University of Missouri – Columbia

Raspberry Pi, just not the pie kind

**By:**

Andy Schuster (ABSDM2)

**Course:**

CMP\_SC 3530/INFOTC 3530 Bazan Antequera - UNIX Operating System

**Topic:**

You may ask yourself, what is a raspberry pi if it isn’t an actual pie? You may be surprised to know that a Raspberry pi is in fact a low-cost credit-card sized computer (What, 2015). I will be researching and discussing the Raspberry Pi. For the past couple months, I have gained valuable information working alongside these credit-card computers. These Pi’s are very useful in the real world due to the fact that you can do almost anything with them. If you want to make your Raspberry Pi into a garage door opener, you can do just that. If you want to monitor your network, you may also use your Pi. Even if you want to use you Pi as a retro video game console, that is doable as well. The possibilities are almost endless. You can install almost any operating system onto the Pi although the recommend OS is Raspbian, a Debian-based OS. Commands that we have used throughout the semester are able to be used via the command line.

**Research:**

Like stated above, a Raspberry Pi is a low-cost credit-card sized computer. Depending on which pi you get, it may have various ports, from HDMI ports to USB-3 ports even to some having a a Gigabit Ethernet port (The Raspberry Pi Foundation). There is also a Micro SD slot, so you are able to flash an OS to it and tell the Pi what operating system to use. The default and recommended operating system for the Pi is Raspbian, now call Raspberry Pi OS. Raspbian is a Debian-based OS and is a form of Linux distribution (The Raspberry Pi Foundation). There are different forms of the OS as well. You are able to download Raspbian with a desktop version, meaning you are able to navigation like you would on a traditionally computer, and a Lite version, which only includes a terminal system and a simple GUI interface (Orlin, 2012). Keep in mind, the lite version is roughly half a gigabyte download and the desktop GUI version is right around 2.5 gigabytes to download. Keeping that in mind, I typically go with the Lite version of the OS then am able to ssh into my Pi after opening up port 22 on the Pi.

So why would you want to use a raspberry pi and not just a VM? VMs are great for networking, running an apache web server, and many more options but when it comes to physical projects, the Pi is your best bet. People have been very creative coming up with ideas for their own Pi. One example of a super creative idea that has become more popular with Pi owners is a smart mirror. One owner started with their Pi, a monitor, two-way glass, and a couple other materials to build a smart mirror (Instructables, 2017). Once the frame is made, the Pi is then used for what is shown on the monitor. Some users have weather widgets, a calendar, and some users even integrated a microphone into their Pi to make their smart mirror voice activated. This is one of many projects that a Pi is capable of. Although a smart mirror is awesome, it can definitely be time consuming. If you’re like me and hate ads on websites and apps, you can do a simpler project such as installing Pi-Hole. Pi Hole is a network-wide ad blocker. In a typical home environment, this can cut out almost all ads to all devices in your home, without having to install an ad blocker on every single device (Complete Pi Hole setup guide, 2019) The Pi-hole works as a DNS server. This allows the Pi-hole to intercept any outgoing or incoming DNS requests and can block or pass certain domains from accessing your device, keeping your computer and other devices safe from ads (Rush, 2018).

**Applications:**

**Downloading the OS:**

The screenshot below is how to install the OS onto the micro SD card. Because it isn’t just downloading the OS and opening it, we are required to “flash” the OS to the micro SD card. The software I used was BalenaEtcher and it is as easy as plugging in the micro SD and choosing the OS img then hitting flash. Once the process is done, the OS is now on your micro SD.

Graphical user interface, application

Description automatically generated

After the process is done, it should look something like this.

Graphical user interface, text, application

Description automatically generated

**Configuring SSH:**

Configuring SSH to your pi is a great addition to have, especially if you have the Lite OS installed. Configuring SSH to your pi is not difficult and only took me a few moments, although it does include hooking your pi up to a monitor or TV to do so. Upon boot of the Pi, you will see the OS booting up. The default username is pi and the default password is raspberry. It is highly recommended to change these default values once logged in. Below is a screenshot on bootup.

A factory in the background

Description automatically generated

Because I used a wired connection by an Ethernet cable, I was not required to configure any WiFi settings. My Pi B + does have Wifi so it is possible although I prefer a wired connection. If a wireless connection is desired, you may run the command **sudo raspi-config** to pull up an easy to follow GUI. The next step is to figure out the IP address of the Pi and to open the SSH port so you will be able to connect from your local system. As stated in my research section, the default OS for the Pi is a Linux distribution so a simple **ifconfig** command will figure out our Pi IP. We can also open up the SSH port using the command **sudo systemctl enable ssh** simply to enable the SSH service, then run the command **sudo sytemctl start ssh.** If ssh is not enable, we will not be able to connect to our Pi from our local system. Below is a screenshot of figuring out our Pi IP address and starting the SSH service.

A picture containing monitor, clock, table, large

Description automatically generated

Like I mentioned above, because the Pi OS is a form of Linux distribution, we are able to use commands that we have seen throughout the semester. The screenshot below shows the use of the echo command as well as creating a folder named “absdm2”.

