Honours
Literature Review

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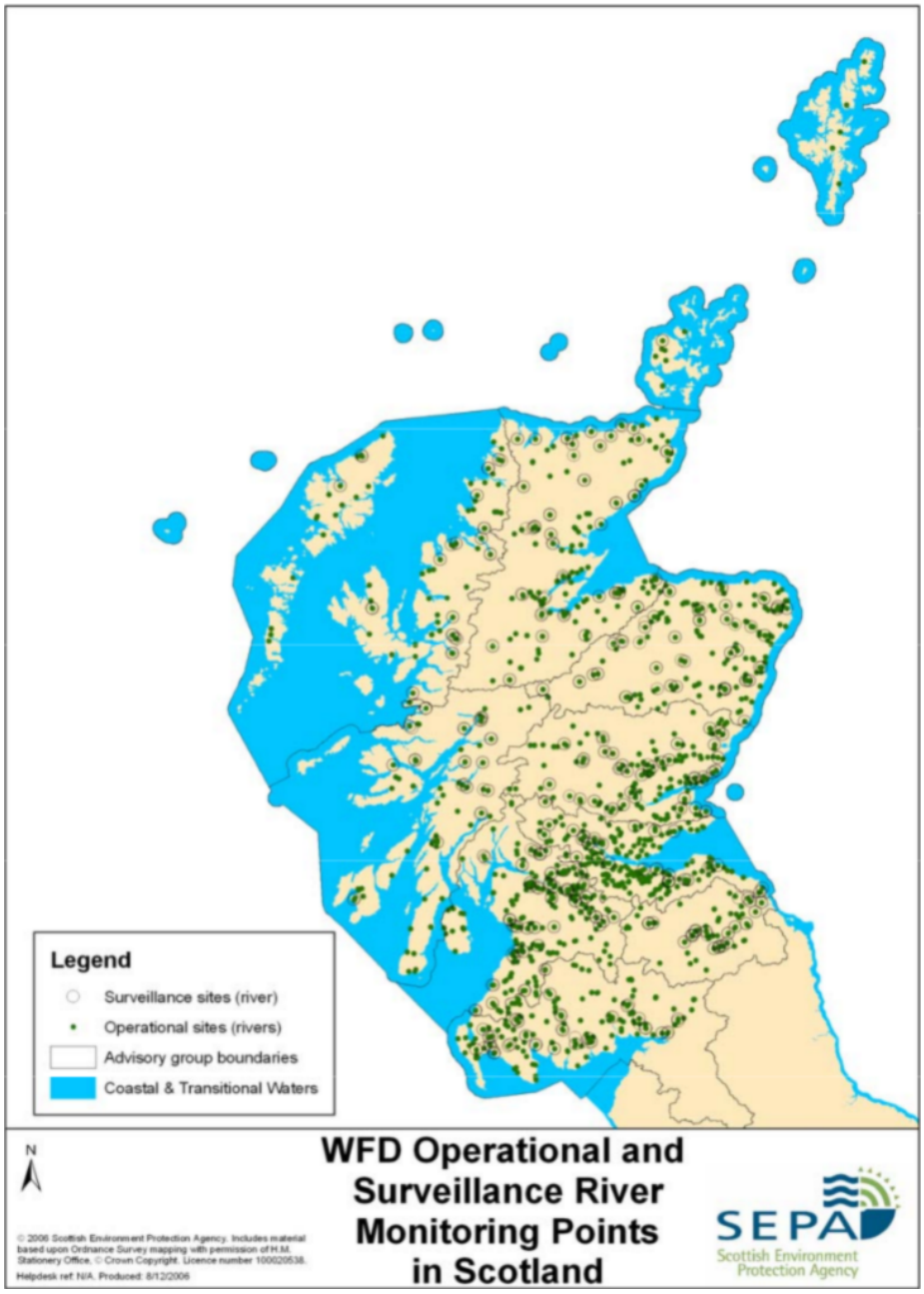
1 Abstract

This report will review the literature surrounding sensor networks, embedded devices, network topologies and sensors used.

