2015 PSU ECE Department Capstone Project

Sensor Platform

Portland State UNIVERSITY
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INTRODUCTION

Using current sensor platforms require programming/electronics experience which most K-12 students, beginners and hobbyists lack.

This project was to design and build a platform which addresses this issue, allowing K-12 students to learn without the substantial technical overhead. Our main goals were usability, customization, low-power consumption and modest price-point. The following table lists main specifications of our design.

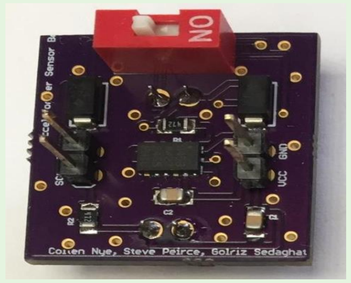
Category	Specification
Configuration	Ability to communicate with: I2C sensors (stackable I2C sensor boards) Up to 3 analog sensors
Power	3.3 V operating voltage USB Connector 5V 3x1.5 AA Battery
Clock Speed	16 MHz
Memory	Micro SD Card connector (stores data collected by sensors) Microcontroller (STM32F205) has Up to 1 MB Flash Microcontroller (STM32F205) has 128+4 kB RAM
Communication	I2C (Inter-Integrated Circuit) ADC (Analog to Digital Converter) USB (Universal Serial Bus) SWD (Serial Wire Debug Interface) USART (Universal Synchronous/Asynchronous Receiver/Transmitter)
User Interface	Platform independent Web-application
Supported Operating Systems	Windows
Customization	Main board can be customized over SWD port
Cost	$ 45.8 per main board

VOLATILE ORGANIC COMPOUND SENSOR (VOC)

Volatile Organic Compounds are Carbon-based chemicals that easily evaporate at room temperature. A VOC sensor's conductivity changes in the presence of a detectable gas based on concentration in the air; this change in the conductivity converts to an analog output signal. Our VOC sensor board employs TGS2602 VOC sensor model which senses VOC's, as well as Ammonia and Hydrogen Sulfide.

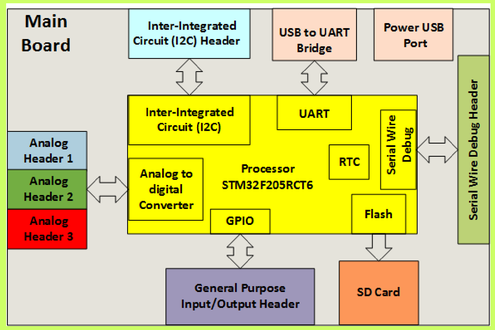
ACCELEROMETER SENSOR BOARD

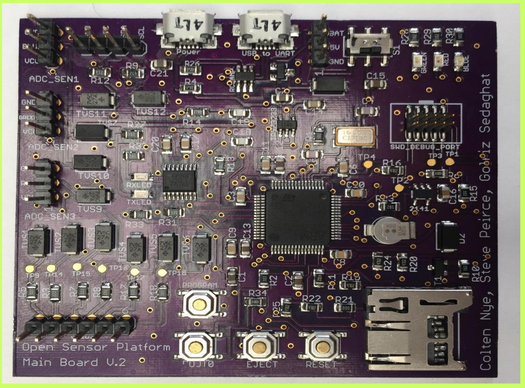
The accelerometer sensor communicates over I2C with the main board. The employed accelerometer is Analog Devices' ADXL345. It is a small, ultra-low Power, 3-Axis and popular with hobbyists. The DIP switch on the board provides two alternate I2C addresses on the board; therefore, using two sensors on the same bus is possible by flipping a switch!



MAIN BOARD

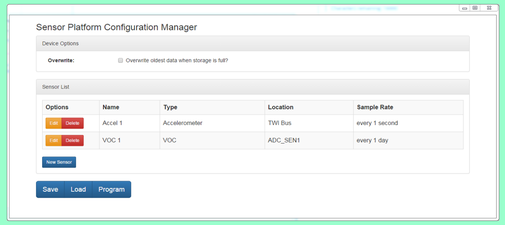
The main board supports I2C and (3) analog sensors. The 32-bit ARM based microcontroller, an STM32F205 by ST Microelectronics, communicates with the sensor boards, reads the collected data from them on user specified intervals, then logs this collected, formatted data to a micro-SD card. The open source design of the main board allows simple users to program and customize the times and sensors positions. Advanced users may upload their own custom binaries via the debug header taking further advantage of this powerful design.



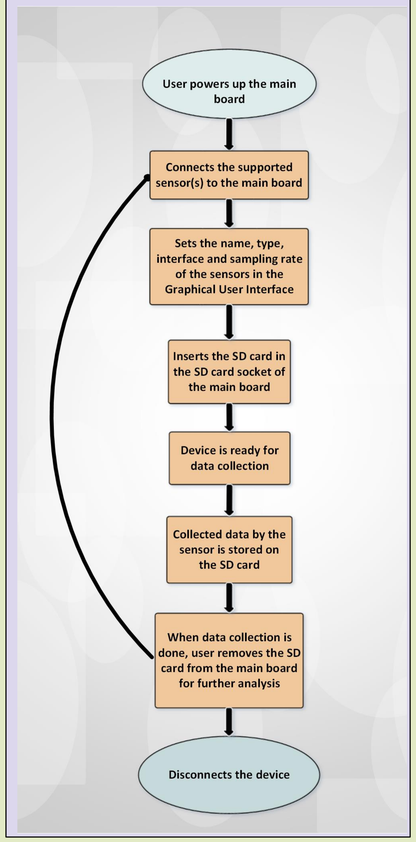


GRAPHICAL USER INTERFACE

The user is able to configure the sensor positions and sampling intervals through a browser-based, platform independent Graphical User Interface, (GUI). This design allows customization and use independent of the operating system.



Our design goal was simple and user-friendly access, allowing anyone to easily employ the device regardless of background.
The current revision includes a User's Manual providing guidance on usage based on the application.
The following indicates the end-user process:



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