Designing A Wireless Sensors Network for Monitoring, Predicting Droughts

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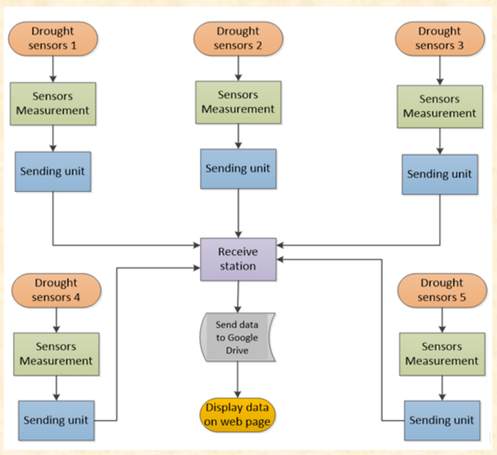
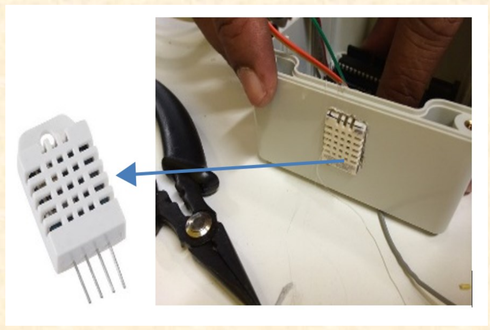
Global warming and lowest of rain were of the most problems that caused to increased drought around the world. In New Zealand, according to National Institute of Water and Atmospheric Research (NIWA) the drought in 2012 and 2013 was the worst for about past 70 years. Therefore there is need for technological intervention to monitor the basic information about the weather, soil condition in order to identify, predict drought conditions. Initial experiments have proved that the developed wireless sensor drought monitoring system was capable of remote real-time monitoring for unattended environment for an extended periods. This monitoring can also help identify drought in the early stages and thereby prompt to take corrective measures to be taken at early stages. Monitoring soil condition is done by using various intelligent sensors in a wireless network. These sensors collect various parameters and then send the pre-processed data wirelessly to a base station. From base station this data was uploaded every two seconds to the cloud (internet) for further analysis, graphing in real time. If a drought condition is identified by the monitoring system then an alert message will be sent to the user via text message or as an email.

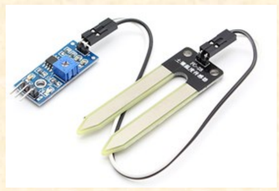
HARDWARE



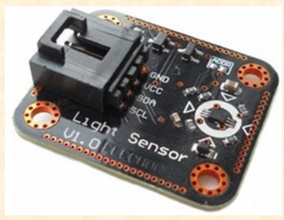
Functional block diagram of wireless drought monitoring system



