Erebus Labs

STEM Sensor Requirements Specification

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Revision: 2.0

Project Description

The objective is to encourage an interest in STEM in K-12 students by delivering a working prototype of an affordable, simple-to-use device for collecting environmental data.

Terminology Notes:

Base Unit: The central device that manages power, communication, and data storage, and has one or more sensors attached to it.

Sensor: The individual data collection devices such as VOC detectors and thermometers that are attached to the base unit.

User Interface: The program that will be run on a laptop or desktop computer that allows the user to view and interact with the data collected.

System: The operational product comprised of base units with attached sensors and a user interface.

Marketing Requirements

1. The system must be modular, allowing multiple sensor types to be employed by one base unit.
2. The system must be low cost.
3. The system must be simple enough to operate that K-12 teachers and students can effectively utilize the device in a classroom.
4. The user interface must accommodate both novice and advanced users.
5. Base unit with sensors attached must be able to operate outside of a classroom.
6. The system must provide a method for users to specify the data collection interval.
7. Hardware and software designs should be open-source.
8. The base unit should be able to collect data for an extended period without user interaction.
9. The base unit should require minimal changes or adjustments for the use of different sensors.
10. The user interface should provide a method for organizing and comparing data from multiple base units employed simultaneously.
11. The base unit should employ a wireless method of exporting data for analysis.
12. The system should be durable.
13. The base unit may also be modular and require user assembly.
14. The base unit may support simultaneous multiple sensor attachment.

Engineering Requirements

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| Marketing  Requirements | Engineering  Requirement | Justification |
| 1, 2, 3, 4 | All sensors must use the same interface to connect to the base unit | Minimizes cost and complexity for users while increasing versatility |
| 4 | The user interface must provide a method for the user to access the raw data collected | Allows advanced users to perform their own data analysis |
| 2 | BOM for base unit should not exceed $20.00 each | Necessary for adoption by K-12 classrooms with limited budgets |
| 2 | BOM for sensors should not exceed $5.00 each | Necessary for adoption by K-12 classrooms with limited budgets |
| 3, 13 | The base unit may use sockets and connectors to attach the controller, power, and communications devices to the PCB | Further modularity provides hardware interactivity and learning opportunities for younger users |
| 3, 4, 9 | The base unit should identify the sensor(s) attached and configure itself appropriately | Simplifies operation for younger users |
| 1, 4, 6 | The system should be able to collect data points at rates between 1 Hz and 1 per day | Accommodates a wide variety of data collection applications |
| 4, 10 | The system should be able to coordinate data collection between 6 base units simultaneously | Accommodates a wide variety of data collection applications |
| 5, 12 | The base units and sensors should be operational after a 1.5m drop-test | The system needs to survive daily use by K-12 students |
| 5, 12 | The base and sensors may be constructed with a water-resistant case | The system needs to survive daily use by K-12 students |
| 5, 12 | The base unit with sensors attached should operate when exposed to temperatures between -20°C and +80°C | Temperature range required for outdoor operation |
| 7 | A publicly-accessible repository will be used for code and documentation hosting | Encourages exploration and experimentation by students |
| 2, 7 | If third-party software is used, it will be open-source | Encourages exploration and experimentation by students, minimizes cost |
| 3, 8 | The base unit should be able to collect data points for 90 days without user interaction | Simplifies operation for all users |
| 2, 3 | If the system is does not use a rechargeable power source, it must not use proprietary battery types | Using widely available batteries minimizes cost |
| 11 | A wireless data dump interface should be utilized by the base unit | Provides a convenient method for users to retrieve data |
| 11 | If a wireless data dump interface is utilized by the base unit, it should not require the user to be closer to the base unit than 3 meters | Provides a convenient method for users to retrieve data |
| 2, 4, 14 | The base unit may contain multiple attachment points to enable multiple sensors to be used simultaneously | Enhances versatility for advanced data collection |