

WESLEY ARCHER

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Play your favourite video games using RetroPie

Download the files to laser cut your very own RaspCade cabinet like this one

MAKE A PROTOTYPE

A prototype cabinet was made out of paper before laser cutting, to make sure it worked.

You'll Need

- > 7" LCD screen and HDMI driver board (eBay)
- > Picade PCB (pimoroni.com)
- > Zippy ball top arcade stick (eBay)
- > 2.8mm & 4.8mm Arcade daisy chain wires (eBay)
- > Female A panel mount USB socket (eBay)
- > 8x 30mm Arcade buttons (modmypi.com)
- > 2x 3-inch, 4-ohm, 3W speakers (modmypi.com)
- > Various 12.7mm stand-offs (modmypi.com)

BUILD YOUR OWN ARCADE MACHINE



Ever wanted your own arcade machine? In this multi-part series, we're going to show you how to build your own RaspCade from scratch

The Raspberry Pi is a perfect choice for an arcade emulator, given its size, power, cost, and flexibility. There are many Pi-powered arcades available, some DIY and pre-built or kit-based, but in this multi-part special we'll be showing you how to build your own from scratch! Over the next few months, you will learn the basics of laser cutting your own cabinet, wiring together arcade controls, and setting up RetroPie for your very own home-made RaspCade! In this tutorial, we'll be looking at what you'll need to get underway...

>STEP-01

Plan your build

Before starting to build the RaspCade, we thought carefully about what would be needed and how to keep it simple. We used an LCD screen that was to hand, but any 7-inch screen should fit! The trickiest part was designing the cabinet, but this should now be as simple as downloading the files and getting them cut by a laser cutter. The parts list is not set in stone, but pay attention to dimensions, particularly the buttons and panel mount parts, as the cabinet is designed for our build in mind.

>STEP-02

Download the designs

To save you the hassle of making your own cabinet, you can download our designs (as a ZIP file) here: magpi.cc/28KV5Mn. The designs have been optimised for use with online laser cutting services, such as RazorLAB (Ponoko to our US readers), to keep things simple. Plastics require special solvents for this and can be quite messy, so 3mm MDF is recommended when cutting, because it's cheap and easy to glue together once assembled. If you want to tweak the designs to your liking, then you'll need Adobe Illustrator (or possibly Inkscape), as they are saved as EPS files.

>STEP-03

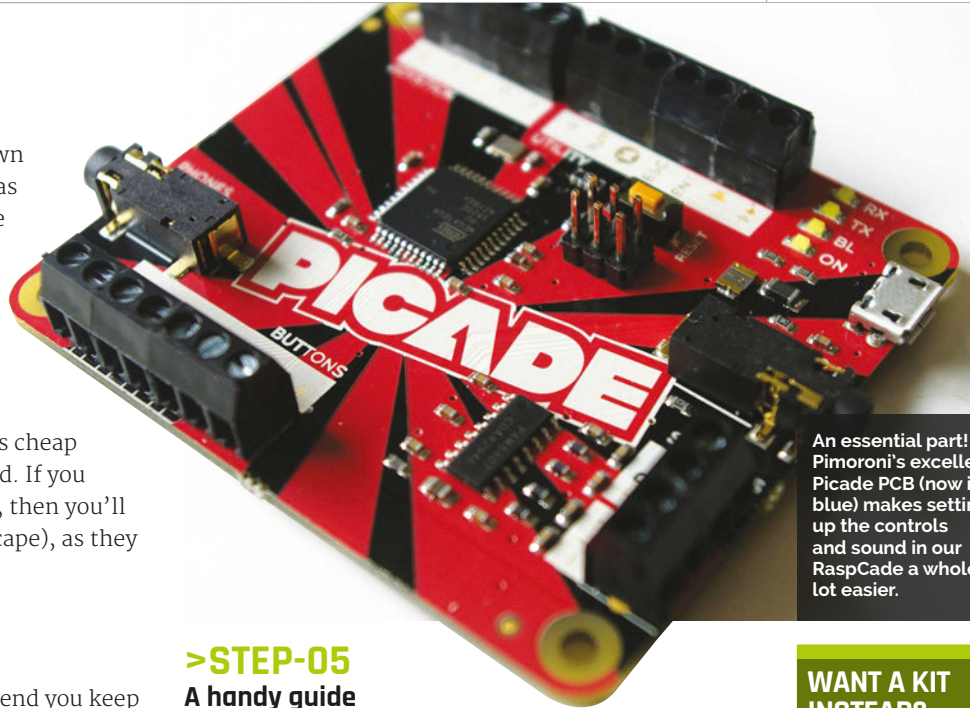
Don't overcomplicate things

As this is a DIY build, we highly recommend you keep things as simple as possible – at least for your first attempt, anyway. Arcade machines nowadays are full of flashing lights and enticing sound effects. Whilst this would be awesome, replicating this at home might be challenging. However, if you're feeling adventurous, then go for it! For example, in our build we are going to add NeoPixels driven by an Adafruit Trinket, and held by custom 3D printed mounts within the clear arcade buttons, but you don't have to do this if you aren't feeling confident.

