Building an IoT platform for remote monitoring of field applications using Sigfox LPWAN

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Introduction

- Currently, the irrigation of landfill remediation fields is done using water trucks, which incurs high water cost.
- Figure 1 shows the Hendra landfill remediation site with the developed IoT system installed. The total cost of the turf used on this area is around $190,000 and it takes $5000 to water it for one day.
- This project aims to design, build and test an IoT platform that can be used to monitor field applications Brisbane City Council (BCC) has at remote locations.

Figure 1: Hendra landfill remediation site

Methodology and Results

The field unit shown in Figure 2(a) comprises the developed IoT solution and a soil moisture probe. The AquaCheck sub-surface soil moisture probe is a capacitance based continuous logging probe with four pairs of soil moisture and temperature sensors distributed evenly along its shaft and communicates via SDI-12 (serial data interface, 1200 baud).

(a) (b)

Figure 2: The field unit

(a) The field unit comprises the IoT solution and a SDI-12 soil moisture probe. (b) The components of the IoT solution.

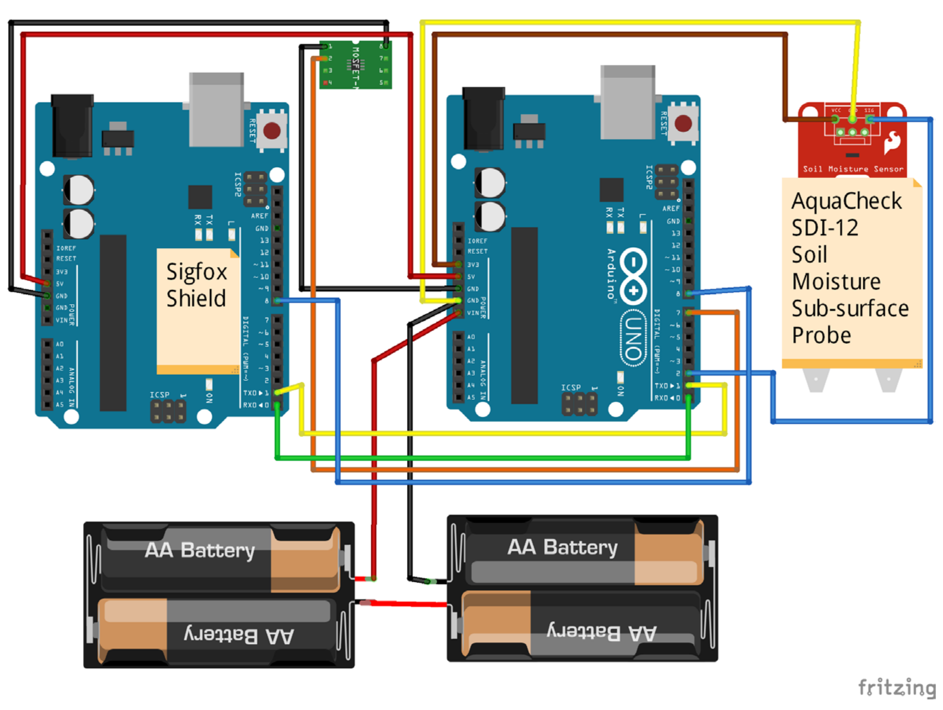

Figure 3: The wiring schematic of the components of the IoT solution

The components of the IoT solution as seen in Figure 2(b) include the Arduino Uno clone board and the Sigfox shield of the Thinxtra Xkit development kit, a dual N-channel MOSFET, an antenna and two rechargeable 2600mAh 3.7V Li-Ion batteries; the connection of them is illustrated in Figure 3. The total cost of this developed IoT solution is around $70 excluding batteries.

The software programs were written using the Arduino IDE and made use of the Sigfox serial library and AVR low power libraries. The current configuration sets the field unit to send two Sigfox messages containing soil moisture and temperature data every hour; the batteries are estimated to last about 36 days with this configuration.

