Adapted from: https://dronebotworkshop.com/tb6612fng-h-bridge/

Module 9 – DC Motor Driver

For this module you will need:

- ESP32
- Breadboard
- Thin jumper wires
- The TB6612FNG DC Motor Driver

Be sure the ESP32 USB is unplugged, and the battery pack power switch is OFF.

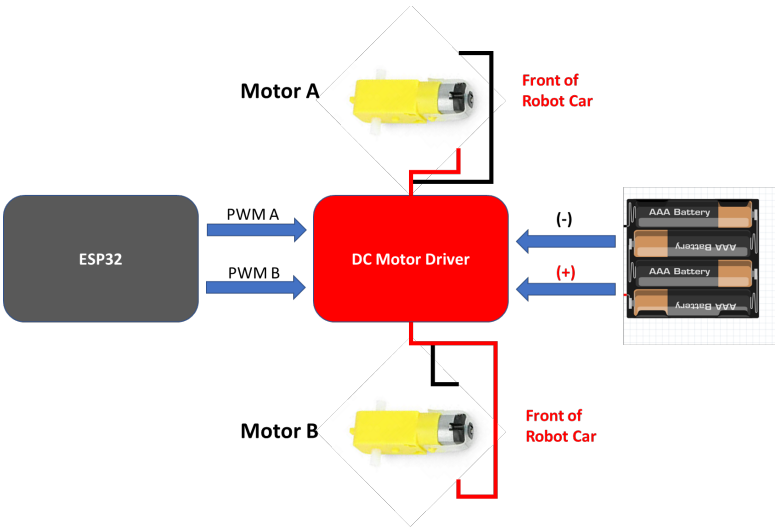
Controlling the speed and direction of DC motors is a very common application for both microcontrollers and microcomputers. You can probably think of many projects that you could build using these devices, from robots to cat toys.

But if you've ever tried connecting a DC motor directly to a microcontroller like an Arduino you'll quickly find out that it isn't feasible. Not only will it not work, as the Arduino cannot provide enough current for the motor, but you will also probably find yourself in the market for a new Arduino very soon!

DC motors require more current than any microcontroller or microcomputer can directly provide, and many of them operate on different voltages that your processor can't deal with. So obviously some sort of interface is required.

The most common method of controlling a DC motor is to use a device called an H-Bridge. This type of controller allows you to control both the speed and direction of a DC motor, and a pair of H-Bridges can also be used to control a bipolar stepper motor.

H-Bridges are used in many motor projects. They are relatively inexpensive and are pretty simple to work with.



In order to control the DC motors from software, we need to use a DC motor driver.