2 Background

The current system for monitoring rivers and bodies of water involves building small concrete huts that record and store data locally. The cost of building these huts makes them prohibitive and is inefficient with today's technology. A person is sent periodically to collect this information manually. Figure I shows one of these monitoring stations found along the River Beauly.

In 2005 the WFD reported 285 type 1a and 1b at risk bodies of water. [SEPA, 2007] By 2006 253 stations such as the one pictured in Figure 1 were in place across Scotland representing 10% of the countrys total water bodies and 26% of the 989 at risk rivers as of 2009. (SEPA, 2009)



The reason for this can be attributed to the cost of these monitoring stations, with the solution proposed in this paper cost could be greatly reduced to a fraction of this.

3 Endpoint Devices

The Internet of Things (IoT) is a burgeoning field that has seen a massive boom in the Smart Devices market. (Lueth, 2018) IoT devices are defined by their low cost and low power and their ability to communicate with each other on the same LAN and have a degree of interoperability. (Vujovic et al., 2014). With the ever increasing rise of such devices the availability of low cost SoC (System On a Chip) devices increases with it. Many vendors have begun targeting the SoC devices after the Raspberry Pi Foundation unveiled the Raspberry Pi 1. Today there exists a myriad of low cost SoCs with differing qualities for differing use cases. (Larabel, 2018) Many System On a Chips are available in the current market. Two of the largest names include Raspberry Pi from the Non Profit Raspberry Pi Foundation and the Arduino board from Arduino LLC.

3.1 Raspberry Pi

The Raspberry Pi Zero W (RPi0), the Non W (Wireless) is pictured below, is a nice fit for our endpoint controller. Its availability and its wide range of support makes it an appealing choice for the controller. The RPi0 is an excellent fit for our project as at idle it will only draw a maximum average of 100mA (Alex, 2017) with further tweaks reducing it. On a relatively low cost battery we can expect this to last a day. Many of the current SEPA stations use solar power to power the electronics inside the shed. (SEPA, 2007) Our sensors will also be battery powered leveraging a solar panel to ensure charge is maintained.

3.2 Arduino

The Arduino is a compelling choice as its Arduino Nano product, pictured below, uses the ATmega328 microcontroller. This is a controller with a miniscule power draw of only 19mA. (ArduinoLLC, 2018) This can be further improved to reach as low as 54 A (0.054 mA). This would enable us to run on a minimal power source such as a 9V battery cell for periods of years. (Madcoffee, 2018)

3.3 Other

Many other SoCs include the ASUS tinker board, BeagleBoard and Bannana PI to name a few. These are all compelling options with a range of hardware benefits over the Raspberry Pi.

3.4 Comparison

	Uno Rev 3	Nano	Pi 3B+	Pi Zero W	BeagleBone	TinkerBoard	Bannana Pi
Cost ()	15	15	35	15			
Power Draw Idle	0.225W	0.01W	2.3W	0.5W			
WiFI	N/A	N/A	802.11 b/g/n	802.11 b/g/n			
Bluetooth	N/A	N/A	4.2	4.1			
CPU Arch	AVR	AVR	ARMv8	ARMv6	ARM	ARM	ARM
Clock Speed	16 MHz	16 Mhz	1.4 GHz	1 GHz			
Core Count	1	1	4	1			
RAM	32 KB	32 KB	1 GB	512 MB			
OS	N/A	N/A	Linux	Linux	Linux	Linux	Linux

The advantage afforded to the RPi0 is its availability, low cost, support but more importantly familiarity. It is important to ensure the barrier for entry, both cost and technical ability, is kept to a minimal for anyone who wishes to deploy one or more of these. Additionally by using the RPi0 we can leverage technologies already created for the device.

References

SEPA. An introduction to the significant water management issues in the Scotland river basin district. 2007.