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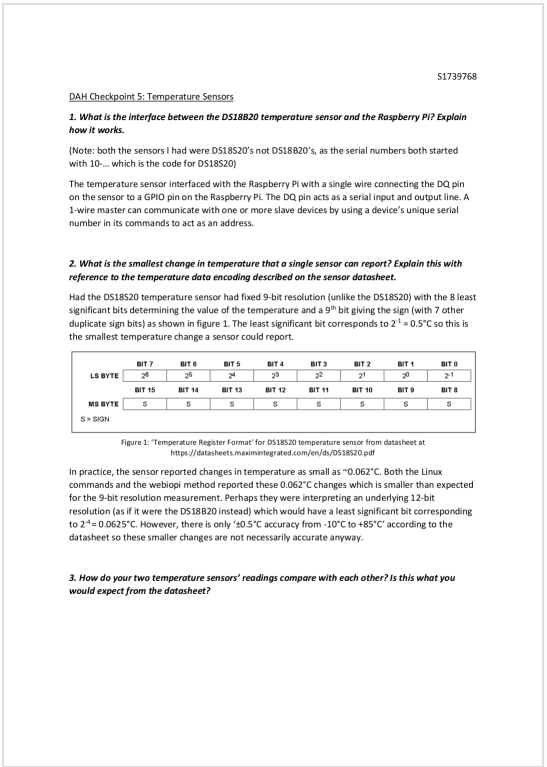

S1739768

DAH Checkpoint 5: Temperature Sensors

***1. What is the interface between the DS18B20 temperature sensor and the Raspberry Pi? Explain how it works.***

(Note: both the sensors I had were DS18S20's not DS18B20's, as the serial numbers both started with 10-... which is the code for DS18S20)

The temperature sensor interfaced with the Raspberry Pi with a single wire connecting the DQ pin on the sensor to a GPIO pin on the Raspberry Pi. The DQ pin acts as a serial input and output line. A 1-wire master can communicate with one or more slave devices by using a device's unique serial number in its commands to act as an address.

***2. What is the smallest change in temperature that a single sensor can report? Explain this with reference to the temperature data encoding described on the sensor datasheet.***

Had the DS18S20 temperature sensor had fixed 9-bit resolution (unlike the DS18S20) with the 8 least significant bits determining the value of the temperature and a 9th bit giving the sign (with 7 other duplicate sign bits) as shown in figure 1. The least significant bit corresponds to $2^{-1}$ = 0.5°C so this is the smallest temperature change a sensor could report.

| | BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|---|---|---|---|---|---|---|---|---|
| LS BYTE | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ | $2^{-1}$ |
| | **BIT 15** | **BIT 14** | **BIT 13** | **BIT 12** | **BIT 11** | **BIT 10** | **BIT 9** | **BIT 8** |
| MS BYTE | S | S | S | S | S | S | S | S |

S = SIGN

Figure 1: 'Temperature Register Format' for DS18S20 temperature sensor from datasheet at https://datasheets.maximintegrated.com/en/ds/DS18S20.pdf

In practice, the sensor reported changes in temperature as small as ~0.062°C. Both the Linux commands and the webiopi method reported these 0.062°C changes which is smaller than expected for the 9-bit resolution measurement. Perhaps they were interpreting an underlying 12-bit resolution (as if it were the DS18B20 instead) which would have a least significant bit corresponding to $2^{-4}$ = 0.0625°C. However, there is only '±0.5°C accuracy from -10°C to +85°C' according to the datasheet so these smaller changes are not necessarily accurate anyway.

***3. How do your two temperature sensors' readings compare with each other? Is this what you would expect from the datasheet?***