

Format SD Card with NOOBS

In this section we will be formatting the SD card with the operating system the raspberry pi needs to run. NOOBS is the “New Out Of the Box Software” that comes with Raspbian, a common operating system used with Raspberry Pi.

- 1.) Insert Micro SD card into machine (may require some sort of SD card adapter).
 - a. IF this is not the first time using this Micro SD card, it will need to be formatted. This can be done using the *SD Card Formatter* application. NOTE: Formatting the SD card will erase all data on it, so be sure to back up files on the SD card you do not want to lose.
- 2.) Download NOOBS from <https://www.raspberrypi.org/downloads/noobs/> (This may take some time).
- 3.) Copy all files from unzipped NOOBS folder to the Micro SD card.

Start up Raspberry Pi

In this section we will use our formatted SD card to get the raspberry pi up and running.

- 1.) Connect the micro HDMI cord into the pi's HDMI display port 0. Then, connect the HDMI side of the cord to the display.
- 2.) Connect the keyboard and mouse to the pi's USB 2.0 ports. (USB 3.0 will work as well but we can reserve those for devices which rely on speed).
- 3.) OPTIONAL: Connect an ethernet cord to the pi if you will not be using WiFi.
- 4.) Insert the formatted SD card into the Micro SD slot (underside of pi).
- 5.) Connect the USB – C power supply to the Pi's power in slot.
- 6.) At this point, the display should receive input from the pi and come alive.

Install Raspbian and Apply Updates

In this section we will complete the on-screen start up of the raspberry pi.

- 1.) Select “Raspbian Full [RECOMMENDED]” and click “install” on the top left of dialogue.
- 2.) Select applicable Country, Language, and time zone. Check the “use US Keyboard” box if you wish to do so (recommended for US users).
- 3.) Set a strong password you are able to remember.
- 4.) Check the applicable box if the display is not properly filled with imagery.
- 5.) Connect to the WiFi network of choice.
- 6.) Update software (this can take some time).
 - a. If this gives an error, manually install updates by doing the following:
 - b. Open a terminal window (Linux command prompt).
 - c. Run the following commands:
`sudo apt-get update` Checks if new packages are available to update
`sudo apt-get upgrade -y` Runs the updates if available
- 7.) Restart the Pi as prompted.

- 8.) Navigate to “Raspberry Pi Configuration.”
 - a. Raspberry Icon on top left of screen > Preferences > Raspberry Pi Configuration
- 9.) Uncheck “Auto Login” box to ensure security.
- 10.) Enable SSH and VNC access for remote use of the pi.

Connect to Pi System Remotely

In this section we will connect to the pi's Linux CLI via ssh with a personal machine (Not the Pi).

- 1.) Open a terminal window on a personal machine.
- 2.) Find IP address of Raspberry Pi. This can be done by visiting myip.com from a web browser on the Pi. (NOT on the personal machine).
 - a. You will want the IPv4 (shorter) version of the address opposed to the IPv6. If this is troublesome, the following steps may help:
 - b. Find the IP address of your internet router (typically printed on the device)
 - c. Enter the router IP address into a web browser. This should display the names and IPv4 addresses of all devices connected to the network
 - d. Record the IP address of the Pi
- 3.) Run command prompt:
`ssh pi@[address of pi]`
- 4.) Enter your password to remotely connect to the pi.

Attach and Enable the Camera Module

In this section we will connect the camera module to the pi. Extra caution must be taken with this step as the parts are delicate and susceptible to damage via static electricity. As a habit, I like to touch something metal immediately before handling the Raspberry Pi. (This could be a desk leg, a lamp, a file cabinet, etc. Anything that will ensure a static discharge from your fingers if one exists.) This perhaps overly-cautious habit is easy to follow with potentially device-saving benefits.

- 1.) Turn off the raspberry pi by issuing a shutdown, and then unplugging the power supply.
- 2.) Gently lift the edges of the black plastic camera module connector on the pi.
- 3.) Insert the camera module ribbon cable (with the blue side facing the USB ports).
- 4.) Gently push down the edges of the black plastic connector.
- 5.) Start the pi back up again by plugging in the power supply.
- 6.) Navigate to “Raspberry Pi Configuration” and enable the camera. Reboot as prompted.

