

ZEIT4230 Engineering Design Practise (z3419283 - Alex Gee)

Obstacle Detection System - Hardware Component Decision Analysis:

1 Sensors

1.1 TMP36 Temperature Sensor - Future Purchase (if required for error minimisation to meet limits or for optimisation purposes)

Requirement AVS-0D-02, the Obstacle Detection System shall detect obstacles within range to an accuracy of $\pm 24\text{cm}$ in order to allow for rounding to the correct grid reference. If this is requirement not initially met, or for other optimisation reasons to be determined, a higher level of accuracy may be required.

As discussed in the Theoretical Overview document, the speed of sound varies with different temperatures and humidities. To minimise this effect and allow the system to be accurate in a larger range of environments an on-board temperature and humidity sensor can be added to accommodate for this.

Table 1 below shows the range available at Core Electronics and compares them based on accuracy and cost.

Sensor	Accuracy ($^{\circ}\text{C}$)	\approx Error at 400cm	Cost	Notes
DHT22	± 0.5	± 0.35	\$13.18	Temperature and humidity
DHT11	± 2	± 1.41	\$5.80	Temperature and humidity
TMP36	± 2	± 1.41	\$2.18	
LM35DZ	± 0.4	± 0.28	\$3.40	Supply Voltage: 4V - 30V

Table 1: Temperature Sensor Options [2], [1], [3], [4], [5]

Humidity: While the DHT22 and DHT11 sensors can measure the humidity, the effect of humidity in comparison to temperature is relatively small, and there is also no simple relationship between humidity and speed of sound. As such the humidity sensing part of these two is irrelevant in comparisons.

Accuracy/Error: As can be seen based on the accuracies, all of the sensors are able to produce a relatively small error (to the $\pm 24\text{cm}$ requirement) at the max range of the HC-SR04 sensors (i.e. under 2cm). This means that all four sensors are viable.

Cost: The cost of the DHT22 is relatively large compared to the overall budget of \$150 (almost 10%), while the TMP36 and LM35DZ offer the same or better accuracy than the DHT11 for a smaller price leaving them as the finalists.

Final Choice (budget-allowing) - LM35DZ

For a 33% cost increase (from $\approx \$2 \rightarrow \3) the LM35DZ offers a 75% accuracy increase and hence is the final choice (assuming the budget allows for the extra \$1 at the time of purchase).

References

- [1] Liu, T Core Electronics, accessed 20 March 2018, <<https://core-electronics.com.au/attachments/DHT22.pdf>>
- [2] Aosong Electronics, accessed 20 March 2018, <<https://akizukidenshi.com/download/ds/aosong/DHT11.pdf>>
- [3] National Semiconductor, accessed 20 March 2018, <<http://www.futurlec.com/Linear/LM35DZ.shtml>>
- [4] Analog Devices, Core Electronics accessed 20 March 2018, <http://dlnmh9ip6v2uc.cloudfront.net/datasheets/Sensors/Temp/TMP35_36_37.pdf>
- [5] Core Electronics, accessed 20 March 2018, <https://core-electronics.com.au/search/?fq%5Bcategory%5D=Temperature+%26+Humidity&fq%5Bcategory_id%5D=892&q=%2A%2A>