ECE 445 Mock Design Review

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Power Block Diagram

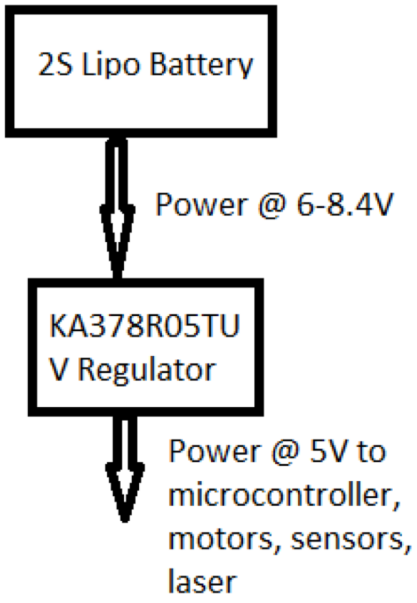

Figure 1

High-level Circuit Schematic

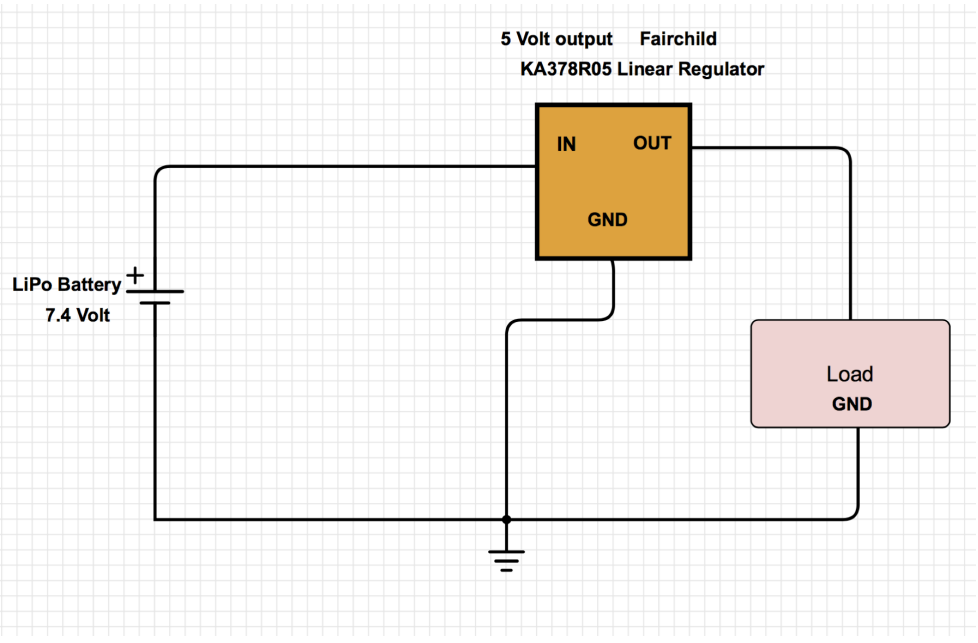

Figure 2

Calculations

Peak Current Draw Calculation

(Listed values are max possible current draws for each component/block)
I_{Motor} = 800mA x 2 = 1.6A [4]
$I_{ESP8266}$ = 500mA [3]
I_{Laser} = 30mA [6]
$I_{RangeSensor}$ = 15mA x 3 = 45mA [5]
$I_{Photodiodes}$ = 250mA
I_{Total} =I_{Max} = 2.45A

Regulator Power Dissipation Calculation [2]

(Max power dissipation of KA378R05TU voltage regulator with heatsink is 15W)
2cell lipo battery voltage ranges from 6V-8.4V
V_{IN_Max} = 8.4V
V_{OUT} = 5V
Max P Dissipation = (V_{IN_Max} – V_{OUT}) * I_{Max} = (8.4V – 5V) * 2.45A = 8.33W
(This shows regulator is capable of handling entire system load)

Minimum Battery Life Calculation

Capacity = 2500mAh = 2.5Ah
I_{Max} = 2.45A
Min Run Time = Capacity/I_{Max} = 1 hour 1 minute

Plot (Vout/ Vin)