>STEP-04

Software for the task

There are many options for emulation software to use on the RaspCade, but we'll be using RetroPie in this build and we recommend you do, too. RetroPie is very easy to set up and provides a fantastic front-end to our RaspCade. It's always being refined and updated by the developer, plus it can play a wide variety of games, so it makes an excellent choice for this project. You can download the latest version of RetroPie here: magpi.cc/25UDXzh.



An essential part! Pimoroni's excellent Picade PCB (now in blue) makes setting up the controls and sound in our RaspCade a whole lot easier.

>STEP-05

A handy guide

If you're reading this thinking, "Why are there only eight buttons instead of ten?", or "I want flashing lights all over the place!", then feel free to only use this series as a guide. You don't need to follow it to the letter. As mentioned earlier, the cabinet design is based on the parts we have available, but if you're feeling creative, feel free to design your own cabinet or tweak the one in the design. We would love to see what you do with your build and hope you share them!

>STEP-06

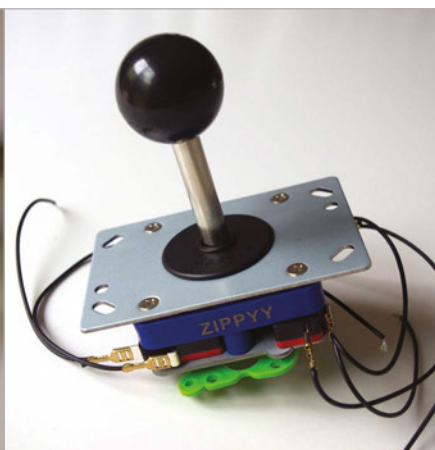
What's next?

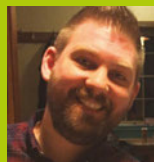
Now it's time to get all your parts so that you're ready for the next stage; most, if not all of them, should be able to be purchased online. Costs may well vary, but you should be able to find everything you need. In the next edition, we'll start building our controls. For this you'll definitely need the joystick, buttons, the arcade wiring harnesses, and the Picade PCB. We'll cover the basics of wiring up all your buttons, including the joystick, and how to use them with the Picade PCB for a hassle-free installation.

WANT A KIT INSTEAD?

If a DIY version is not for you, then why not check out Pimoroni's PiCade instead? magpi.cc/1U9cMLz

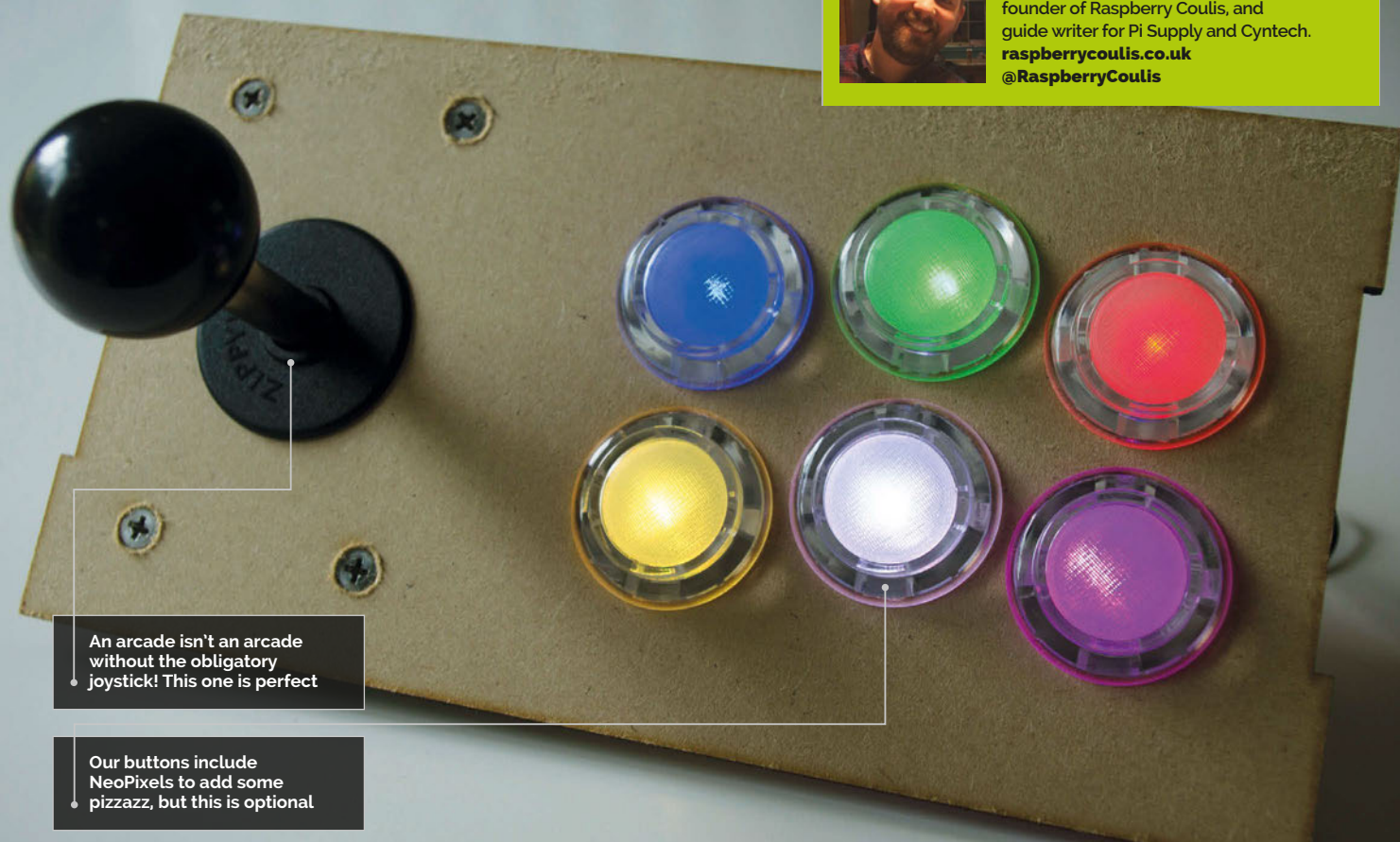
Below Some of the components we need in our build, including the obligatory joystick





