



Department of Electronic & Telecommunication Engineering

University of Moratuwa

Assignment – 8

EN2532 - Robot Design and Competition

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Power Budget Calculation

The current and voltage requirements of the components that are being used in our robot are as follows,

Component	Quantity	Voltage	Operating Current	Maximum Current
Pololu motor	2	6 V	2.06 A (1.03 A x 2)	5.6 A (2.8 A x 2)
N20 motor	2	6 V	2 A (1 A x 2)	3 A (1.5 A x 2)
IR panel	1	5 V	100 mA	100 mA
Ultrasonic Sensor	3	5 V	45 mA (15 mA x 3)	45 mA (15 mA x 3)
Raspberry Pi 3B+	1	5 V	3 A	3 A
Solenoid	1	12 V	350 mA	350 mA
Arduino Uno	1	5 V	200 mA	200 mA
Motor Controller	2	5 V	80 mA (40 mA x 2)	80 mA (40 mA x 2)
Total			7.835 A	12.375 A

Voltage

The component that requires the maximum voltage in the component list is the Solenoid. It requires 12 V, and all the other components require 6 V or less. Furthermore, the Solenoid only requires 350 mA which is relatively low. Therefore, we decided to use a boost converter along with a 11.1 V battery for our robot.

Capacity

The maximum current draw and the operating current draw of the robot are 12.375 A and 7.835 A respectively. Since the maximum current draw only occurs when the DC motors are in the stall condition, considering a continuous current draw of 12.375 A is not realistic. Therefore, the capacity requirement for the robot is based on the operating current. Furthermore, we decided that a 20-minute continuous run-time for the robot is sufficient for our application. Therefore, the required capacity of the power source is calculated as follows,

$$Capacity = CurrentDraw(mA) * Time(hours)$$

$$Capacity = 7835 * \left(\frac{20}{60}\right)$$

$$\underline{Capacity = 2611 mAh}$$

Discharging Rate

The capacity of the required battery is 2611 mAh. The operating current of the robot is 7.835 A. Therefore, the required discharging rate should be greater than,

$$\text{Discharging Rate} = \frac{7835}{2611}$$

$$\underline{\text{Discharging Rate} = 3C}$$

The summarised requirements of the power source are as follows,

Voltage	Capacity	Discharging Rate
11.1 V	2611 mAh	3C or above

Battery Selection

The NiCd battery is not considered as a viable battery option due to the toxic nature of the battery and the memory effect associated with its rechargeability.

The Lead Acid battery is also not considered as a viable battery option, since it is considerably heavy, and it is not suitable for a compact mobile robot as ours.

	Alkaline	NiMH	LiPo	Li-ion
Capacity	Low	High	High	High
Discharging Rate	Low	Low	High	Low
Power Density	Low	Moderate	High	High
Rechargeability	Not Available	Available	Available	Available

Since we require a rechargeable battery with high capacity and discharging rate, we identified the LiPo battery as the most suitable based on the above comparison table.

The following LiPo battery in the market fulfils all the identified requirements.



<https://tronic.lk/product/11-1v-2200mah-3s-25c-lipo-battery-xt60-plug>