A flat screen television

Description automatically generated

**SSH into our Pi Remotely:**

Now that we know our Raspberry Pi IP and we have opened up port 22, SSH, we are able to remotely connect to our Pi using ssh. This can easily be done by running the command: **ssh pi@ipaddress.** From a previous screenshot, we know that the Pi IP is 192.168.1.68. The screenshot below shows the command used to connect remotely.

Text

Description automatically generated

Now that we are connected to the Pi, we are able to disconnect the monitor from the HDMI and unplug the keyboard. Keep in mind, enabling ssh and figuring out the IP address of the Pi can both be done remotely with no keyboard or having to connect an HDMI to a monitor. This can be done by removing the extension from the ssh file after flashing the OS to the micro SD. Then you will have to go into your routers IP and figure out the Pi IP like that. All we technically need is the Pi connected to a power source and internet. The screenshot below shows the command **ls** and showing the folder I previously created while not ssh into the pi. It is now there because we are remotely connected. Once we have remote access, we are able to use our Pi

Text

Description automatically generated

**Pi-Hole**

Once we have a remote connection, we are able to install pi-hole. First, we need to set our Pi IP as a static IP. Depending on your router, it may switch up your Pis IP every so often. To prevent this, you will need to go into your routers admin GUI and reserve the Pi IP so it will never change. To install Pi-Hole to your Pi, the command is **wget -O basic-install.sh https://install.pi-hole.net.** This will pull the necessary files to install Pi-hole. Once that command is ran, you can run **sudo bash basic-install.sh.** Both these commands are posted in screenshots below.

Text

Description automatically generated

Text

Description automatically generated

Once the above command is finished, it will open up the pi-hole GUI. The Gui is entirely user chosen. You can change settings such as which protocol you want ads blocked on, which third party block lists you want to use, and much more. Typically, I use all of the recommend settings. A screenshot is below of the GUI.

Graphical user interface, application

Description automatically generated

After instillation, you will be given a password and a URL to your pi-hole interface. I highly recommend selecting “yes” to the pi-hole interface upon instillation. The password is used for the admin page that will allow you to monitor which ads are being blocked. A screenshot is below.

Graphical user interface, application

Description automatically generated

Once instillation is fully complete, you will then be able to access the web interface GUI. You can do this by entering the IP address of your Pi. Because we set this up as a static IP, this IP should never change. This is how the web interface will look.

Graphical user interface, application, website

Description automatically generated

If you thought you were finished, not quite. You need to add the Pi IP address to the devices where you do not want ads. You can do this network wide or just to certain devices. All you need to do is add the Pi IP address as a DNS configuration to the device of your choice. The screenshot below shows my connected my Pi-hole to my iPhone. Once you have pi-hole on your decive or your network, you can see the results in the pi-hole GUI.

Graphical user interface, text, application

Description automatically generated

**Disclaimer**: I have had pi-hole installed for some time and have noticed it does not block 100% of ads but still does a fantastic job. I can download the most popular game app on the app store, aka ad galore, and experience no ads at all. After disconnecting from my WIFI and playing the game again, it was typically an ad after every round or level. Popular apps/websites such as YouTube and Facebook have found a workaround for pi-hole users. Keep in mind, this only works in your network while connected to WIFI but is possible by adding a VPN service on your pi-hole device.

**Sources:**

What is a Raspberry Pi? (2015, August 20). Retrieved November 21, 2020, from https://www.raspberrypi.org/help/what- is-a-raspberry-pi/

The Raspberry Pi Foundation. (n.d.). *Buy a 4 Model B –*. Raspberry Pi. Retrieved November 23, 2020, from https://www.raspberrypi.org/products/raspberry-pi-4-model-b/?resellerType=home

The Raspberry Pi Foundation. (n.d.-b). *Operating system images – Raspberry Pi*. Raspberry Pi. Retrieved November 23, 2020, from https://www.raspberrypi.org/software/operating-systems/

Orlin, J. (2012, October 21). *Getting Started With The Raspberry Pi Is Not As Easy As Pie*. Tech Crunch. https://techcrunch.com/2012/10/21/getting-started-with-the-raspberry-pi-is-not-as-easy-as-pie/#:%7E:text=The%20default%20operating%20system%20for,Debian%2C%20a%20version%20of%20Linux.

Instructables. (2017, September 18). *How to Build a Raspberry Pi Smart Mirror!* https://www.instructables.com/How-to-Build-a-Raspberry-Pi-Smart-Mirror/

A. (2019, October 9). *Complete Pi Hole setup guide: Ad-free better internet in 15 minutes*. SmartHomeBeginner. https://www.smarthomebeginner.com/pi-hole-setup-guide/

Rush, C. (2018, February 21). *Getting Started with Pi-hole - Your Network-wide ad blocker*. StakeBox. https://www.stakebox.org/blogs/learn/getting-started-with-pi-hole-your-network-wide-ad-blocker#:%7E:text=The%20Pi%2Dhole%20acts%20as,other%20devices%20safe%20from%20ads