EE 41430

SmartLint©

Design Review 0

Group 3: SmartLint
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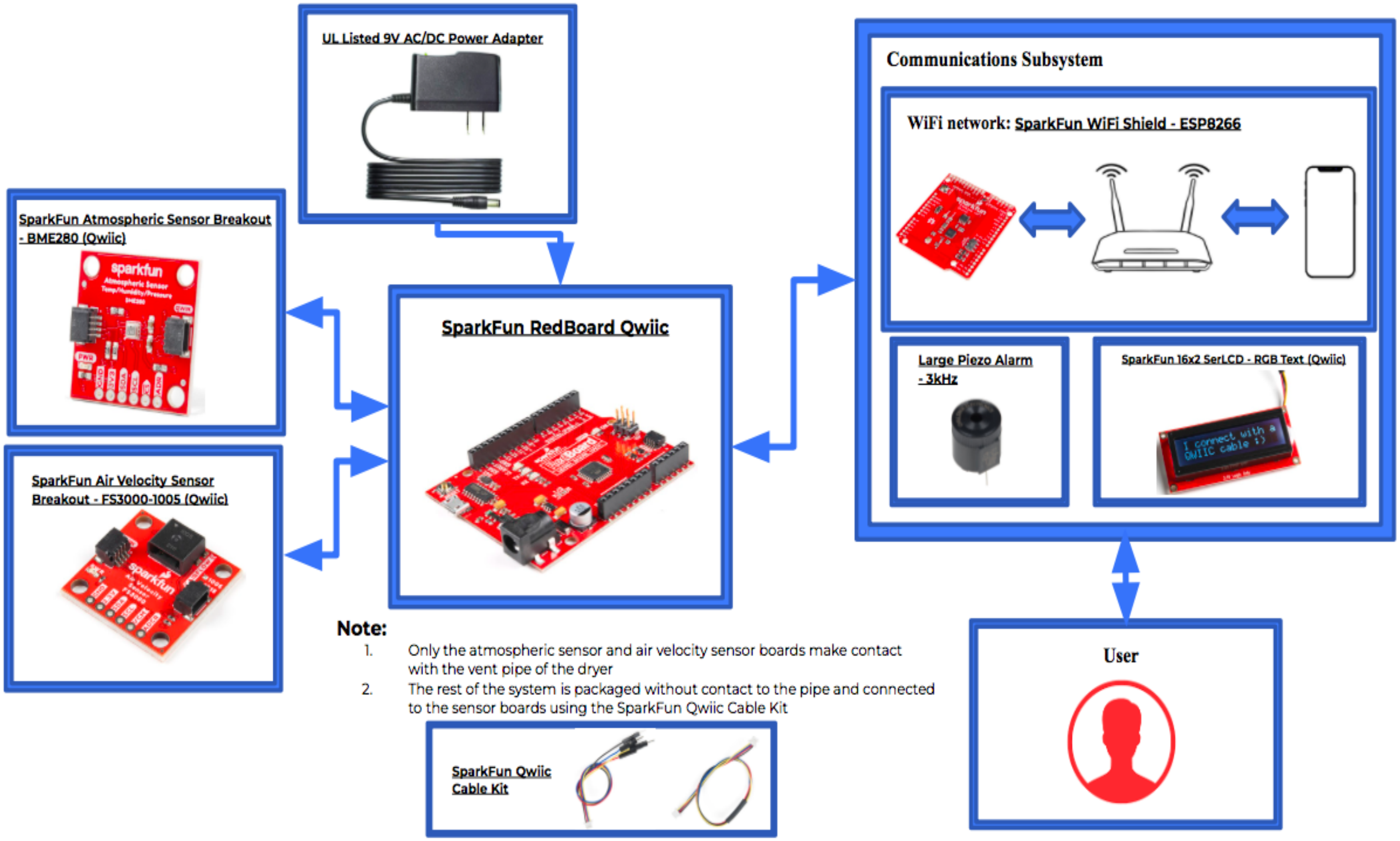
I. System Block Diagram

SmartLint System Block Diagram



Note:

1. Only the atmospheric sensor and air velocity sensor boards make contact with the vent pipe of the dryer
2. The rest of the system is packaged without contact to the pipe and connected to the sensor boards using the SparkFun Qwiic Cable Kit

II. Major Subsystems & Requirements

1. **Power Subsystem:**
    a. Function: provide power to the microcontroller and other peripheral devices via a wall wart plug that connects to the microcontroller's "barrel jack" (7 – 15 VDC range). This can be accomplished with a 9V AC/DC Power Adapter. Alternatively, use batteries (Li-Ion) to power the associated devices. via the same connection.
    b. Interface(s): N/A
    c. Associated Device(s):
        i. 9V AC/DC Power Adapter
        ii. SparkFun RedBoard Qwiic microcontroller
            1. Will provide power to periphery subsystems: atmospheric sensing subsystem, airflow sensing subsystem, WiFi shield)
    d. Unknowns & Potential Problems: need to determine practically what the best AC/DC power adapter and cord is. We could run into an issue of having a dryer unit that is far away from a house plug. Also, determining the overall power requirements of the system will help us determine if a battery solution is possible or more practical.
2. **Atmospheric Sensing Subsystem**
    a. Function(s): sense heat, humidity, and pressure in the dryer venting pipe expelled from the dryer unit. It will periodically communicate data back to the

microcontroller. The microcontroller will process these measurements and determine what communications and/or actuation needs to occur.

