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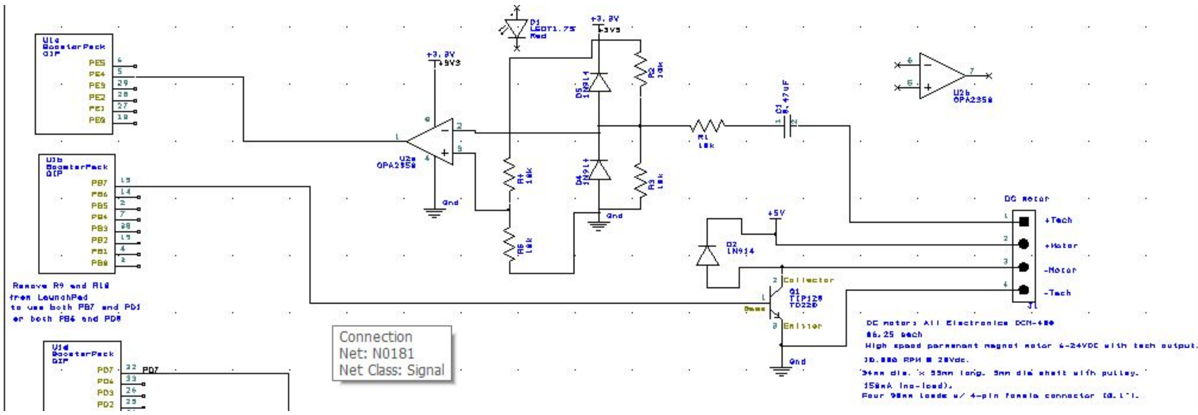
Deliverables (exact components of the lab report)

A) Objectives (final requirements document) **separate doc**

B) Hardware Design (PCB Artist file)

DC motor and tachometer interfaces, showing all external components

LCD and switch interfaces, showing all external components



C) Software Design (upload your files as instructed by your TA)

Make sure to include units on all your software variables

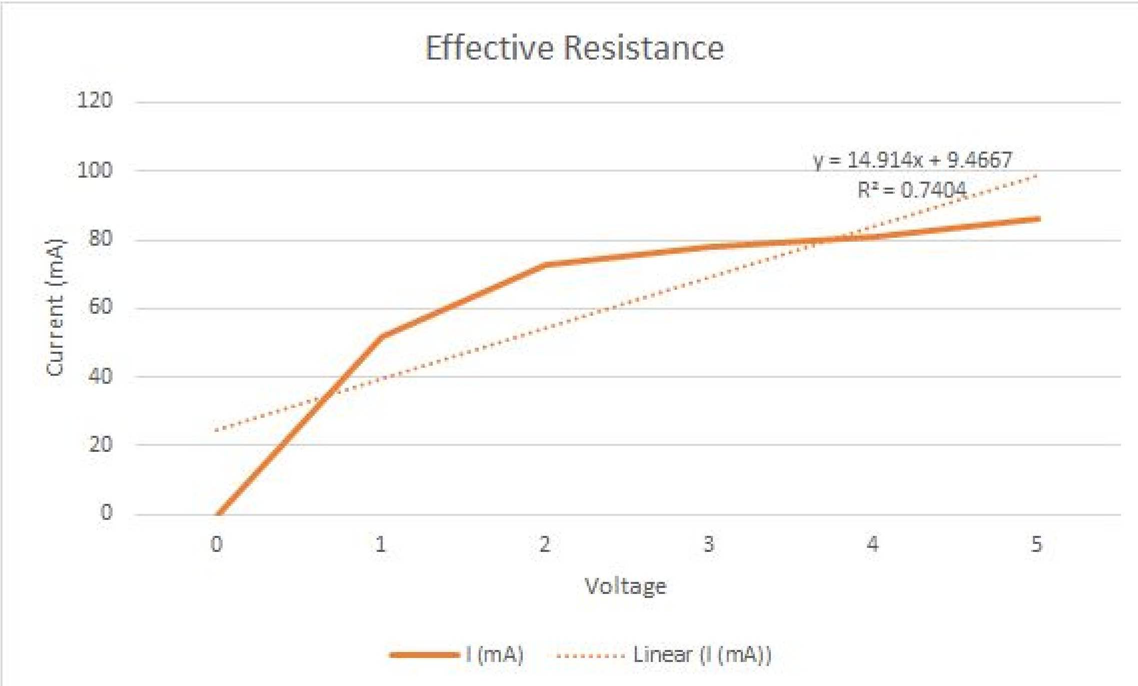
Make a clear distinction between variables used for debugging and variables needed in the controller

If you organized the system different than Figure 10.3 and 10.4, then draw its data flow and call graphs

D) Measurement Data (<u>underlined sections of the lab manual</u>)

Procedure 1) Give the voltage, current, and resistance measurements

V	I (mA)	R
0	0	0
1	52	19.23077
2	73	27.39726
3	78	38.46154
4	81	49.38272
5	86	58.13953

