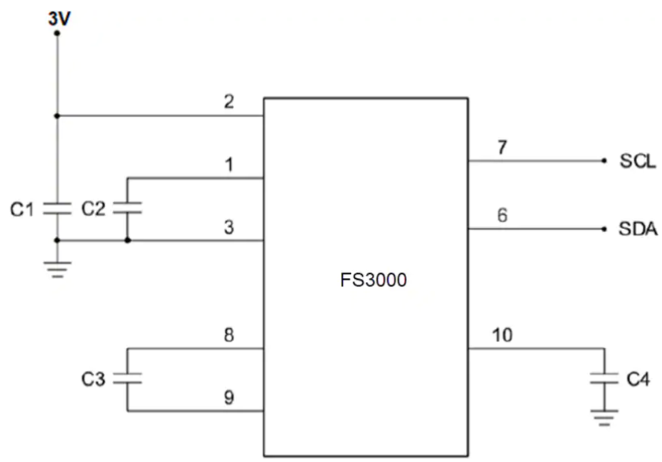
1. Requires a Vdd supply voltage of 1.71 - 3.6V, so using 3.3V from ESP will suffice
2. Requires soldered I2C or SPI connection using wire, I2C (up to 3.4 MHz) and SPI (3 and 4 wire, up to 10 MHz)
3. 

Figure 17: I²C connection diagram

B. I2C from microcontroller to FS3000:

1. Requires a Vdd supply voltage of 3.3V
2. Requires a pull-up resistor of 2.2kΩ to 10kΩ.
3. With two lines (data and clock) it needs 100kHz and 400kHz bit rate.

4. Capacitors should also be the same for both lines (C1 = C2).

5. 

C. Microcontroller to Power supply:

   1. Will step down 120V from household wall plug in to 5V/2.1 A using standard USB wall adapter and microUSB cord.

D. Microcontroller to communication devices, including LED and piezo alarm:

   1. Piezo alarm can handle voltages of 3-18V, input can be a simple voltage controlled by a digital switch.
   2. Similar to Piezo alarm, LEDs can take a simple DC current as input. Each LED should have approximately 0.7V drop so can be designed in a simple, grounded circuit.

E. Relevant physical connections:

   1. Connecting Pipe Subsystem to the back of the dryer unit and to the user's existing dryer vent tubing
   2. Connecting/securing the Casing Subsystem to the Pipe Subsystem

III. Problems To Be Addressed

A. How to attach the sensor(s) within the dryer sleeve:

   1. Which sensors will be inserted into the dryer sleeve?
   2. How should each sensor be placed in the dryer sleeve?

B. Which sensor(s) will be on-chip vs. off-chip?

C. How to write messages or data readouts to a webpage via WiFi?

   1. Can we use a sub-page of the team website as a testing ground for our WiFi communications and data/messaging?

D. Measurements of temperature, airflow, pressure, and humidity:

   1. What are the measurement thresholds that are indicative of lint ignition?
   2. What are the measurement thresholds that are indicative of lint back-up (or the beginning of a lint problem)?
   3. What are the measurements, for each type of sensor, that will trigger an alarm, message, or alert?
   4. How will the sensors' measurements be prioritized in the case of conflicting data?
   5. Does the location in the pipe or the proximity to the dryer change the efficacy of some or all of the measurements?

E. Casing/Pipe subsystem requirements:

   1. Can we 3D print an encasement for the board and microcontroller? If this is plastic, will contact with the dryer pipe threaten to melt it at high temperatures? What other casing could we use?
   2. Can we use a cut-out section of dryer sleeve that will serve as the intermediary interface between the back of the dryer and the dryer sleeve?

Is there a thicker or more robust type of pipe we can use than a dryer sleeve?

3. How will this interface be connected and installed to both the back of the dryer and the dryer sleeve?