Hello and welcome to Raspberry Pi Robotics! My name is Matt Gazzard and I am a Computer Science student at Nottingham Trent University. In the coming worksheets, I'll be walking you through how to setup your Raspberry Pi with the CamJam EduKit 3 to be used as a robot. Each worksheet will also come with the research links used to write each worksheet so you can expand on your knowledge further.

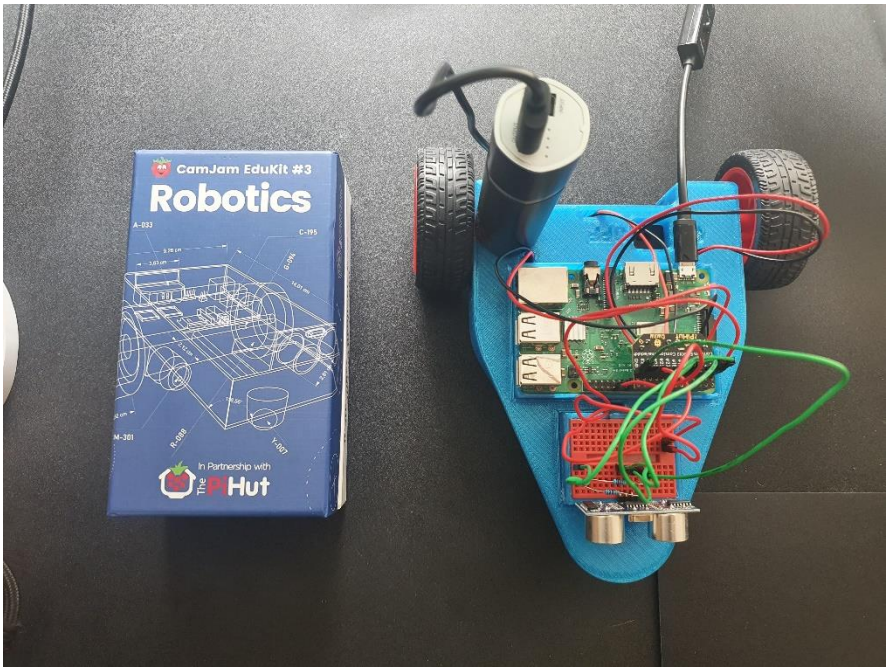

Figure 1 Robot made by Matt Gazzard

In this worksheet, you will learn what a Raspberry Pi is and how it can be setup in preparation for being used with robotics components.

What is a Raspberry Pi?

Whilst it may sound delicious, the Raspberry Pi we are referring to is a type of microcomputer and unfortunately not a tasty treat. However, do not despair as there is plenty of enjoyment to be had out of Raspberry Pi's!

Raspberry Pi's are affordable, lightweight and small which makes them perfect for use in embedded systems. Any microcomputer that is used as part of a whole, larger system can be classed as an embedded system (BBC, n.d.). In the case of our robot, the Raspberry Pi acts like the brain, connecting each component of our robot and allowing them to work together.

For my robot, I used a Raspberry Pi 3 Model B+ which is the type shown in Figure 2. As you can see across the top of the board there are a collection of pins. These will be important later!

Figure 2 Raspberry Pi 3 Model B+ (Raspberry Pi, n.d.)

Setup

For now, we are going to setup your Raspberry Pi. Doing so may seem scary but if anything should go wrong, you can always begin anew. The very nature of these types of computers is experimentation and flexibility so never feel intimidated. As Raspberry Pis are very customisable, they do not come preinstalled with an operating system, such as Windows or macOS, like a regular computer does. Therefore, we will start by using your personal computer to download the operating system to an SD card. A computer cannot function without an operating system which makes this part of the process mandatory (GCF, n.d.).

Components list:

- Raspberry Pi
- Power supply
- Micro SD card
- PC
- HDMI cable (optional)
- Monitor (optional)
- Mouse
- Keyboard

Operating System:

1. On your PC, follow this link: Raspberry Pi OS – Raspberry Pi (Raspberry Pi, n.d.).
2. Install Raspberry PI Imager to your PC.

3. If you are using a Raspberry Pi 3 or newer, pick “Raspberry Pi OS (64-bit).” Otherwise select the default which is “Raspberry Pi OS (32-bit).”
4. Follow the steps within this video to flash your micro SD card with the OS: How to use Raspberry Pi Imager | Install Raspberry Pi OS to your Raspberry Pi (Raspbian) - YouTube (Raspberry Pi, 2021).
5. You are now ready to boot your Pi!

