Electrical and Computer Engineering Capstone Project Proposal

Version 2.0

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**Erebus Labs**

**Open Sensor Platform**

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# Abstract

# Introduction

## Background

## Problem Description

## Previous Attempts

## Existing Products

# Project Statement

Our goal is to design and prototype an open-source hardware/software solution for collecting data from sensors that is both inexpensive and accessible to non-technical users. This solution will consist of the main device, a web application for programming the device, and a number of peripheral sensors. We will consider the project a success if we can procure the programming application, at least 5 working main boards, 4 working sensor boards (2 of each connection type), and demonstrate successful system integration by May 6, 2015.

# Methodology

|  |  |  |
| --- | --- | --- |
| Processor | STM32F205X  Microcontroller | Microcontroller communicates with the sensor boards, reading the collected data from the sensors on a predetermined interval, via the browser configuration tool. |
| Sensor and main board interface | ADC, I2C | The system should be able to identify and support different types of communication via I2C or analog input via ADC. |
| I2C Type Sensor board | Accelerometer | Sensor boards are designed to be “stackable” for I2C devices as they are uniquely addressable as per I2C specification. |
| ADC Type Sensor board | Volatile Organic Compound (VOC) | The ADC channels have a predetermined “snap-in” connector type thereby limiting the possibility of damage due to incorrect installation. |
| Storage | SD Card | Sampled data is logged to an SD Card for safe storage after power-loss or in case of a physically damaging event. |
| Main board programming | JTAG ICP interface through development environment | This programming must be done at least once prior to shipment, and is referred to as “In Circuit Programming”. |
| Development Board | Keil ULINK Pro | This bootloader firmware allows the HID (Human Interface Device) connection over USB to support the browser-based editing. |
| User interface design | Chrome based web browser application | User is able to connect to the system via USB, and program the sensor values through a Chrome based web browser application, via STM’s supported “In Application Programming”, referred to as IAP. |
| Data collection | Flash memory | User is able to save the collected data on a flash memory to prevent data loss, as well as extract the collected data for further analysis. |
| Open Source Design |  | A more advanced user is able to customize the bootloader using a JTAG unit, but there is no need for the user to modify the bootloader while using the platform. |

## Hardware

### Main board

|  |  |
| --- | --- |
| Microcontroller | STM32F205X (STMicroelectronics) |
| Communication Interfaces | * Up to 3 I2C (Inter-Integrated Circuit) * Up to 3 SPI (Serial Peripheral Interface) * On-board SDIO (Secure Digital Input Output) Interface |
| Advanced Connectivity | * USB 2.0 full-speed/high-speed device/host/On-The-Go controller with dedicated DMA (Direct Memory Access) * Ethernet |
| Memory Type | Up to 1MByte Flash Memory |
| Clock Source  Characteristics | * 4 – 26 MHz crystal oscillator * 32kHz oscillator for RTC (Real Time Clock) with calibration |
| Low Power | * 1.8 to 3.6V operating supply voltage * Sleep, Stop and Standby modes * VBAT supply for RTC (Real Time Clock) * Power-ON Reset Circuitry * Power-Down Reset Circuitry * Brown-out Reset Circuitry |
| Other peripherals | * Up to 17 Timers * Three 12-bit Analog to Digital Convertors /Two 12-bit Digital to Analog Convertors * Camera interface * Random number generator |
| Debug and programming mode | * SWD (Serial Wire Debug) * JTAG (Joint Test Action Group) In Circuit Programming |
| Software Platform | * STM32Cube initialization code generator * Cortex Microcontroller Software Interface Standard (CMSIS) |
| Development environment | * CooCox CoIDE * OpenOCD * Keil uVision |

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Figure 1.1 – High Level System Design

### Sensor Boards

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| --- | --- |
| Accelerometer | SparkFun Triple Axis Accelerometer Breakout - MMA8452Q |
| Communication Interface | * I2C digital output interface (operates to 2.25 MHz with 4.7 kΩ pull-up) |
| Operating Voltage range | * 1.95 V to 3.6 V supply voltage * 1.6 V to 3.6 V interface voltage |
| Output characteristics | * Output Data Rates (ODR) from 1.56 Hz to 800 Hz * 12-bit and 8-bit digital output |
| Other characteristics | * Low power consumption * Two interrupt pins, which allows power savings by relieving the host processor from continuously polling data * Current Consumption: 6 μA – 165 μA |

|  |  |
| --- | --- |
| Volatile Organic Compound (VOC) Sensor | Carbon monoxide gas sensor detection alarm MQ-7 |
| Communication Interface | * ADC interface |
| Output characteristic | * Analog output |

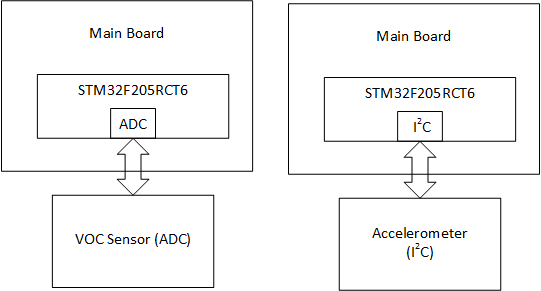


Figure 1.2 - Sensor Connections

## Firmware

## Software

### Configuration

#### System Configuration

#### Sensors Configuration

### Programming

## Support

# Schedule

# Budget

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Version #** | **Revision Date** | **Author** | **Comments** |
| 1.1 | 1/14/2015 | Golriz Sedaghat | Changes were made in Detailed Problem Description and Methodology, also figure 1 has been modified and figures 2 and 3 has been added |
| 2.0 | 2/27 | Colten Nye | Restructured and updated entire document |
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