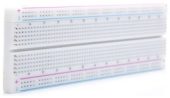
Raspberry Pi: GPIO

with Mark Niemann-Ross

Equipment List

You'll need a **Raspberry Pi**. Any model with a 40-pin GPIO works—get a model with header pins. Don't get the Raspberry Pi Model Zero without headers.



Breadboards allow for speedy circuit assembly. Get one with a red and black rail on both sides. Get either a mini or full size. Don't get anything smaller than four inches long.

Jumper wires make quick connections between circuits. A package will come with a variety of colors and sizes. Be sure to get some male to male and some male to female.

Chapter 1. Project: A Push-Button and LED Project

In this chapter, the Raspberry Pi will watch your pushbutton and flash an LED. Learn how to connect LEDs and pushbuttons correctly and safely. Then learn how to use Python to watch a button and light an LED. The LED Echo project teaches the basic concepts of connecting circuits to the GPIO and then controlling the interaction with different languages.

Equipment you'll need:

A **switch or pushbutton**. Don't spend a lot of money. I bought a standard doorbell at my local hardware store for a couple of dollars, then attached a pair of jumper wires. It's big, obvious, and durable. Some electronics kits will include smaller circuit pushbuttons that insert into a breadboard. I think they are too small.

LEDs are cheap. Buy a grab bag with a selection of colors and sizes. Some kits will include RGB LEDs as well as green, yellow, red, and blue. Unlike lightbulbs, these never burn out unless you hit them with excessive voltage.

For this project, you'll need one **220-ohm resistor**. But you can't buy just one. Get a kit with a wide range of ohms—from 10 ohms to 1M ohms. One-quarter to one-half watt is fine for our purposes. This will cost you less than $20 USD.

Chapter 3. Project: Sensors, Meters, PWM, and 1-Wire

In this project, we'll learn how to connect multiple temperature sensors to the Raspberry Pi, then use an analog meter to display their status.

The **DS18B20** is a temperature sensor using a 1-Wire interface. This can be purchased from many online sources, search for DS18B20 and you'll find you can get them for about $2 apiece, typically $5 for $10. Get the waterproof sensors—they're more fun. You can also buy just the chips without the wire and case for about half the price of the weatherproof version.

The project uses a five-volt analog meter to demonstrate PWM. These meters are getting a bit harder to find locally, but they are still available from online stores for a reasonable

price. You might even be able to salvage a VU meter from an old stereo, but it's possible the Raspberry Pi will pin the needle.

In the video on PWM in depth, there is a side project that demonstrates PWM frequency and duty cycle. You'll want to buy a small speaker, or salvage one from a broken radio.

Chapter 5. Use SPI for Sensors and Displays

The **BME280** integrated circuit detects temperature, humidity, and air pressure—it's a pretty amazing little module. Search for BME280 and you'll see lots of options for just the chip. I bought mine from Waveshare because it already had jumper wires attached, so no soldering necessary.

Be careful: the BMP280 (notice the BMP instead of BME) doesn't have a temperature sensor. Also, be careful not to buy just the sensor—make sure it's mounted on a circuit board with connectors.

This chapter also uses a 1.5-by-1.5-inch color OLED display. I ordered mine from Waveshare via Amazon for about $20. Since the chapter is about SPI, check to make sure whatever version you get supports SPI and that you can find the code libraries before you order it.

Chapter 7. Project: Stepper Motors with I2C

Search the internet for "pca9685" and you'll find lots of options for purchase of this handy motor driver board. Most of them go for less than $10. You can get them cheaper if you're willing to assemble it yourself.

You have two options for servo motors: SG90 or SO5NF. They are both dependable and pretty much interchangeable. Search the internet for either of those names or stop by your local electronics or radio control hobby supply store.

This project also uses a BME280. If you purchased one for chapter 5, you can use it again for this project.

Chapter 8. In Depth: Programming Languages

This chapter is easy: LEDs, a pushbutton, and some resistors. The same stuff you purchased for chapter 1.

Chapter 9. Project: Connect to UART Serial

This project demonstrated serial communication with the Raspberry Pi, and the easiest way to connect is with the USB to TTL serial cable–debug/console cable for Raspberry Pi from Adafruit.com. It's $10 and comes with complete and very helpful instructions for Mac, Linux, and Windows. If you have old serial devices you bought from army surplus: don't connect them to your Raspberry Pi! It's likely they use voltages far beyond what the Raspberry Pi can handle.