Booting Raspberry Pi:

1. Insert your micro SD card into the micro SD card slot of your Pi.
2. If your Pi has USB ports and a HDMI port, connect your keyboard and mouse, along with a monitor. Otherwise, see “Booting Raspberry Pi Headless (Advanced)” further below.
3. Insert your power supply into the power supply slot.
4. If you have connected everything correctly, the Pi will boot to a logon screen.
5. Enter the default username “pi” and the default password “raspberry”.
6. You should now be logged in and able to see the desktop.

Booting Raspberry Pi Headless (Advanced):

A “headless” setup refers to connecting to your Raspberry Pi remotely to set it up. If your Pi does not have the ports needed to connect a monitor, mouse and keyboard, a headless setup will be necessary. Please see the following video for instructions: New Method to Setup Raspberry Pi Without Keyboard or Mouse (Headless) - YouTube (Draper, 2021).

Remotely connecting to Raspberry Pi:

If you have done the headless setup, this step will not be necessary as you will already have installed VNC Viewer on your PC. The PC and Raspberry Pi will have to be on the same network for you to be able to remotely connect them.

1. From the Pi desktop, connect to Wi-Fi by selecting your desired network in the right-hand corner, as shown in Figure 3, and entering the Wi-Fi password.

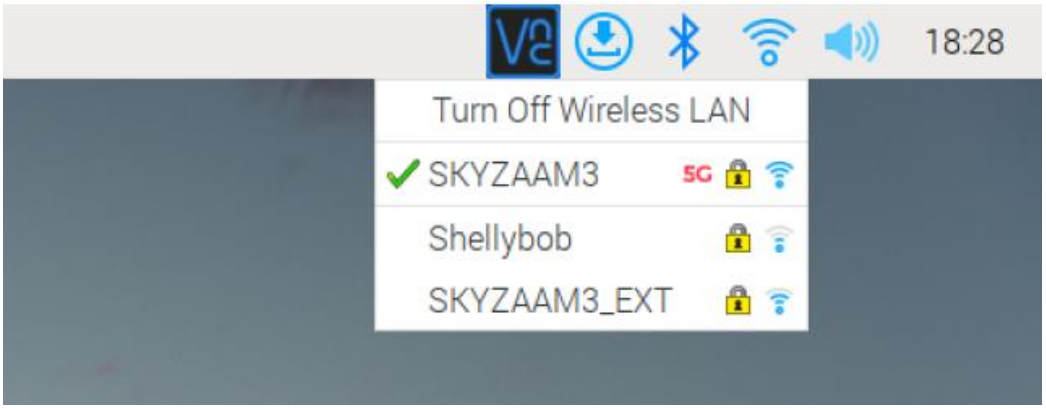

Figure 3 Connecting to Wi-Fi

2. Then, click on the Raspberry Icon in the top left-hand corner, go to “Preferences” and select “Raspberry Pi Configuration” (Figure 4).

