Battery Management Lab

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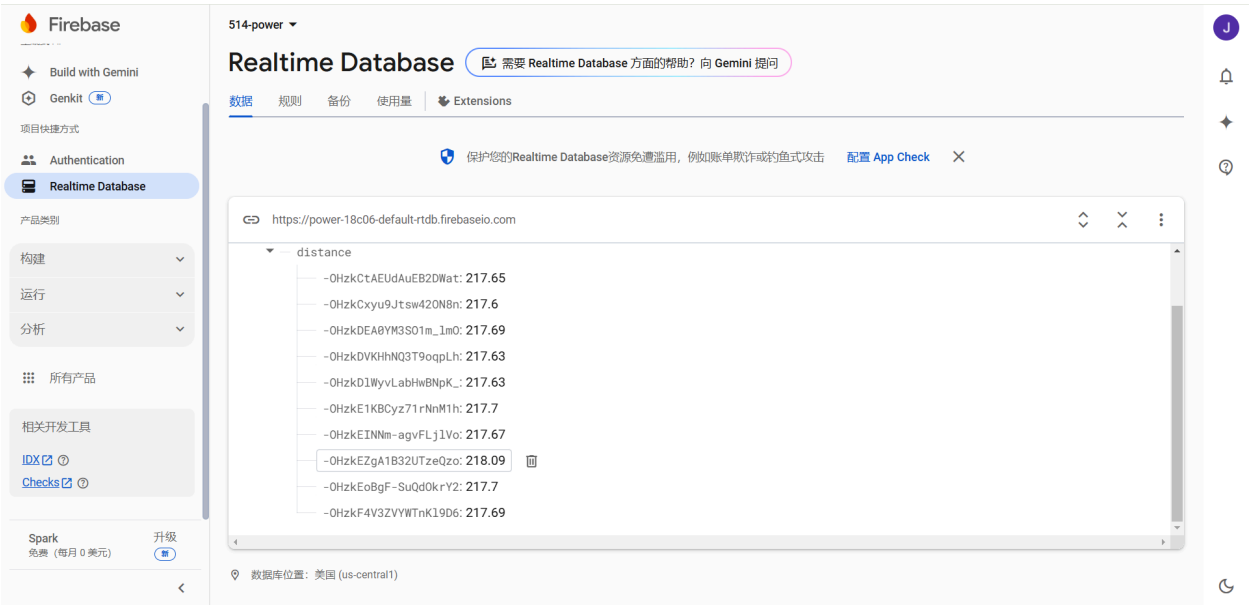
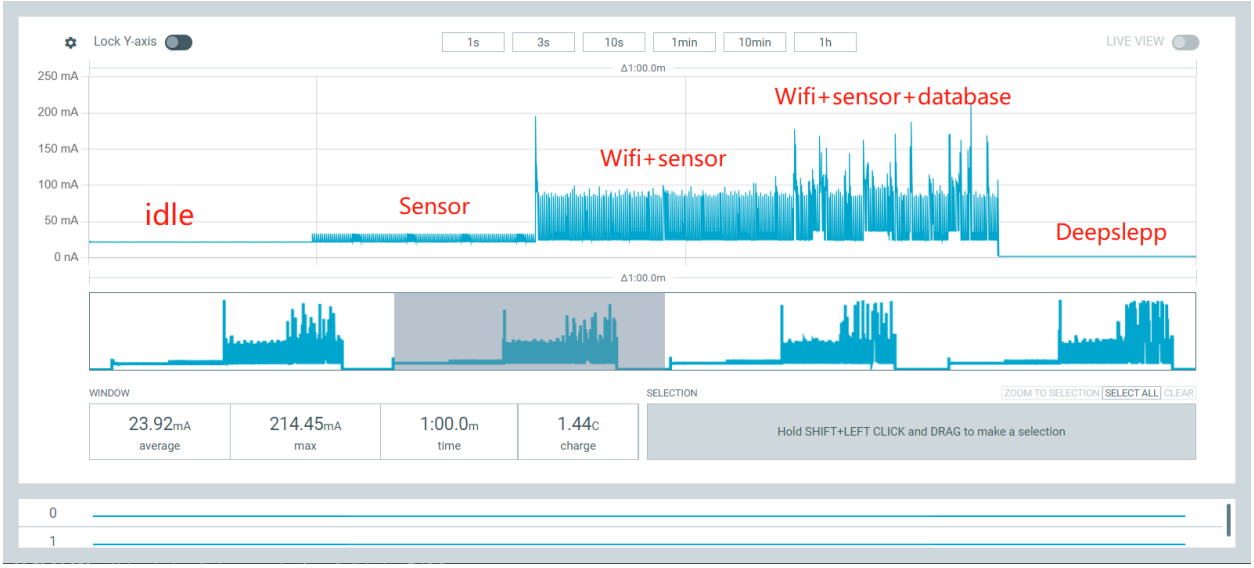
Transmitting your HC-SR04 Data to Firebase



