Low-cost imaging system poised to provide automatic mosquito tracking

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"A remote system like ours can dramatically reduce the labor needed to monitor mosquitoes in a given area, thus greatly increasing the capability to do more monitoring," said research team leader Adam Goodwin from Johns Hopkins University. "If you can provide more mosquito data, then you will more quickly catch outbreaks and save more lives."

In The Optical Society (OSA) journal *Biomedical Optics Express*, Goodwin and colleagues' paper is part of a feature issue on Optical Technologies for Improving Healthcare in Low-Resource Settings. In the paper, they describe the new system, which is designed to transmit images from inside a *mosquito trap* that are detailed enough for entomologists to distinguish mosquito wing patterns and the color of scales, features that indicate whether a mosquito is a *species* that carries disease. This information can be used to plan interventions that work best against that species.

"The new system is a classic application of an internet of things (IoT) device," said Goodwin. "It could eventually be paired with computer vision algorithms to automatically determine species and provide that information to public health systems."

**Developing a remote imaging trap**

In the many areas of the world where mosquito-transmitted disease is problematic, understanding which mosquito species are present in what numbers requires continually trapping *mosquitoes* at multiple locations. A worker must then drive around a county or region to drop off and pick up hundreds of traps per week and bring the specimens back to the lab to be identified under a microscope.

"Our new optical system can be placed inside a traditional mosquito trap to provide remote surveillance of the abundance, diversity and distribution of mosquito species," said Goodwin. "Using imaging is particularly appealing because as
long as image quality is high, several mosquitos could be identified from an image at once."

In most cases, public health systems only need to determine if there are changes in the number or type of mosquitos from day to day or hour to hour, not minute to minute. This means a camera sensor would only need to be turned on a few times a day at most. This would keep the power consumption within the range feasible for an internet-connected device.

**Testing the system**

To test the new system, the researchers compared entomologists' ability to classify specimens from a digital microscopy image and images from the remote imaging system. There was not a significant difference in their capabilities between the image types. Although the entomologists didn't perform well on species classification for either the microscopy images or the remote system images, they did very well on genus classification.

"Entomologists are not used to identifying specimens from an image because they normally have the specimen in person and manipulate it with tweezers under a microscope," said Goodwin. "However, recent work using convolutional neural networks to classify mosquitos from an image does show promise."

The researchers plan to continue optimizing the remote trap and plan to integrate computer vision algorithms as well as internet-connectivity into the system. "This would enable species information to be sent directly to the public health system for decision-making," said Goodwin. "This is where we think the system will really shine."

**More information:** Adam Goodwin et al, Development of a low-cost imaging system for remote mosquito surveillance, *Biomedical Optics Express* (2020). DOI: 10.1364/BOE.382391

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