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An arcade isn't an arcade without the obligatory joystick! This one is perfect

Our buttons include NeoPixels to add some pizzazz, but this is optional

You'll Need

- > Picade PCB (magpi.cc/29DpDCz)
- > Zippy ball-top arcade stick (eBay)
- > 2.8mm & 4.8mm arcade daisy chain wires (eBay)
- > Female A panel mount USB socket (eBay)
- > 8x 30mm arcade buttons (modmypi.com)
- > Various 12.7mm standoffs (modmypi.com)
- > 4x M4 countersunk 16mm machine screws and bolts
- > 3.5mm female-to-male stereo jack extension

BUILD YOUR OWN RASPCADE: CONTROLS



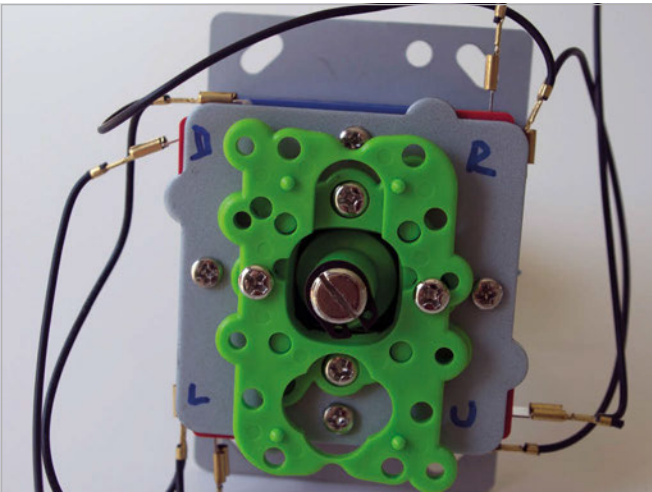
In this second part of the build, we'll be showing you how to assemble your controls as part of your RaspCade home-build!

Arcade controls can be mind-boggling, especially with all the wires involved. It is no surprise that people get confused, but there's no need to panic. The joystick and buttons are essentially switches with positive and negative terminals. Today we'll be going over wiring basics, and using Pimoroni's Picade PCB as a brilliant way of setting up your RaspCade controls quickly and easily. If you haven't already done so, buying dedicated arcade wiring looms or harnesses makes the whole process much easier because they are designed to be assembled quickly, without any soldering. Are you ready? Then let's get started!

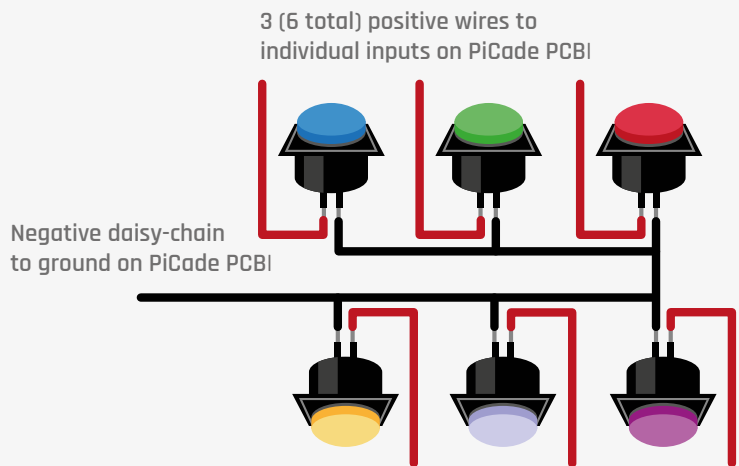
>STEP-01

Plan your wiring first

Before you put your controls in place, it is worth doing a test run first. Connect your wires and be sure you understand what goes where before placing them in your cabinet. The arcade wiring harnesses are perfect for this as the spade connectors simply slide on (and off) the buttons, so no soldering is required. Each button (including the joystick) has a positive and negative terminal. You can 'daisy-chain' the negative terminals (connect them together), which means you only have one ground wire instead of several. Once you're happy, carefully press the buttons into place: they are a tight fit!