Power Consumption Measuring

5 Stages power consumption



1. Idle ESP32 (not running WiFi or ultrasonic sensor)
   Average Current: 21mA
   Power consumption: 21mA * 5V = 0.105W
   Estimated battery-lasting time: 500mAh/21mA=23.8h

2. Only ultrasonic sensor working
   Average Current: 23mA
   Power consumption: 23mA * 5V = 0.115W
   Estimated battery-lasting time: 500mAh/23mA=21.7h

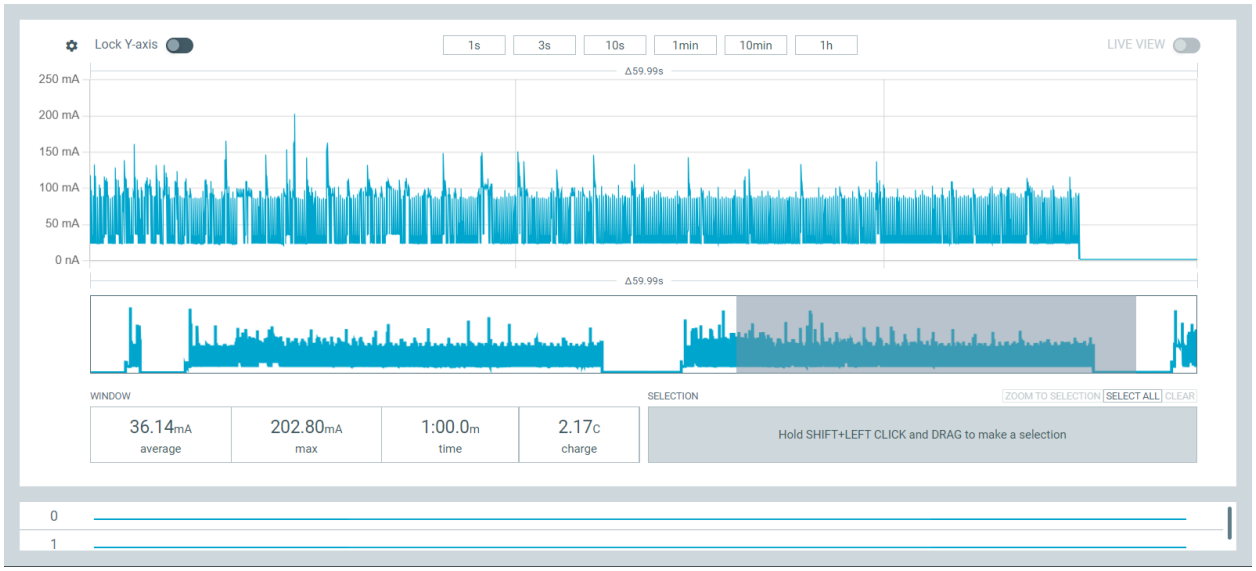
3. Ultrasonic + Wifi working
   Average Current: 28mA
   Power consumption: 28mA * 5V = 0.140W
   Estimated battery-lasting time: 500mAh/28mA=17.8h

