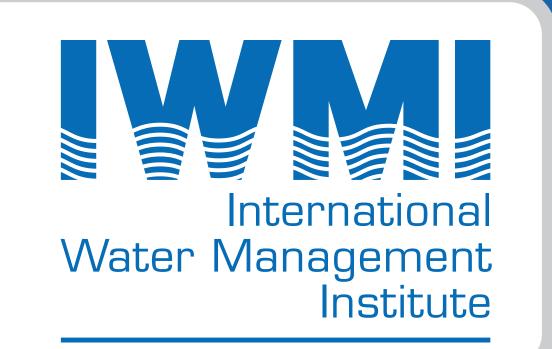


A national upgrade of the climate monitoring grid in Sri Lanka. The place of Open Design, OSHW and FOSS.

Yann Chemin^{1,2}, Niroshan Bandara², Nishadi Eriyagama¹

¹IWMI, Sri Lanka, ²UoMoratuwa, Sri Lanka



Introduction

The National Climate Observatory of Sri lanka is a proposal designed by&for the Government of Sri Lanka in September and discussed with private and public stakeholders in November 2014.

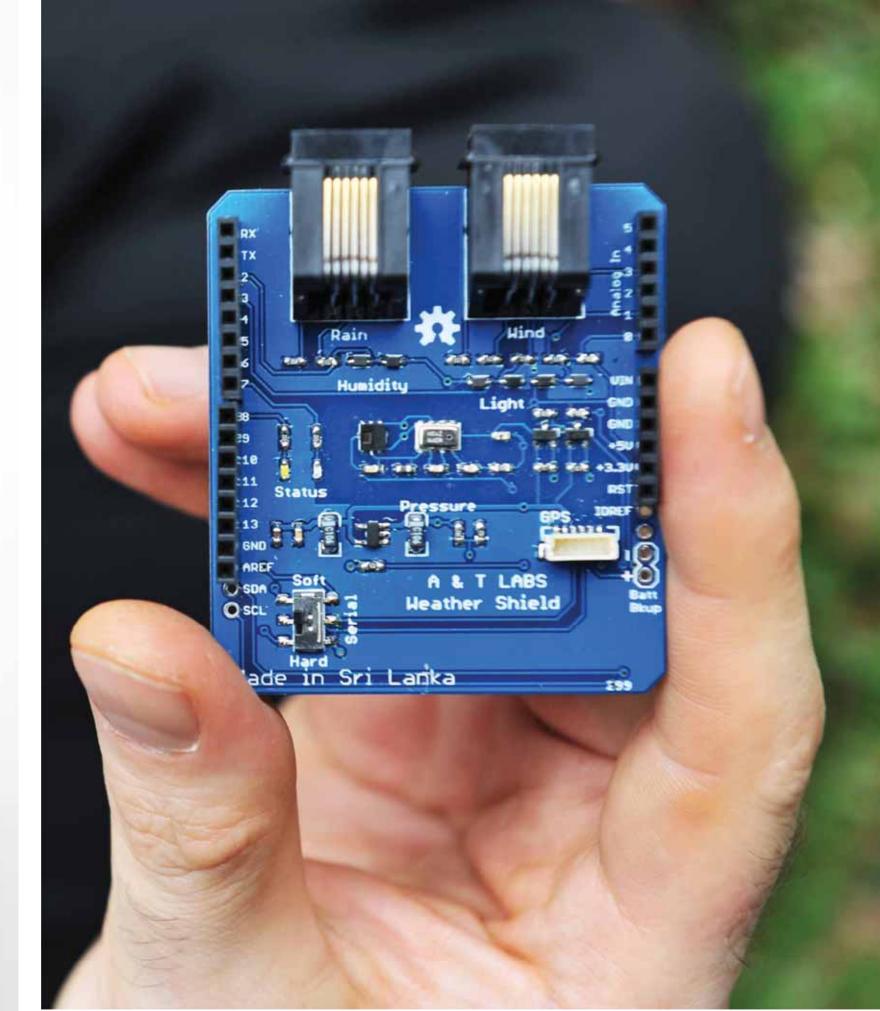
The idea was initially to install a networked grid of weather instruments from locally-made open source hardware technology, on land and sea, that report live the state of the climate. After initial stakeholder meetings, it was agreed to first try to connect any existing weather stations from different government and private sector agencies. This would bring existing information to a common ground through the internet. At this point, it was realised that extracting information from various vendors would take a a great deal of efforts, but was still the best and fastest way, as considerations from ownership and maintenance are the most important issues in a tropical humid country like Sri Lanka.

Thus, the question of Open Design, open source hardware (OSHW) and free and open source software (FOSS) became a pivotal element in considering the operationalisation of any future elements of a national grid. Reasons range from ownership, to low-cost and customisation, but prominently it is about technology ownership, royalty-free designs/blueprints and local availability.