It's worth labelling your joystick when wiring. The switch is in the opposite direction, as it is activated when the joystick moves in that direction



A Fritzing diagram showing how to wire up your arcade buttons, including the daisy-chain connection

3 (6 total) positive wires to individual inputs on PiCade PCB

>STEP-02

Bolt your joystick in place

If you're using our arcade cabinet design, the four holes should line up with the mounting plate on the joystick. Unscrew the ball-top and slide the plastic collar off, then bolt the joystick in place using four M4 screws and bolts. You can use a countersink drill bit to tidy this up if you like, but it isn't essential. Also, do not over-tighten the bolts as this could damage the cabinet. Once you have done this, replace the plastic collar and screw the ball-top back on. Now onto the wiring underneath...

>STEP-03

Better get yourself connected!

Connecting your controls is not as difficult as you might think. Grab your 4.8mm arcade harness and slot one connector onto each negative (black) terminal. Daisy-chain these so you have one wire connecting the four negative terminals. Next, use some wire cutters to cut and strip the end so you have a wire that can be connected to the Picade. You may need to extend this wire, but this can be done easily, even by a soldering newbie. Next, connect one wire to each of the positive (red) terminals. Each of these will be connected to the Picade, too.

>STEP-04

Push the button

Before wiring your buttons, carefully push them through the holes in the cabinet. They are a tight fit, so be gentle where you push to avoid snapping the cabinet. Once they are in, use the 2.8mm arcade harness and daisy-chain all the negative terminals (any can be used, but use the same one on each button) and strip the end again. Then connect one to each positive terminal so you end up with seven wires ready to connect to the Picade (six positive and one negative). We can now move onto the final two buttons on the front panel.

>STEP-05

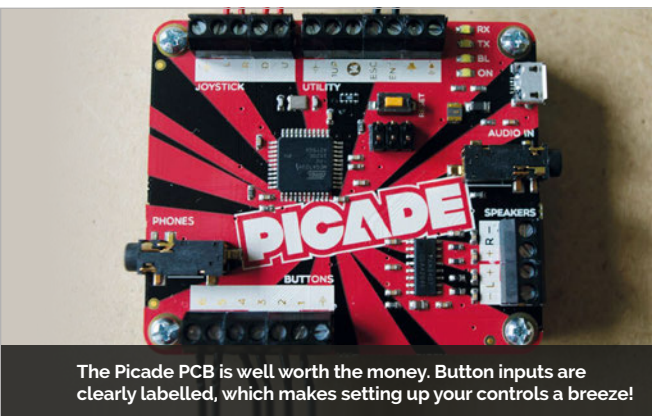
Assembling the front panel

The front panel consists of two arcade buttons, a USB port, and the headphone jack. The buttons pop into place the same way the others, and you also need to daisy-chain the negative terminals: you should have three wires (two positive and one negative). The USB port screws into place and the other end will be connected to our Pi. You can use this to connect a WiFi dongle, or a USB thumb drive to store all your games, making it simple to add more. The headphone jack screws into place, allowing you to play your RaspCade without disturbing everybody.

>STEP-06

Connecting to the Picade PCB

Connecting all the wires is really simple thanks to the Picade PCB. This has several screw terminals, all nicely labelled for our arcade controls. Simply find the relevant terminal and then screw the wire into place. You should have eight wires for the buttons and four for the joystick, as well as three ground (negative) wires. It isn't essential to put the wires in exactly the right place, so if your 'up' button is connected to the 'down' terminal, it can still be configured once in RetroPie. The Picade simply connects to the Pi via USB and that's it!



The Picade PCB is well worth the money. Button inputs are clearly labelled, which makes setting up your controls a breeze!

TIN THE WIRE ENDS

If the wires don't stay in the Picade PCB, tin their ends with a soldering iron to fatten them up.

BE GENTLE WHEN ASSEMBLING!

The buttons are a tight fit and the cabinet is relatively thin. Be gentle when pushing the buttons into place.

Our 7-inch screen mounted on the RaspCade cabinet panel – it looks fantastic when playing a game!

We've added the RaspCade logo to our designs, but you can add your own if you prefer



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You'll Need

- > 7-inch LCD screen (Search '070-FPCA-R1' on eBay)
- > HDMI LCD driver board (Search 'PCB800168' on eBay)
- > Male-to-male HDMI coupler or short HDMI lead
- > Insulation tape
- > 8× standoffs (any size) (modmypi.com)

