Lab 12. Power Transistors, H-bridge controller

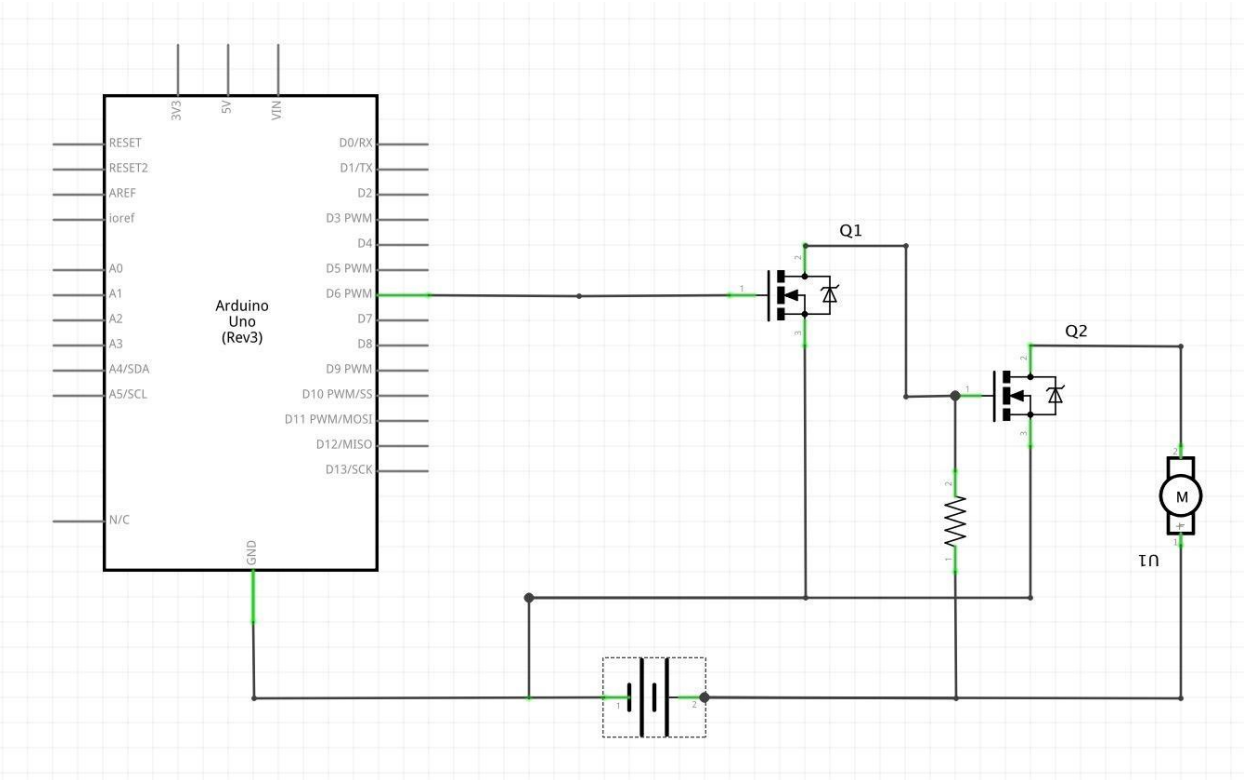
1. For this lab ***work with a partner***.
2. Test the voltage of your battery pack and record it open the circuit. **5.921 V**
   https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/measuring-voltage

3. Test the motor using the battery packs and measure the current. **87.4 mA**
   https://www.youtube.com/watch?v=dfzm3r8VyOw

4. Write down the model number of the power transistor you are given for turning on the motor. **IRF848**
5. Look up the spec sheet for the power transistor and fill in the following:
   a. Is it N-channel or P-channel? **N-Channel**
   b. Maximum source-drain voltage: **500 V**
      Explain what this means:
      Max voltage that can be applied across the drain and source terminals
   c. Maximum gate-source voltage: **+-20 V**
      Explain what this means:
      Max voltage that can be applied across the gate and source terminals
   d. Maximum current at room temperature: **8 amps**
      Is this power transistor suitable for turning on the motor? If not, see your TA:
      Yes

   e. What factors could make the power or the heat excessive on your power transistor causing it to burn out?
      Short circuits and drain-source voltage