The Sigfox messages sent by the IoT solution are received by Sigfox base stations and stored in the Sigfox backend; from here, the messages are posted to a free IBM cloud platform and a web user interface has been set up using the Node-RED IoT flow presented in Figure 4. The user interface seen in Figure 5 can display both real-time data and historical data stored in a database. The link to this user interface is: http://xkit-2c5ca8.mybluemix.net/ui/.

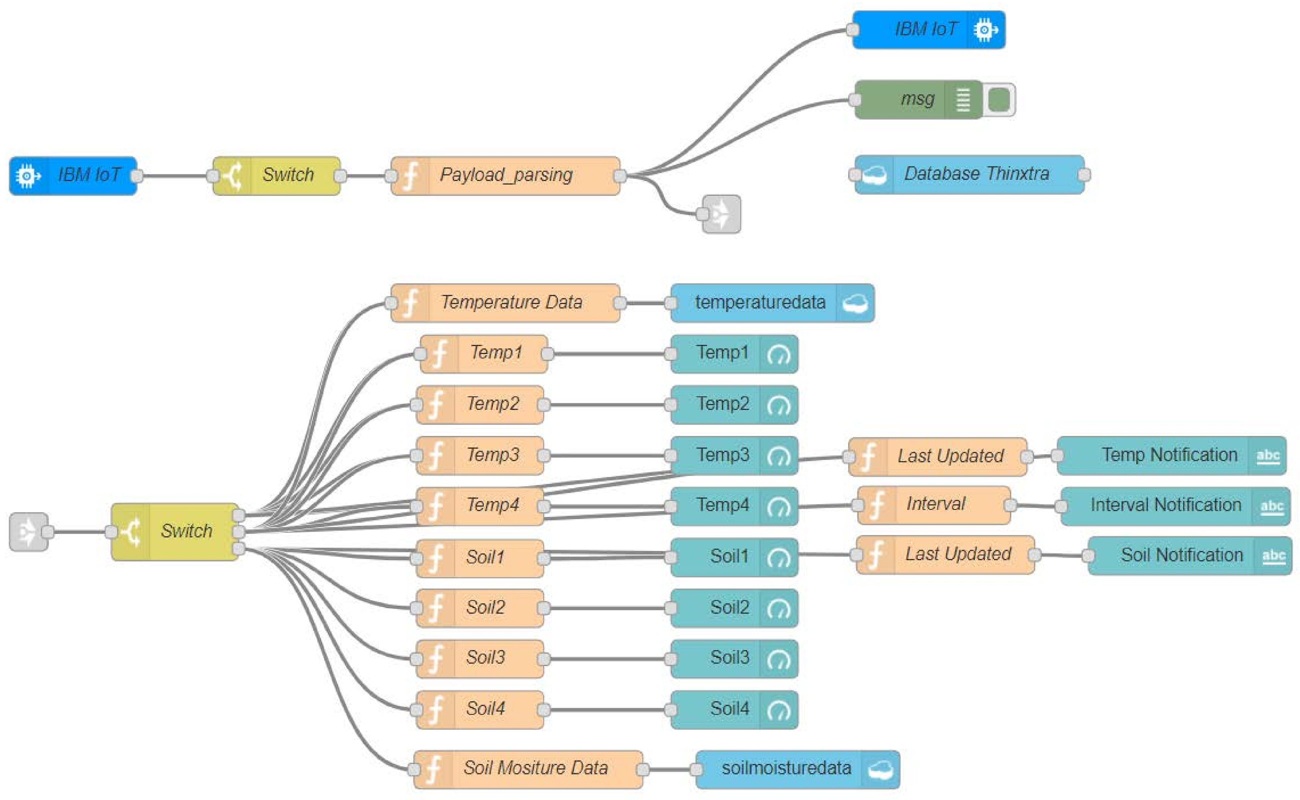

Figure 4: The Node-RED IoT flow

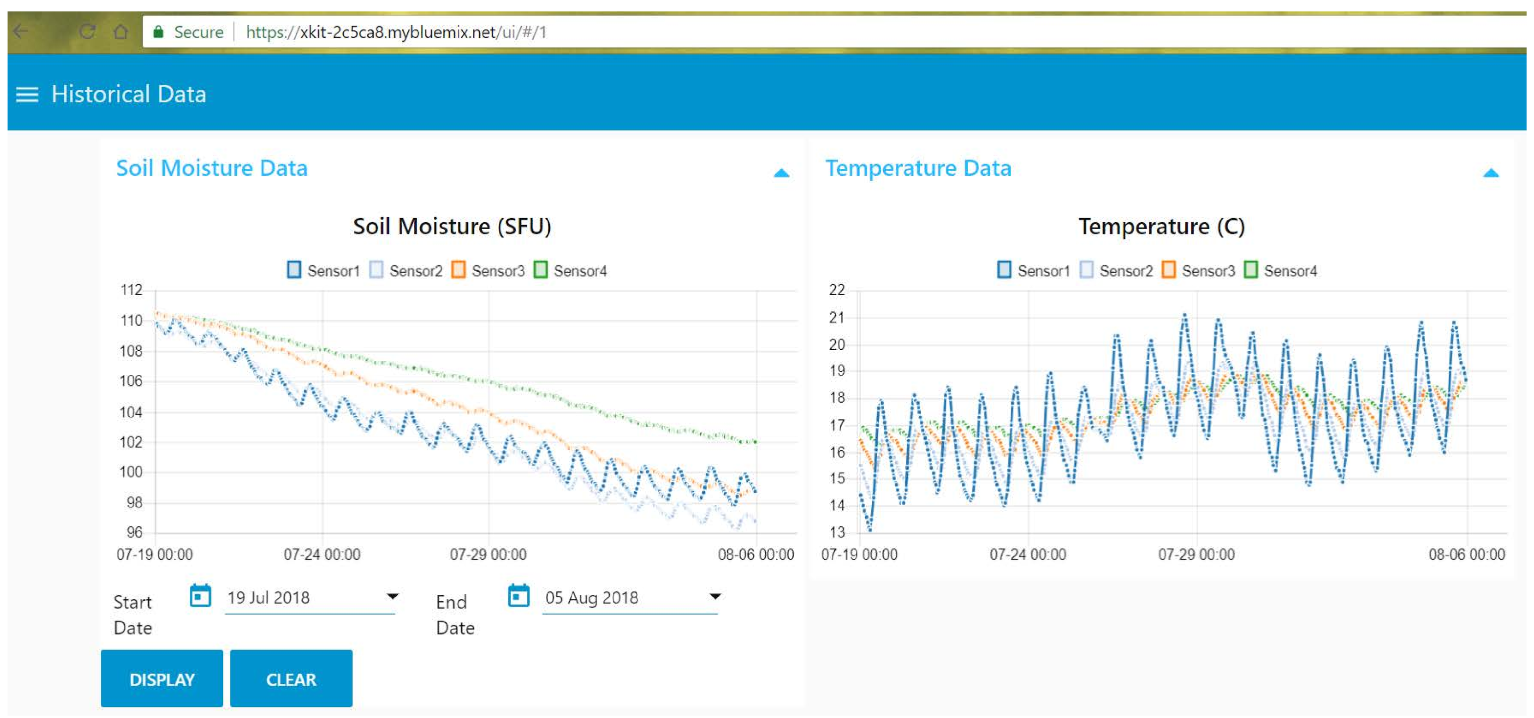

Figure 5: The web user interface displaying soil moisture and temperature data collected by the IoT field unit installed at the Hendra landfill remediation site

Conclusion

A simple and cost effective IoT solution has been developed and assembled; the IoT solution is able to interface with sensors through analog, I2C or SDI-12 and send uplink messages using the Sigfox network.
An end-to-end development of an IoT application using the Sigfox network has been implemented. Two field units to monitor soil moisture in the garden and a landfill remediation site respectively have been constructed and deployed.
In the future, a printed circuit board (PCB) that uses a microchip with the Arduino bootloader and highlights low-power features can be designed and manufactured.