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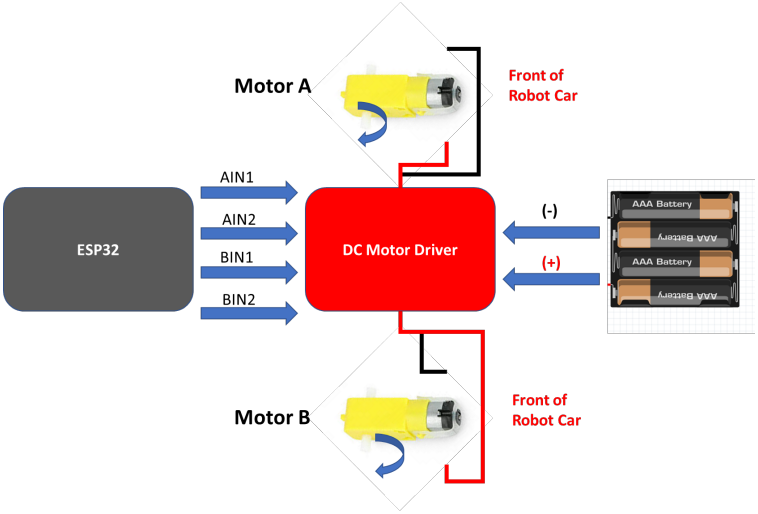
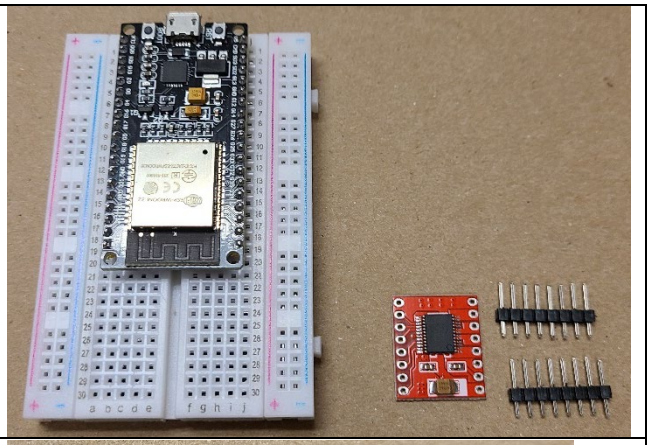
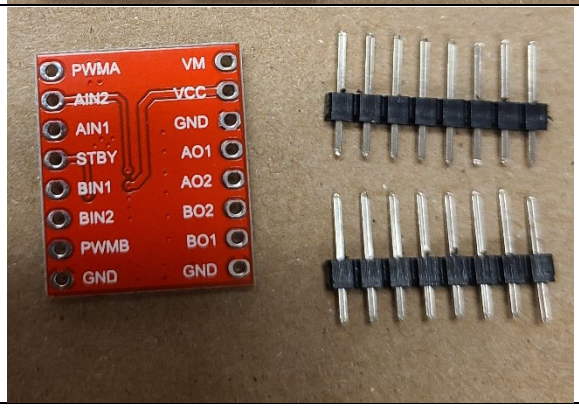
The ESP32 will output two Pulse-Width Modulation signals A, and B. These will drive Motor A (the left motor) and B (the right motor) of the vehicle. The PWM signals will allow us to control the speed of the motors.

The direction of the motors will be handled by 4 additional inputs from the ESP32: **AIN1, AIN2** and **BIN1, BIN2.** Just like how we manually swapped the terminals of the single AA battery, these inputs we will control to control the direction of the spin of the motors.



Follow the steps below:

Place the motor driver next to the breadboard with the ESP32, along with it's pin headers	
Turn the motor driver upside down	

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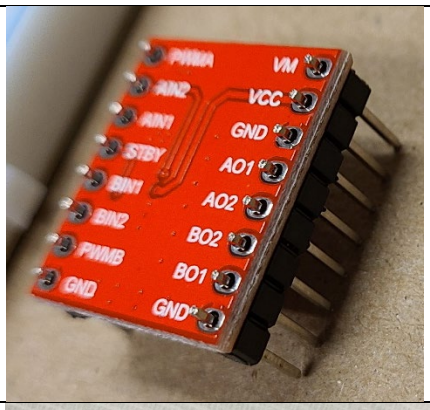
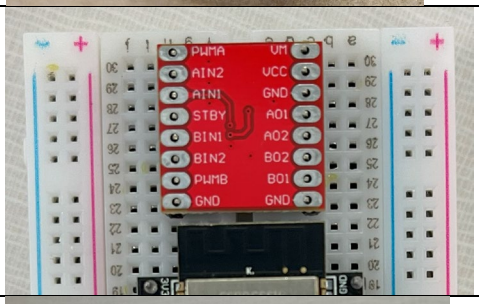
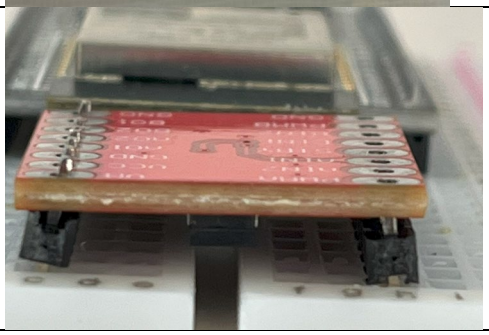
Put the motor driver on the header pins with the short side through the holes.	
Set the motor driver with it's pins on rows 23 – 30, columns **C** and **H**	
Set the motor driver with it's pins on rows 23 - 30	
Carefully press the motor driver down, **be sure to not hurt yourself with the pins.** Press fully down. The tension on the pins should be enough to create an electrical connection, without the need for solder. If solder is needed, visit a solder station.	