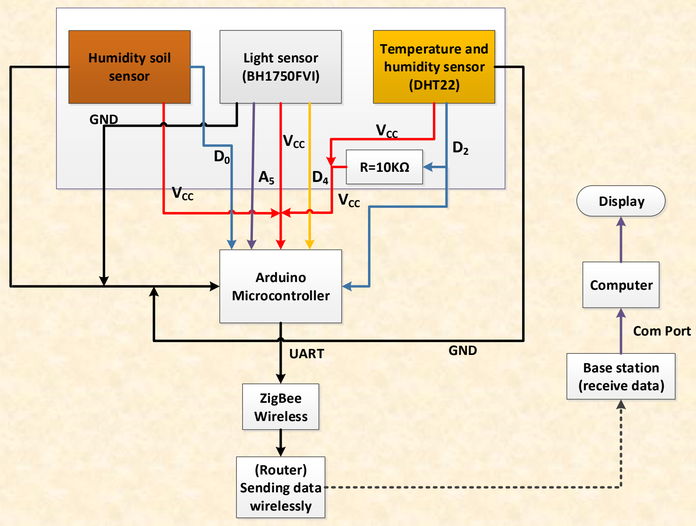
Digital Temperature and Humidity Sensor



Soil Moisture Sensor



Light Intensity Sensor

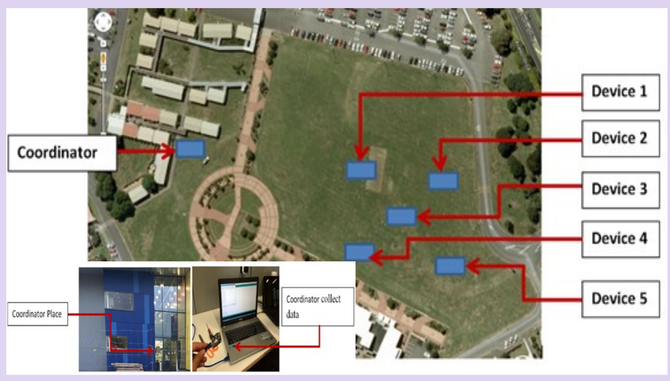


Circuit Block Diagram of Sensor Module

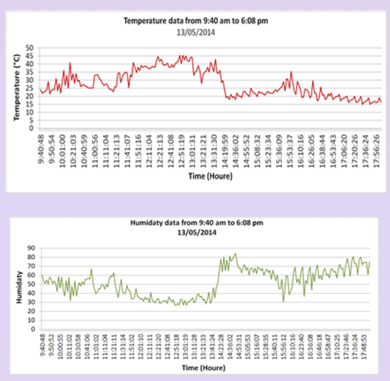
Wireless Drought Monitoring Sensor

EXPERIMENTAL RESULTS

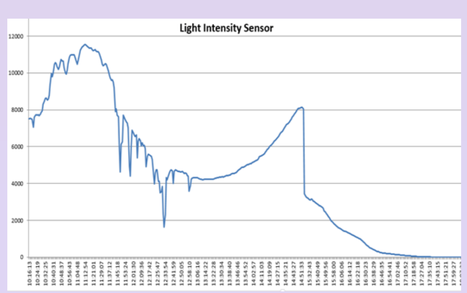
The system has been successfully tested with five wireless sensor units on a farm



Sensor Placement on a farm



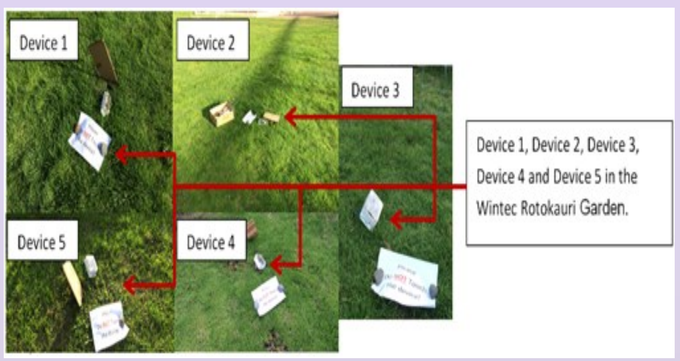
Data from Temperature/Humidity Sensor

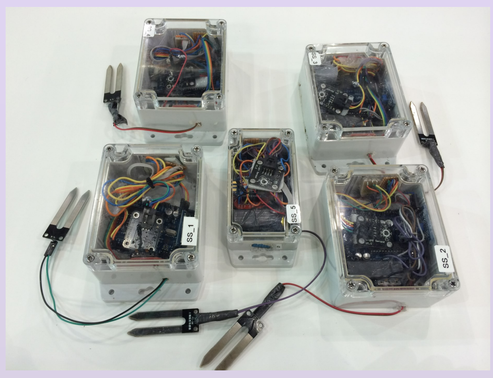


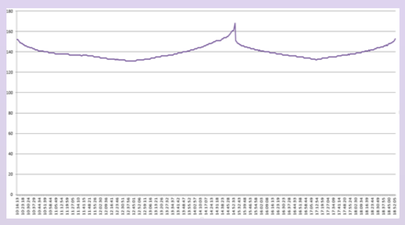
Data captured by light intensity sensor

Sensor ID	Luminance (lux)	Relative Humidity (%)	Ambient Temp (°C)	Soil Moisture
S1	4955	23.8	37.4	721
S2	7538	24.3	37.3	681
S3	4310	29.4	31.9	665
S4	4255	29.9	31.9	159
S5	7526	51.8	22.2	154

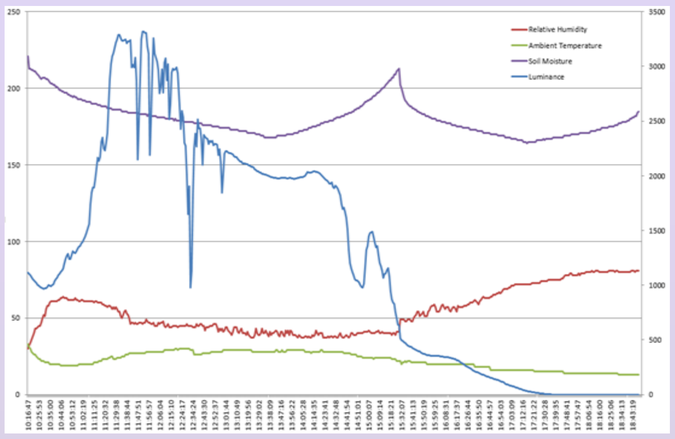
Data packet from sensors send to the Base Station







