Community-led monitoring to improve water quality

UpStream

Economic and Social Research Council

MOST 科技部 Ministry of Science and Technology

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WaterBox Fact Sheet (1)

- **What is the WaterBox?** The WaterBox is a low-cost water quality sensing device. It can monitor water quality parameters continuously and transmits data in near real-time.
- **What can the WaterBox measure?** The basic WaterBox measures three parameters: conductivity, pH and temperature. Additional parameters can be measured by attaching more sensors to it, as detailed in the table at the end of this document.
- **Who developed it?** It was developed in Taiwan by Location Aware Sensing System (LASS), a social enterprise founded in 2015 that develops sensors for and with citizens.
- **Customisation and 'open' principles are at the heart of the WaterBox:** The WaterBox is fully customisable. LASS and the WaterBox are founded on 'open' principles, meaning that the device and its software can be used and modified freely, and its design is publicly accessible.

By enabling citizens to collect local and actionable environment data, LASS aims to engage, empower and enable action, ultimately improving water quality.

Figure 1: Images of WaterBoxes recording water quality. Photos taken at Dadongshi Creek (大東勢 溪) in Miaoli (苗栗) and Dongbiankeng Creek (東汴坑 溪) in Taichung (台中).

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WaterBox Fact Sheet (2)

- **COST**

The basic unit, which measures pH, temperature and electrical conductivity, currently costs 8,000 NTD/£205. Costs of the additional sensors are given on page 4.

- **DATA STORAGE AND TRANSMISSION**

WaterBox data can be stored on the device's internal MicroSD card and/or transmitted wirelessly to the WaterBox manufacturer's (LASS) server via LoRA (long-range, low-power), NB-IoT (narrow band IoT) or LTE-M (Long-Term Evolution Machine-Type Communication). The potential to use any of the three most widely-used wireless transmission platforms for Internet of Things (IoT) applications allows flexibility and supports long-term use of the WaterBoxes.

The LASS server has default APIs, which means that data can be easily embedded into another organisation's website or readily extracted for analysis.

- **POWER**

The latest WaterBox has two power options:

✓ A fixed internal lithium battery that can be **recharged continuously by solar panel**.

✓ A **replaceable battery** without solar panel. The battery case is for two rechargeable 18650 batteries (see photo right). The WaterBox can run for around 9 days without changing the battery.

Figure 2: WaterBox setup with replaceable batteries

- **MAINTENANCE**

The sensors rely on interference with the sensing electrodes that are attached to the probe. As such, it is recommended that the WaterBox is checked and cleaned weekly where possible to ensure that it is free of debris.

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WaterBox Fact Sheet (3)

FUTURE DEVELOPMENTS

Through the UpStream project, we're gathering suggestions about how the WaterBox can be improved and are working with developers to make improvements.

We'll be updating this fact sheet as the project develops – check our website for the latest developments.

Figure 3: The WaterBox kit

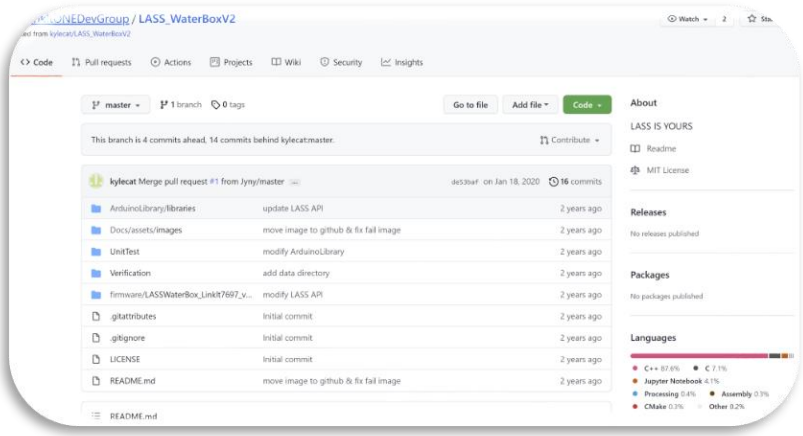

Figure 4: LASS's WaterBox GitHub project: https://github.com/LinkItONEDevGroup/LASS_WaterBoxV2

MORE INFORMATION

LASS has set up a GitHub page with further details and source code for the WaterBox (see image and link left).

For more information on the WaterBox please contact Amy.Jones@rpsgroup.com (UK) or lpwang@ntu.edu.tw (TW).

Opportunities to get involved in the UpStream Project

- Attend a workshop or catchment walkover to learn more about the project
- Help install and/or maintain water quality sensors within our pilot sites
- Explore our website, including the 'knowledge exchange hub', to access virtual outputs
- Volunteer to monitor data collected, spot pollution spikes and report to the wider community
- Continue the knowledge exchange process by sharing your own experiences relevant to UpStream

Please email eleanor.starkey1@ncl.ac.uk (UK) lipen.wang@rainplusplus.com (TW) to register your interest.

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WaterBox Fact Sheet (4)

Sensors that can be added to the WaterBox

Parameter	Provider	Data Communication Protocol	Hardware Interface[1]	Sample Code[2]	Buy	Indicative cost[3]
pH	Atlas Scientific[4]	I2C, UART	I2C, UART	I2C and UART	Link	£80+
		Voltage analogue	Voltage analogue	Voltage analogue		£51+
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage anaolgue	Link	£29
Conductivity	Atlas Scientific[4]	I2C, UART	EZOTM conductivity circuit	I2C and UART	Link	£145+
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage analogue	Link	£51
Oxidation Reduction Potential (ORP)	Atlas Scientific	I2C, UART	EZOTM ORP circuit	I2C and UART	Link	£87+
		Voltage analogue	Voltage analogue	Voltage analogue		£57+
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage analogue	Link	£65
Temperature	Atlas Scientific[4]	I2C, UART	EZOTM RTD circuit	I2C and UART	Link	£52+
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage analogue	Link	£5
Dissolved Oxygen	Atlas Scientific	I2C, UART	EZOTM dissolved oxygen circuit	I2C and UART	Link	£141+
		Voltage analogue	Voltage analogue	Voltage analogue		£104+
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage analogue	Link	£122
Colour	Atlas Scientific	I2C, UART	2.54mm Dupont Line	I2C and UART	Link	£38
Pressure	Atlas Scientific	I2C	2.54mm Dupont Line	I2C and UART	Link	£80
	DFRobot	Voltage analogue	2.54mm Dupont Line	Voltage analogue	Link	£9
Flow	Atlas Scientific	I2C	EZOTM embedded flow meter totalizer	I2C and UART	Link	£128+
Level	MaxBotix	PWM	2.54mm Dupont Line	No	Link	£79+
Turbidity	DFRobot	Voltage analogue/digital	2.54mm Dupont Line	Voltage analogue	Link	£7
Ammonium	Vernier	Voltage analogue/digital	SparkFun Vernier Interface Shield Or Vernier Arduino® Interface Shield Or Digital / Analog adaptor	Using Vernier Analog (BTA) Sensors with Arduino®	Link	£198
Calcium	Vernier	Voltage analogue/digital			Link	£198
Nitrate	Vernier	Voltage analogue/digital			Link	£198
Chloride	Vernier	Voltage analogue/digital			Link	£198
Potassium	Vernier	Voltage analogue/digital			Link	£198

[1]Plugs, sockets, cables and electrical signals that pass between the unit and the communications network; [2]Example code for interacting with the sensor; [3]Costs based on exchange rates Jun'21; [4]Standard sensors included in WaterBox