Product Design Specifications (PDS)

Project: Indoor Air Quality Monitor

I. Function

This design project is aimed at designing a device which can monitor indoor air quality. The device will be used to improve indoor air quality in low-income areas of countries such as India and Rwanda. Our client requires that the device indicate the level of air quality in a simplistic manner. Also, the device should specifically detect pollutants and particulates in the air which are the direct result of tobacco smoke and biomass fuel burning. The device should have some means of storing the data which it collects. The stored data should be easily downloaded for further research.

II. Client Requirements

- The device must monitor indoor air quality specifically related to tobacco smoke and biomass fuel burning
- The device must indicate the current air quality in an extremely obvious and clear manner
- The device should have some internal memory to which it can record data
- This data should be easily downloaded to a computer for further studying and analysis
- The device should be primarily powered through the wall outlet
- The device should have a rechargeable battery which will serve as a "back-up" power source
- The device should be sufficiently small and lightweight
- The device should be able to function for a significant amount of time without breaking down

III. Design Requirements

1. **Physical and Operational Requirements**

    a) **Monitoring Capabilities:** The device must monitor current levels of air pollutants, specifically volatile organic compounds (benzene, carbon tetrachloride, chloroform, and dichloromethane), carbon monoxide, and particulates.

    b) **User Interface:** The device will indicate the current air quality to the user in a simplistic manner. The device will use different colored light emitting diodes (LEDs) to tell whether the air quality is poor (red), fair (yellow), or good (green) in a manner analogous to a stoplight. The various LEDs will light up based on danger threshold levels for hazardous air pollutants.

    c) **Data Storage:** The device must be able to frequently store the information which it is monitoring to an internal hard-drive. The data should be easily downloaded via a USB port.

    d) **Safety:** The device should be safe and pose no immediate risk to the user (s).

    e) **Power Supply:** The device will be powered through a common electrical wall outlet. However, the device will have an internal rechargeable battery which will charge during normal use and supply power during an outage.

f) **Operating Environment:** The device should be able to function correctly at various temperature humidity levels. Specifically, the device should work properly at all humidity levels and between 10 and 40 °C.

g) **Size/Weight:** The device should be approximately 8x10x8 cm and have a mass no greater than 2 kg.

h) **Materials:** The device will consist of sensors for the various compounds being monitored, various circuit components, a project box, LEDS, a programmable microcontroller such as that in Arduino ®, a plug for going into a wall outlet, and a rechargeable battery.

2. **Production Requirements**

i) **Quantity:** Initially, only one functional device will be constructed. However, it is expected that several more of these devices may be manufactured and put to work as early as this summer.

j) **Budget:** The initial prototype should not take more than $1000 to construct.

3. **Miscellaneous**

k) **Standards and Specifications:** The device should be able to detect levels of particulates and pollutants at certain threshold levels. The device should be tested by seeing whether or not the LED lights change at given particulate or pollutant levels indicated by more exact instruments.

l) **Customers:** Our customers will be those conducting studies on indoor air quality in India and Rwanda, as well as those running Project Quit Tobacco, a U.S NIH funded project.

m) **User-Related Concerns:** The main concern here is that the device is accurate enough to indicate to the user a potentially dangerous air quality situation. Also, the device should pose no significant electrical shock risk to the users and researchers.

n) **Competition**: There are several similar devices on the market. However, none of these seem to monitor exactly the same pollutants as our device will. Also, most of these devices have a somewhat more complicated user interface.