BUILD YOUR OWN RASPCADE: DISPLAY

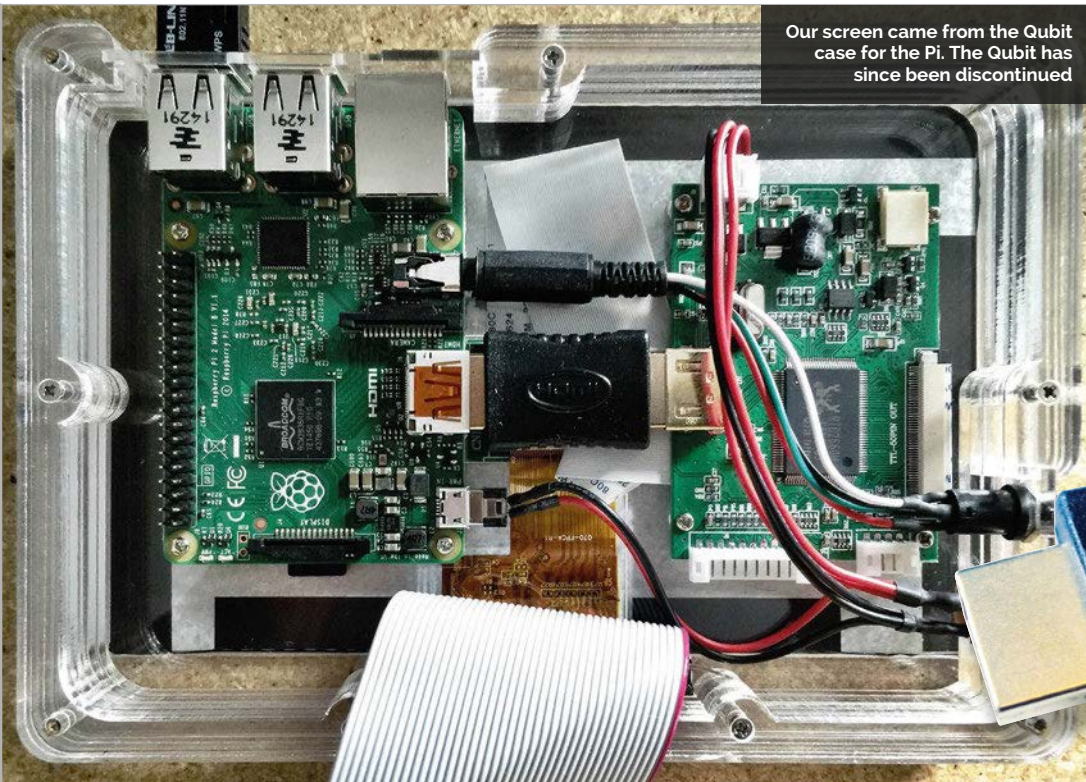


In this third part of the build, we'll be showing you how to assemble your display as part of your RaspCade homebuild!

Now that you have your controls sorted, it's now time to get our display up and running as without this, the RaspCade is nothing but a box with fancy controls! You could hook your Raspberry Pi up to a TV, but where's the fun in that? You can use pretty much any display in your RaspCade, but in our build we used a 7-inch screen and the RaspCade cabinet is designed with this in mind. The trickiest part in this guide is mounting the screen, but as you will see, this doesn't need to be elegant. Let's go!

>STEP-01 The screen

The screen we're using was part of a now discontinued case for the Raspberry Pi called the Qubit. It's a 7-inch IPS screen with a maximum resolution of 1024×600, and looks fantastic when up and running. If you'd like to use the same display, then look on eBay for a 070-FPCA-R1 screen and you should find plenty. However, you can use any 7-inch display, as our cabinet has been designed to accommodate screens of this size. Just remember



that you'll need an HDMI LCD driver board to make your screen work!

>STEP-02 The HDMI LCD driver board

The driver board makes the screen work properly and allows you to connect it to your Pi. Our screen uses the PCB800168 HDMI LCD driver board, which can be found on eBay, although it did come with the Qubit case. The screen connects to the driver board using a 50-pin flex cable (similar to the one on the Raspberry Pi Camera Module), and the driver board connects to your Pi using an HDMI lead. To save space in our build, we used an HDMI coupler adapter, but any HDMI lead will work.

>STEP-03 Mounting the driver board

As we're connecting the driver board to our Raspberry Pi using a HDMI coupler adapter, we need to make sure it's as close to the Raspberry Pi as needed. We connected the HDMI to the Pi and the driver board, then used a pencil to mark eight holes on the bottom panel of our RaspCade, in line with the mounting holes on the driver board and the Pi. We then drilled eight holes in the panel, and used the standoffs to secure both the Pi and driver board in place.

>STEP-04 Mounting the screen

Before you secure the screen in place, it's a good idea to check that it lines up nicely first. We drew around the screen on the back of the RaspCade panel with a pencil when we were happy, so we could line up

the screen when taping it in place. We then applied insulation (or electrician's) tape around the edges of the screen, to ensure that it was held securely in place. Once the cabinet is assembled, nobody will see this, so it doesn't have to be perfect! This way, we could keep the design simple and cut out unnecessary parts.

>STEP-05 Powering the screen

As the screen needs to be powered separately to the Pi, the Qubit included a barrel jack connector that also provided power to the Pi, via a micro USB connector: see the close-up of the Qubit to learn how this was done. As we used the barrel jack connector, our power supply also uses this rather than micro USB, but it's relatively simple to convert an existing Pi power supply to barrel jack instead of micro USB if you wanted to. Just be sure to use a decent power supply to ensure you have enough power: we recommend using at least 2.5A.

>STEP-06 Connect everything together

Once you're happy that your screen is mounted in the right place and that your driver board and Pi are too, it's now time to connect everything together. Connect the 50-pin flex cable from your screen to the driver board (the same way you would for the Camera Module), and then connect your HDMI adapter/lead from your driver board to your Pi. You'll then need to connect the power leads (one to the driver board and the other to the Pi), and then connect your power supply. We're almost ready to power up!

Above top This is our HDMI LCD driver board. You'll need a driver board to get your screen working properly

Above We used this HDMI coupler adapter to save space in our build, but any HDMI lead will work

BE CAREFUL WITH THE SCREEN!