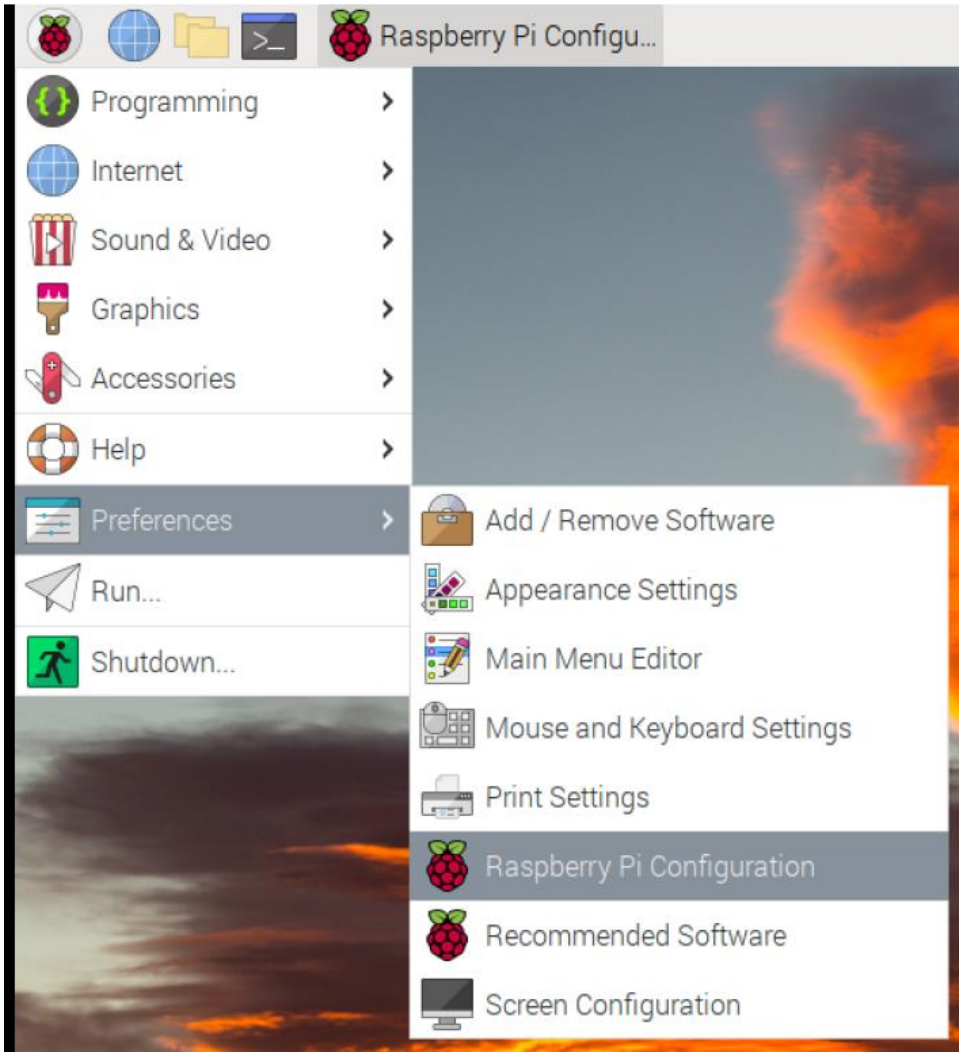

Figure 4 Configure Raspberry Pi

3. Once opened, go to “Interfaces” and turn VNC on (Figure 5).

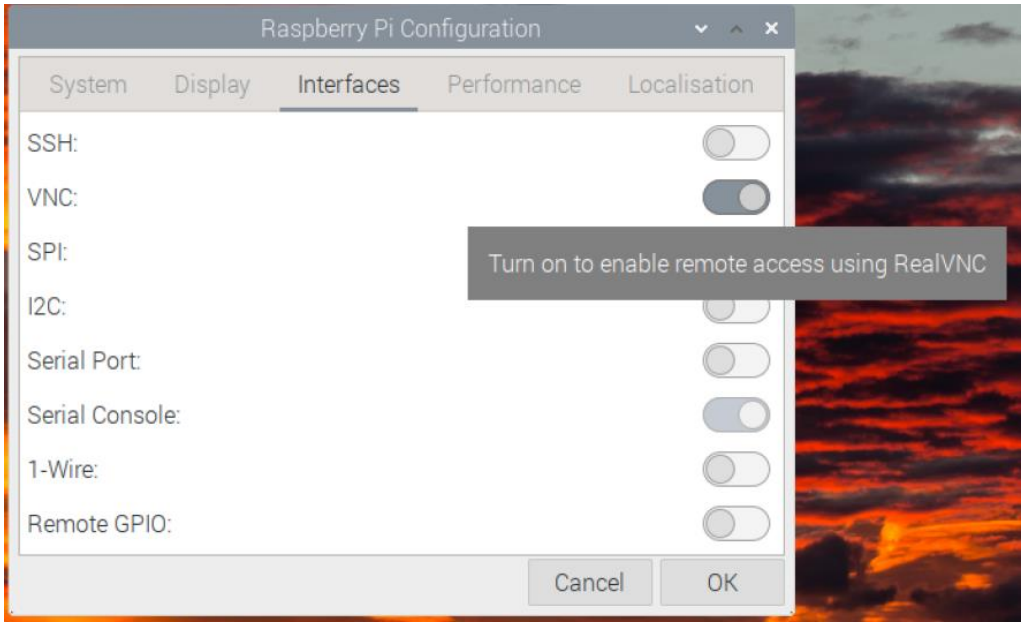

Figure 5 Turn on VNC

4. Hover over the Wi-Fi icon in the top right-hand corner and make a note of your unique IP address. The location has been highlighted in yellow for you in Figure 6.

