

Robotics I – Homework (3/30/20)

In the previous homework we focused on the motor contribution to our robots. In this homework we will focus on the controlling aspect, which is the brain of our robots. This is considerably more difficult to understand as you must correctly make connections to it and then correctly program it. The videos will help you get a handle on all this. Don't worry about the programming too much as we will deal with that at another time, but get a feel for how it all comes together. The photo below is an example of the microcontroller that we will be working with for our robots.



Microcontrollers: Microcontrollers are the brain of the circuit. It makes decisions based on the how you program it. Since it is the brain of the circuit, or in our case, the brain of our robots, an awful lot of things tends to be connected to it. We basically connect things through **I/O pins** (Input/Output pins). You will see a long row of holes (pins) along both sides of the microcontroller. Most of these pins are **digital** in that they are either on or off. Others of the I/O pins are **analog** pins in that they can be on, just a little bit on, completely on, off or anything in between, similar to controlling the intensity of a light bulb using a dimmer switch. Some of these digital pins also have a little wiggly line next to their number. This means that that pin can also be used as a PWM pin. PWM stands for Pulse Wave Modulation also known as Pulse Width Modulation as we are able to control the width of the wave we're sending to the device we're controlling. The videos will show you what a pulse wave looks like. For our robots, we will use them to control the speed of our motors and gear motors.

Take a look at this video called, "You can learn Arduino in 15 minutes." The Arduino is a microcontroller that is very common with hobbyists. We will be using these, or one that are very similar to these. I doubt that one can learn how to run an Arduino in 15 minutes, but it's a good overview of what it is, what it does, how it works, and some applications. You can skip the advertisement at the end. <https://youtu.be/nL34zDTPkcs>

Homework: The microcontroller in the photo above is an Arduino Uno. In the video other types were mentioned. Name two other types, and how are they different from the Arduino Uno?

Homework: Shields were also mentioned. What are Arduino shields? Give some examples.

Homework: The video mentions the Arduino Development Environment. Officially, this is called the IDE (Integrated Development Environment). What is the Arduino environment that he's talking about?

Homework: In his demonstrations of what the Arduino microprocessor can do he often mentions a device called a potentiometer. Draw a picture of a potentiometer (label it) and explain what it does.

Homework: The video shows a square wave. Draw a few square wave and label one of them.

In the video, he talks a lot about the coding. We'll eventually get around to this, but hopefully you got the main idea! This is also called programming and the language that the Arduino uses is called C++ with some Arduino modifications.

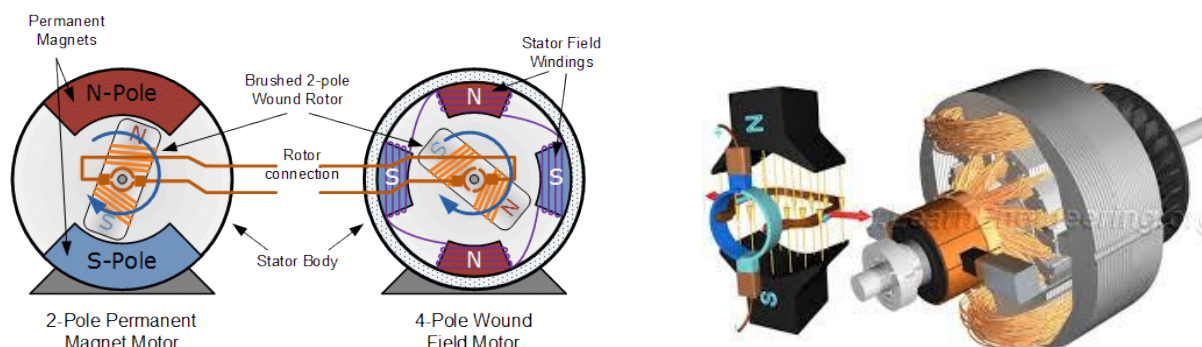
This next video, <https://youtu.be/dyZolqNOomk>, deals with both the Arduino microcontroller and also the motor driver module that we focused on in the last homework unit. It nicely shows how we connect everything, without having to deal with the programming of the microcontroller.

Homework: How did the individual in this video get the motor to go forward and then backwards? (Explain what was happening)

Some of the videos or tutorials you saw earlier worked with how to program the microcontroller. This is always done through an attached computer. At some point you will have to download the program you write into the microcontroller. It's not a bad idea to go back to some of these videos or tutorials. For instant, <https://lastminuteengineers.com/l298n-dc-stepper-driver-arduino-tutorial> is a great tutorial that you should probably go back to often. How to program the Arduino to run the motors is shown at the end of this tutorial! Take a look at it to get a feel for what you will eventually need to do to make our robots run.

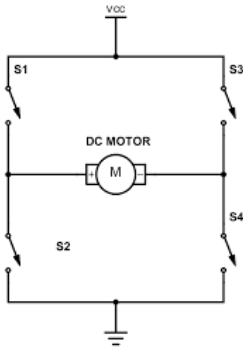
This last video is very good, but very long and somewhat difficult in its content. You should try to figure out how a DC motor works, how an H-Bridge works, how a motor driver works, and how the Arduino microcontroller works, for you will need to know all of these at some point to do Mechatronics and Robotics. https://youtu.be/dyjo_ggEtVU

DC Motors:

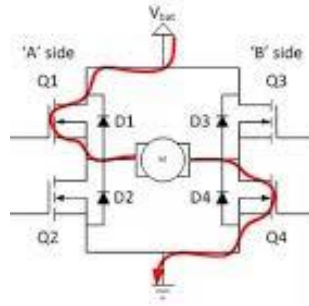


H-bridge to control

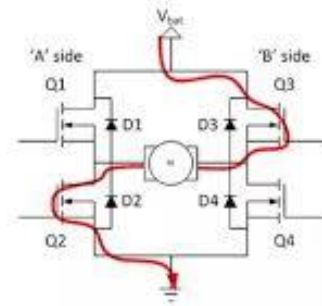
motor direction :



Motor goes one way



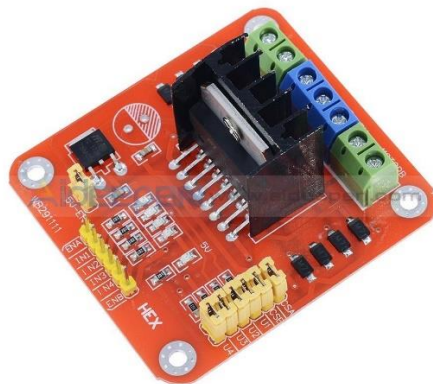
Motor goes the other way



Homework: Explain a little how a motor works.

Homework: Explain what an H-bridge is and how it works.

To really understand how motor drivers and microcontrollers work you're really going to have to play with these devices. I was hoping that we would be meeting again at the school, but it doesn't look like that will happen. So, we will be trying to figure out how we can get some of these devices and electrical components to you. We'll probably have to mail them out.



Homework: Draw a diagram of this motor driver module above and label where the motors are attached, where the power (9V and its ground) is attached, and from which pin can we get our 5V from.

Homework: Also show on your diagram what are the controlling pins to control the motors. Of these 6 controlling pins, which two controls the motors to go clockwise (if we put 5V to it), and which two controls the motors to go counter-clockwise should we put 5V to it?