



**GIORGIO GILESTRO**

Dr Gilestro heads up a research laboratory at the Department of Life Sciences at Imperial College London. [magpi.cc/2i3vTHt](http://magpi.cc/2i3vTHt)

# ETHOSCOPE

Scientists have created mini robotic labs powered by Raspberry Pi to test the behaviour of flies – and learn more about humans

## Quick Facts

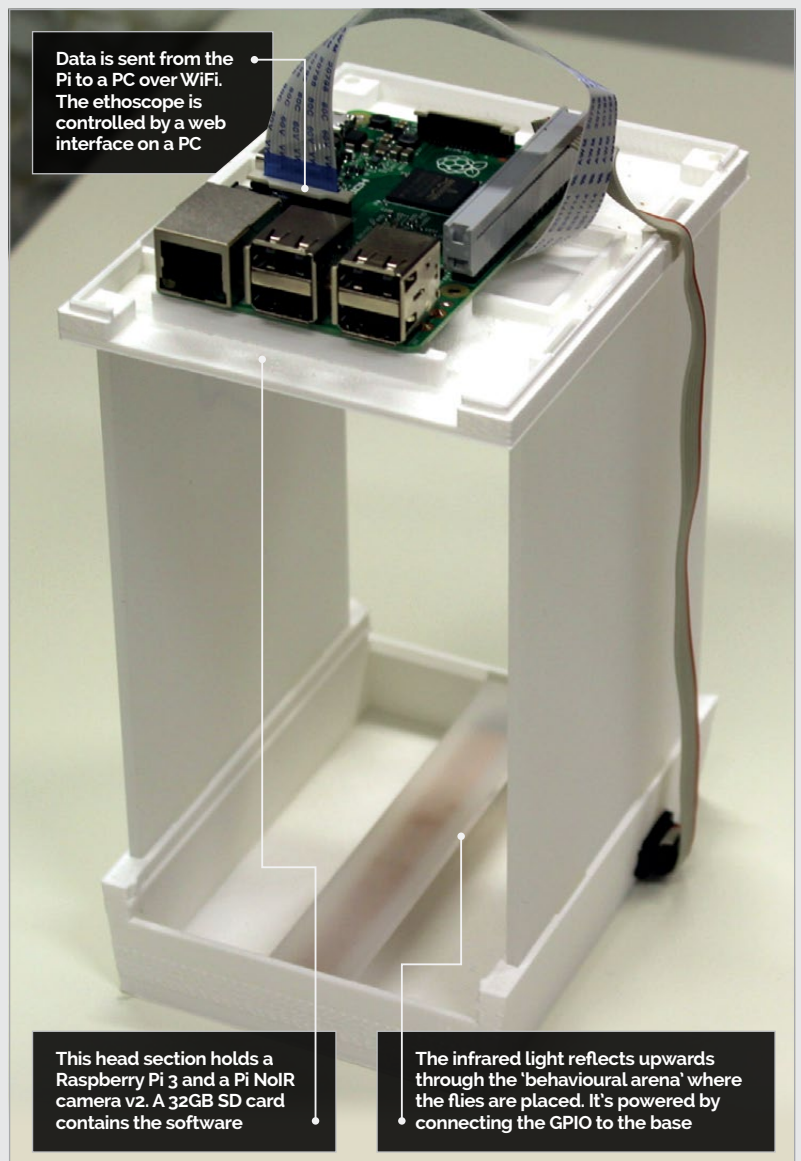
- They help scientists gain insights into human illnesses
- The ethoscope records and classifies flies en masse
- It can monitor fly behaviour and study responses
- The Pi-based ethoscope can be built for £100

**T**he Raspberry Pi isn't quite capable of performing complex brain surgery (at least not yet), but that doesn't mean it can't help scientists work out how our minds are wired. So when a group of researchers looked for a low-cost way of conducting studies in neuroscience, they turned to our favourite computer. The result is a machine with the potential to make ground-breaking discoveries about common human behaviour. And its secret ingredient? A load of flies, of course.

## Behavioural arena

Dr Giorgio Gilestro and his colleagues from Imperial College London have used the Raspberry Pi to create what they call an ethoscope: a device that can not only track animal behaviour using open-source hardware and software, but profile it using machine learning algorithms. They use fruit flies within their studies because they are similar to humans in genetic and behavioural terms: they can be used to study mental and physical human diseases and give insights into sleeping and socialising.

