

Raspberry Pi add-ons

Ben Everard investigates the extras on offer for the device that has turned us all into tinkerers.

The Raspberry Pi is probably the most successful British computing product in a decade, but it's also one of the most misunderstood. Too many people think of the Pi as just a cheap desktop, but by the time you've bought a monitor, keyboard, mouse and SD card, you'll have spent almost as much as you would buying a cheap laptop – and it's a whole lot less powerful.

The real innovation of the Pi, then, isn't its cost, but its form factor. It's small, it can be run off a few batteries (or solar cells), and has GPIOs (General Purpose Input and Output pins) exposed. This trio of features is almost unprecedented in computing, and before the Pi, it had never been done at this price point.

Because it's not just a new device, but a new type of device, a lot of people struggle to

understand how to use it, though. This was a particular problem when the Raspberry Pi first came out: there were few tutorials explaining how to use it, and if you wanted to use the GPIO you had to build any add-ons for yourself. Fortunately, times have changed quite rapidly, and a whole ecosystem of components for the Pi has sprung up.

Every day, it seems, we hear news of some new device that connects to the Pi to enable some function or add some feature. Many of

these haven't been developed by large companies, but by hobbyists who saw a need and filled it. It's been great to see just how quickly new and innovative devices have come on to the market.

Here, we're going to look at three of our favourite add-ons, so if you've got a Raspberry Pi acting as a paperweight, blow off the dust and put it to a more productive use; if your Pi project is already complete, well, you know it needs just one more feature don't you?

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Camera module

Take pictures on your Pi.

Before we get on to what the camera module is, let's first clear up what it isn't. If you're looking for a cheap webcam to Skype with your family, the Raspberry Pi camera module isn't for you. Not least because Skype doesn't run on the device. The Raspberry Pi camera is easy to use, but not in a plug-in-and-use-graphical-tools kind of way. Instead, it's designed to be scriptable.

Now, with that cleared up, let's get started. The camera module comes as a ribbon interface that slots into the vertical connector between the Ethernet port (or the Ethernet port-shaped gap on the model A) and the HDMI connector. Lift the top of the connector up, slot the ribbon in with the silver side facing the HDMI port, then push the top back down.

With this done, you'll need to make sure you've got the latest version of Raspbian with:

```
sudo apt-get update
sudo apt-get upgrade
sudo rpi-update
```

Then run **rasi-config** and make sure that the camera is enabled. Finally, restart and you should be ready to go.

All the magic is done with two commands: **raspistill** and **raspivid**. It should be pretty obvious which one takes still images and which takes videos. You can, of course, just run it like this, and type the command each time you want to use the camera. To capture a still image, it just takes:

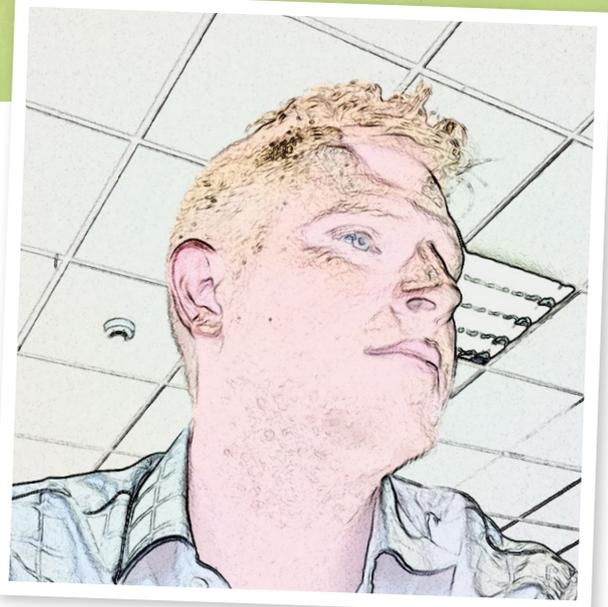
```
raspistill -o image.jpg
```

However, that's not where the fun lies. Because you can run these from the command line, you have full power to include it in your programs. For example, if you never know what white balance to use, why not use all of them with the following Python script:

```
from subprocess import call
for awb in ['off','auto','sun','cloud','shade','tungsten','fluoresce
nt','incandescent','flash','horizon']:
    call(["raspistill -n -awb " + awb + " -o image" + awb + ".
jpg"], shell=True)
```

As you can see from the above, you can control the camera from Python, even though there aren't any Python bindings, by using a system call. You can do this in most languages, so hack away in your language of choice. Since all the options are available as command-line switches, you should easily be able to build the options you want into the system call. Next, how about trying to make a stop-motion cartoon of your life?