The screen is delicate as it doesn't have any case protecting it. Just be careful when handling it.

GOOGLE IS YOUR FRIEND

Don't panic if you get stuck finding what you need. A quick Google search often gives you the answer!



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You'll Need

- > RaspCade designs (magpi.cc/21jHT61)
- > Access to a laser cutter
- > Wood glue (DIY store)
- > 2× 3-inch, 4Ω, 3W speakers (ModMyPi.com)
- > 8× countersunk M4 nuts and bolts
- > A drill with a countersink head
- > Various 12.7mm standoffs (ModMyPi.com)
- > 2× small jewellery box hinges

BUILD YOUR OWN RASPCADE: CABINET ASSEMBLY!



In this fourth part of the build, we'll be showing you how to assemble your laser-cut cabinet as part of your RaspCade home arcade machine

In the first part of our build, we talked about our custom-designed RaspCade cabinet so that you could download the designs and laser cut your own. In this guide, we will look at this in more detail and provide an overview of assembling our RaspCade, so that we can take a giant step towards playing our retro video games. We'll also look at adding speakers to our RaspCade and mounting all our kit inside in preparation for the next edition, where we'll finally get our arcade machine up and running!

>STEP-01

Our RaspCade designs

You're going to need a laser-cut RaspCade to get started, but we designed one so you don't have to. Designed in Adobe Illustrator and saved as an Encapsulated PostScript (EPS) file, our RaspCade cabinet is optimised for online laser cutting services, so getting your own cabinet is as simple as downloading our design (magpi.cc/21jHT61) and then uploading it to your chosen service. Jason Barnett (@booeerb) at Cyntech kindly helped with our first prototype, and we used Just Add Sharks (justaddsharks.co.uk) for our final cut, which cost us around £15 including delivery.

>STEP-02

Some drilling necessary

To allow for some wiggle room when assembling the RaspCade, you may have to drill your own mounting holes to suit. As we used the Qubit case for the screen, we glued a layer from this to our base, as



The cabinet simply slots together and is held firm with some strong wood glue

We've designed this cabinet so it can be laser cut quickly and without breaking the bank!



The speakers are attached to the sides of the case

it meant we could mount the LCD driver board and Pi very easily, but it's equally easy to add your own mounting holes and standoffs. In our build, we used a small drill bit to add several mounting points on the base unit, so that we could install standoffs for the Picade PCB, as well as holes for the two speakers.

>STEP-03

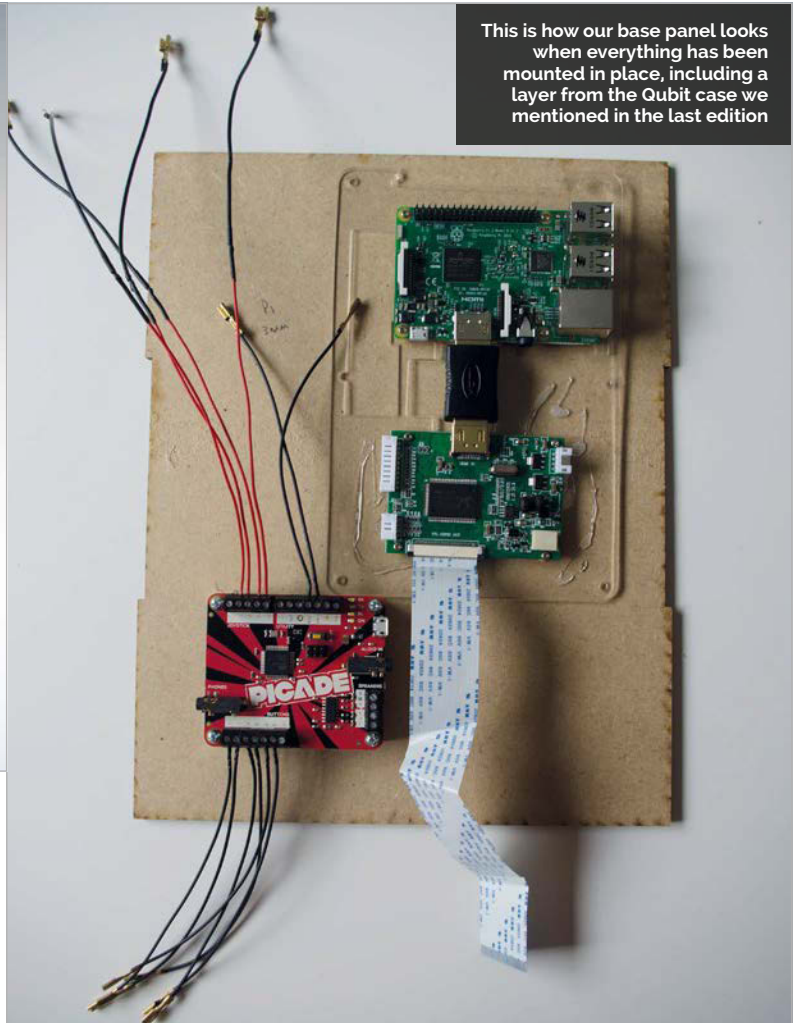
Mounting the speakers

It's very easy to mount the speakers, as the ones we used come with four holes that are ideally suited to M4 bolts. After placing our speaker in the correct position first, we marked the positions for our holes with a pencil, drilled the holes, and then used the countersink bit to countersink the hole so that the bolt would sit flush with the cabinet when assembled. It was then very simple to solder the positive and negative wires to each speaker, ready to connect to the Picade PCB. It's useful to put some coloured electrical tape around the positive wires, so you can find them quickly later.

