IOT Temperature Monitoring Application Final Report

Ahmed Haroun
3rd Year Electronic Engineering Student at the University of Sheffield

The project aim was to build a wireless temperature sensor using LORAWAN to be used in the Tinsley Bridge site. There are various pieces of machinery, quench tanks, and enclosure onsite, and the aim was to build a sensor which can be easily fitted into all these different places freely. The main aim is to maintain the equipment by being more efficient in terms of costs and time, as well as providing a quicker fault detection method. As the likelihood of failure for electrical systems which have had preventive maintenance is three times lower than those which did not.

Initially, a comparison has been made on the sensor technology available. At Tinsley Bridge, the ds18b20 sensor was being used in quench tanks which is a waterproof probe sensor and is currently not wireless. This provided an estimate on the range, accuracy and readings required. I ended up using the BME 280 sensor at home, which gives out temperature, pressure and humidity readings and is relatively very small which would be more practical with its placement.

Due to the lack of a LORA device initially, WIFI was used instead to test the idea. The Wemos D1 Mini ESP8266 is a standalone board which supports WIFI and was initially used in this project. Sensor data was being sent over WIFI and published onto an MQTT broker running using a python script on a Raspberry pi 3. The data was store on Influxdb which is a time series relational database that worked great for this application, the dashboard to display this data was made on grafana. The idea at this stage was to work on the backend so that when LORA starts to be used it can be fairly easy to switch over. The main issue with using WIFI was that there was no connection initially because the network being used was common to all flats in building where I live, and those tend to have large firewalls which are difficult to surpass before a timeout is reached on the chip. Therefore, a Hotspot connection to a smartphone was used and solved the issue.

When the Adafruit feather 32u4 standalone board which has an ATMEGA processor and LORA sx1276 radio on board was recieved, implementing this using LORAWAN became possible. The python script used to run the broker was easily adjusted for use with The Things Network using the Python SDK on TTN website. Initially, for the majority of the internship I was located in Birmingham, which is a relatively flat city with many tall buildings. From my room, I was not able to get a connection to a gateway which was 0.9 miles away (at the most) even after the first node connection. The building which had the gateway was at a very similar altitude to my home, and located at ground level. However, after moving back to Sheffield I was able to get a connection to a gateway (about 0.8 miles away, and at an altitude of 150m) from the first end node connection to the gateway. The same storage and display methods were being implemented as with WIFI.

The main thing I believe I would have done differently is trying to acquire a LORA mapper early on, because I came to realize that troubleshooting my end node is very difficult. As after running the code on the board and not getting anything, I was not sure if the issue was with the external pin mapping I had to do, a bug in my code, or the fact that I was not in range of a gateway at all. So, having a mapper definitely saves time and frustration.

Useful Links:

1. https://www.thethingsnetwork.org/docs/applications/python/api-reference.html
2. https://appcodelabs.com/introduction-to-iot-build-an-mqtt-server-using-raspberry-pi
3. https://www.docker.com/blog/happy-pi-day-docker-raspberry-pi/
4. https://grafana.com/tutorials/install-grafana-on-raspberry-pi/#3