6. Create a circuit using a motor, a battery pack, and a power transistor.
   a. Identify which pins on your MOSFET are ground, source, drain.
   b. Turn the power transistor on by connecting a wire from gate to VCC. The motor should start turning.
      Feel the power transistor with your finger. If it gets warm unplug immediately and debug, or ask the TA for help.
      IF YOU FRY A POWER TRANSISTOR, TELL THE TA. WE WILL NOT EXECUTE YOU (promise).
   c. Pull out the wire, the motor may continue to turn or stop. Why?
      i. **There is no voltage source if unplugged**
   d. Connect the wire to ground. The motor should turn off. Check again for power transistor temperature and SHUT OFF IMMEDIATELY if it's too warm.



7. Write a function on the arduino to set the power to the motor that takes the following parameters:

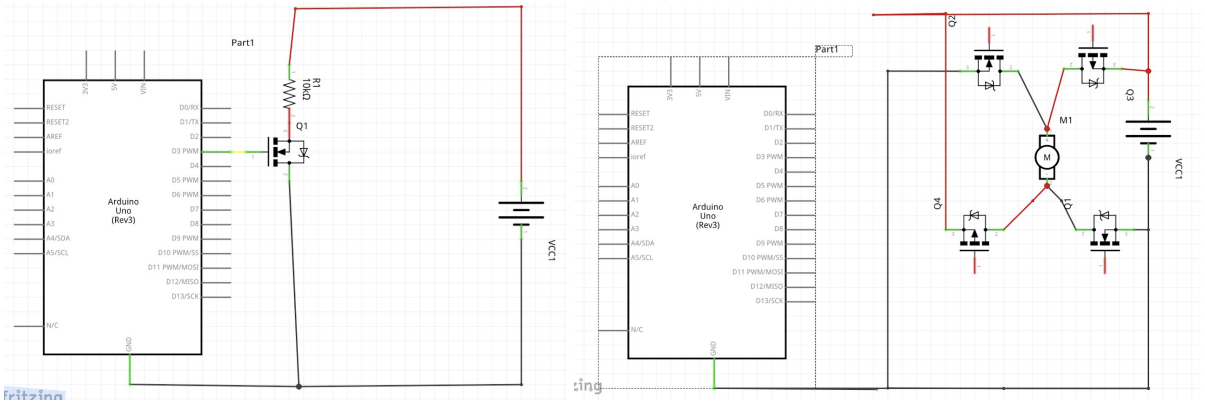
   void power(int pin, int percent, int duration);

   where the pin selects which pin to pulse, percent represents a percentage from 0 (off) to 100 (full power), and duration is in milliseconds. Test with a loop like the following:

   ```
   void setup() {
     power(11, 100, 3000); // turn pin 11 to 100% power for 3 seconds
     power(11, 50, 3000); // turn pin 11 to 50% power for 3 seconds
     power(11, 20, 3000); // turn pin 11 to 20% power for 3 seconds
   ```

8. Determine the duty cycle percentage for your motor at which the motor stops working. Note that this will not be the same for every motor, particularly because the batteries might be more or less fresh for your group.
   a. 10%

9. draw a schematic for H-bridge controller using P-type MOSFETS for the upper voltage, and N-type for the lower.



10. If P-type power transistors are available, build the h-bridge controller. If not, you will have an opportunity to do so (optional) later in the course for extra credit (50%).

Instructions for using Multimeter:
https://docs.google.com/presentation/d/1UtWdwMKPM_1U_cKbMH5r66xctJkw6k8Usr4p1mgLGjY/edit?usp=sharing

Submissions:
Have a copy of the lab content and submit it with all questions and blanks filled.
Submit photos of your circuit.
Submit your video record for each part.
Draw the circuit in Fritzing for each part and Submit screenshots.
Save and submit the code.