Low-cost monitoring device uses light to quickly detect oil spills

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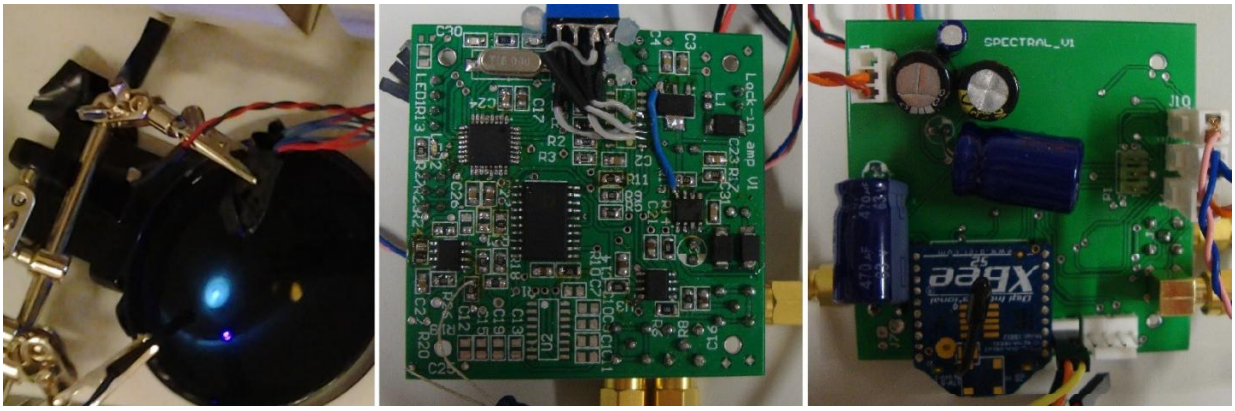

Researchers developed a device that uses florescence from oil (left) to detect its presence and identify the type of oil. The small and simple device incorporates inexpensive electronic components (right). Credit: Oscar Sampedro, Universidade de Vigo.

Researchers have developed a simple device that can detect an oil spill in water and then pinpoint the type of oil present on the surface. The device is designed to float on the water, where it could remotely monitor a small area susceptible to pollution or track the evolution of contamination at a particular location.

"Fast detection of a spill is crucial for a quick antipollution response to avoid, as much as possible, the progressive mixture of the oil into the

water, which would make cleaning more difficult and inefficient," said the leader of the research team, Jose R. Salgueiro of Universidade de Vigo, Spain. "Also, knowing the oil type makes possible a more specific response to counteract the pollution."

While there are technically complex and expensive instruments that use aircraft or satellites to look for oil across large areas, the new work shows that it is possible to make a simple and effective device that can be used to monitor a certain area on an ongoing basis. In The Optical Society's journal *Applied Optics*, the researchers describe their new low-cost oil-sensing device and detailed it's capability to distinguish from five types of oil tested in the study.

Detecting oil's fluorescence fingerprint

When crude or refined oil absorbs ultraviolet (UV) light, it emits a unique fluorescence spectrum. The new device uses this fluorescence spectrum as a sort of a fingerprint to identify the oil type by comparing the measured fluorescence with information in a database.

Although most instruments that detect fluorescence use an expensive and delicate spectrometer, the researcher team used an inexpensive and simple setup of four photodiode detectors with different colors of cellophane film filters. This let them record four signals, each consisting of different regions of the fluorescence spectrum. The device uses inexpensive UV LEDs as light sources and a low-cost microcontroller like the ones used to operate drones. It also includes a commercial radio module to send data and receive configuration commands.

The researchers tested their instrument by conducting laboratory measurements on three types of crude oil provided by an oil company and two types of refined oil. They recreated the conditions of an oil spill by generating thin films of each type of oil on a water surface.

"The four signals proved to be enough to build a specific fingerprint for every oil type used in our study, letting us identify the different types of oil," said Salgueiro. "This approach dramatically reduces the cost of the instrument and simplifies contamination testing."

Testing in a natural environment

Now that the researchers have demonstrated their device in the laboratory, they plan to construct a solar-powered prototype that could be placed in a buoy, for example, and left in a lake or off shore in the ocean for months. The prototype device, including the buoy, will have a height and diameter of about 30 centimeters and will have the capability to send measurements to a remote user via a radio module or even by satellite modem.

The investigators are also working to record the fluorescence fingerprints for other common types of oil that weren't included in this study so that even more types of oils could be identified.

"Our device could help keep better track and control of pollution, especially by detecting potential pollution sources," said Salgueiro. "Once the pollution is produced it will help to quickly detect the problem, identify the nature of the pollution and contribute to a better response."

More information: Óscar Sampedro et al, Remote photonic sensor to detect crude and refined oil, *Applied Optics* (2017). DOI: 10.1364/AO.56.002150

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