4. Ultrasonic + Wifi + Sending data to Firebase
   Average Current: 43mA
   Power consumption: 43mA * 5V = 0.215W
   Estimated battery-lasting time: 500mAh/43mA=11.6h

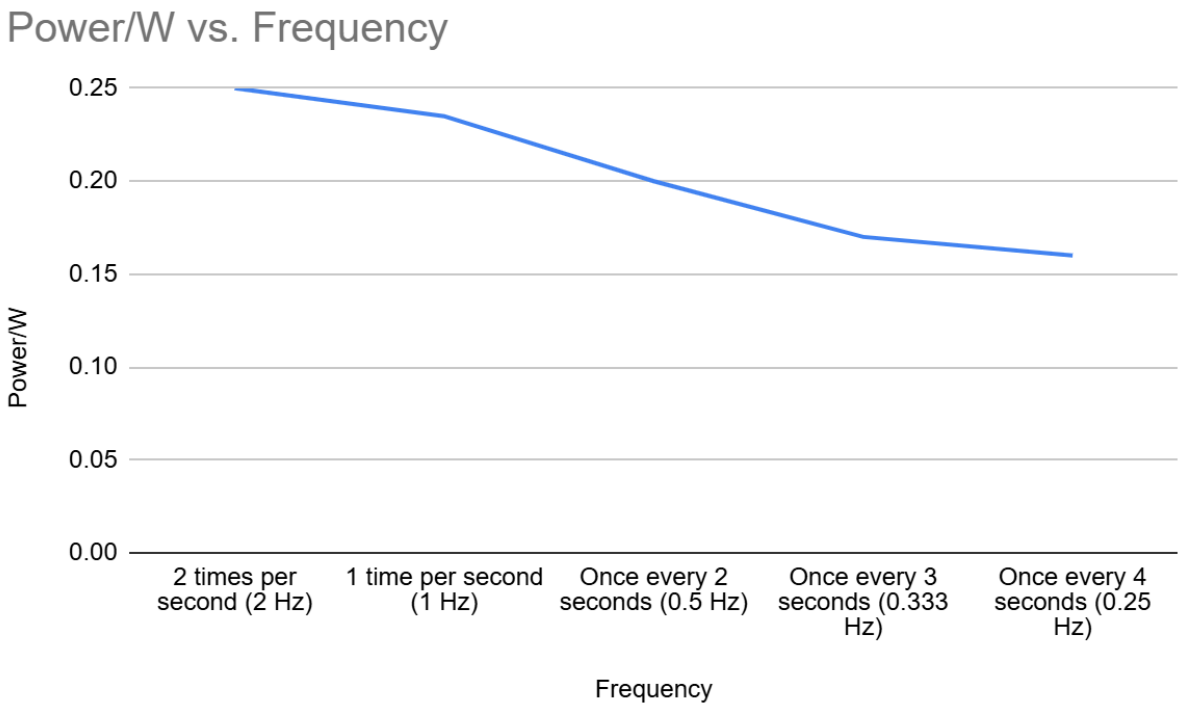
5. Deep Sleep mode
   Average Current: 1.8mA
   Power consumption: 1.8mA * 5V = 0.009W
   Estimated battery-lasting time: 500mAh/1.8mA=277.7h

Different data transmitting frequency test

I wrote a code to send data to firebase in different frequencies(each frequency runs 12 seconds) and here's the result plot: It's easy to see different power consumption in different data sending frequencies.



Frequency	Power/W	Current/mA	Time/h
2 times per second (2 Hz)	0.25	50	10
1 time per second (1 Hz)	0.235	47	10.6
Once every 2 seconds (0.5 Hz)	0.2	40	12.5
Once every 3 seconds (0.333 Hz)	0.17	34	14.7
Once every 4 seconds (0.25 Hz)	0.16	32	15.6



From the plot, we can know that when data transmitting frequency decreases, the power will also decrease.

