Smart Sensing for Computer Racks

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Goals

- ❑ To provide an economic solution for small- to medium-sized companies in order to benchmark and obtain valuable information regarding the cooling of computer racks
- ❑ To provide secondary measures to increase efficiency in energy consumption for cooling systems such as a gradient warning system visualized by LEDs

Objectives

- ❑ Use MATLAB to provide a meaningful representation of data collected via the Arduino Uno, allowing data centers to successfully analyze heat distribution to increase cooling efficiency

Figure 1. Inlet temperature trend during facility cooling failure

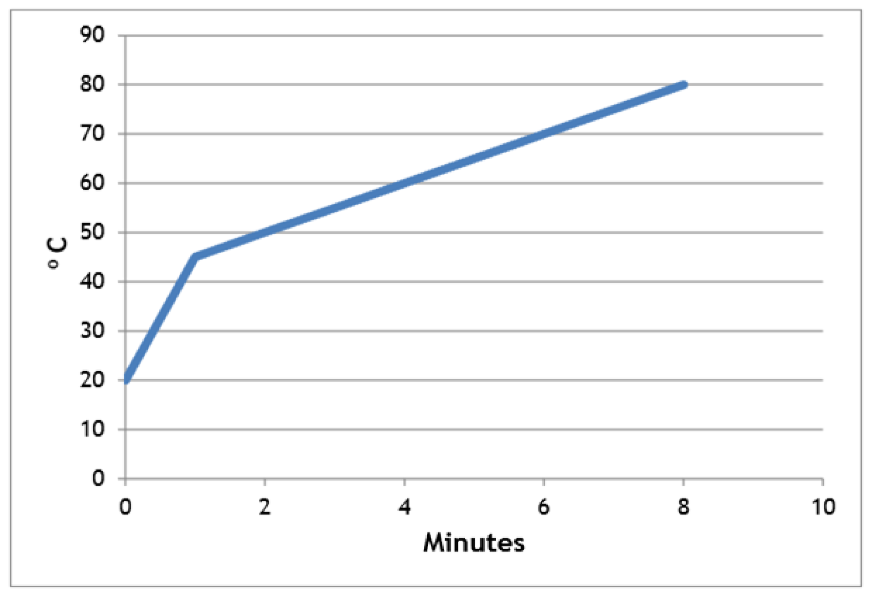
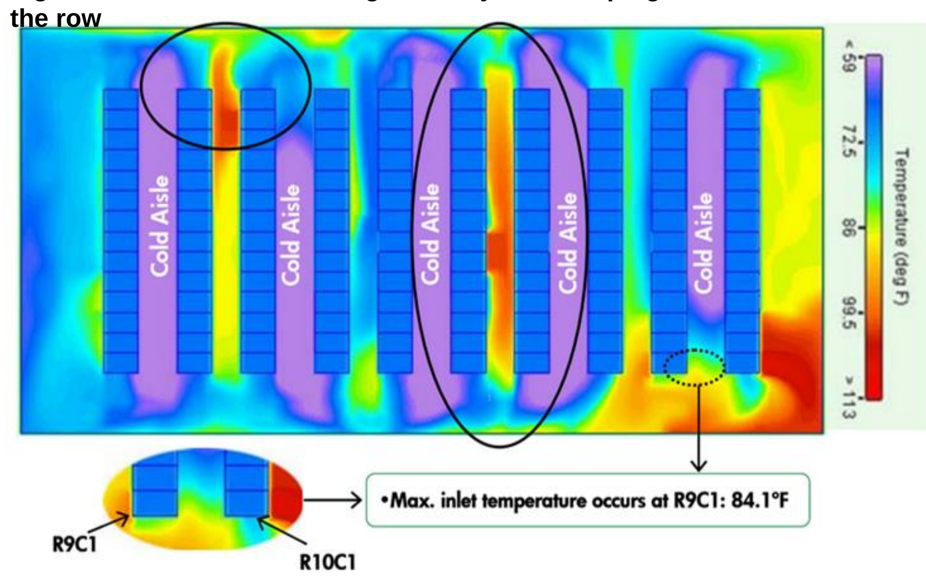
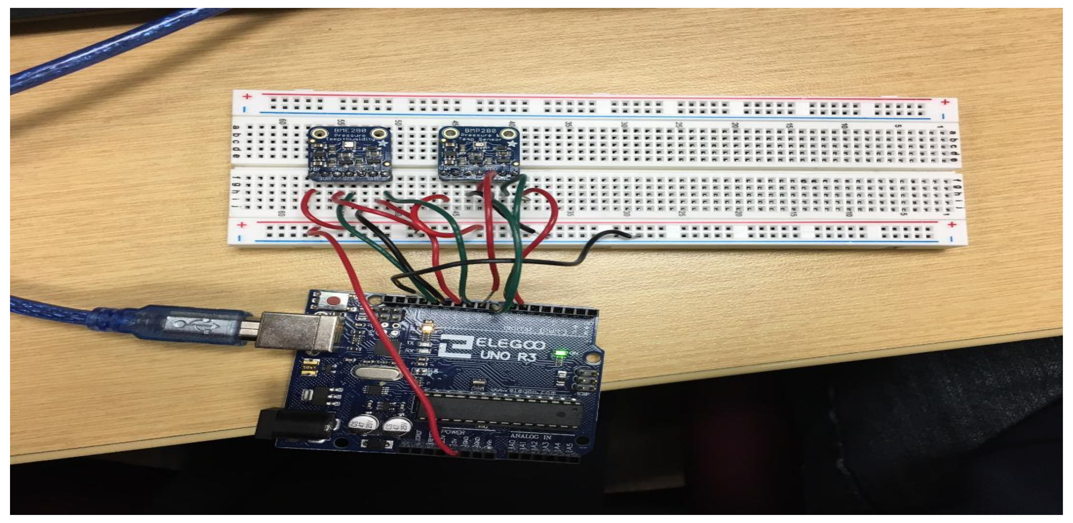


