MAKERS
OF THE WORLD,
UNITE
AND
TAKE OVER

...you have nothing to lose except your fear of breaking things. **Les Pounder** meets some of the hardware hacking revolutionaries setting their ideas free.

All around the world, makers are tinkering and hacking with projects as small as a one-inch cubed router, VoCore (**www.indiegogo.com/ projects/vocore-a-coin-sized-linux-computer-with- wifi/x/67844**) and as large as a fire breathing dragon called Gon Kirin (**www.treehugger.com/gadgets/ maker-faire-2012-gon-kirin-fire-breathing-dragon. html**). What links every project, no matter its scale, is that it was once a spark of an idea in a maker's head – and 99% of these projects have been created thanks to Linux and free software. Projects such as the Arduino, the Shrimp and the Raspberry Pi (mostly) are open source, enabling creative people to reuse them in all sorts of ways without having to ask anyone's permission to do so.

Makers come in all shapes and sizes, with a diverse range of backgrounds in art, engineering and even anthropology, and using technology such as the Arduino and Raspberry Pi they are able to realise their ideas in new and interesting ways – and a Maker Faire is the perfect place to share these ideas. Not only are the projects showcased at these events based on open technology, but they also use open knowledge, as instructions and guidance are openly shared in person and via their respective websites. We went to one of these, the Manchester Mini Maker Faire, to find out more about the weird and wonderful projects that are coming to life thanks to free software.

> **"Makers have a diverse range of backgrounds in art, engineering and even anthropology."**

Minecraft makers

Patrick Fenner is a calm and collected chap who works out of the Does Liverpool makerspace, and his passion for re-inventing and hacking knows no bounds. "Today, Ross [Dalziel], Adrian McEwen and I are running a stall of things that are connected to the internet but which shouldn't be, such as our train set. We have a Raspberry Pi running a *Flask* server – *Flask* is a self-hosted web server that can provide a self-hosted API. In this case we're using it for an API and a webpage, which enables external control of the trains via any internet-connected device. This is then connected through an AlaMode [AlaMode is an Arduino-compatible board that connects to the Raspberry Pi GPIO pins] to give you the Arduino side,

which is then linked to the physical buttons, which are used to trigger actions such as speed and direction changes through H bridges".

Patrick, being a freelance engineer, uses projects such as this as an opportunity for research and development. "The types of control used in this project are useful in applications such as home automation, turning lights on and off remotely or monitoring temperature data and sending the data to an external destination."

Ross Dalziel, also from Does Liverpool, is working on two projects, one of which involves *Minecraft*. Ross explains "We have been using Arduino-compatible boards called Shrimps to control aspects of the *Minecraft* world. For example, we have a light switch on the stall that will change the time of day on our *Minecraft* server. This is then connected to a Python sketch that makes calls to the *Minecraft* server to set the time of day accordingly." The whole build took Ross around an hour to complete. As well as Minecraft, Ross has been working with a school in Barrow-in-Furness to develop a low-cost device to check water pollution. "The water sensor can sense how dirty a sample of water is by using a simple LED and a light-dependent resistor. The clarity of the water produces data, which is then used to draw graphs in *Minecraft*. I'm interested in using *Minecraft* for experiments, despite it being a closed platform."

Ross elaborates "Minecraft really allows children to be involved with the infrastructure of the game such as creating a Bukkit server [a Bukkit server enables players to host their own *Minecraft* world for others to play] to enable enhancements in the game. It's informative to see what people will do when running their own *Minecraft* world and the infrastructure behind it."

The Shrimp project

One project in particular that has drawn a lot of attention in the maker community is the Shrimp project by Cefn Hoile. "The Shrimp is an Arduino Uno-compatible circuit", says Cefn. "It is fully pin- and
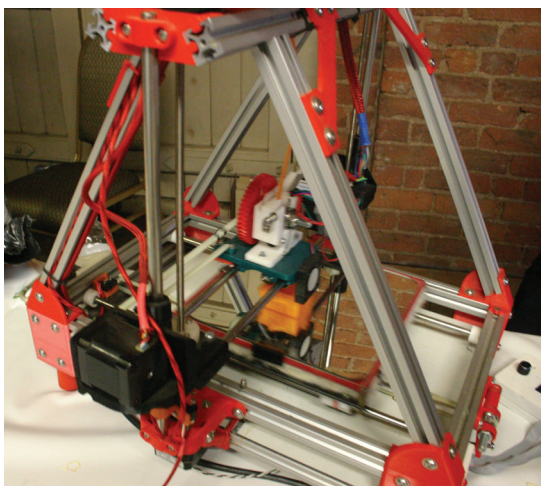
Your local hackerspace probably has a 3D printer or two for you to test your latest creation.