› **Raspberry Pi camera module sketch mode == awesome!**



```
raspistill -ifx cartoon -ISO 800 -tl 100 -t 10000 -w 300 -h 300
-o test_%04d.jpg
```

Here we're using quite a few of the command line options. **-ifx** is image effects, and it allows you to do all sorts of cool stuff. In this case, we're using it to render the pictures in a cartoon style. **-ISO** sets the ISO sensitivity. We've used a high one since image quality doesn't matter too much in this case. **-tl** sets the timeout between the photos in milliseconds, while **-t** sets the total time for the timelapse capture, again in milliseconds. **-w** and **-h** are width and height in pixels. Finally, **-o** is the image filename (the **_%04d** is a number that's incremented with every picture).

These, of course, are just a few examples to get you started. For a full list of options for the camera, just run **raspistill** from the command line (with no options). Some of them won't make any sense unless you've got some photography experience, but with a bit of fiddling, you should get the hang of things.

As we mentioned before, **raspivid** can be used in a similar way to capture videos. To capture a simple video, run:

```
raspivid -t 5000 -o video.h264
```

and the more advanced options are similar to **raspistill**.

Once you've mastered the basics, you can try out some more advanced projects. How about facial recognition using *OpenCV*? There's a tutorial from the Think RPI blog to get you started at <http://bit.ly/13WDdoy/>.

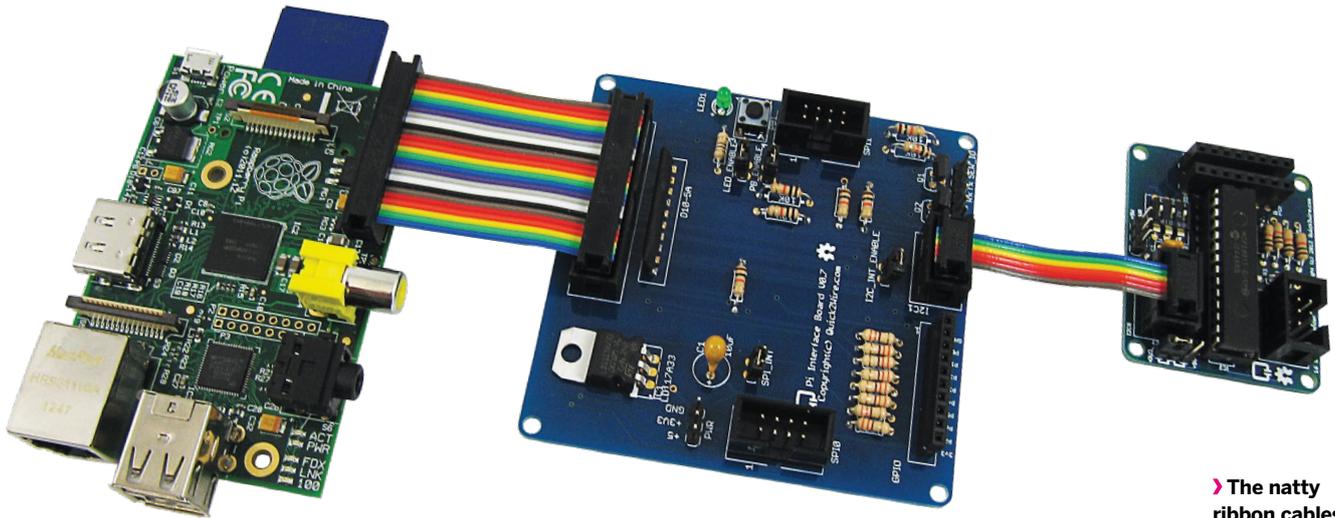
Other cameras

Connect your webcam or DSLR

So far, the official Raspberry Pi camera module is the only camera that can link up to the vertical connector, but the Pi can still talk to a wide range of cameras via USB. Not all webcams will work, but there's an incomplete list available of the ones that currently do at http://linux.org/RPi_USB_Webcams. It's well worth checking before you buy one.