b. Interface(s): I2C and UART interfaces available. BME280 acts as the Slave in each protocol.

c. Associated Device(s):

   i. SparkFun RedBoard Qwiic microcontroller (Master)

   ii. SparkFun Atmospheric Sensor Breakout - BME280 (Slave)

   iii. SparkFun Qwiic Cable Kit

      1. SPI will have 4 data signals: chip select (CSB), serial clock (SCK), serial data input (SDI), serial data output (SDO)

      2. I2C will have 3 data signals: serial clock (SCL), data (SDA), Slave address (SDO)

d. Unknowns & Potential Problems: lack of experience with the specific microcontroller could lead to difficulties specifying signal bits, however the manual should help solve this. Microcontrollers can be very frustrating to get working so plenty of time for programming should be allotted.

3. Airflow Sensing Subsystem

a. Function(s): sense airflow in the dryer venting pipe and periodically communicate measurements back to the microcontroller. The microcontroller will process the measurements and determine what communication and/or actuation needs to occur.

b. Interface(s): I2C digital, two-wire interface with a bidirectional data line (SDA) and a clock line (SCL).

c. Associated Device(s):

   i. SparkFun RedBoard Qwiic microcontroller (Master)

   ii. SparkFun Air Velocity Sensor Breakout - FS3000-1005 (Slave)

   iii. SparkFun Qwiic Cable Kit

      1. I2C will have only two data signals: clock line (SCL) and data (SDA)

d. Unknowns & Potential Problems: we have not yet determined which thresholds for temperature, humidity, and/or pressure are relevant or critical to accomplishing our function. We are not sure to what degree these 3 measurements will be most effective (and how they will be related to each other) with regard to accomplishing the system's purpose of detecting an issue in the dryer.

4. **Communications Subsystem:**

   a. Function(s): the communications subsystem will be designed to communicate with the user through 3 mediums: through a device (such as a smartphone or laptop), through an audible noise (via piezo alarm), and at the dryer unit (via LCD display to user). Serial signals (UXTX and RXTX) from the microcontroller can be converted to WiFi in order to connect to a user's Home Area Network (HAN), if one exists, and will be able to upload measurements, alerts, or other notifications to a user connected to the same network. We have not yet determined the best representation of these messages (i.e. push to a webpage, push to a downloadable application, text alerts, etc…). Depending on the threshold of the measurements acquired by the sensing subsystems (temperature, pressure, humidity, and airflow), the piezo alarm can be triggered with a "high" signal to audibly alert the user, should they be within earshot. Similarly, the LCD can display messages or measurements to the user in plain text at the dryer unit to prompt action or user intervention.

b. Interface(s): UART/serial communication for microcontroller to WiFi communication. Microcontroller to piezo alarm can be connected at an output pin with a wire. The LCD panel will also connect to the microcontroller via a provided Qwiic cable and is communicable via SPI, UART, or I2C.

c. Associated Device(s):

    i. SparkFun RedBoard Qwiic microcontroller
    ii. SparkFun WiFi Shield - ESP8266
    iii. Home Area Network (HAN)
    iv. Large Piezo Alarm - 3 kHz
    v. SparkFun 16x2 SerLCD - RBG Text (Qwiic)
    vi. SparkFun Qwiic Cable Kit

d. Unknowns & Potential Problems: it is unclear if we have enough interfaces from the main microcontroller to service all of the communication devices adequately. How we plan these interfaces may impact the availability to host the LCD panel, for example.

5. **Casing and Dryer Interface Subsystem**

    a. Function(s): The function of the casing is to put all the components together. Also with the casing it will have a more clean interface for the user to interact with.

b. Interface(s): 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 is smooth.

c. Associated Device(s):

   3D printer

d. Unknowns & Potential Problems: It is unclear how to arrange the components to have the dimensions of the product. We will look over this once we get all the components and know the dimensions of everything. Heating may have an unknown effect on the casing. We will need to examine heat tolerances on the casing materials.

III. Plan For Achieving Design Review 1

Tasks:

1. Team assignment
   a. Breakout into different teams
      i. Power subsystem
      ii. Atmospheric sensing subsystem
      iii. Airflow sensing subsystem
      iv. Communications subsystem
      v. Casing and Interface subsystem
      vi. Microcontroller Programming
   b. Each team develop detailed descriptions of the components that make up their subsystem
   c. Communicate with all teams to determine necessary connections between components
   d. Establish interdependencies of subsystems and order in which the systems will be designed, tested, and implemented.
2. Research
   a. Determine acceptable criteria for airflow conditions
      i. Use the sensor data sheet to determine what data returned corresponds to the desired reading range

        ii. Test using a detached dryer sleeve(?)
    b. Investigate chip data sets to understand how to connect external components
3. Identifying and resolving unknowns
    a. Each team identify any known problems
        i. Present a course of action for each problem
    b. Each team detail any unknowns that need to be confirmed
4. Establish plan for ordering necessary components
    a. Investigate prices and lead times for all approved components
    b. Think about what materials will be needed for testing that need to be procured; which materials can be used from campus supplies (i.e., 3D printer, testing materials available in Stinson-Remick 253).
5. Access and update team website