>STEP-04

Assembling the cabinet

Our RaspCade design includes simple box joints, so assembling the cabinet is pretty straightforward. We recommend doing a test run before gluing together, just so you are confident you get each panel the right way round! Using a strong wood glue, start by gluing one of the side panels to the base unit and then let that dry. We propped ours against a wall whilst the glue dried (which can take 24 hours) to ensure it was held in the correct position. We then added the other side panel, repeating the same process.



This is how our base panel looks when everything has been mounted in place, including a layer from the Qubit case we mentioned in the last edition

>STEP-05

Let the glue dry!

The hardest part for us was waiting for the glue to dry properly before starting the next panel! However, it's worth waiting to be sure that the glue has dried properly, otherwise it could ruin your build. When we added the top panel, we tied string around the sides and placed a small weight on top (a tin of beans would do!), to hold the panel together whilst the glue dried. This meant that we had a perfectly square cabinet frame once everything had dried, and now we could add some internal parts, including our Raspberry Pi!

>STEP-06

Connect your wires

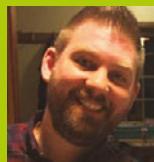
Before gluing all the panels together, we found it easier to put our electronics in place first. We connected our buttons, joystick, and speaker wires to the Picade PCB and then screwed the Picade PCB onto the standoffs so it was secured inside. We then glued the front panel in place, then the joystick panel, and then the screen, ensuring we waited for the glue to dry each time. Lastly, we added two small jewellery box hinges to the back panel and a magnetic catch, so we could get to the insides of our RaspCade quickly and easily if needed!

BE PATIENT WHEN GLUING!

Think where you will put your RaspCade when the glue is drying and don't mess with it for at least 24 hours!

DON'T OVERTIGHTEN SCREWS

Our cabinet is made from MDF, so don't overtighten any screws, otherwise you could damage the wood.



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BUILD YOUR OWN RASPCADE: SOFTWARE



In the final part of our build, we'll be getting the software working so you can start playing with your RaspCade!



The RaspCade booting up, whilst displaying our custom splash screen

You'll Need

- Class 10 micro SD card (16GB upwards recommended)
- RetroPie magpi.cc/25UDXzh
- USB flash drive (optional)
- Our custom splash screen magpi.cc/2dFLR9N

This USB port makes adding new game ROMs a breeze!

Now that we have finally assembled our RaspCade, the last part of this build is to get the software up and running so that we can start playing retro video games to our heart's content! Today, we'll be looking at how to install RetroPie, configuring your controls, adding your games, and any other tweaks to get the most out of our RaspCade so that you can play your favourite games whenever you feel like it!

>STEP-01

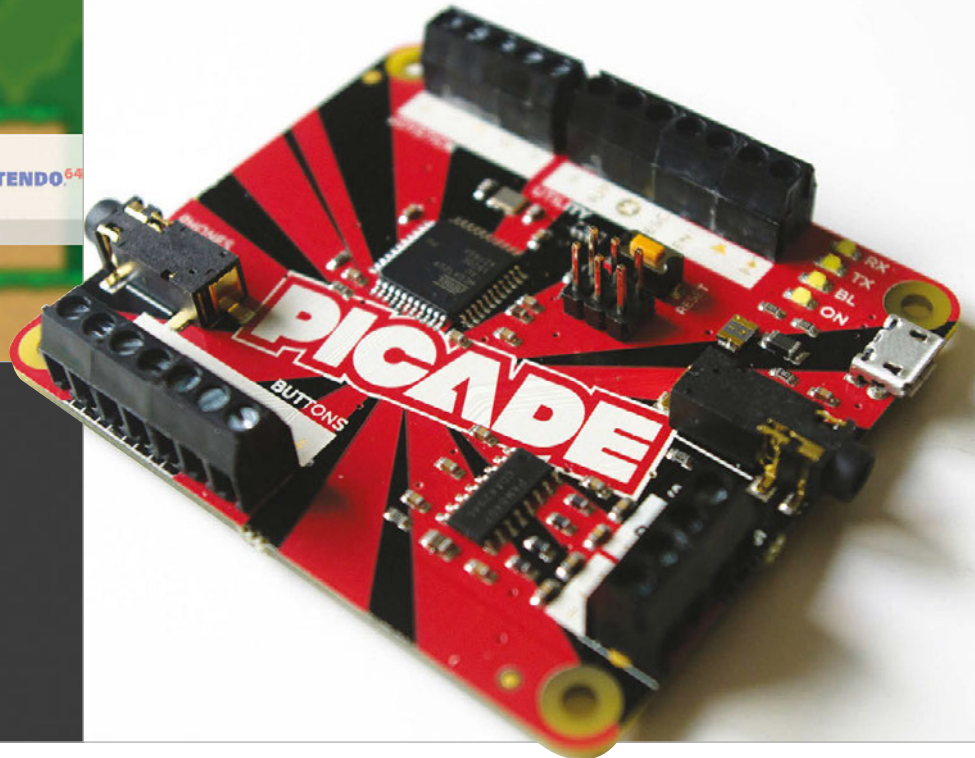
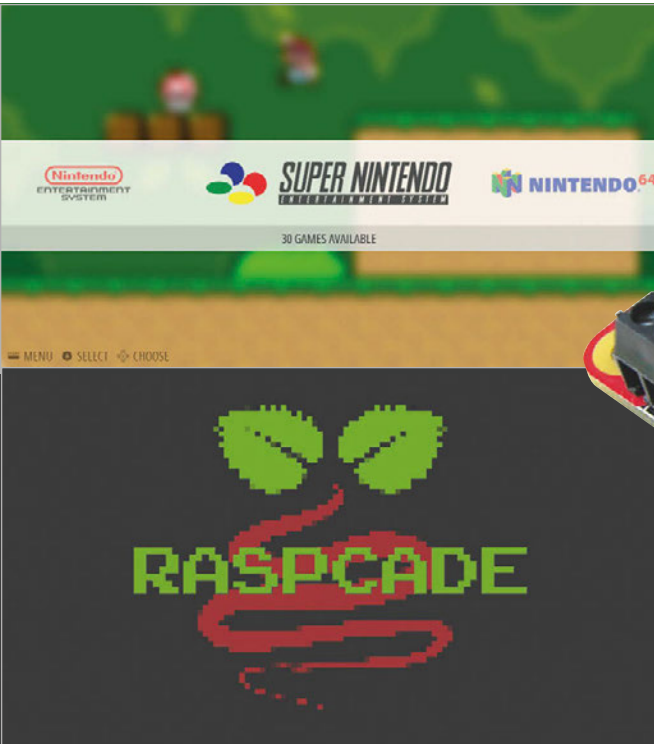
Download RetroPie

