10 WORDS

Sensor data/analytics to reduce wildfire responder exposure to smoke.

499 WORDS

THE OPPORTUNITY

Wildfires have intensified in scale and impact in the last few decades1. Yet there’s limited data available to understand the long-term effects of smoke exposure among first responders on the front lines2. For instance, cardiovascular and neurological diseases are believed to be linked to high levels of carbon monoxide (CO) exposure2,3,4.

CO is one harmful component of smoke, is a toxic, odorless, colorless gas which can have immediate effects on physical and mental performance, often unnoticed by the person exposed5. Current methods of determining the prognosis and treatment can also be subjective and possibly dangerous4.

Our research indicated an opportunity to develop on-the-field technology to measure and record CO levels. The solution could also provide large-scale, quantitative data to study CO correlations with other harmful substances such as PM2.5 and respirable crystalline silica found in smoke2,6,7,8. There’s no wearable, rugged, low-cost CO device available today.

Health professionals and other scientists can use this data to monitor and determine long-term effects of CO on first responders, and perhaps extrapolate the data to improve the clinical care of active and retired first responders.

OUR SOLUTION

The F.R.E.E. (First Responder Emission Evaluator) Sensor technology has two basic functions: 1) Data gathering and upload capabilities through a **compact, rugged CO monitoring device** worn by first responders in the field, and 2) Provision of a **data dashboard**, allowing support teams to make safer deployment decisions based on CO exposure of individual crew members.

The wearable CO sensor was designed with the following parameters: 1) Low cost, 2) IoT solution leveraging the IBM Cloud, 3) Built-in memory card, 4) Low power consumption for long battery life, and 5) Accuracy. IBM technologies employed are the DB2 database, Watson Studio for visualization, and IBM AI to analyze patterns that might help correlate CO levels to PM2.5 and other toxins exposure.

We constructed two prototypes. Both used the MQ-7 CO sensor, SD memory card, Arduino base board, and temperature sensor. Because the MQ-7 CO sensor consumes excessive power during warm-up, we are also evaluating the 3SP\_CO\_1000 Spec Sensor, a more expensive but low-power component.

The main prototype uploads data to the IBM Cloud via a micro USB cable, and the other uses a Bluno Arduino with built-in Bluetooth, allowing transfer via cellphone for upload to the Cloud when coverage is available.

We envision two uses for the data. The first would populate a data dashboard for support personnel charged with deploying fire crew resources. The data could be incorporated into existing resource management/scheduling software or we could provide a stand-alone dashboard app that fire captains can utilize on their cellphones. The second could be used by medical professionals and researchers to analyze impacts of cumulative exposure, help set occupational exposure limits, and improve the diagnosis and treatment of affected first responders.

F.R.E.E. Sensor is a **groundbreaking** opportunity to mine large-scale data from first responder CO exposure. Its data dashboard will be invaluable for rapid decision-making in managing fire crew exposure to smoke at the front lines.

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OTHER interesting stuff:

How NASA measure CO from wildfires

<https://climate.nasa.gov/news/2781/carbon-monoxide-from-california-wildfires-drifts-east/>

High exposure increases risk of disease among firefighters

<https://wildfiretoday.com/2018/02/06/study-shows-firefighters-exposure-smoke-increases-disease-risk/>

This mentions the use of CO detectors in the field:

<https://www.fs.fed.us/air/health_impacts.htm>