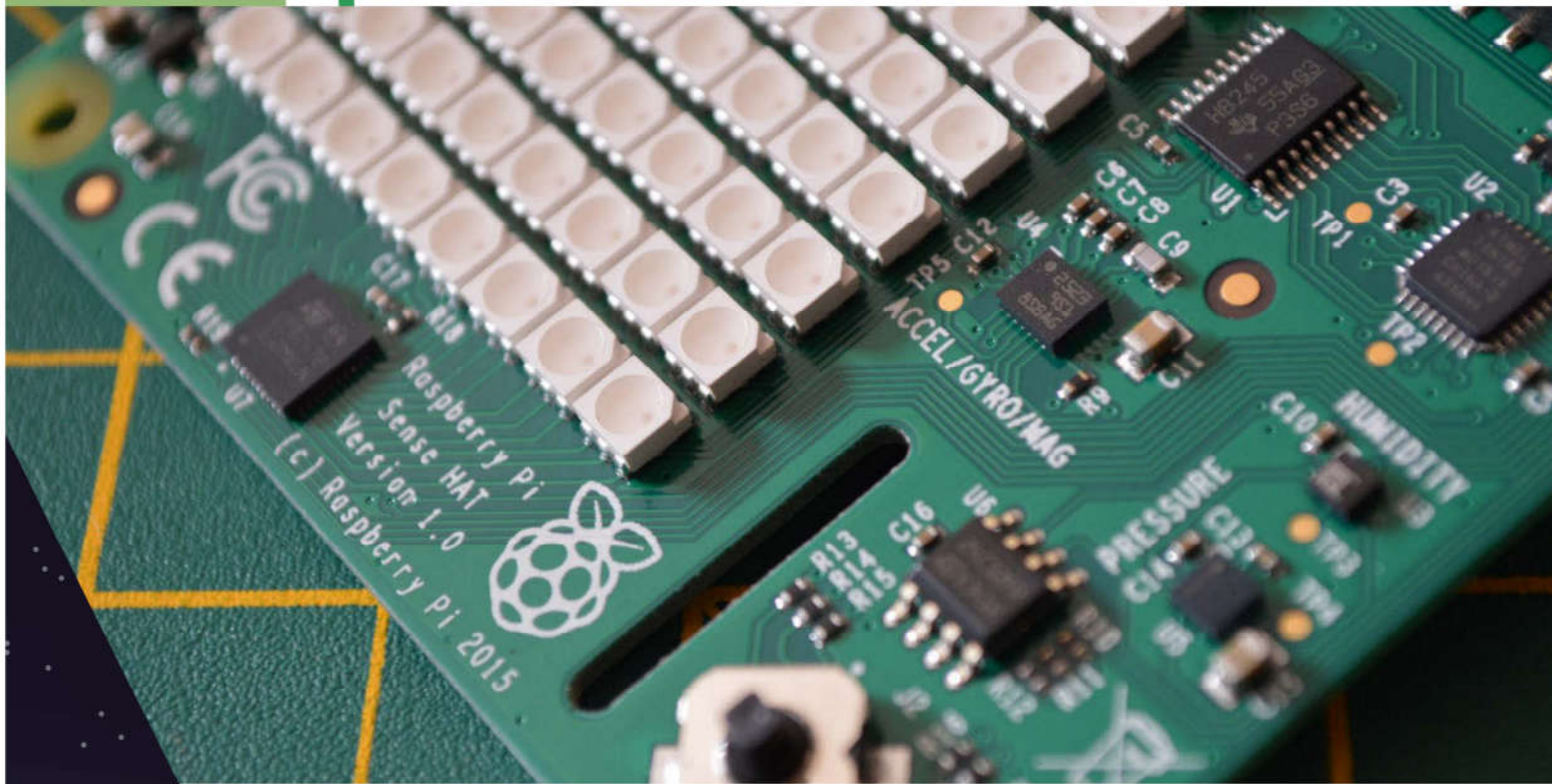


[CHAPTER ONE] WHAT IS THE SENSE HAT?

