Utilizing Infrared Sensors for Thermal Comfort

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Introduction & Objective

Heating, Ventilation and Air Conditioning (HVAC) systems commonly use fixed points set by few standards, which automatically assume that all people have the same requirements for thermal comfort. In this way, not only are people inaccurately comfortable, but buildings then consume large amounts of energy to operate HVAC systems at these estimated points.

In our lab, we sought to discover the variations required for thermoregulation through the usage of non-invasive thermal sensors. Both environmental and physiological measurements of a person needed to be closely monitored; assessing these measurements allows the operation of HVAC systems to accurately fit the thermal comfort of individuals and cut the energy usage within buildings.

Figure 1. HVAC system in commercial building
Cr: ecee.colorado.edu

Acquired Skills

- Learned the coding mechanisms and fundamentals to operate Arduino platform
- Building sensors through the usage of the Arduino platform to collect data necessary
- Fundamentals of physics for electric circuits
- Soldering wires and pins
- Assessing human test subjects
- Analyze data

Methodology

Sensor setup

For the experiment, I was in charge of making the sensors that would be used to determine the variations of temperature, humidity, and pressure of the environment surrounding the participant. The BMP280 sensors determined the temperature and pressure while the DHT22 sensors determined the temperature and humidity of the area around the participant. Measuring these variables was crucial to the accuracy of determining the thermoregulation of the participant through identifying the area around him/her.

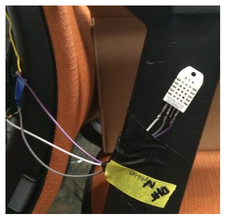

Figure 2. DHT22 1

Figure 3. DHT22 2

Figure 4. BMP280 sensors

Stemming from the Arduino for power and connection to the code, a multiplexer (TCA9548a) was used in order to connect all of the sensors.

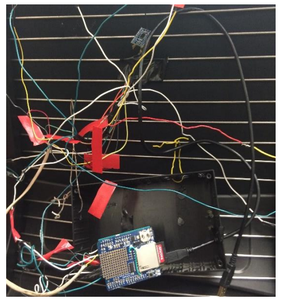

Figure 5. Multiplexer and Arduino connections

The sensors were placed on a chair in areas that would be close enough to collect data of the area close to the participant, but not so close that it may interfere with their movement and everyday procedures.

Results

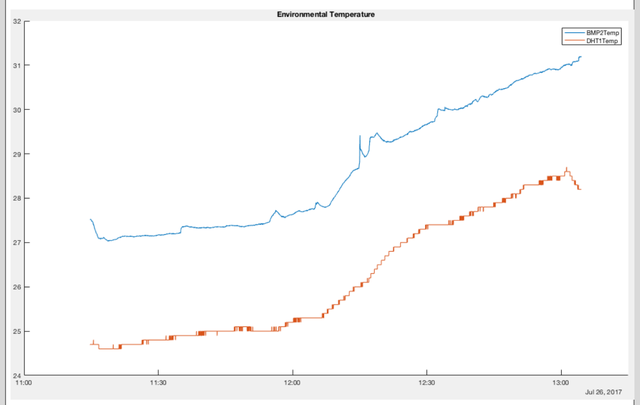

Figure 6. Temperature Results

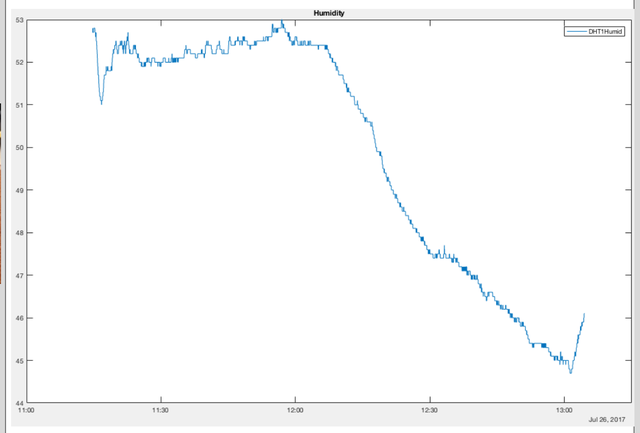

Figure 7. Humidity Results

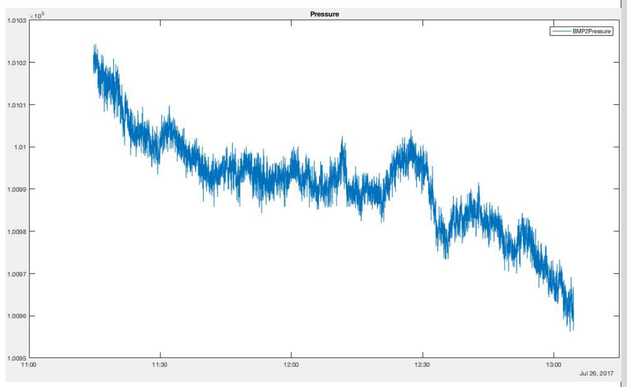

Figure 8. Pressure Results

Relation to STEM Coursework & Future Work

I learned how to work with the Arduino platform throughout this experience. Additionally, I was able to learn how to assemble wires with solder while learning essential problem-solving skills. Throughout the time of this program, I was able to learn more about the civil engineering aspect of solving everyday problems and more about the field in general. I explored and gained a deeper understanding of the importance of managing thermoregulation in buildings and its effect in the environment and the future. Through learning how to utilize various types of sensors and successfully create an experiment that helps to determine thermal comfort, I now obtain a better understanding of what it takes to work in the field of engineering and STEM in general.

Acknowledgements

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