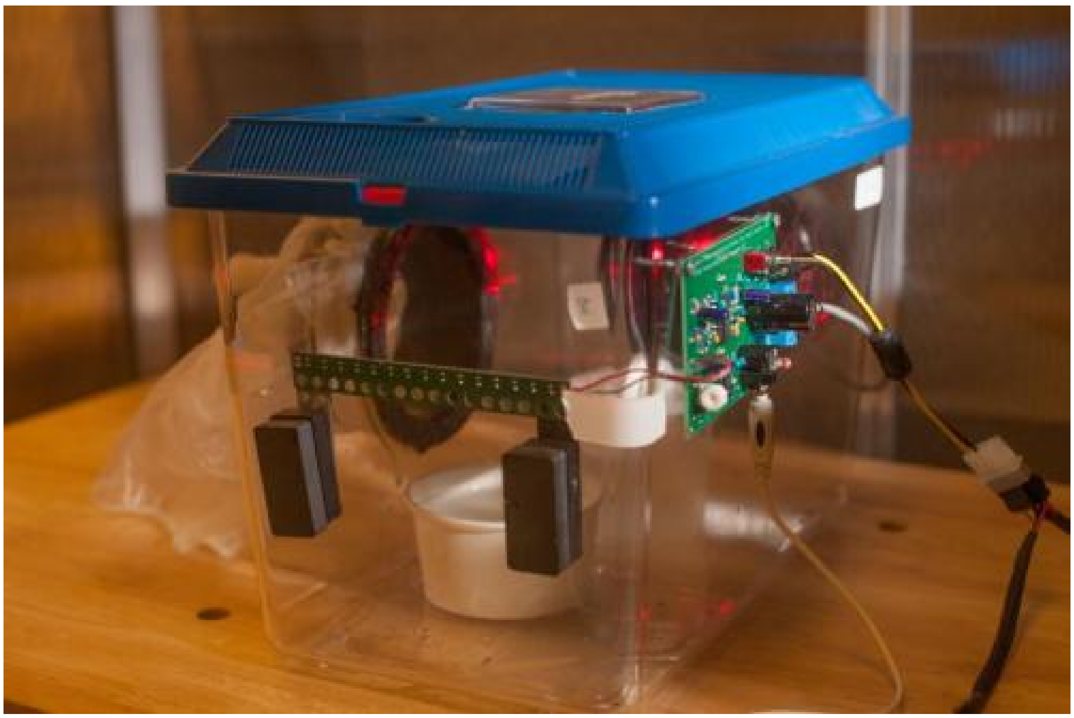
Saving crops and people with bug sensors

April 29 2014, by Sean Nealon



This is one of the devices built by the researchers to collect data on insect behavior. Credit: Peter Phun

University of California, Riverside researchers have created a method that can classify different species of insects with up to 99 percent accuracy, a development that could help farmers protect their crops from insect damage and limit the spread of insect-borne diseases, such as malaria and Dengue fever.

Over the past 60 years, insect classification research has been limited by factors including an overreliance on acoustic sensing devices, a heavy focus on wingbeat frequency and limited data.

The UC Riverside researchers overcame those limitations by building an inexpensive wireless bug sensor that can track many insect flight behavior patterns and generate much larger amounts of data that can then be incorporated into classification algorithms.

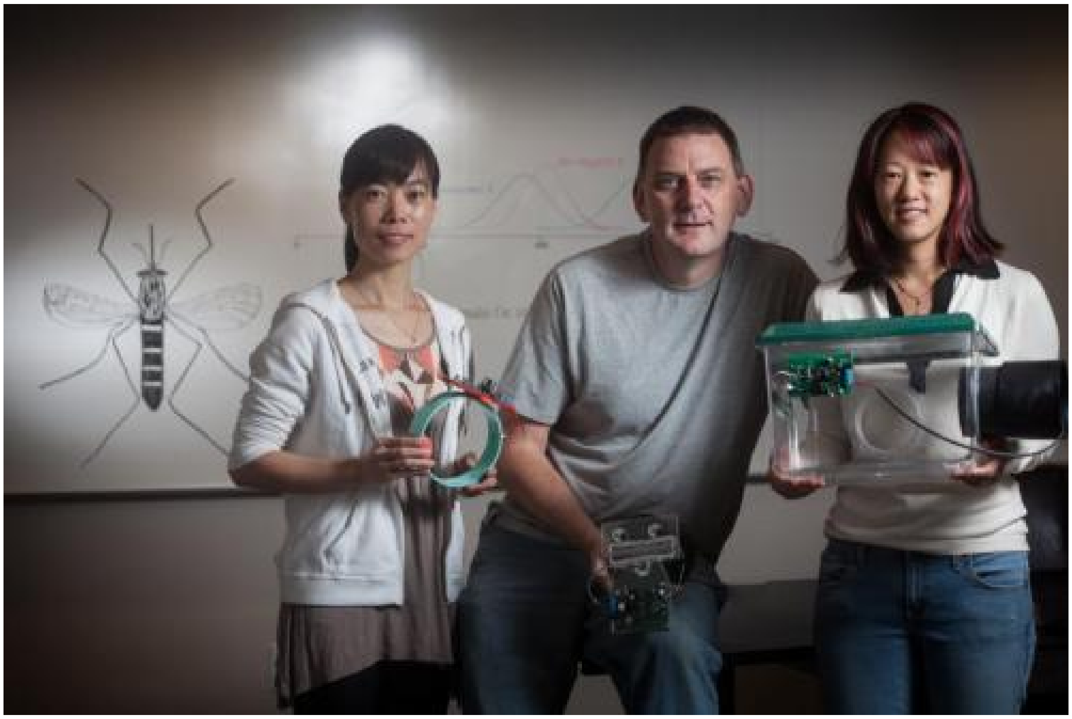
In about three years, by having dozens of sensors running in parallel 24 hours a day, the UC Riverside researchers have collected tens of millions of data points, more than all previous work in this field combined.