Figure 2. Exhaust from the high-density rack wraping around the end of the row



- ❑ Get an array of sensors, such as the BME280 and the BMP280, to record temperature and humidity



- ❑ Provide an easy-to-follow visual for system engineers to identify the temperature conditions of data centers using LED strips that change color based on fluctuations in the temperature readings

Acknowledgement

We would like to thank Prof. Hana Godrich for her guidance in making this project possible and for her consistent effort in aligning our team's goals and objectives.

Methodology

- ❑ SPI protocol is used to wire the sensors with the Uno; in addition, adafruit libraries are used to implement the code
- ❑ FastLED Library allows for fine control of LED strips, such as color switching, brightness, and number of LEDs to turn on.
- ❑ Develop code in MATLAB to accurately map and depict temperature readings into an understandable temperature vs time graph
- ❑ Develop wireless communication interface between MATLAB and Arduino.

Steps

1. Sensor arrays are used to observe the temperature and humidity inside computer racks, which are then recorded to a log file.
2. The recordings are passed to a MATLAB script which processes the previously obtained data in a moving average filter. In addition, these are sent to a website and database to be displayed.
3. If the temperature crosses a threshold, the LEDs promptly change color and brightness to alert system engineers.

Results

- ❑ Figure 4 shows simulations of a computer rack heating curve, from two BME280 sensors, during peak conditions with closed air flushed onto the rack from the top.