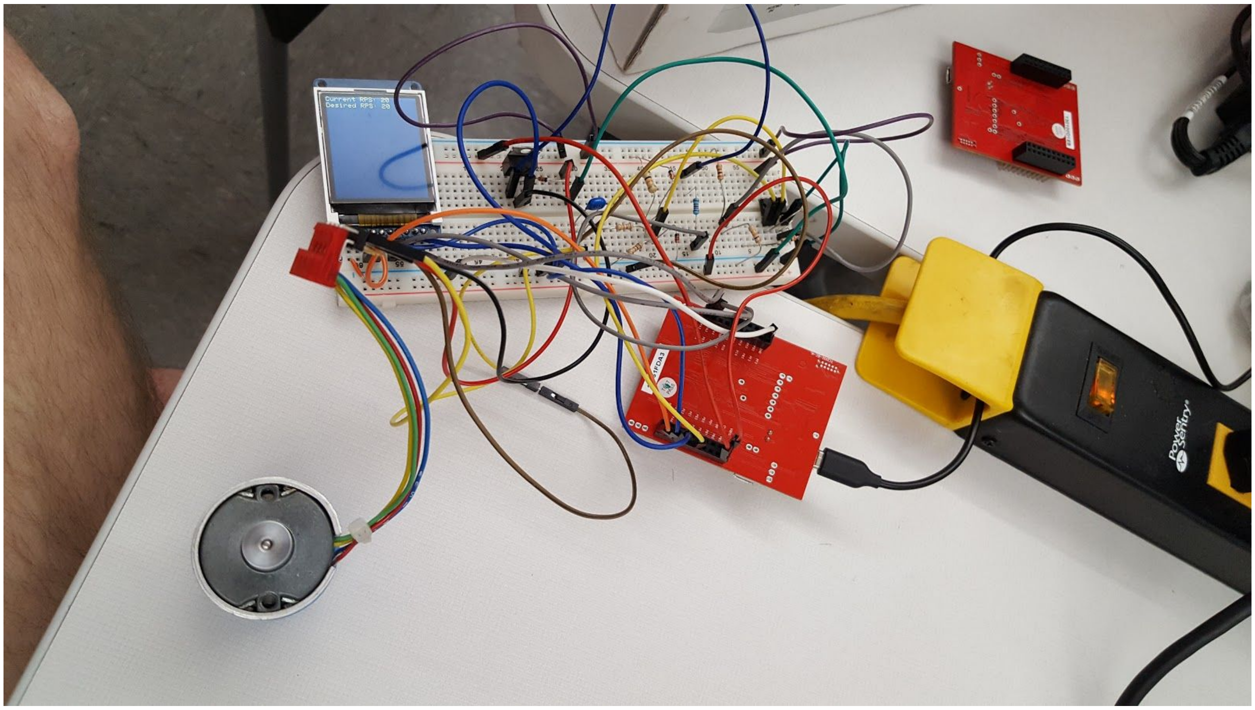


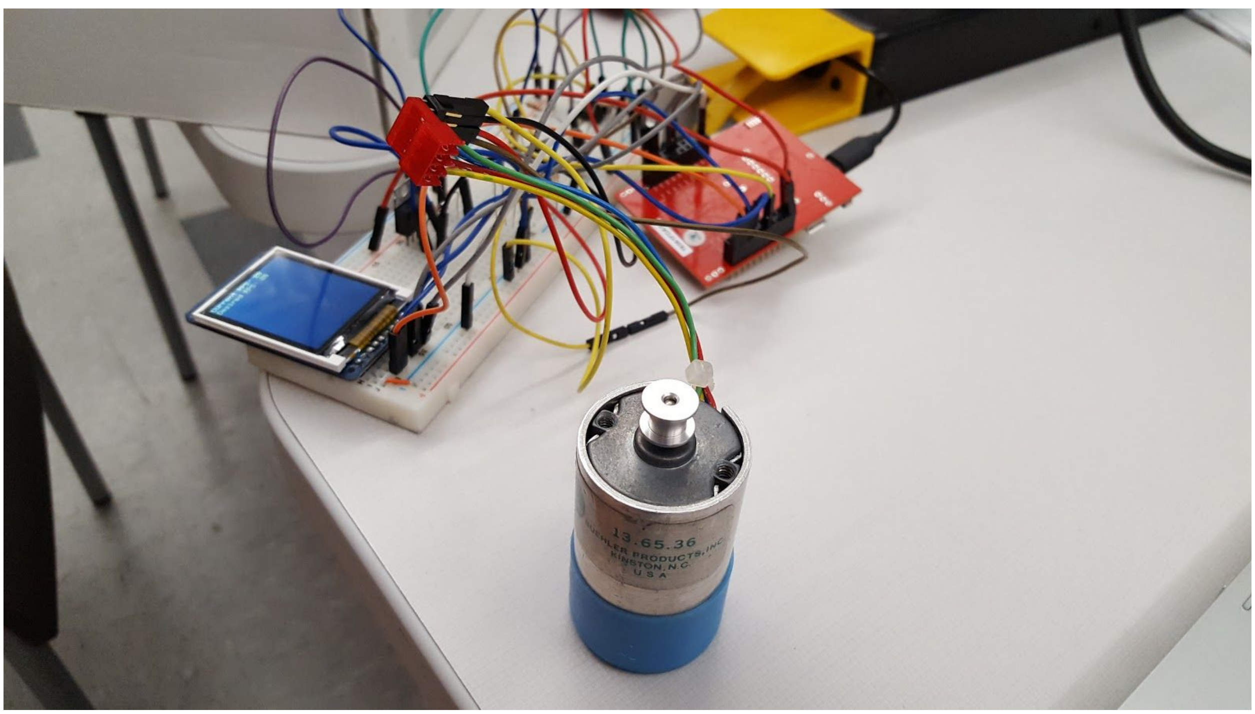
Procedure 2) I_{BE} and I_{CE} while spinning.