RetroPie plays a key part in our RaspCade, so head over to their website (magpi.cc/25UDXzh) and download the SD card image. Be sure to download the correct one for the Pi model that you're using, although we do recommend using the Pi 3 for this to get the most out of your RaspCade. For those of you who are unfamiliar with RetroPie, it's a fantastic piece of software that runs various video game emulators, but all within a beautiful user interface that closely matches today's generation of consoles. It's actively developed, and updates are pretty regular!

>STEP-02

Write your SD card

Now you have your SD card image, you can write this to your SD card using your preferred software. Check out Raspberry Pi's official documentation on how to do this (magpi.cc/1V50j8E). We do recommend investing in a quality SD card here; a Class 10 card is essential, as it will provide fast read and write speeds. The card will also need a decent amount of storage space if you want to store your ROMs on it; we would recommend at least 16GB of space for this, but up to 32GB is supported.



>STEP-03

Boot your RaspCade

Once your SD card has been prepared, it's now time to pop this into your Pi and boot up your RaspCade! All being well, you should see the RetroPie logo as your RaspCade boots. You can use our custom RaspCade splash screen (magpi.cc/2dFLR9N) if you like and we'll cover how to change this shortly. The first boot usually takes a little longer than normal, as the file system will be expanded to fill your SD card, but you'll know when it's done when you see the welcome screen.

>STEP-04

Setting up your controls

Fortunately, RetroPie makes setting up your controls a simple process; you're asked to do this during the first boot. You should now see the welcome screen asking you to hold a button on your device to configure it. Press and hold one of the buttons on your RaspCade

and then follow the on-screen prompts, pressing the relevant buttons when needed. You can skip assigning a button by holding any button until the tutorial moves on. All being well, you should be able to assign directions to your joystick, as well as the eight arcade buttons.

>STEP-05

Transferring your ROMs

ROMs, short for Read-Only Memory, are the game files. These are basically a collection of the files you'd find on a game cartridge if you took the data straight off them, and you'll need them play certain games on your RaspCade. The quickest way of transferring the ROMs to your RaspCade is by following the USB guide on RetroPie's website (magpi.cc/2dmE14h), as this will automatically transfer all the files to the correct place without any major user input. You can use the USB port on the front of the RaspCade to do this, too!

>STEP-06

Restart and play!

Once you have added all your ROMs, you need to restart your RaspCade so that RetroPie can load them. You should notice that different gaming systems will appear after you have rebooted, mirroring those that you've added. Now you can simply pick your system, choose your favourite game, and start playing on your very own RaspCade! You may need to tweak a few more settings, such as the display and controls for different systems, but we recommend getting to know the RetroPie wiki page (magpi.cc/2emU7fV) as there's a wealth of information there.

Above We highly recommend using Pimoroni's Picade PCB as it takes the hassle out of your controls and sound – a definite must!

CUSTOM RASPCADE SPLASH SCREEN

Use our custom RaspCade splash screen by following the guide here (magpi.cc/2emUokJ) to complete the look!

ROMS ON USB INSTEAD

Use a USB flash drive to store your ROMs instead of the SD card by following the guide here for easier transfers: magpi.cc/2emUxmK



Above Whilst not in this guide for simplicity, putting NeoPixels inside the buttons adds some pizzazz to the RaspCade