Remove the LED circuit from LED circuit and resistor from the breadboard.

If attached, detach the Ultrasonic sensor from only the 5V power. Leave the remaining ultrasonic pins where they are.

Connect the ESP32 pins to the motor driver using jumper wires according to the diagram below:

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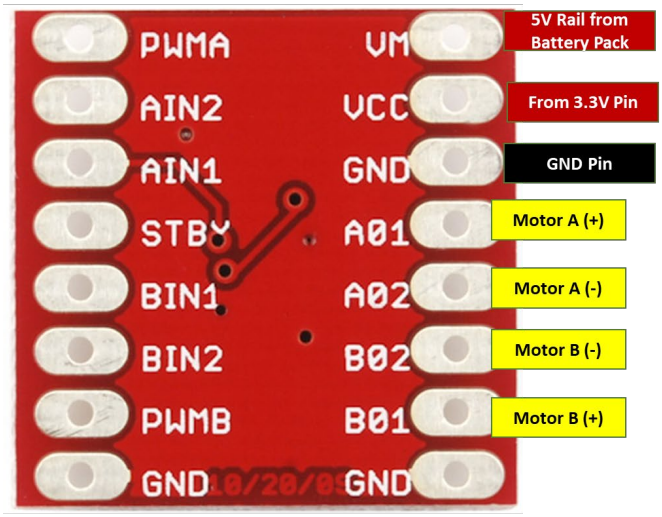

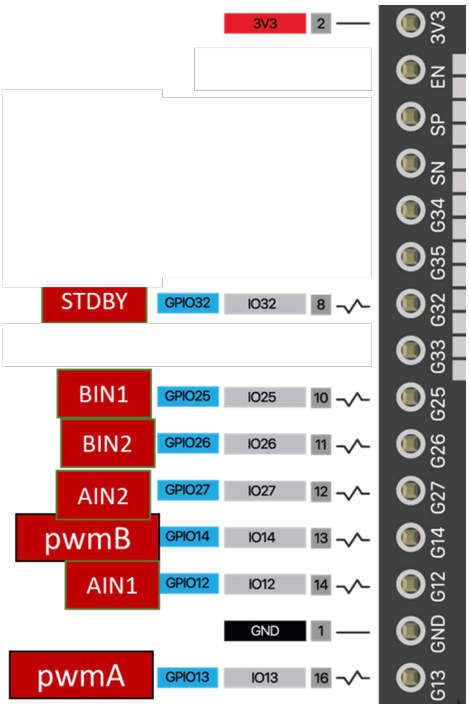

Remember: **Motor A is the motor on the left side of the vehicle when the back of the vehicle is facing you. Motor B is the motor on the right side of the vehicle when the back of the vehicle is facing you.**

Step 0	Remove all wiring from the breadboard, leave only the black board and red board.
Step 1	Black Board Pin 13 -> pwmA
Step 2	Black Board GND -> (-) GND Rail
Step 3	Black Board Pin 12 -> AIN1
Step 4	Black Board Pin 14 -> pwmB
Step 5	Black Board Pin 27 -> AIN2
Step 6	Black Board Pin 26 -> BIN2
Step 7	Black Board Pin 25 -> BIN1
Step 8	Black Board Pin 32 -> STBY
Step 9	Red Board VM -> (+) Power Rail
Step 10	Red Board GND -> (-) GND Rail
Step 11	Red Board VCC -> Black Board 3V3
Step 12	Black Board 5V -> (+) Power Rail
Step 13	Red Board A01 -> Motor A (+)
Step 14	Red Board A02 -> Motor A (-)
Step 15	Red Board B01 -> Motor B (+)
Step 16	Red Board B02 -> Motor B (-)

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Open the Arduino IDE, load the file: **stemcamp_scripting_challenge.ino**

Observe the code, and verify the pins match the connections from earlier.