"We set out not knowing what was possible," said Eamonn Keogh, a computer science professor at UC Riverside's Bourns College of Engineering. "Now, the problem is essentially solved. We have created insect classification tools that can outperform the world's top entomologists in a fraction of the time."

The research findings are under review for publication in an upcoming issue of the *Journal of Insect Behavior*. Keogh's co-authors are: Yanping Chen, a computer science graduate student at UC Riverside (the lead author); Adena Why, an entomology graduate student at UC Riverside; Gustavo Batista, of the University of Sao Paulo in Brazil; and Agenor Mafra-Neto, of ISCA Technologies in Riverside.

Filled with tables, chairs and computers, Keogh's lab at the University of California, Riverside Bourns College of Engineering looks like many computer science labs.

But, open the closet door and there are a couple dozen shoebox-size plastic containers from a local pet store, each filled with up to 100 insects and connected to an optical sensor. The sensor consists of a phototransistor array, which is connected to an electronic board and a laser pointing at the phototransistor array.



From left, Yanping Chen, Eamonn Keogh and Adena Why. Credit: Peter Phun

When the insect passes across the laser beam, its wings partially block the light, causing a small light fluctuation. The fluctuations are captured by the phototransistor array as changes in current, the signal is then filtered and amplified by the custom designed electronic board. The output of the electronic board is fed into a digital sound recorder and recorded as an MP3 and downloaded to a computer.

The goal is to make this automated classification method as simple, inexpensive and ubiquitous as current methods such as sticky traps and interception traps, but with digital advantages such as higher accuracy, real-time monitoring and the ability to collect additional flight behavior patterns.

In their experiments, the UC Riverside researchers worked with six species of insects. As they added additional insect flight behavior patterns to their classification algorithm, they were able to increase their success classifying the different species.

For example, using only wingbeat sounds they had an 88 percent success rate. When they added time of day the success rate jumped to 95 percent. Then, after adding location, the success rate increased to 97 percent.

The researchers believe that success rate can further be improved by adding additional variables, such as height at which the insects fly and environmental variables such as temperature and humidity.

In a separate experiment, the researchers tested classification accuracy by adding an increasing number of species. With two species, they had 99 percent accuracy. That percentage slowly declined as they added more species. For example, with five species they had a 96 percent accuracy rate and with 10 species it was 79 percent.

For hundreds of years humans have attempted to kill unwanted insects. While some blanket methods have been successful, they can be costly and create environmental problems. The sensor developed by UC Riverside researchers aims to change that by counting and classifying the insects so that the substance used to eradicate the harmful insects can be applied on a precision targeted level.

Keogh – who originally developed the sensor with Legos, a 99-cent store laser pointer and a piece from a television remote control – believes the sensors can be built for less than $10 and be powered by solar power or a battery that lasts a year.

In the next year, Keogh, who grew up in Ireland and worked painting carousel horses while attending college in the United States, plans to focus on deploying the sensors around the worldwide. Currently, they are being used on a small scale in Brazil and Hawaii.

Keogh is working with a Tovi Lehmann, an entomologist with the Laboratory of Malaria and Vector Research at the National Institute of Allergy and Infectious Diseases in Rockville, Md., to deploy them in Mali.

More information: arxiv.org/abs/1403.2654

Provided by University of California - Riverside

Citation: Saving crops and people with bug sensors (2014, April 29) retrieved 11 May 2024 from https://phys.org/news/2014-04-crops-people-bug-sensors.html