'Lab-on-a-drone' sends science skyward to keep track of smelly air pollution

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This modified quadcopter drone can detect and analyze hydrogen sulfide gas while in the air. Credit: Adapted from *Analytical Chemistry*, 2023, DOI: 10.1021/acs.analchem.3c02719

Polluted air can contribute to the development of asthma and other conditions, and the first step toward combating its effects is continuous, accurate monitoring. Most measurement devices are stationary, placed just feet above the ground, but contaminants can drift away. Now, researchers publishing in Analytical Chemistry have developed a "lab-on-a-drone" system that, unlike similar gadgets, can detect and analyze levels of pollutants, such as smelly hydrogen sulfide gas, all while still floating in mid-air.

Hydrogen sulfide (H_2S) is one of the stinkiest air pollutants, well known for its putrid, rotten-egg odor. Though it's naturally found in well water and volcanic emissions, it's also a common byproduct of petroleum refineries and wastewater treatment plants. The gas is an irritant, and in high enough amounts, it can be toxic.

Most methods to quantify H_2S and other pollutants rely on ground-based instruments, and expensive devices such as satellites are required to collect measurements at higher altitudes. Unmanned drones have been used by researchers to gather samples in mid-air, but analyses still had to be performed on the ground with traditional instruments.

So, João Flávio da Silveira Petruci and colleagues wanted to create an inexpensive "lab-on-a-drone" that could sample and analyze H_2S gas while in the air and report the results in real time—a first for devices of its kind.

Using a 3D printer, the team manufactured a custom device that was

mounted to the bottom of a commercially available quadcopter drone. It took advantage of a unique chemical reaction between H_2S and a green-glowing fluorescein mercuric acetate molecule. When excited by an onboard blue LED light, the interaction caused a decrease in the green fluorescence intensity, which was detected and quantified. This reaction is highly selective and was not affected by other, interfering gaseous air pollutants.

The team took their drone to a wastewater treatment plant, where it sampled air on the ground, then at around 30 and 65 feet in the air at three different times throughout the day. The detection device transmitted its results via Bluetooth to a smartphone, allowing for real-time monitoring.

In the evening, there was a clear increase in H_2S concentration as the drone increased altitude, though it never exceeded the acceptable ambient level. The researchers say that this system could be adapted to detect other pollutants in the future.

More information: Vanderli Garcia Leal et al, AirQuality Lab-on-a-Drone: A Low-Cost 3D-Printed Analytical IoT Platform for Vertical Monitoring of Gaseous H2S, *Analytical Chemistry* (2023). DOI: 10.1021/acs.analchem.3c02719

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