Distributed Mesh Sensor Network using Raspberry Pi's.

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Introduction

The Internet Of Things (**IoT**) is an ever growing market with **ZigBee** and **WiFi** powered devices becoming more and more prevalent in peoples homes. Much of this stems from the rise of (Ultra)-Low Power IoT Devices (**LPIoTD**) that are used by enterprise to deploy sensors to inform automation systems. This is commonly used for things such atmospheric control where a number of sensors in a room will allow a central server control temperature and air conditioning to each room individually. The use of these LPIoTD is expanding into other areas, such as river monitoring, as described in my literature review, which was previously a manual task performed weekly.

By harnessing this technology we can gain a deeper understanding of how variables from different aspects of life can have an affect. Unfortunately the majority of these implementations are proprietary. Anyone interested in deploying such a network would be required to obtain a bulk purchase of potentially hundreds of Single Board Computers (**SBC**) which are purpose built for the task and pay licensing fees.

Thanks to the rise of the Non Profit "Raspberry Pi Foundation" and its (mostly) open source "Raspberry Pi" line, we have access to a plethora of Low Power SBC'S which we can leverage to produce our own LPIoTD.

Project Aim

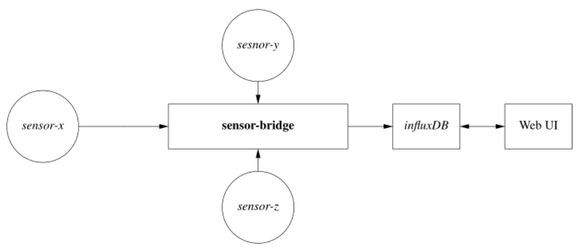
This project aims to provide an open source and easy to deploy utility for setting up a monitoring system.

It will provide a framework to allow others use or build a top, opening up the field to a wider range of people from enthusiasts to small business. A reliable backbone will be essential to providing a useful piece of software and built using secure and stable software. Due to the nature of where these sensors are deployed, a robust network is required (allowing for nodes to drop and come back up again) which our choice of B.A.T.M.A.N allows. This protocol can even route around a dead node, allowing packets to reach the bridge from any node.

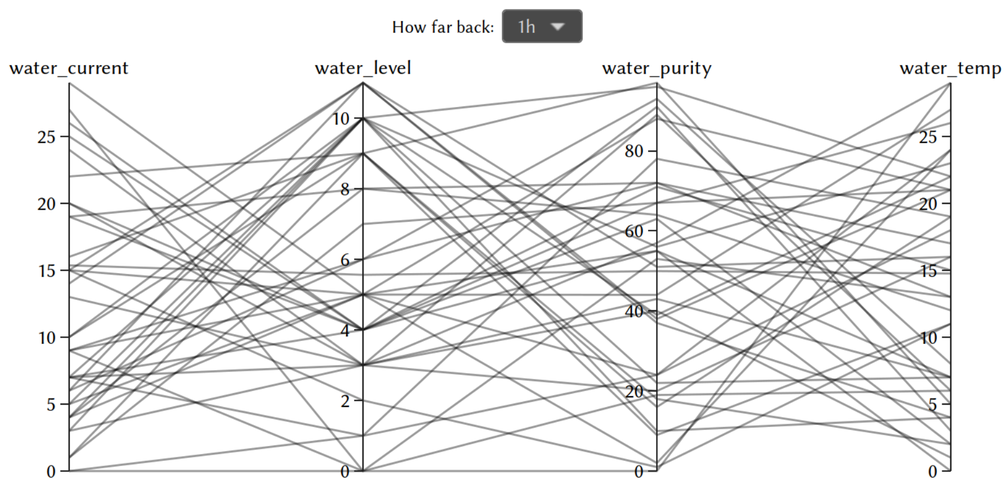
Methods

The project is divided into three distinct sections, the setup scripts written in POSIX complaint shell, a program to facilitate the reporting of readings from the sensors written in Golang, due to its ability to cross compile binaries, and a Spartan Web UI. This UI is expected to be expanded up on by users of the tool as different data types will require different forms of representation.

