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ESP32 Audio Sensor Debugging Journal

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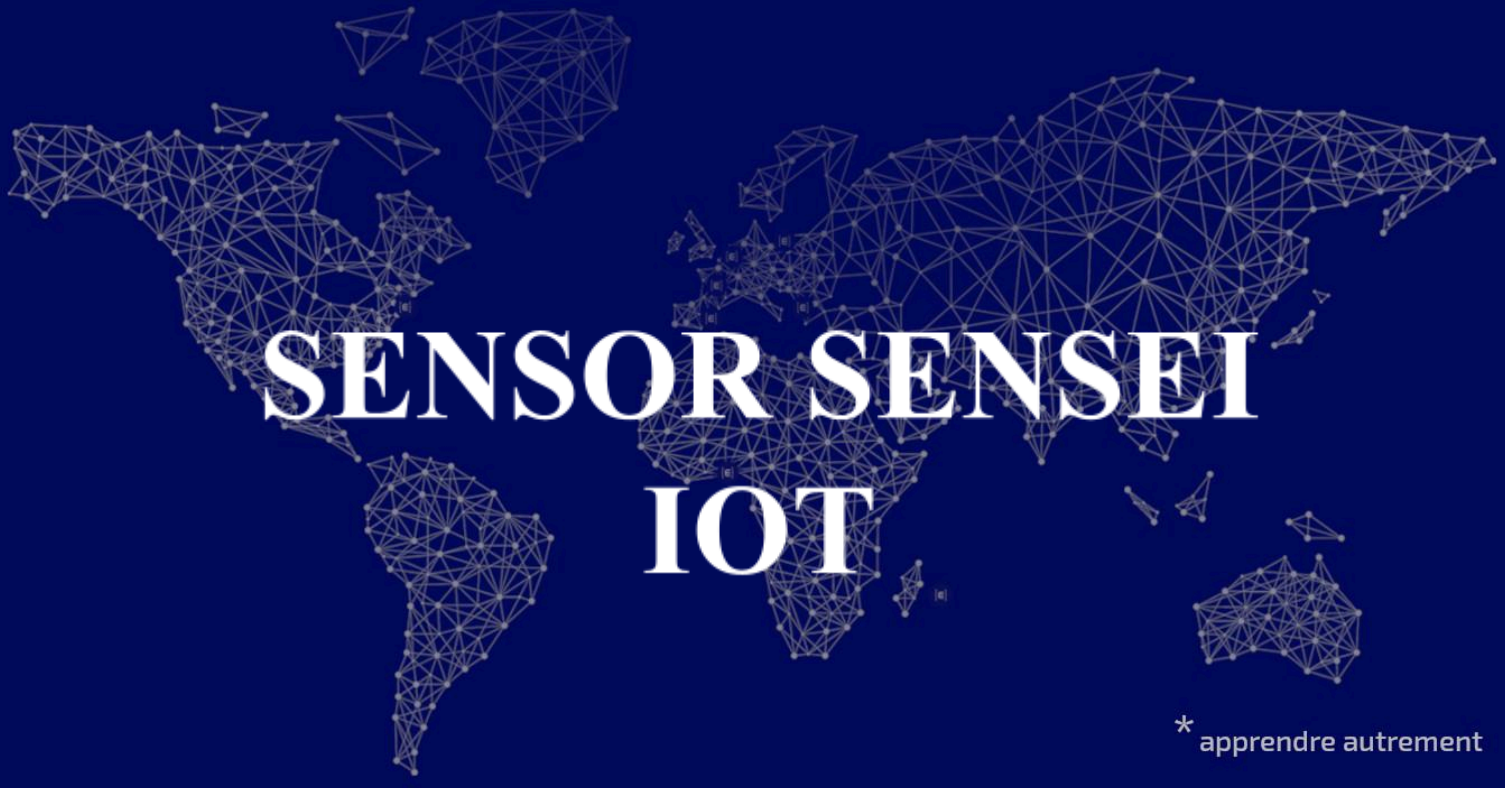

SENSOR SENSEI IOT

* apprendre autrement

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Problems Identified

I've observed unstable and inconsistent readings from the audio sensor connected to the ESP32. Values sometimes seem stuck in abnormal ranges or fluctuate excessively without apparent reason.

Debug Log Analysis

The ESP32 debug log shows concerning patterns:

```
I (355) SOUND: Test de lecture ADC sur 3 secondes...
I (355) SOUND: Lecture ADC #1: 4095
I (465) SOUND: Lecture ADC #2: 4095
...
I (765) SOUND: Lecture ADC #5: 0
...
I (1765) SOUND: Lecture ADC #15: 0
I (1865) SOUND: Lecture ADC #16: 0
...
```

The sensor readings are showing binary behavior - either maxed out (4095) or zero (0):

- 25 out of 30 readings were at maximum value (4095)
- 5 out of 30 readings were at minimum value (0)
- No readings fell in between these extremes

These values indicate the sensor is not functioning properly:

- A reading of 4095 means the ADC is maxed out (12-bit ADC, 2^12-1 = 4095)
- A reading of 0 means no voltage detected
- The complete absence of intermediate values suggests a connection issue or hardware fault

Debugging Tests Performed

1. Raw Reading Verification

I used the `sound_read_raw()` function to directly examine the unprocessed data from the sensor. The values showed an unusual binary pattern - either completely saturated (4095) or zero (0), with nothing in between.

2. Filtered Value Analysis

When using `filter_adc_reading()`, I found that this function often returned `-1.0f`, indicating an insufficient number of valid readings. This is consistent with the highly unstable readings jumping between extremes.

3. Moving Average Testing

Even the `apply_moving_average()` function couldn't properly smooth these readings since they're jumping between maximum and minimum values with no transition.

Likely Hardware Issues

Based on the debug logs, the most likely issues are:

1. **Loose or intermittent connection** - The sudden drops to zero followed by returns to maximum suggest a connection that's making and breaking contact

2. **Short circuit** - The predominance of maximum readings (4095) could indicate a short circuit in the sensor wiring
3. **Sensor power issues** - The pattern could result from unstable power to the sensor
4. **Defective sensor** - The sensor itself may be damaged

Calibration Questions

Calibration Procedure

Given the current binary readings (0 or 4095), calibration isn't possible until the hardware issues are resolved. Once fixed, I need to determine the optimal values for constants like `MIN_VALID_READING`, `MAX_VALID_READING`, and `ADC_FILTER_THRESHOLD`.

Parameter Adjustment

How can I adjust the `MOVING_AVG_SIZE` parameter to get a good balance between responsiveness and signal stability once the hardware is working correctly?