Regular digital cameras can also be accessed through *Gphoto2*. Most modern digital cameras are supported to some extent, but not all features are available on all cameras. For example, you can get photos off almost any camera, but it's unlikely you'll be able to control a point-and-click unless you've specially picked it. Find out what this software can do at the project's website, <http://www.gphoto.org/>, and you can find a list of cameras known to work with remote capture at <http://www.gphoto.org/doc/remote/>.





› The natty ribbon cables add a splash of colour to Pi projects, but won't work with some cases.

Quick2Wire GPIO expansions

Extra ports to improve your Pi's connectivity.

One of the best features of the Raspberry Pi is the exposed GPIO pins. These allow you to add whatever circuitry that you want to your Raspberry Pi. They're both easy to use and easy to understand; with a single line of Python or *Bash*, you can turn them on or off, or read their input. While they're good, though, they're not perfect.

You can see a lot of pins, but not all of them are available to use, and there's no analogue input or output. They also have very little protection, and if you apply the wrong voltage (or even if you accidentally link the wrong two pins together) you can fry your Raspberry Pi a little too easily.

Several companies have developed products to help simplify the process and each works better in different situations. For example, Ciseco's Slice of Pi gives access to 16 GPIOs that are protected to work at both 3V and 5V; the Pi Face adds some useful features, such as buttons, LEDs and relays (to control motors etc); and the Gertboard adds a wide range of input and output features that are useful for learning about the various applications. You can even hook up an Arduino and use this to control input and output, although this will require programming in C. However, we're going to look at Quick2Wire's I2C and SPI board.

GPIO expanders

SPI and I2C are both Serial Peripheral Interface and Inter-Integrated Circuits (often written I²C and pronounced 'eye-squared-C'). In its basic usage, the Quick2Wire setup comes in two parts: the main board breaks out the I2C and SPI ports as well as adding protection for the Pi and voltage selectors. The company also makes I2C boards that add GPIO ports and analogue input and output to your device. These boards can also be daisy-chained to add even more ports to the Pi. You will have to do plenty of work yourself and solder the boards on your own but, once done, connecting them is simply a case of plugging in the ribbon cables.

“It was simple to program the board with Python.”

There's quite a bit of setup to get a Quick2Wire board up and running. Not least the need to configure kernel modules. You will find an online guide on the Quick2Wire website, at <http://quick2wire.com/articles/beta-kit>, though it did miss a few things, such as the location of the Python library (which can be found at <https://github.com/quick2wire/quick2wire-python-api>). We also found that we needed to install the *python3-setuptools* package.

Once up and running, though, it was straightforward to program the board with Python. Right now, it's not a question of which Raspberry Pi GPIO board is best, but which is most suitable for your project: Ciseco's Slice of Pi is a great, low-cost device to make Pi GPIO use a bit safer; the Pi Face is a really good board for experimenting with physical computing, especially if you don't have a specific use in mind; while the Quick2Wire boards are incredibly useful if you need the power of SPI or I2C to daisy-chain peripherals and port expanders. **LXF**

Other extras

Accessories and expansion kits

Right now, there's an embarrassment of riches for anyone looking to expand their Pi's features. Adafruit (www.adafruit.com) supplies a range of Pi products that's been specially designed for tinkerers in the US. UK Pi players can get their hands on Adafruit gear through Pimoroni (<http://shop.pimoroni.com>), which also stocks a few of its own products, including the popular Pibow case.

As well as the more general purpose peripherals, there's also a host of more specialised add-ons. The BrewPi (<http://brewpi.com/>) has been designed to help thirsty geeks make beer – look out for it in future issues of *Linux Format*. Hardware hackers keen to ply their trade are also turning to Kickstarter. In fact, the first UK kickstarted project was a Raspberry Pi arcade machine by Pimoroni. Keep an eye on crowdfunding sites for upcoming projects.