# DITAQM- an Educational Framework for a Embedded, Low-Cost, and Open-Source Air Quality Sensor Package

Elam Day-Friedland
Albany High School, Albany, California, USA

April 12, 2021

---

## Abstract

In this paper, we present a fully integrated framework for distributed air quality sampling with a focus on STEM education and extensions to add more sensors. This is aimed at high-school students with an initial exposure to computer programming. (we expect that teachers / student will do this collaborativley) Within this framework we have included a custom-designed embedded circuit integrating four discrete air quality sensors run by an ESP32 (a WiFi enabled microcontroller). The four natively supported sensors were chosen with consideration for the ability to detect a breadth of pollutants as well as cost and are as follows: the PMS7003 particulate matter sensor, the MiCS6814 MultiGas sensor, the BME280/680 temperature, pressure, humidity, and organic compound (BME680 only) sensor, and the MH-Z19B CO2 NDIR CO2 sensor. The firmware is written in MicroPython, a subset of the Python 3.4 standard optimized for low-spec devices such as microcontrollers, so that it is simple to set up, with no data wires required after initial flashing yet easy to extend. The cluster is contained within a 3D printed enclosure designed to withstand both indoor and harsh outdoor environments. The framework uses a docker-based NodeJS and MySQL stack for handling and coordinating users, sensors, and data. All source files referenced in this paper are available at https://github.com/t3chy/diyaqi. We designed this project to be fully free and open source, with the software and hardware components licensed under the GNU General Public License v3 and CERN Open Hardware License v2 (Strongly Reciprocal) respectively.



---