I_{BE} = 1.5 mA

I_{CE} = 1.2 mA

Procedure 3) Two screen shots of the hardware in operation.





Procedure 4) Specify the maximum time to execute once instance of the ISR **1.71ms**

Procedure 4) Specify the average controller error

Depending on how large the jump in desired RPS is, anywhere from 1-10 RPS. For a jump of 5, the error is ~2 RPS.

Procedure 4) Specify the approximate response time

The PI loop updates every second, so the system has a response time of 1 second.

Procedure 5) Measurements of current required to run the system, with and without the motor spinning

50 mA without motor

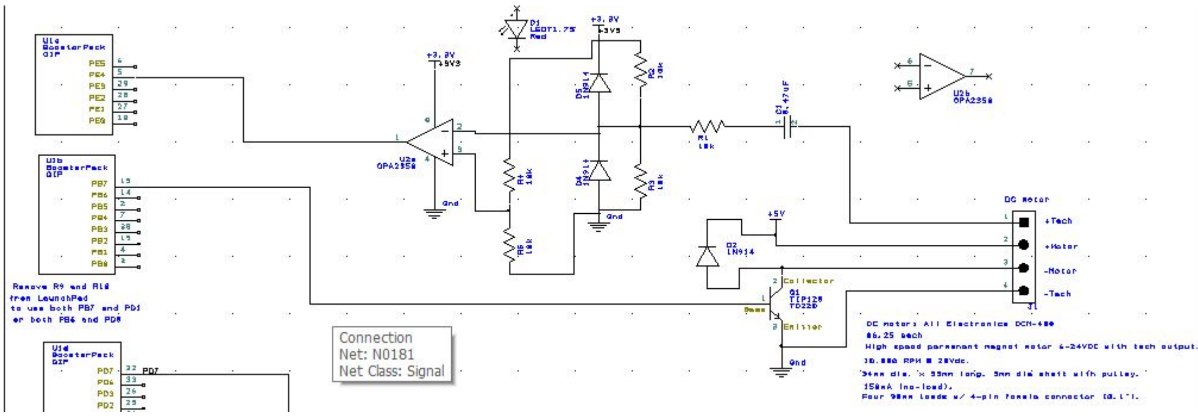
102-136 mA with motor

E) Analysis and Discussion (give short 1 or two sentence answers to these questions)

1) What is torque? What are its units?

Torque is a rotational force, given by the cross product of r (radial distance) and F (force). Torque is measure in Newton-meters (Nm).

2) Draw an electrical circuit model for the DC motor coil, and explain the components. Use this circuit model to explain why the current goes up when friction is applied to the shaft



As the load torque increases, so does the back EMF. Because of that, more current begins to flow through the circuit and so we put an 1N914 diode to stop that.

3) Explain what parameters were important for choosing a motor drive interface chip (e.g., TIP120 or 2N2222). How does your circuit satisfy these parameters?

The TIP120 was a good choice for a low-current power supply such as the TM4C's VBUS line. Since the line can't put out much more than 120 mA, the TIP120 was useful because it needs a small voltage supply to be saturated and not much current to drive the motor. The 2N2222, on the other hand, needs at least 800mA to be able to push current to the motor.

4) You implemented an integral controller because it is simple and stable. What other controllers could you have used? For one other type of controller how would it have been superior to your integral controller.

We could have used a PID loop rather than a PI controller. Though it may give some overshoot, a PID controller is much faster to reacting to changes in the system thanks to the derivative. Overshoot may be unacceptable in some environments as it might be dangerous but in this lab overshoot would be fine (Unless it tried to pull more current than the board could provide).

5) It the motor is spinning at a constant rate, give a definition of electrical power in terms of parameters of this lab? Research the term "*mechanical power*". Give a definition of mechanical power. Are the electrical power and mechanical power related?

Electrical power - P = VI

Mechanical power - P = E/t

1V/1A = 1W = 1J/1s