## Battery Life Estimate

Sensor device:

| Component | Model | Voltage (V) | Current (mA) | Power (mW) = V × I | Duty Cycle (%) | Final Power Contribution (mW) |
|---|---|---|---|---|---|---|
| Processor | Seeed Studio XIAO C3 | 5V | 28.9 mA | 144.5 | **10%** (only when both mic & proximity trigger) | **14.45mW** |
| Microphone | MAX9814 | 5V | 3.1mA | **15.5mW** | **100%** | **15.5mW** |
| Proximity Sensor | GP2Y0A21YK0F | 5V | 30 mA | **150mW** | **30% (only when sound is detected)** | **45mW** |
| Resistor | **R1 (2kΩ)** | 5V | | **12.5mW** | **100%** | **12.5mW** |
| Resistor | **R2 (3.3kΩ)** | 5V | | **7.6mW** | **100%** | **7.6mW** |

How did you determine your "days of use" metric ?

To estimate the “days of use” for my device, I calculated the total power consumption per hour and divided it by the expected battery capacity. Assuming a 5V battery, I used the formula:

Battery Life = Battery Capacity (mWh)/Average Power Consumption (mW)

I also considered the duty cycle of each component, ensuring that the processor remains off most of the time, significantly extending battery life.

What do you think is the optimum size for the battery in your device ?

Given the average power consumption of ~95.05mW, an appropriate battery size depends on the expected runtime. For a small portable device, I estimate a 500mAh LiPo battery (5V) would provide one day power supply. So I would use 1000mAh to ensure it's ultimate performance or multiply day per charge.

What hardware/software/cost/effort tradeoffs could you make to improve the user experience ?

**Hardware Trade-offs:**

- Using a lower-power proximity sensor or a more efficient microphone could further reduce energy consumption.
- Replacing the 5V power supply with a 3.3V system could improve efficiency.

**Software Trade-offs:**

- Implementing a deep sleep mode for the ESP32C3 instead of keeping the mic on at 100% duty cycle could significantly extend battery life.
- A smarter wake-up algorithm could reduce false activations.