The special add-on to the Raspberry Pi that lets it interact more with the world around, as seen on the ISS!



The Raspberry Pi can do a lot of things thanks to its size, portability, and ability to connect to the internet easily. With the GPIO ports you can control electronics and interact with the world. One of the best ways of doing this is by using an add-on like the Sense HAT.

The Sense HAT is a very sophisticated add-on board for the Raspberry Pi. While HAT is an acronym (Hardware Attached on-Top), it does act in a way like a hat for your Raspberry Pi. The Sense HAT contains a suite of sensors that allows the Raspberry Pi to sense the world around it, along with an array of LEDs on top which can be used to display information on what the board can sense, and a little joystick.

The Sense HAT is a vital component of the Astro Pi, the specially adapted educational Raspberry Pis which were sent up to the International Space Station with British ESA astronaut Tim Peake to run code created by children. This wasn't what the HAT was originally designed for, though, as the Sense HAT's Project Lead Jonathan Bell explains:

"I sort of hijacked a pet project of James [Adams's] and turned it into a space-faring board," says Jonathan. James Adams is the Director of Hardware at Raspberry Pi, and along with Jonathan, was one of the main driving forces behind the Sense HAT.



Above British ESA astronaut Tim Peake, who will be using the Sense HAT on the ISS for various experiments created by school children

“Effectively we wanted to produce a board that would be a neat, fun example of how to design a HAT” Jonathan continued. “It was an exercise in how to design a HAT which could be put into mass-production: how would somebody go about doing that so hundreds of thousands of HATs could be made, and how would we design the board to deal with that.”

Half-way through development, what was once a relatively basic HAT had some sensors added to it, similar to the kind used on mobile phones. “Eventually we said, hang on a minute, what happens if we put loads of sensors on this thing and turn it into a kind of a cool toy!”

When the Sense HAT was eventually completed, it had three key sensors: separate pressure and humidity sensors that can also both measure temperature, and a motion sensor that contained an accelerometer, a gyroscope, and a magnetometer. As mentioned before, these sensors are joined by the 8 x 8 LED screen and the joystick.

Each sensor, the LED screen, and the joystick can all work independently of each other as well as all together at once. You could simply have the LED screen display little images for you, or have the Sense HAT keep track of the temperature throughout the day; it’s very flexible to use!

All of this is accessible on the Raspberry Pi by just popping the Sense HAT on top of the the GPIO pins and using the right Python code, which is what the space-bound Astro Pis on the ISS are doing.

“The Astro Pi experiments make good use of the HAT itself,” Jonathan told us. “Some of them in quite unusual ways. We have a few Easter eggs up there, which you’ll have to find out about, but there have been some ingenious uses of the sensors. One of the experiments that caught our

eye in terms of sensing was one that attempted to detect an astronaut. The astronaut detector sits there, monitoring the humidity, and if there is a certain percentage change in humidity in the module it thinks there's an astronaut present. It flashes a message on the LED matrix saying "Are you there?"

The Astro Pis also have a special metal case which allows them (after a few other tweaks to the Raspberry Pi) to be spaceworthy, and we'll talk much more about that in the section about the Astro Pi. A whole host of experiments designed by British school children went up with the Pi for Tim Peake to use, and the data from those experiments which make use of the Sense HAT will be sent down to Earth.

The Sense HAT is capable of many things thanks to inventive use of the sensors or even just the code that controls it, and in this special digital edition we hope to inspire you to create some cool projects of your own.

The Sense HAT costs £23/\$39.95 and can be bought from the Swag Shop (magpi.cc/SenseHAT), Adafruit (magpi.cc/1TGGFy6) or from any other distributor listed on the Raspberry Pi website (magpi.cc/1TGGUt5).

Below The Sense HAT is quite small, but packs a large number of sensors and features

• The LED matrix is a series of 64 independently programmable lights

• The various sensors can be used to detect environmental variables in the surrounding

• The Sense HAT fits neatly on top of the Raspberry Pi's GPIO pins

• The joystick can be used for inputs from the SenseHAT