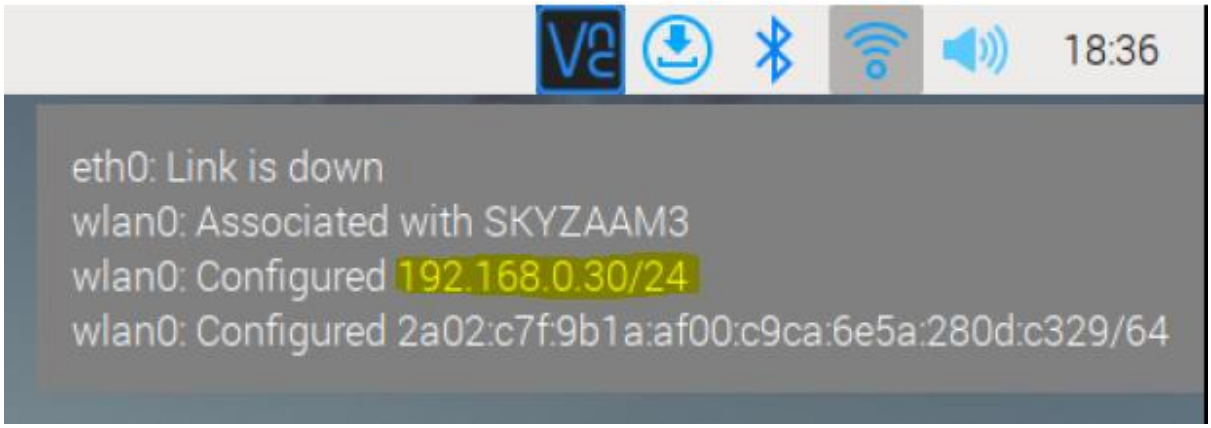

Figure 6 Get IP Address

5. Install VNC Connect on your PC, not your Pi, from the following link: [Download VNC Viewer | VNC® Connect (realvnc.com)]
6. Once installed, type in the IP address for your Raspberry Pi into the search bar and hit enter (Figure 7).