Upload the code to the ESP32.

Detach the USB cable.

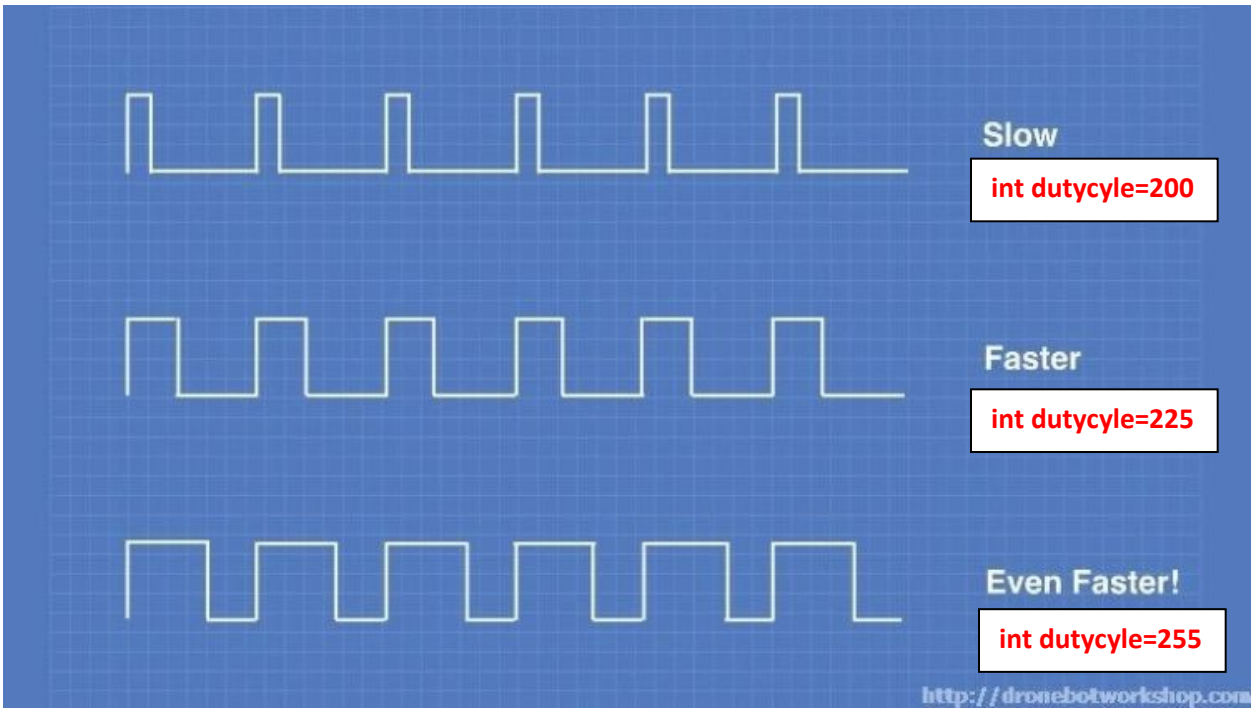
With the robot on the ground, turn on the power switch.

Observe that the robot does a dance.

Pulse Width Modulation (PWM)

Pulse Width Modulation, or PWM, is essentially what it sounds like. A pulse is sent to the transistors controlling the H-Bridge, which turns the electronic "switch" off and on at a pretty rapid rate.

The width of the pulse can be changed to set the ratio of "on" versus "off". This has the effect of controlling the speed of the motor.



Next, open the document: **Challenge: Follow the Line**