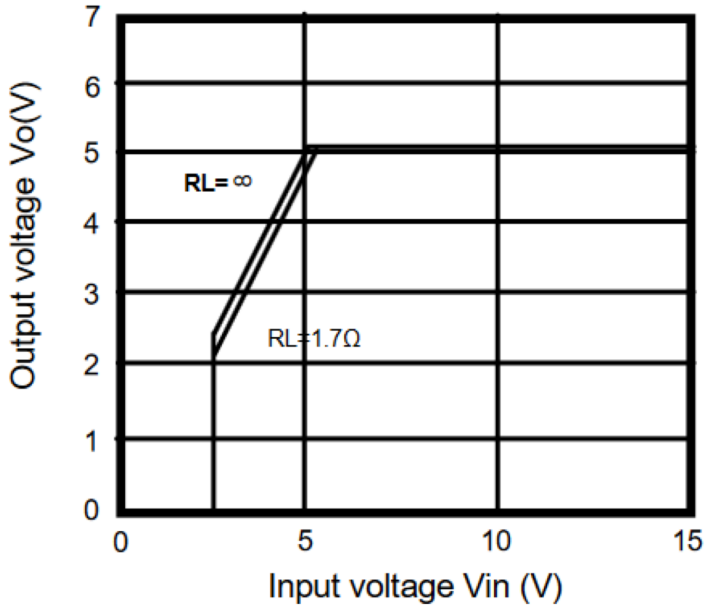

Figure 3

Power Module Block Description

Power Supply:
The power supply is essential in keeping all systems working efficiently and safely. The power supply will consist of one KA378R05 low dropout voltage regulator [2]. The voltage regulator will be used to output 5 volts to each DC motor and to the sensor module. These low voltage dropout regulators will work well with the 7.4 volt LiPo battery due to the low voltage drop from 7.4 to 5 volts. Also, the voltage regulator max current rating is 2.5 amps.

Battery:
The battery is an industry-standard 25C 7.4 Volt 2500 mAh battery [1]. This is a 2 cell battery which consists of 3.7 volts per cell. Its peak voltage is 8.4 volts and minimum is 6.4 volts. The max current is 62.5 amps which bodes well with our circuitry. This will power the microcontroller, two DC brushed motors, and the sensor module for a period of time.

Requirements and Verification

Power Supply Requirements
The power supply must be able to regulate the voltage to 4.8-5.2 volts from the 7.4 V LiPo battery. The regulator must be able to deliver a maximum of 2.5 amps.

Power Supply Verification
We will attach a 6 ohm resistive on the output of the regulator and measure the voltage across the resistor with a multimeter.

Battery Requirements
The battery must be able to deliver 6.4-8.4 volts with a maximum of 2.5 amps of current for 15 minutes to the voltage regulator.

Battery Verification
We will attach a 3 ohm resistive on the output of the regulator and measure the voltage across the resistor with a multimeter.

Safety Statement

There are many safety hazards involved with our project but one of the main ones is the use of the 7.4 Volt 2500 mAh 25C LiPO battery. When using this battery, we have to ensure that each cell in this battery is kept above 3.2 volts (6.4 collectively) when discharging it or else the battery could get permanently damaged. Also, we have to ensure that the max voltage is not be above 4.2 volts (8.4 collectively) when fully charged. Furthermore, when charging the battery, we have to ensure that we don't overcharge or else it could cause a fire. We have to work within these minimum and maximum voltage restrictions to ensure that we use this battery safely. Also, the max rating for the temperature of the battery is 60 degrees Celsius but we will set the threshold at 48 degrees celsius to ensure the battery doesn't over heat. To ensure that these batteries are working properly, we will monitor the temperature and voltage of the battery while the droid is powered on. We will use a thermistor to measure the temperature and a voltage divider circuit to measure the voltage of the battery.
Also, while using this battery safely, we need to ensure that all our other modules have the correct power, voltage, and current rating to prevent the other components from overheating. As the design process continues, we may need to implement voltage/ current readings for certain devices to establish optimal safety and efficiency.

Citations

[1] Onyx battery manual, Hobbico Inc. [Online]. Available at: http://manuals.hobbico.com/dtx/dtx-onyx-lipo-manual.pdf [Accessed: 15- Feb- 2016].

[2] KA378R05 Low Dropout Voltage Regulator, Fairchild. [Online]. http://www.mouser.com/ds/2/149/KA378R05-1010721.pdf [Accessed: 15- Feb- 2016].

[3] Adafruit Huzzah ESP8266 Breakout, Adafruit. [Online]. https://www.adafruit.com/products/2471 [Accessed: 15- Feb- 2016].

[4] Brushed DC Motor, Pololu. [Online]. https://www.pololu.com/product/1117 [Accessed: 15- Feb- 2016].

[5] Ultrasonic Ranging Module, Micropick. [Online]. http://www.micropik.com/PDF/HCSR04.pdf [Accessed: 15- Feb- 2016].

[6] Laser Diode Module with Clamshell Packeging, Farhop. [Online]. https://www.amazon.com/farhop-9x21mm-Module-Clamshell-Packaging/dp/B01M0U5PCO/ref=sr_1_6?rps=1&ie=UTF8&qid=1487658082&sr=8-6&keywords=laser+module+dot&refinements=p_85%3A2470955011 [Accessed: 15- Feb- 2016].