

Robotics I - Homework

Hope everyone is doing well. These are crazy times, with a lot of uncertainty, but hopefully we can all find ways to be helpful to one another and get through this together. Sometimes, it's the challenges in our lives that make us stronger and wiser, so stay optimistic and take this as another learning experience!

For your Robotics homework I tried to find videos that will get you prepared for our next unit, which is making a robot that can sense large objects and then making decisions based on how you programmed it. It's not always easy to find exactly the videos I need, and I certainly don't like teaching Robotics without the hands-on, so be patient. You might have to look at 2 or 3 of these posted videos (and perhaps research some of your own) to understand how some of these things work. Try to answer the questions I ask. This will help you to focus on what you will need to know and it will give me something to grade you on.

Gear Motors: Our first topic is gear motors. What are they, how to make one, and how do you calculating their speed ratios, otherwise known as its gear ratio? Motors without gears usually go too fast or too slow for what we need them for. Adding gears acts like a transmission on a car. We can control the speed of the car without changing too drastically the speed of the engine itself. Engines and motors (at any given voltage) like to run at a certain speed. We can change that speed using gears. The other advantage is we are exchanging speed for power (or power for speed). Check out this video called, "Gears and Wheels (part I)" at the following URL: https://www.youtube.com/watch?v=D_i3PJlYtuY

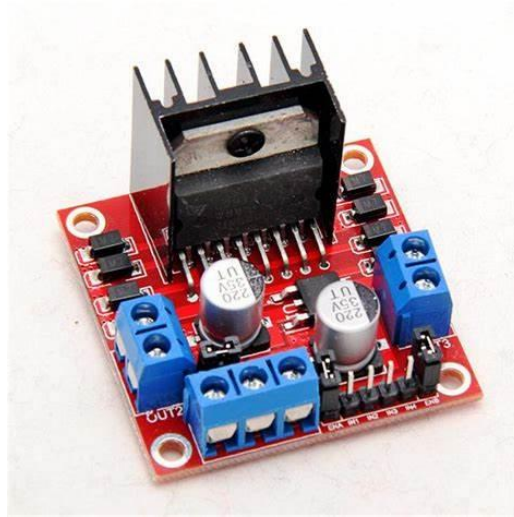
Homework: a) Draw two gears that are attached at a gear ratio of 3:1 (be sure the number of teeth are correct on each gear – I'll be counting)

b) Draw two gears that are attached at a gear ratio of 1:2

In this next video (How to Make a DC Gear Motor) you will see how gears are put together to create a home gear motor. You will **not** be asked to build this but rather to **calculate** the gear ratio of the first gear compared to the last gear, which was explained in the previous video. Assume that the larger gears have 3 times the number of teeth on them compared to the number of teeth on the smaller ones (a 3:1 ratio). <https://www.youtube.com/watch?v=wX4rUB7b7Yc>

Homework: So again, if the bigger gears in the video you just watched has twice the number of teeth as the little gears, what is the gear ratio of this system? Be sure to show how you came up with this calculation.

Motor Drivers: Our next topic is motor drivers. What are they, why do we need them, and how do they work? The photo below is a photo of the L298N motor driver module that we will be using.

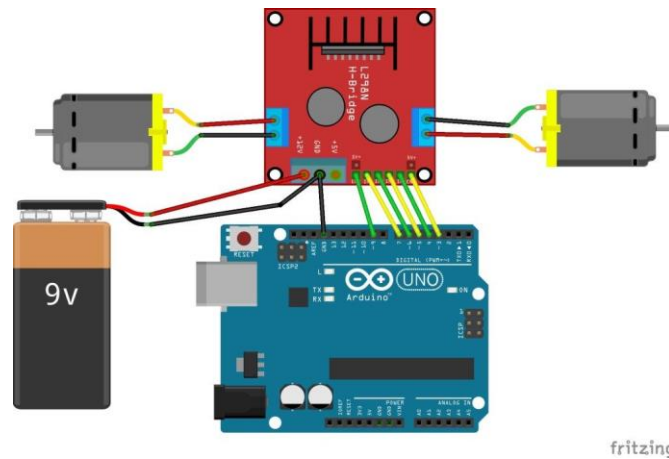


A motor driver module includes the motor driver chip. That big black piece in the back, that is sticking up, is actually the motor driver chip with its heat sink attached to it. You can see a screw attaching this chip to a thing with many fins on it. This fin containing thing is called a heat sink and is needed to dissipate the heat away from the chip. It spreads the heat that the motor driver chip will inadvertently produce away from the chip itself so that it doesn't burn out. As this chip is expected to handle a lot of power (amps), it **will** heat up. The module you see also has attachments for two motors and the power supply (battery). These screw attachment connectors are in blue. The module also has electrical components to help handle stray voltages that will be created by the motors we attach. These are the two silver capacitors you see in the front and all the little tiny black diodes you see in the back.

Now if you look very closely you will see in the middle, between the two silver capacitors, a black little square chip with three little legs protruding from it. This is a voltage regulator. Its purpose is to produce exactly, or pretty closely, 5V. And this is useful when we want this motor driver module to be driven by some sort of controller. We will later have this module be controlled by a microcontroller, the Arduino microcontroller. The videos you will be watching will often refer to this Arduino microcontroller because it's the brain for controlling what our robot will do. The microcontroller itself does not have the power to run the motors directly. It is the job of the motor driver module to do this. If we were to attach the motors directly to the controlling microcontroller, the microcontroller would burn up. It just can't handle that kind of power/electricity running through itself. However, the microcontroller needs exactly a 5V source of power to power itself up and it is this voltage regulator that will give us that 5V it needs.

Ok, so now you can see that a motor driver module includes a motor driver chip, but also included in this module are things to protect the motor driver chip, things to connect the wires to, and finally, has a voltage regulator on it to produce exactly the 5V needed to run the microcontroller that we will attach to it later on. As you continue going through this lesson, this will all become a little clearer to you!

Below is a photo of an Arduino microcontroller connected to a motor driver module. Also connected to the motor driver module are two motors and a battery.



We'll be connecting such a system when we are able to get back together. For this week, 3/23 to 3/27 we will focus on the motor driver module. Next week we'll focus on the Arduino microcontroller and its connections.

Here are two URL sites that can help you further understand how motor driver module work. Take a look at these and answer the questions that follow. The first link is a video of connecting a motor to a motor driver module and then running this motor without a microcontroller. Take a look at it - his accent is strong, but it's easy to follow. <https://youtu.be/TEZ2-3H0GY>

Homework: In the video you saw a diagram that the narrator drew to explain all the possible connections. Redraw that diagram with all its labels.

Homework: Explain how the narrator got the motor to go in one direction and then in the other direction? (you might need to see the next link to better explain this)

This next link is not a video but rather a tutorial on the motor driver module. It also explains how to connect an Arduino microcontroller to it. For this week focus on the motor driver module info and next week we'll introduce the microcontroller aspect.

<https://lastminuteengineers.com/l298n-dc-stepper-driver-arduino-tutorial/>

Homework: a) What does PWM stand for? b) Draw a PWM wave.

Homework: a) Explain what a duty cycle is. b) How can changing the duty cycle change the speed of a motor (explain).

Hope to see you soon, Mr. Larivee (larin@centralschools.org)