

Erebus Labs

STEM SENSORS

BUDGET

Version 1.6

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VERSION HISTORY

| Version # | Implemented By | Revision Date | Reason |
|-----------|----------------|---------------|--------------------------------------------------------------------------------------------------|
| 1.5 | Scott Lawson | 6/4/2014 | Added Final BOM Costs |
| 1.4 | Scott Lawson | 6/1/2014 | Removed 2.2 – Remaining Costs section Separated BOM section into Initial Estimation and Final |
| 1.3 | Scott Lawson | 2/1/2014 | Fixed Header and cover sheet typos Split Total Anticipated Budge & Remaining Costs |
| 1.2 | Scott Lawson | 1/31/2014 | Added development boards cost to section 2.2 Fixed type in BOM costs |
| 1.1 | Scott Lawson | 1/30/2014 | Changed to Standardized Format Added microcontroller costs |
| 1.0 | Scott Lawson | 1/28/2014 | Initial Release |

NOTE TO READER

This is a template obtained from:

<http://www2.cdc.gov/cdcup/library/templates/default.htm>

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1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

This document describes the budget allotted and cost estimations for the Erebus Labs STEM Sensor. This document is intended to be a living document. As such, it should be updated whenever new budget-related information is available. The reader should be aware that information contained in this document may change at any time.

1.2 OBJECTIVE STATEMENT

Encourage an interest in STEM in K-12 students by delivering a working prototype of an affordable, simple and flexible device to collect environmental data.

1.3 OVERVIEW

This document is divided into two sections:

1. Development Costs

This section contains estimated costs related to the development of the STEM Sensor. This section is further divided into two sections: a ledger to track purchases that have already been made, and a summary of the total anticipated development budget from the beginning of the project.

2. Bill of Materials Costs

These are costs associated with the production of a single sensor unit, excluding amortized development costs. This section contains both the final BOM cost as well as a copy of the initial estimation before many design decisions were made for comparison.

2.2 INITIAL ESTIMATION

| Item | Cost (Ea) | Quantity | Ext. Cost | Cost Factors |
|-------------------------------|---------------|---------------------|----------------------------|---------------------------------------------|
| Sensor | 1.00 – 25.00 | 5 – 8 | 5.00 – 50.00 ₁ | Type, Quantity of each type |
| μController | 1.50 – 5.00 | 5 – 8 | 7.50 – 40.00 | Onboard Features, power consumption |
| Batteries | 0.75 – 12.00 | 5 – 16 ₂ | 12.00 – 60.00 ₂ | Rechargeable, composition, form factor |
| Passives₄ | 0.05 – 2.00 | 50 – 100 | 20.00 – 30.00 ₁ | Values and tolerances required |
| Interfaces₅ | 0.50 – 8.00 | 16 – 25 | 8.00 – 50.00 | Wireless vs. Wired |
| PCBs₆ | 4.00 – 18.00 | 4 – 6 | 24.00 – 48.00 | PCB Area, sensor requirements |
| Other SI₇ | 0.50 – 2.00 | 16 – 30 | 8.00 – 50.00 ₁ | Battery selection, sensor output |
| Packaging | 3.00 – 75.00 | 2 – 3 | 9.00 – 225.00 | Materials: laser-cut acrylic vs. 3D-printer |
| Software | 0.00 | 0.00 | 0.00 | Only utilizing free development software |
| Development Boards | 10.00 – 60.00 | 4 | 40.00 – 240.00 | Options available for selected controller |
| Total: | | | | 300.00 – 700.00 |

1. Extended cost does not scale linearly with quantity because it is assumed that the maximum quantity would not be entirely comprised of the most expensive components.
2. Quantity and extended cost assume either a small amount of expensive rechargeable proprietary batteries, or a larger amount of cheap (AA or 9V) batteries.
3. Resistors, capacitors, inductors, LEDs
4. Antennas, transceivers, receivers, cable jacks
5. Assumes a PCB for the base unit as well as separate PCBs for the interchangeable sensors.
Example: Minimum extended cost is based on a 2in x 2in base unit PCB with two 1in x 1in sensor PCBs at \$2.00 per square inch, x2 prototypes.
6. Other semiconductors: op-amps, voltage regulators, discrete transistors

3 BOM COSTS

3.1 FINAL

| Item | Cost | Quantity | Avg Cost/Unit | Notes |
|--------------------|---------|----------|------------------|--------------------------------------------|
| Sensors | \$10.00 | 1 | \$10.00 | Temperature Sensor, O2 sensor |
| μController | \$6.49 | 1 | \$6.49 | PSOC3 CY8C3246PVI-147 |
| Batteries | \$3.48 | 4 | \$0.41 | AA Batteries and Holders |
| Other | \$38.87 | 47 | \$0.83 | Regulators, jumpers, resistors, caps, etc |
| Interfaces | \$8.23 | 4 | \$2.06 | Ethernet for sensors, USB for base |
| PCBs | \$34.30 | 3 | \$11.43 | Switching Main Board, both sensors |
| Packaging | \$10.00 | 1 | \$10.00 | Laser-cut acrylic from EPL, hand assembled |
| Total: | | | | \$111.37 |

3.2 INITIAL ESTIMATION

| Item | Cost (Ea) | Quantity | Ext. Cost | Notes |
|--------------------|-----------|----------|-----------|--------------------------------------------|
| Sensor | \$4.00 | 2 | \$8.00 | Temperature Sensor, CO sensor |
| μController | \$5.52 | 1 | \$5.52 | PSOC3 CY8C3245PVI-150 |
| Batteries | \$0.50 | 4 | \$2.00 | AA Batteries |
| Other | \$0.50 | 1 | \$0.50 | Regulators, jumpers, resistors, caps, etc |
| Interfaces | \$0.50 | 4 | \$2.00 | Generic jack for sensors, USB for base |
| PCBs | \$6.00 | 1 | \$6.00 | 2"x2" base PCB, 1"x2" PCB per sensor |
| Packaging | \$3.00 | 1 | \$3.00 | Laser-cut acrylic from EPL, hand assembled |
| Total: | | | | \$27.02 |

APPENDIX A: GLOSSARY

A.1 ACRONYMS

| Acronym | Meaning |
|------------------|---------------------------------------------------------------|
| ADC | Analog-to-Digital Converter |
| BOM | Bill of Materials |
| CO | Carbon Monoxide |
| CSV | Comma-separated-value formatted file |
| EEPROM | Electrically Erasable Programmable Read-Only Memory |
| EPL | The Portland State University Engineering and Prototyping Lab |
| I ² C | The Inter-Integrated Circuit communication protocol |
| ISR | Interrupt Service Routine |
| K-12 | Kindergarten through 12 th grade school |
| LED | Light Emitting Diode |
| PCB | Printed Circuit Board |
| PSoC | Programmable System On Chip |
| SI | Silicon |
| SPI | Serial Peripheral Interface Bus |
| STEM | Science, Technology, Engineering and Math |
| TRM | Technical Reference Manual |
| USB | Universal Serial Bus |