Using Simulation Tools and IoT Data to Predict Fire Spread

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Abstract

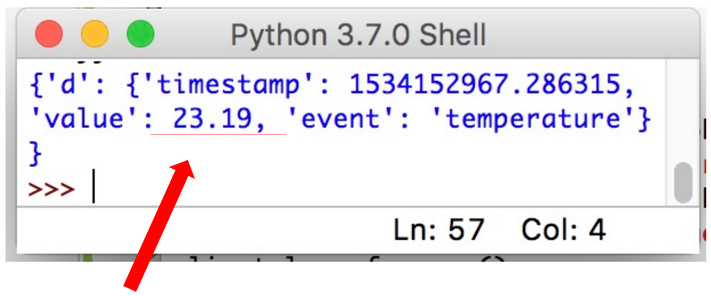
Although high-rise buildings are being built with fire-resistant construction, they are still prone to fire spread (Ahrens). This project focuses on helping solve that problem by using Raspberry Pis and sensors to detect fire in high-rise buildings and predicting how the fire will spread.

Implementation

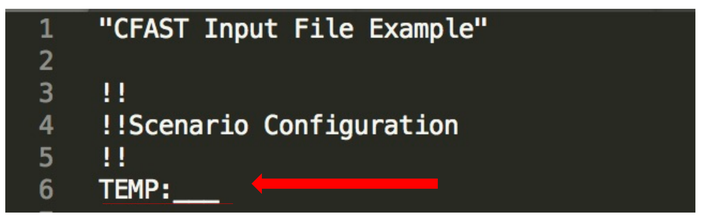
Smart Community Alerting Network (SCALE) boxes are Raspberry Pis with sensors attached to them for monitoring air quality and other environmental factors. SCALE boxes collect and send data to a broker via MQTT—a machine-to-machine connectivity protocol with a publisher, broker, and subscriber (*MQTT.org*). The broker receives the data from SCALE boxes and sends it to subscribers, (local machines). The local machine parses the data and looks for information, (such as high levels of smoke), which indicate a fire might have occurred in the building. If there is any triggering data, then the information gets sent to an input file to be used for CFAST—a computer program that can be used to simulate the impact of fires in a building *(NIST).* CFAST requires different information in order to run, such as the temperature of the building and dimensions of the rooms. The floor plans and dimensions already exist in the input file, however, information on the temperature and smoke levels do not, and are automatically put into the CFAST file. CFAST then gives an output of what the fire might look like and how it might spread in the time period specified by the user.

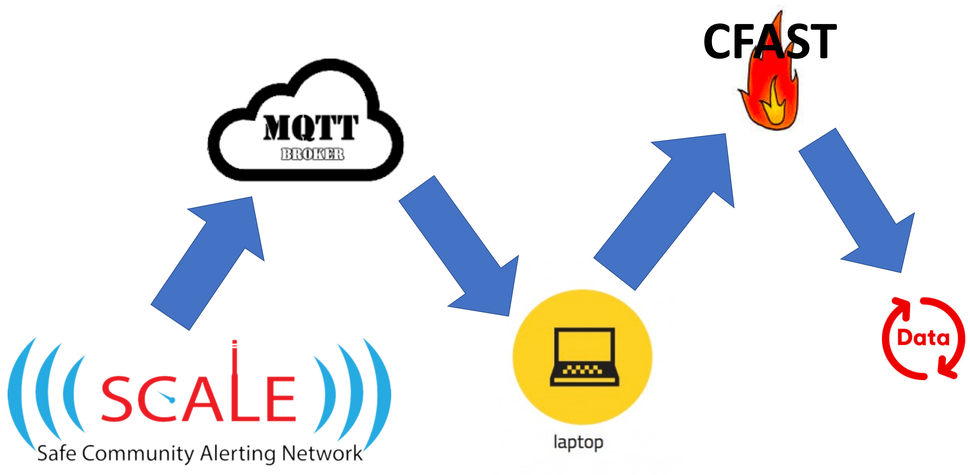
Results

The temperature and smoke thresholds of the SCALE boxes in Donald Bren Hall were lowered and, consequently, triggered the software to begin running in normal conditions. The software took the information from the SCALE boxes, (which it received through the MQTT broker), and used them as inputs for the CFAST software. CFAST then gave data on how the simulated fire would spread in the room and expand to other locations in DBH in a certain period of time.



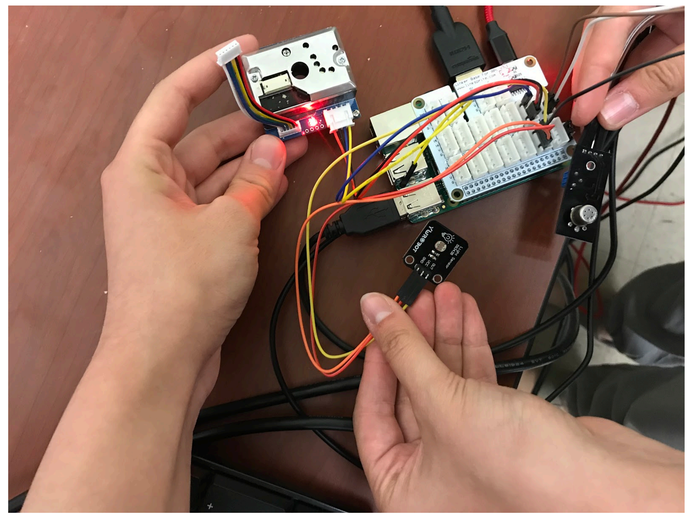
The temperature value printed on the Python Shell (which comes from SCALE Boxes) is automatically used as an input for TEMP (temperature value) for the CFAST input file





Conclusion

The software recognizes the threshold for fire and automatically runs CFAST. However, CFAST requires accurate coordinates of the fire in the room, but the software currently cannot give the coordinates. Work needs to be done to finish implementing this feature.



A SCALE Box with a dust and two light sensors

References

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Acknowledgements

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