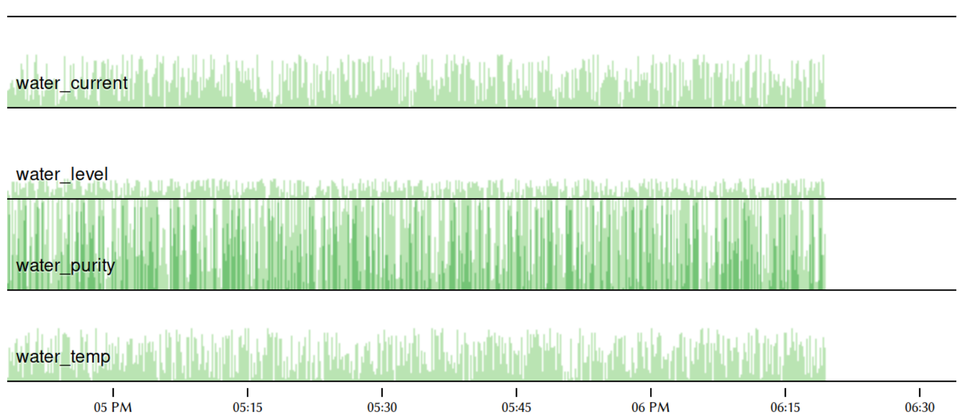
The distributed mesh networking is provided by the B.A.T.M.A.N Advanced protocol, which operates on layer 2 of the OSI stack, meaning compatibility, high performance & little overhead, perfect for low powered devices.



Figures and Results



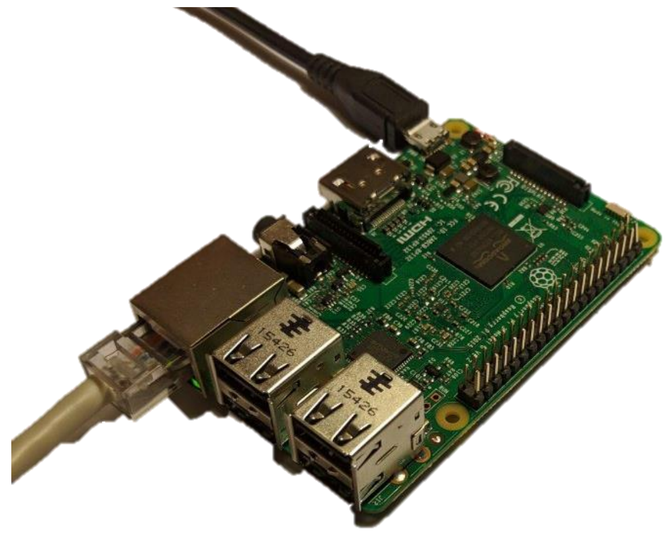
Using data display techniques such as parallelism we can quickly display to the user the individual sensors reporting to the server. In addition the graph is a useful way of showing outliers in any given dataset.



Whereas the simple cubism stream graph will allowing the display of natural patterns in the data as more is collected.

This sample set was built from a handful of Raspberry Pi's with the data values multiplied to show how a wide range of data looks (as these values are usually rather static).

Conclusion



Raspberry Pi running the Database and UI

By leveraging the many amazing Free and Open Source (**FOSS**) projects available it is possible to create a highly complex, distributed network of these low cost devices.

The robustness of the network is key, as mentioned before, and from testing nodes on the 'critical' path (fastest current route) can be removed with only a small delay in routing.

The User Interface provides an "at a glance view for users to understand the current state of the network, while the setup script allowing for rapid provisioning of nodes on demand.

Acknowledgments

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The many Open Source projects and libraries that allow this project to function, namely;

open-mesh.org -B.A.T.M.A.N Advanced protocol which allows the mesh network to function

Finally the Raspberry Pi foundation for developing and creating such a well documented and ubiquitous SBC.

References

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