Test the Camera

Optional

- Open a terminal window on the pi and run the command
`sudo raspistill -o cam.jpg`
- This command takes a still photograph with the camera. You may notice a camera dialog appearing and disappearing on the display as the photograph is taken. The file is then outputted (-o) to the file we named “cam.jpg”

Install Motion and Configure Pi for Camera Function

Motion is the camera signal monitoring software we will be using. We will ensure that the camera server starts when the pi turns on and runs in the background.

- 1.) In a terminal window on the pi, run the following command:
`sudo apt-get install motion`
- 2.) Activate the camera driver by running the following command:
`sudo modprobe bcm2835-v4l2` ("four L two" not "four one two")
- 3.) Ensure Pi will activate the camera driver on the start up by appending the following line to the modules file. Run the command:
`sudo nano /etc/modules`
 - a.) Add this line at the bottom of the file.
`bcm2835-v4l2`
- 4.) Set the camera server as an automatically run daemon by modifying the following file. (A daemon is a process that runs in the background). Run the command:
`sudo /etc/default/motion`
 - a.) Find the "start_motion_daemon" variable in this file and set it to "yes."

Further Configuration of the Motion Software

In this section we will apply some configuration of the motion software to ensure it operates properly in a server we can view remotely. Some of these fields have some leeway in their settings, but these are the values I found to be optimal on my personal network and machine.

- 1.) Create a backup of motion's configuration file in case we want to refer back to it or undo our changes.
`sudo /etc/motion/motion.conf /etc/motion/motion.conf.bak`
- 2.) Open the motion configuration file.
`sudo nano /etc/motion/motion.conf`
- 3.) Find and set the following options (may be helpful to make use of nano's "ctr + w"):
 - a. Ensure that motion runs our daemon
`daemon on`
 - b. Create logfile for debugging
`logfile /tmp/motion/log`
 - c. Ensure ability to view stream from outside of pi's localhost
`stream_localhost off`
 - d. Set the frame rate (100 is highest quality)
`framerate 90`
 - e. Set width and height for stream picture. *A compatible resolution must be chosen or else the stream will not start!*
`width 640`
`height 480`
 - f. Ensure stream and web port are correct
`stream_port 8081`
`webcontrol_port 8080`
 - g. Set the stream quality to optimal level
`stream_quality 100`

```
quality 100
```

```
h. Disable web control local host  
webcontrol_localhost off
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```
i. Set the post capture to 5  
post_capture 5
```

- 4.) Restart the motion software to apply the changes we have made. Run the following command:

```
sudo service motion restart
```

- Followed by:

```
sudo motion
```

View the Stream on Raspberry Pi

By now, we should be able to view the stream on the raspberry pi.

- 1.) Navigate to the web browser and open the URL <http://localhost:8081>
- 2.) You should be able to view the stream!

View the Stream Remotely

In this step we will use our personal machine to remotely log into the pi and access the camera stream.

- 1.) Using a personal machine, open a web browser to the following address
[http://\[IP address of Pi\]: 8081](http://[IP address of Pi]: 8081)
- 2.) You should be able to view the stream!
- 3.) This web address can be accessed from any mobile device that is connected to the network.

Closing Remarks

It is good practice to shut down and disconnect the power supply from the raspberry pi when not in use. The shut down can be issued remotely via the command below. Once shutdown, unplug the power supply from the device.

```
sudo shutdown -h now
```

The keyboard, mouse, and display are no longer needed for the raspberry pi to function as a security camera. These cords can be disconnected from the device. The pi can also be repositioned anywhere than maintains a WiFi connection to the configured network; feel free to move around the device and position the camera as you see fit. To start the camera server back up again, all you have to do it plug in the power supply.

It is often desirable to house the Pi and camera module in some sort of container so as to protect it and keep it neat. I found a wooden box with a lid to do an effective job of this. Keep in mind that the connection to the live stream is only operational on devices that are connected to the same network.