The internet of things encompasses refrigerators, home heating systems, and devices made out of Meccano.

binary-compatible with an Uno. It comes as a kit that you build on a breadboard. It's a cheaper alternative to the Arduino, and by building the Shrimp you will learn some of the fundamentals of how it works." The idea of a low-cost Arduino is intriguing, and a few projects have sprung up based on it. "The ShrimpKey, created by Sjoerd Dirk Meijer, is a substitute for the Makey

"The low cost of the Shrimp kit enables anyone to try it out, and this helps it reach more people."

Makey, an Arduino board that can turn everyday objects into controllers. Makey Makeys are extremely simple to put together – from an electronics point of view it's just a load of 20MΩ resistors connected to an Arduino." This is great news, as the Makey Makey currently retails at around £40. When you consider that some larger projects require more than one Makey Makey, it can get quite expensive, whereas adding the extra components necessary to turn a Shrimp into a ShrimpKey costs pennies. "The low cost of the kit enables anyone to try it out, and this helps it reach more people. We are also keen to keep our documentation evolving and at this time our main focus is on maintaining the high level of quality documentation and projects on our site."

Cefn's Shrimp, other Arduinos and the Raspberry Pi can be used with Scratch, so with the Shrimp and Scratch for Arduino you would expect to have an exceptionally cheap platform for study. Kimball Johnson, of the HacMan space in Manchester, told us "In practice it is easy to do but it needs a context and teachers will want to know 'What is the activity that I can do with it?' rather than just wanting to learn more about the tools that are being offered to them. So projects need to focus on the context and the goal rather than showing off the hardware that it contains."

We love the idea of making *Minecraft* interface with real-world data.

Kimball is keen to point out a potential block for the use of Arduino/Shrimp in school. "One of the main reasons for the development of the Raspberry Pi was due to the locked-down nature of school ICT suites. The use of the Shrimp in school is a good idea, would a child be allowed to plug one into a USB port on a school machine?" It's clear that the Shrimp is a popular tool for low-cost prototyping, but with the locked-down state of school networks and some ICT departments resistance to utilising products outside

"Events such as Pi Wars pit devices against each other in a sort of robot Olympic games."

of the "norm" there is some way to go for the Arduino to make it into the classroom.

Raspberry Pi radar
Like magpies, we were drawn to Jon Stockill and Leeds Hackspace. "We've probably brought more LEDs than anyone else, as the main project is an LED cube measuring 8 by 8 by 8 LEDs – a total of 512 LEDs! The cube displays any tweets that use a pre-programmed hashtag. The whole cube cost

around £150 to put together and took around two weeks to build. We have named the project a 'Geek trap', as when we use the plasma fire demo it just attracts everyone to our stall."

The cube drew us in, but we stayed with the Leeds hackers for their other projects, including a Raspberry Pi-powered software defined radio (SDR) project. "This project is an ADSB (Automatic Dependent Surveillance Broadcast) receiver," Jon tells us, "which receives signals from aircraft transponders. Historically radar would ping an aircraft and it would respond with a four-digit identification number, and if the air traffic controller was lucky, also the aircraft's altitude. Over the last few years all of that has gone digital. Certainly all of the big airliners, when they respond to ADSB, they provide data such as aircraft identification, direction, speed, altitude and position. So with ADSB the air traffic controller has more data to work with and can organise aircraft with greater precision. For my project all of this data is displayed in a map and stored in a database." SDR is currently *en vogue* with hackers and there are a growing number of DVB-T USB TV tuners that can be hacked to work with many different types of radio transmissions including airband frequencies commonly used by airlines and marine-based organisations.