But instead of manually watching the flies and scoring their movements, as has been the case in the past, the Pi-based ethoscope is able to process and analyse real-time video. In doing so, it allows scientists to automate such time-consuming processes. "We can also study hundreds or

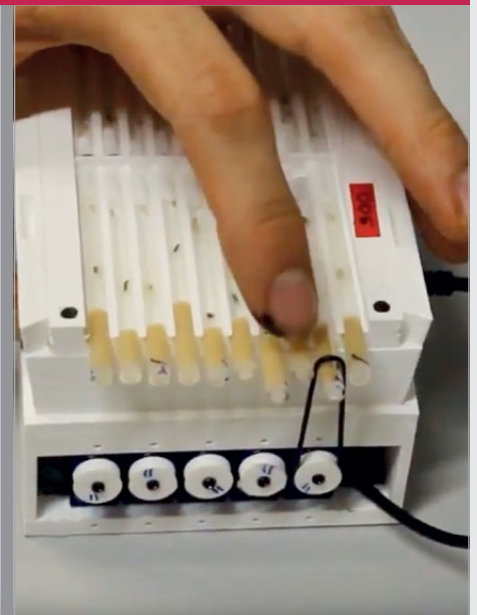
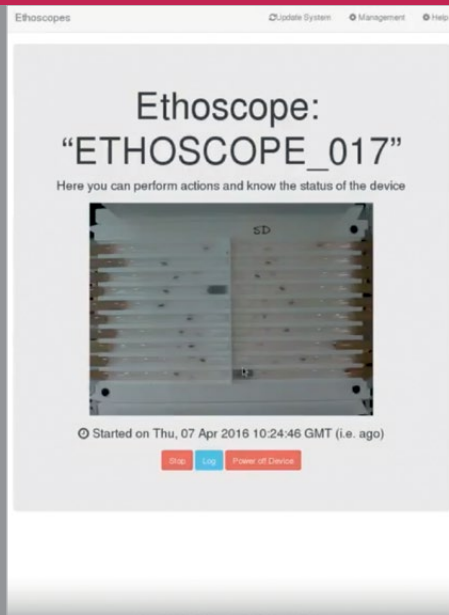


maybe thousands of flies at once because [the ethoscopes] are so small and cheap to maintain," explains Giorgio. "By using the Pis, we have enough computer power to analyse their behaviour using video

imaging and we can be wallet-friendly at the same time."

At first, the group used USB webcams connected to desktop computers running software that would analyse the behaviour of the

## WATCHING THE BEHAVIOUR OF FLIES



### >STEP-01 Setting it up

A total of 20 flies are placed into the 20 3D-printed tubes that make up this particular behavioural arena. The unit is then inserted into the bottom of the ethoscope.

### >STEP-02 Monitoring automatically

Software built on top of Linux and Python makes use of the Pi NoIR camera and begins to gather data. A web interface controls the device and allows the flies to be watched.

### >STEP-03 Wake up!

In the sleep study, the ethoscope will work out when a fly appears to be sleeping. This added module can flip the tube to wake it up and see what happens.

flies being filmed. “This was very accessible because almost everyone has a computer and a webcam, but it wasn’t very scalable or user-friendly,” Giorgio says. “There was also an issue of people running the program on different computers and hardware.” Using the Pis got around this problem and the scientists, led by PhD student Quentin Geissmann, eventually came up with a scalable device.

**Right** Dr Gilestro’s laboratory has 80 Pi-powered ethoscopes set up within it

**Bottom Right** As well as 3D-printing the cases, it’s possible to make the ethoscope from LEGO or cardboard

Eight behavioural arena decks have been created for research into areas such as feeding, sleep patterns, and decision-making. It’s certainly proving to be revolutionary (“it’s been very well received in the community,” he



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After deciding to use a 3D-printed modular design for the body of the ethoscope, they were able to place a Raspberry Pi on top, connected to a downward-facing camera. The idea was to film a ‘behavioural arena’ at the bottom, filled with flies and lit by an infrared LED.

adds) and because the ethoscope is open source and the full instructions are online, it’s been quick to take off. In actual fact, there is already talk of future iterations. “It’s almost like a commercialised product,” Giorgio tells us.