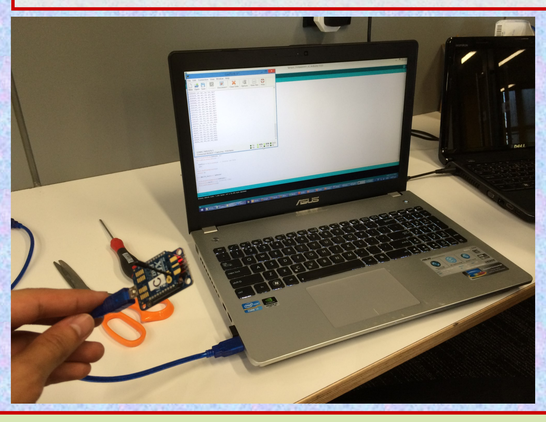
Data from Soil Moisture Sensor

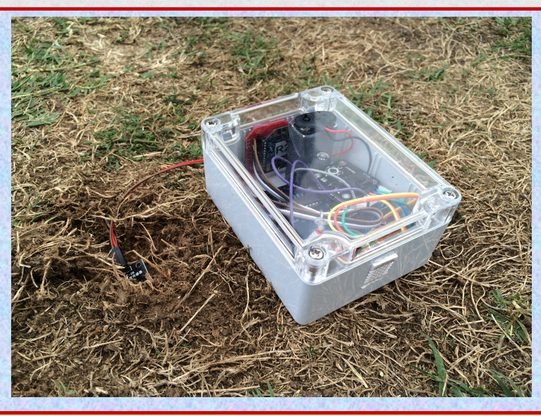


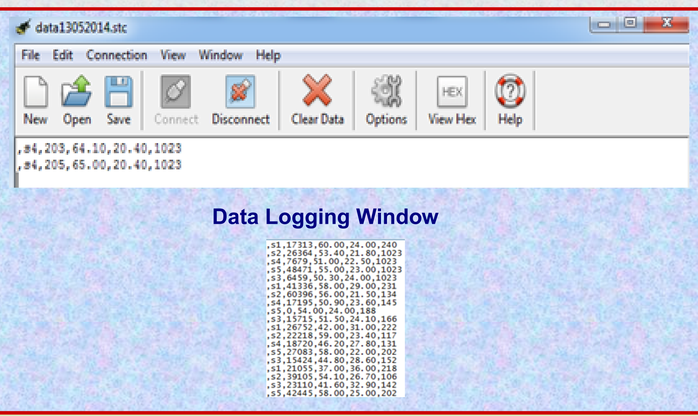
Combined Reading of a Sensor Module plotted on Google® Apps

SOFTWARE INTERFACE—DROUGHT DETECTION

Five drought monitoring wireless units are deployed around a farm. These units continuously monitor the soil then send data to coordinator which is inside the building. Once all the system's hardware is connected, the serial port is opened on the software program. The program initially records and displays the number of sensors in the network. This feature enables us to verify whether all the sensor nodes are communication with coordinator and working properly. Any sensor node failure can be detected and rectified at this stage. We successfully deployed and tested our drought monitoring wireless system that is capable to provide spatially distributed soil/atmospheric data relevant for plant growth. The coordinator software records, displays the data in real time and simultaneously uploads on to Google® Apps. By connecting the system to the internet we can login to the system and get real time soil/atmospheric data faraway on any mobile device with internet connection.







Data Logging Window

Data Being Displayed on a Mobile Device

Summary: The work described here is preliminary but demonstrates that smart, simple sensor devices can be used to monitor and predict drought. This wireless sensor network based drought monitoring system was developed, successfully works and it can monitor four different soil/atmospheric parameters. Once the data is captured it is recorded and displayed on Google Apps to be accessed by the user from anywhere.

Further research could include looking at integrating a GPS sensor and a sensor to detect soil salinity in each wireless sensors unit. By gather the data over time, a pattern can be formulated which can help us to not only to identify drought but also predict future droughts.