Electrical and Computer Engineering Capstone Project Proposal

Version 1.0

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**Erebus Labs**

**Open Sensor Platform**

Submitted By:

**Colten Nye**

**Steve Pierce**

**Golriz Sedaghat**

Supervisor:

**Dr. Lisa Zurk**

Sponsors:

**Dr. Mike Borowczak**

**Dr. Andrea Burrows**

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**1 INTRODUCTION**

An understanding of science and technology is necessary for anyone who wishes to make informed choices about many controversial issues in the todays’ society. In recent years, in many countries, there has been a significant focus on making younger generation passionate about Science, Technology, Engineering and Mathematics (STEM). Efforts have been made to promote interests in STEM related fields among the students and encourage them in considering an STEM career in the future.

This document proposes the design and implementation of an open source sensor platform device, which allows K-12 students and their teachers to collect data by either employing the built-in sensors implemented on the platform or connecting their own sensor module to the platform and process the collected data through a GUI interface, without requiring them to have a technical knowledge of programming and electronics.

**2 PROJECT STATEMENT**

2.1 Background

The focus of Erebus Labs & Consulting LLC is on the development of Secure Hardware/Software solutions; and furthermore, Educational Outreach and STEM integration in K20 classrooms. In this respect, one of the concerns has been regarding K12 students using current sensor designs which often require programming/electronics experience and there is almost no open source and cost affordable approach to the sensor designs for K12 students.

There has been a previous related work done by one of the Portland State University capstone teams last year, 2013-14, which would be considered as a first revision proof of concept for this design.

2.2 Detailed Problem Description

The purpose of this project is to build an open source sensor platform device which is consisted of a main board and sensor boards containing built-in sensor arrays that would communicate with the main board; furthermore, the platform has the capability of adding at least one sensor module. The focus would be on the usability of the device by high school students and people who may not necessarily have technical knowledge of programming and electronics. The possible candidates for built-in sensors of the platform are VOC (volatile organic compound), moisture, Oxygen, temperature, … which would allow the students to collect the raw data from their environment and analyze them using a GUI interface independent of the operating system of their machine. System should have low power consumption (maximum of 3 month duty cycle) as well as low cost (maximum of $50 per unit) which would make the system more efficient and affordable.

**3 METHODOLOGY**

**Power**

**SD Card**

**STM32 MCU**

**Input**

**A/D**

**Conversion**

**Main Board**

**Data Out**

**Sensor Board**

Figure 1 – High Level System Design

Figure 1, demonstrates a high level overview of the system. One of the main considerations in the design would be sensor and main board interface. In this regard system should be able to identify and support different types of sensor communication interface I2C, SPI or USB as well as sensor’s analog or digital output. The main board contains microcontroller which communicates with the sensor boards and read the collected data by the sensors. The possible candidate for the MCU is STM32 which has many capabilities useful for this application; such as, multiple I2C buses, USB, SPI interfaces, low power consumption, on-board SDIO support, DMA support for SDIO, STMCube software platform and Cortex Microcontroller Software Interface Standard (CMSIS). The collected data would be saved on a SD card primarily in order to prevent data loss, as well as extracting the collected data for further analysis. The programming of the design would be browser-based/USB-Host which makes the user interface independent of the operating system.

**4 PROJECT SCHEDULE**

Table 1 lists the summary of the key tasks and key dates from beginning to the end of the project, which would help the team stay on track and determine whether or not the project is on schedule.

|  |  |  |  |
| --- | --- | --- | --- |
| **Task Name** | **Duration** | **Begin Date** | **End Date** |
| Proposal |  | 1/12/15 |  |
| Functional Decomposition of System |  | 1/31/15 |  |
| Identify Components |  | 1/31/15 |  |
| Final Schematic |  | 2/15/15 |  |
| Final PCB layout |  | 3/1/15 |  |
| Boards Fabbed |  | 3/8/15 |  |
| Integration |  | 3/29/15 |  |
| Testing, debugging and Fixing |  | 4/1/15 |  |
| Release |  | 5/6/15 |  |

Table 1 – Project milestone

**5 BUDGET**

Table 2 provides a summarized list of part numbers and descriptions, vendors, quantity and list prices for all system components.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Supplier** | **Part #** | **Quantity** | **Unit Price** | **Total** |
| Sensor |  |  |  |  |  |
| Microcontroller |  |  |  |  |  |
| Battery |  |  |  |  |  |
| Interface |  |  |  |  |  |
| Packaging |  |  |  |  |  |
| PCB |  |  |  |  |  |
| **Total:** | | | | | |

Table 2 – Bill of Material

**6 REFERENCES**

[1] Hemmo, Vale. *Encouraging Student Interest in Science and Technology Studies*. Paris: OECD, 2008. Print.

[2] http://www.st.com/web/en/resource/technical/document/datasheet/CD00237391.pdf

**7 REVISION HISTORY**

|  |  |  |
| --- | --- | --- |
| **Version #** | **Revision Date** | **Comments** |
|  |  |  |
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