Create your own power-saving strategy

We have learnt that low data transmission frequency and the deep sleep stage consume low power. So I decided to do those changes based what I learnt from the lab:

- Lower the data transmitting frequency from 1s to 10s.
- If the measured distance is more than 50cm, let the ESP32 into deep sleep mode for 30s.
- If it keeps measuring, each 12s lets the ESP32 into deep sleep mode for 12s.
- Delete the running process without WIFI connection.

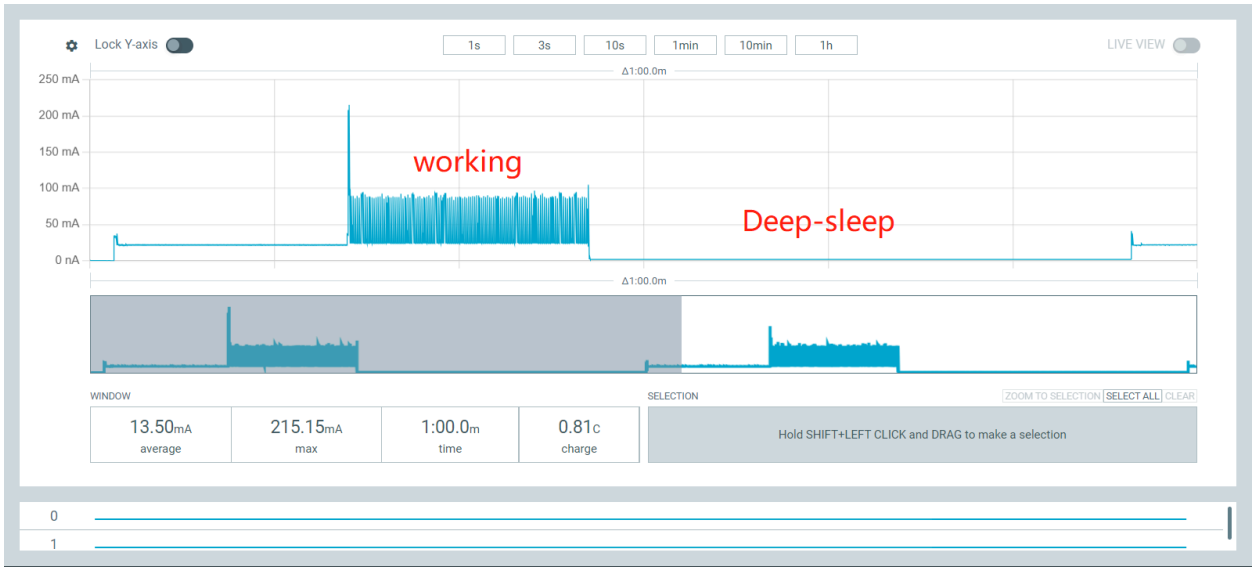
Here's the key changing code:

```
//update the upload frequency to 10 seconds
int uploadInterval = 10000;
```

```
// Now, turn on WiFi and keep measuring
  Serial.println("Turning on WiFi and measuring for 12
seconds...");
  connectToWiFi();
  startTime = millis();
  while (millis() - startTime < STAGE_INTERVAL)
  {
    //not measure distance while connecting to device
    //measureDistance();
    delay(100); // Delay between measurements
  }


//if distance changes more than 50 cm, send data to firebase
  while (millis() - startTime < STAGE_INTERVAL)
  {
    float currentDistance = measureDistance();
    if (abs(currentDistance - lastDistance) > movementfilter) {
    sendDataToFirebase(currentDistance);
    lastDistance = currentDistance;
  }
    else{
    // Go to deep sleep for 30 seconds
    Serial.println("Going to deep sleep for 30 seconds...");
    WiFi.disconnect();
    esp_sleep_enable_timer_wakeup(sleepDuration * 1000); // in
microseconds
    esp_deep_sleep_start();
    }
    delay(100); // Delay between measurements
  }
```

Here’s the results:



Estimated battery-lasting time: 500mAh/13.5mA=37h > 24h

Github link: https://github.com/liiilyqin/514Lab5-battery