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EMBEDDED SYSTEM

Analysis

POWER & PERFORMANCE

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1 Power

1.1 Datasheet information:

No.	Name	Description	Min	Max	Typical	Note
1.	ESP32 devkit	The operating voltage of ESP32 ranges from 2.3 V to 3.6 V. When using a single-power supply, the recommended voltage of the power supply is 3.3 V	500 mA	-	-	Average current in actual test is no more than 150 mA with 600 mA spike
2.	MPU6050	The sensor has 3 distinct feature and power consumption is based on what features are used in combination Gyroscope/Accelerometer/DMP	3.6 mA	3.9 mA	3.6 mA	Look like only Gyroscope is used
3.	Nema 17	The motor operates in 2 phase, with rated voltage and current in the datasheet, model KH42JM2B182A	0.85 A	0.9 A	0.88 A	The stats in official datasheet and product mark is different so i take them as low/high values.

1.2 Calculation:

With the above stats, we can assume that the pair of motor will draw $0.88 \times 2 = 1.76$ A per phase and 3.52 A in total.

Therefore, we need about 4A current (at max) and about 3.7 A average. The battery we chose, a 3-cell Lion battery with 30 C max discharge current and 2000 mAh capacity, merely meets the requirement. We expect it to sustain at least half an hour before recharge.

With some calculation, we can get the maximum performance of the Nema 17 stepper motor [1]:

$$MaxSpeed = \frac{V}{2LI_{max} \cdot spr} \quad (1)$$

$$Mintimeperstep = \frac{2LI_{max}}{V} \quad (2)$$

$$P_{max} = I_{max}V \quad (3)$$

Hence, at nominal voltage ($3.7 \times 3 = 11.1$ V), we get the result of 6.18 revolutions/s, 0.809 ms/step and 9.77 W max power.

At max voltrage ($4.2 \times 3 = 12.6$ V), we get 7.02 revolutions/s, 0.712 ms/step and 11.1 W max power.

References

- [1] <https://www.allaboutcircuits.com/tools/stepper-motor-calculator/>