Atmospheric Sensing on Unmanned Aerial Vehicles

Ligia Frangello
Utah State University
AggieAir

Processed Aerial Imagery by AggieAir

Introduction

AggieAir conducts research using aerial imagery and remote sensing for applications in agriculture. Unmanned Aircraft Vehicles (UAVs) are used to collect images to be further processed.

Currently, during the image processing, the thermal images are corrected by using Vicarious Calibration; which is not cost, area, and time-effective. However, Vicarious Calibration can be substituted by using a Bosch BME280 atmospheric sensor (Figure 1), Modtran, and 6V modeling.

Reasons for using the BME280 sensor:

- Faster image correction
- Cost effective
- Scalable to be used with a bigger set of data
- Ensure adequate atmospheric correction of thermal camera during flight
- Able to monitor weather conditions changes during the flight

Figure 1

Bosch BME280 sensor size comparison to an American Quarter

Methods

Accessing the data from the BME280 sensor required implementing the driver code and writing an Arduino program to collect and display the data.

The testing of the BME280 sensor was done by mounting the sensor next to a Campbell Scientific weather station (Figure 2), and a Teensy IO Board was used to collect pressure, humidity, and temperature from the sensor. The data sets from the sensor and the station was then inserted into an spreadsheet and compared.

Results

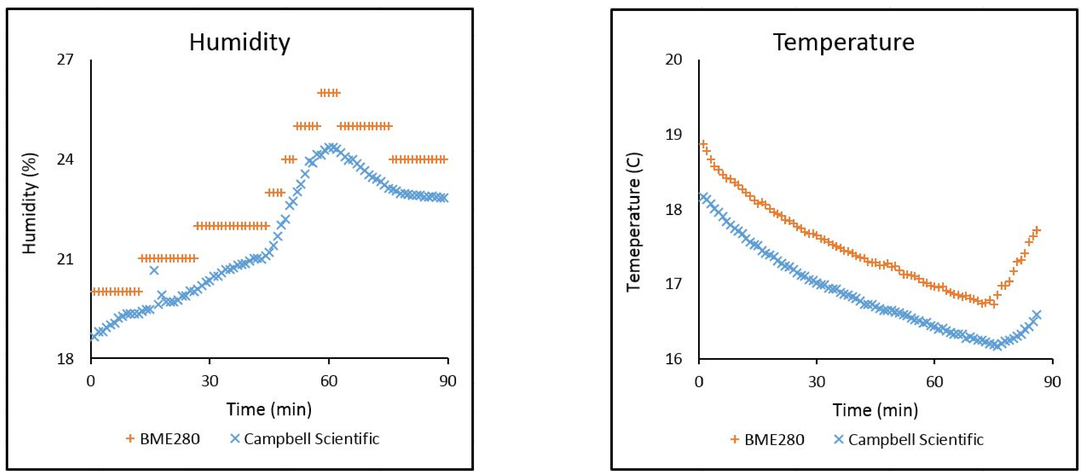
Figure 3 shows a graphical comparison of the pressure and humidity values collected from the weather sensor and station.

Humidity Statistical Index	Value
root mean squared error (rmse)	1.173
mean absolute error (mae)	1.108
coefficient of correlation (r)	0.977
coefficient of determination (d)	0.955

Temperature Statistical Index	Value
root mean squared error (rmse)	0.824
mean absolute error (mae)	0.797
coefficient of correlation (r)	0.971
coefficient of determination (d)	0.942

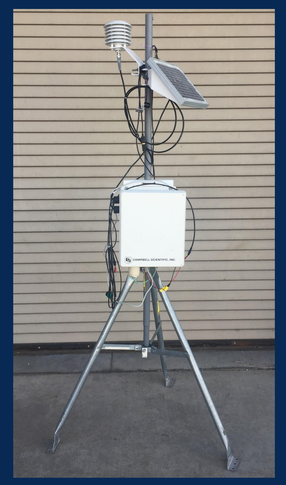
Tables showing error statistics from data collected

Figure 3



Graphical comparison of the pressure and humidity values collected from the BME280 sensor and Campbell weather station over the course of hours.

Figure 2



Campbell Scientific weather station

Conclusions

The humidity data shows a low resolution data collection by the BME280 sensor. The temperature data shows a constant bias error, which it can be easily adjusted.

The data from the sensor has not been used to correct thermal imagery yet, but based on preliminary results, the error margin is acceptable and the BME280 atmospheric sensor will be implemented in a future AggieAir aircraft.

Ligia Frangello
Utah State University
Computer Science
ligiaf@aggiemail.usu.edu