Figure 4. Simulations of a heating curve

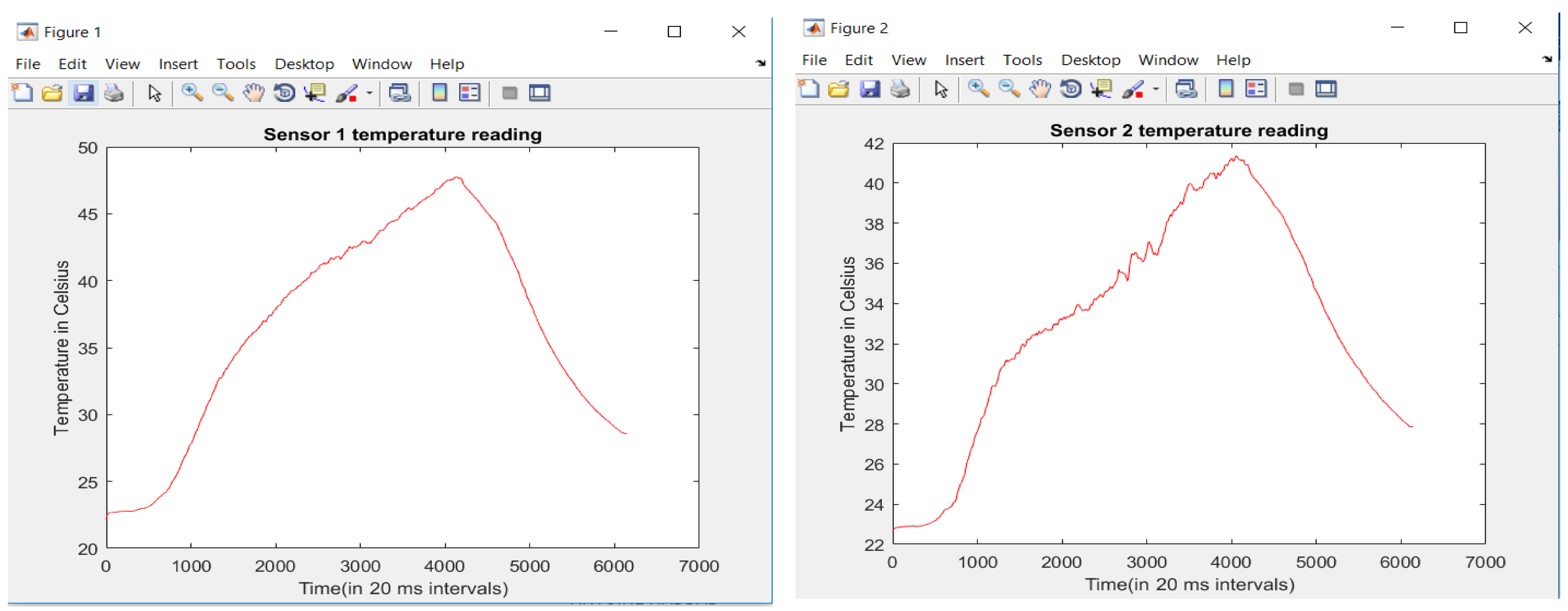


Figure 3. Temperature and humidity readings from BME280 sensors

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Temperature of sensor 1 = 22.28 *C
Pressure of sensor 1 = 1010.53 hPa
Approx. Altitude of sensor 1 = 22.55 m
Humidity of sensor 1 = 34.80 %

Temperature of sensor 2 = 22.61 *C
Pressure of sensor 2 = 1012.86 hPa
Approx. Altitude of sensor 2 = 3.29 m

Temperature of sensor 1 = 22.31 *C
Pressure of sensor 1 = 1010.50 hPa
Approx. Altitude of sensor 1 = 22.89 m
Humidity of sensor 1 = 34.70 %

Temperature of sensor 2 = 22.63 *C
Pressure of sensor 2 = 1012.85 hPa
Approx. Altitude of sensor 2 = 3.28 m

Temperature of sensor 1 = 22.33 *C
Pressure of sensor 1 = 1010.52 hPa
Approx. Altitude of sensor 1 = 22.76 m
Humidity of sensor 1 = 34.73 %

Temperature of sensor 2 = 22.64 *C
Pressure of sensor 2 = 1012.86 hPa
Approx. Altitude of sensor 2 = 3.53 m
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References

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