piRover Builds with K2

Power and Control Research Rev 1.3

Overview:

During this activity you will research a controller project that interfaces to a high-power load. You will investigate the power supply and interface circuitry. You will share your findings with the class during the next class session.

Prerequisites:

Prior to beginning the instruction provided in this lesson you must have completed the following:

1. Digital Outputs

Performance Outcomes:

1. Use the web to research controller projects that drive high-current, high-power loads. The instructor will discuss and provide examples.
2. Analyze the power supply and power distribution for your selected project.
3. Analyze the output drive circuity required to interface the high-current load to the low-power output port(s)

Resources:

1. Transistors, Relays, and Controlling High-Current Loads – ITP Physical Computing (nyu.edu)
2. Example: Raspberry PI based Motor Speed Control (projects-raspberry.com)

Materials:

1. None

Discussion:

As you learned in the Digital Outputs lesson, the ability to power a load directly from a GPIO port is extremely limited. Assuming a 3-volt GPIO output that is sourcing 16 mA, the maximum power to the load is around 50mW. The author of a prior resource suggested that current be limited to 2 mA. Output power from the port is then limited to 6mW!

When using microcontrollers such as the Pi or an Arduino, you frequently need to control devices that require much more power.

Examples include DC motors, high-power lights or lamps, and heaters. For these applications, you need a DC power supply that can deliver high-current to the load but also provides a regulated voltage to power the controller.

The high-current load must be interfaced to the controller's outputs using some sort of drive circuitry. This may be as simple as an "old-school" magnetic relay, but a solid-state device is more likely. Solid state drive circuitry can be discrete transistors or a solid-state switching module such as the one included in your parts kit.

Directions:

Name _____

1. Research and select a controller project (Raspberry Pi, Arduino, other?) that requires switching of a high-current load. A minimal example is provided in the Resource section above. **Copy a minimum of three links to projects below. Highlight/bold the one that you select.**

2. The project must include a schematic or block diagram with components identified. Copy an image of the schematic or block diagram below.

3. Investigate the power supply for your project. Document your findings in the spaces below.

4. Is the project battery powered? Does it use an AC power supply? What are the specifications? Can you determine the amount of power required?

5. Is there a fuse or protection circuitry for the source? Does that indicate the maximum amount of current required? How does that indicate power required?

6. Review the load. Can you determine the current required to activate the load? Given the source voltage, what is the load power? This may require you to use other resources to determine typical power for your device. For example, if you are controlling a washing machine,

then what is the typical motor required? If this is in horsepower, can you convert it to Watts?

7. What voltage level is required to power the controller (Pi, Arduino, other)? How does the power supply provide this? Is a voltage regulator used to distribute power to the controller? Explain below.

8. How is the load controlled by a controller port? What interface circuitry is required between the high-current load and the controller's output port? Is there a transistor? A drive module or chip? Relay?

9. Research the interface circuitry identified in the prior step. Share as much detail as possible on the operation of the circuitry in the space below. Can you determine how much current is required from the controller's output port?

Assessment:

Document your research completed. Submit this document with a link to your selected project and responses to the questions on power supply and control. Be prepared to share your work with the class during the next class session. Do your best. Some information may not be available, or we'll need to analyze it as a class.