



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Ron Freeman	Project Number J1012
Project Title ZeroAQI: An Affordable, Portable, Open-Source Air Particulate Matter Sensor	
<p style="text-align: center;">Abstract</p> <p>Objectives Recent wildfires resulted in unhealthy and hazardous air quality conditions with the recommendation to shelter in place. However it was uncertain to me if the air quality in my home or public locations in my neighborhood were safe. This led me to develop ZeroAQI, with the objective to prove the feasibility of a low cost Air Quality Index particulate sensor system for reporting the concentration of particulate matter smaller than 2.5 microns and the goal of creating a portable, affordable, and open-source system.</p> <p>Methods The Raspberry Pi s GPIO interface cannot handle the 5v logic levels generated by the sensor. A voltage divider created from three 10K Ohm resistors level shifts the 5v logic to 3.3v logic. To read data from the sensor, code is imported from the PIGPIOD example set. The user interface is based on the Flask Python web server framework. As an additional user interface and to make the project more interactive, I implemented a chatbot with a command interaction list via the telegram chatbot API. For portability, I utilized a 5v 2.1 A phone battery to power the entire system for several days per charge. To test the accuracy of the system, I compared results of the ZeroAQI AQI-PM2.5 with the Bay Area Air Quality Management District Redwood City Regional Station AQI-PM2.5 as reported by airnow.gov.</p> <p>Results I found that ZeroAQI has a 12% accuracy when compared to the regional station allowing it to deliver to the user accurate enough results to make an educated decision on the health of the air.</p> <p>Conclusions ZeroAQI has a few limitations. The controller board relies on an internet connected Wi-Fi network to be able to communicate. This can be solved by connecting to a mobile hotspot, but it is not perfect. The particle sensor relies on still dry air to function, rendering it useless in windy or wet conditions. The sensor is also vulnerable to sunlight, as it functions by detecting reflected infrared light from particulate in a darkened chamber. Clean healthy air is crucial to life and everyone should be able to access localized and instant air quality measurements to make informed decisions for their health and safety. ZeroAQI's dedicated GitHub page with source code and build instructions facilitates ease of assembly. ZeroAQI's \$23 affordability and portability is useful in many applications such as detecting microparticles from 3D printers and other unexpected polluters.</p>	
Summary Statement I developed ZeroAQI, a \$23 portable, open-source personal air particulate matter sensor system that is accessible to everyone.	
Help Received I would like to thank my parents for purchasing the parts I identified as necessary for the project.	