Manchester, so much to answer for
HacMan has been Manchester's hackspace for many years, and is based in the northern quarter of Manchester. The HacMan stall is groaning under the weight of an enormous etch-a-sketch. "Project-A-Sketch was one of the first projects built by HacMan when they were based at MadLab. In fact it was conceived around the time of Stockport Hackspace, which was the hackspace for Manchester before we moved to a better location", Kimball tells us. Further along the stall there is a rather interesting arcade cabinet. "Originally it was a standard upright arcade cabinet that was donated to us which housed a rather large, heavy CRT screen. We have now modified it to run with an LCD screen, which is much better for the environment." Kimball then goes on to explain how they reduced the depth of the cabinet and replaced

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Manchester Mini Maker Faire

Manchester Mini Maker Faire is now in its third year and is hosted at the fabulous Museum of Science and Industry (MOSI) in the heart of Manchester. MOSI is the natural home for Maker Faire, with many inventions from the industrial revolution rubbing shoulders with computers from the 20th century technological revolution. Manchester Mini Maker Faire is a great place to meet fellow makers and gain inspiration for your next project with four floors full of inventive projects, hands-on workshops and talks. Maker Faires have been slowly cropping up around the UK, normally in major towns and cities. Brighton Mini Maker Faire is exceptionally popular, and Newcastle upon Tyne has a much larger Maker Faire in April each year, drawing crowds from around the country for a full weekend of indoor and outdoor hacking.

The concept of Maker Faires comes from *Make* magazine, as a way of bringing kindred spirits together.

the innards "with a mini ITX-based board and placed it on a hinged panel for easy access. For the LCD screen we removed the panel and bezel and mounted the screen using duct tape."

Arduino anthropology

Manu Bruggmann is an anthropologist at Lancaster University, and is part of the Highwire programme, a digital innovation PhD programme for those in the computing, design and management worlds. Manu's project is unique among the many stalls here today, he has brought a dress with a very special property. "I spent five months in the Arctic writing about the indigenous people there and their engagement with technology. One of the most important stakeholders in my research were reindeer herders, because they are the ambassador for their culture. One of the biggest challenges that these people are facing is the increasing number of wind farms being developed in the area. Reindeer are extremely afraid of wind farms, so in a diameter of 16km reindeer will not approach a wind farm. But big companies install wind farms in this area due to the low cost of land enabling them to build forests of wind farms. This has affected reindeer herding massively."

"One stakeholder told me that 'wind farms suffocated their culture', and that statement drove the development of the dress. The restriction of the dress, the shape shifting aspect, is designed to be uncomfortable to create empathy with their culture and how it is slowly being suffocated. The dress will restrict how you can breathe, walk and move, in the same way that their living space becomes uncomfortable." Manu's project is an analogy and a political statement for the people that he spoke to, and it's powered by an Arduino running a random number generator sketch. "The Arduino is connected to three winches attached to the dress. Each winch can be controlled to make the dress tighter or looser depending on the random number that has been generated. It works slowly but it is constantly changing based on the random numbers generated"

I ask Manu if he has thought of any commercial applications for his project. "It is not the intended purpose, but it has crossed my mind. A jacket that

The Project-A-Sketch uses an Arduino to project lines on the screen. And yes, you can shake it to wipe the screen…

This is Frank – HacMan's life-size version of the Operation game, complete with screens, buzzers and LEDs, and powered by an Arduino.

becomes thin in summer, a poor insulator to keep the wearer cool. But it could expand and trap air in winter to keep the wearer warm in the cold weather. This could inspire someone with a commercial interest to take a look at the project and adapt it for the market.

"If any of these projects have sparked a fire of creativity inside you, good – go forth and build!"

I'm not a computer scientist – I'm an anthropologist – but it was possible for me to make the dress using the Arduino."

Do it yourself

If any of these projects have sparked a fire of creativity inside of you, good! Go forth and build great things! Websites such as **instructables.com** and **hackaday.com** contain tutorials and inspiring projects from makers across the globe. There are also events such as Pi Wars (**piwars.org**), which will pit devices against each other in a sort of robot Olympics. Oggcamp (**Oggcamp.org**), the popular unconference, also sees its fair share of hackers and makers.

There are many online retailers for the maker community, including **Pimoroni.com**, **adafruit.com**, **4tronix.co.uk** and **store.ryanteck.uk**.Go forth and build wondrous things, mash data with electronics and produce banana keyboards using ShrimpKey, traffic lights with Pibrella or an internet-connected coffee mug. And make sure that you tell Linux Voice all about your inventions! **LV**

We love you all

Many thanks to the makers, volunteers and attendees of Manchester Mini Maker Faire, who each year put on a free Maker Faire for everyone to enjoy, and special thanks to the Museum of Science and Industry (MOSI) for providing an astonishing location full of excellent inventions.