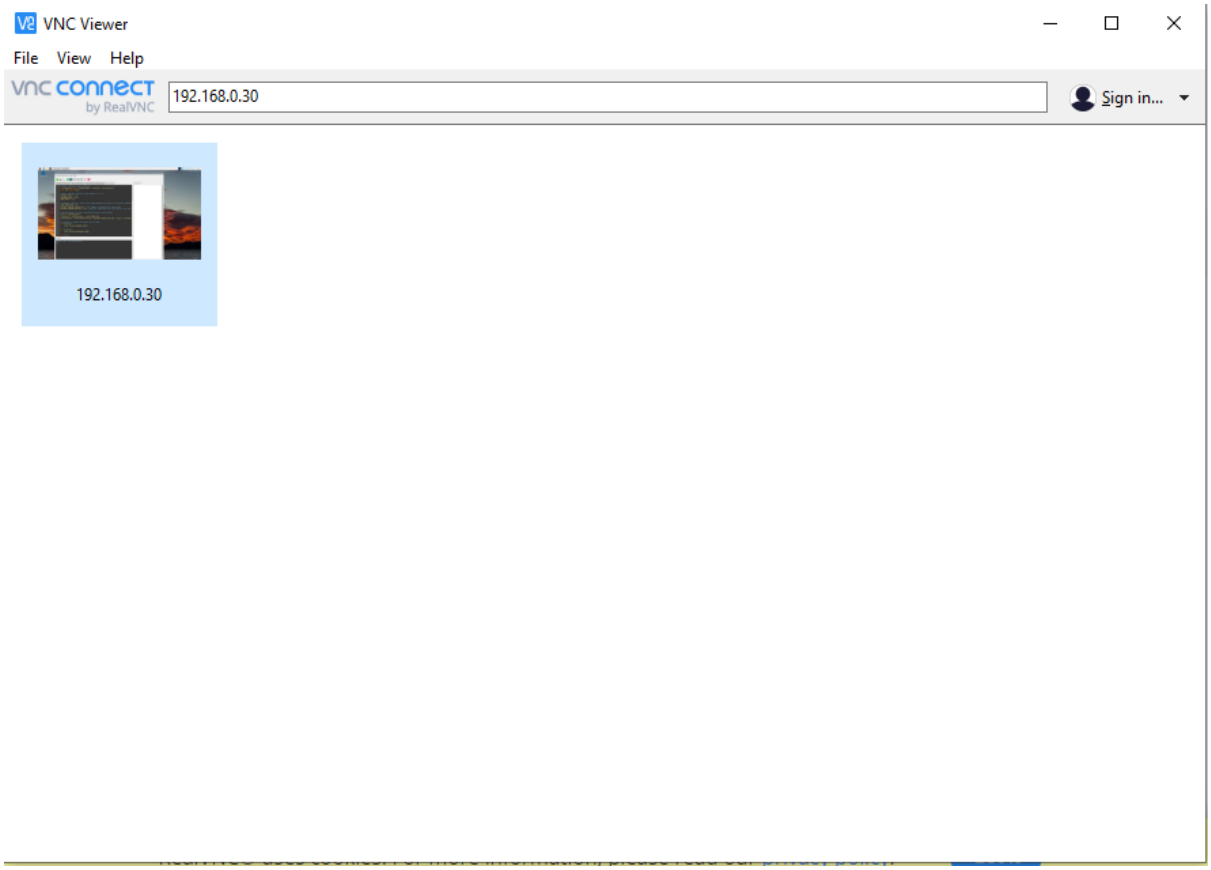

Figure 7 Enter IP Address into VNC Viewer

7. Enter your Pi username and password and hit enter (Figure 8).

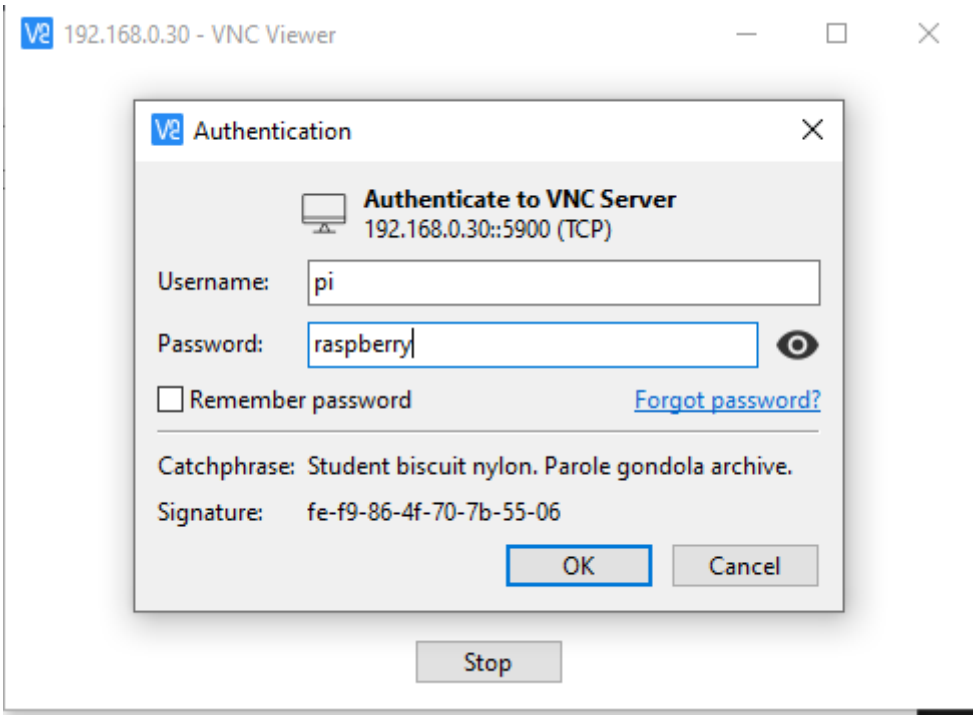

Figure 8 Login to Raspberry Pi

8. If you enter the correct details, you will be able to see a "virtualised" version of your Raspberry Pi's desktop. Cool right?

If you complete these steps, you can connect to your Raspberry Pi remotely from any PC as long as they are on the same network. When you have the Pi mounted on your robot, this will make sending commands to it much easier.

Build your robot

For my own robot, I was able to use a specialised piece of equipment called a 3D printer. As it is unlikely you will have access to one, you will have to make your own chassis or buy one online. CamJam suggest that you build your robot in the box its components come in. See the following link for an example: camjam-edukit-3-robot-assembly-instructions.pdf (dscl.org) (Anon., n.d.).

If you want to learn more about how the GPIO pins on your Raspberry Pi can be used, please see the following links:

- Projects | Computer coding for kids and teens | Raspberry Pi (Raspberry Pi, n.d.)
- Raspberry PI 2, 3, Zero & ZeroW GPIO explained - NotEnoughTech (Zolnierczyk, 2016)

END OF WORKSHEET 1

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