Building on previous work from [1] we proposed to open design specifications and prototypes for weather monitoring for various kinds of needs. The Meteorological Department clearly specified that the highest variability observed spatially in Sri Lanka is rainfall. They also expressed their willingness to investigate OSHW electronics using their new team of electronics and sensors specialists. A local manufacturer is providing an OSHW micro-controller product, a start-up is providing additional sensor boards under OSHW specifications and local manufacture of the sensors (tipping-bucket and other wind sensors) is under development and blueprints have been made available in the Public Domain for a CNC machine, 3D printing or Plastic Moulding.

Entrepreneurship & OSHW Sensors/circuits





Weather shield production (Thilina, A&T Labs)

OSHW rain gauge design (Niranga, scion.lk)

Partners

The Lanka Rainwater Harvesting Forum (lankarainwater.org) was in need of volumetric estimation of the contribution of rainfall to runoff into collecting storages or aquifers. Regular reporting of high quality rainfall events and intensity is still a challenge to be addressed in Sri Lanka. A combination of OSHW and FOSS is being used to created a royalty-free, cheap raingauge design, with full control of on-board data collection and statistics. Development of the initial 10 raingauges include capacity-building, collaborative mannufacture from the ground to scouting and installation, and full ownership of all aspects (hardware sourcing locally, software modification, communication troubleshooting, etc.).

The Irrigation Department in Malwatu Oya had a requirement for real-time rainfall information to manage reservoirs in cascade ("daisy chain") systems and mitigate flooding downstream. 2 generic prototypes are installed, and SMS reporting to reservoir managers is under preparation. Eventually, the reservoir management model should receive live data to be rerun as often as needed. This will permit re-assessing decision-requirements from any new rainfall with measured, dangerous intensity. The irrigation department capacity-building was provided in two trainings, one for engineers (decision-making support) and technicians (reporting and maintenance). Interest for further level of control in the system is low.

Reporting online is following several potential routes, and an open design GPRS protocol is being developed, to simplify future weather stations design specifications in Sri Lanka.

Open Design Specifications

In the interest of longterm continuity and control of technology by the Meteorology Department and any other interested party in Sri Lanka, this document calls for the development of an Open Design Specification of hardware, software and implementation of weather instruments for use in Sri Lanka.

By adhering to openness at every step of the product development, any institution or private entrepreneur able to make, implement and deliver following these requirements can provide support to the Meteorological Department or any other interested party. Additionally, any institution or private party can provide support, repair and maintenance services to any of the system, now and any time in the future.

Open Specifications should remain in the public domain and available from the Meteorological Department website for future use, from expansion to maintenance, and for developing a skilled-based society and climate-aware future generations.

Local entrepreneurship stimulation



Setup by local balcksmiths & electricians.

Electronics SMEs producing OSHW products

55CION

Meteorological Department Future Advantage

Open Design calls for online sharing of blueprints, in this case this encompasses several parts. A weather instrument consists of several elements, electronic circuitry, sensors, power supply, casing and a structural support. Availability of all elements blueprints would be a must, and is mostly feasible, when unpractical (for example, a battery for a solar panel), operational specifications are sufficient. The minimum requirements as of the writing of this document are for the electronic circuitry, and the sensors.

Available blueprints

A basic setup for a system gathering information from sensors is an electronic circuit able to compute information incoming from different connections. A microcontroller performs these kind of operations. Several Open Source HardWare blueprints are available online and can be manufactured by any factory on demand. As an example, the Arduino family of microcontrollers has online blueprints available for download in many places over the Internet, that can be used with Free & Open Source Software (FOSS) to develop a factory requirement for the manufacture of electronic circuitry directly. Additional circuits made for the operational purposes of the weather instruments, as for sensors, storage or communication, should be provided with the same blueprints.

Sensors

Sensors being the central point of interest, it is also important to have their blueprints, for control of their precision and accuracy, according to the future needs. Sensors for electronic weather stations generally have two parts, one mechanical and one electronic. The Open Design of the mechanical part needs to be provided in an open 3D electronic file format and according to the material and method of manufacture, either:

- 1. An Open CNC/3Dprinting file format
- 2. An Open Engineering Blueprint file format

The electronic Open Design requirements for the sensor follow the main OSHW requirements as below.

Hardware requirements

Any electronic circuitry developed as part of the weather station Open Design should be provided to the Meteorological Department along with three electronic format files. Those are:

- 1. EAGLE files (usually a set of Open XMLtype format files)
- 2. Schematic file (usually a PDF document file)
- 3. Pin Mapping file (usually a PNG picture file)

Any new design should be manufactured independently by a thirdparty using the three sets of above-mentioned files. On proof of operational replicability, the new design can be adopted and documented online instantly by the Meteorological Department.

Free & Open Source Software

All of the operational capabilities of the weather station are eventually programmed. This program is made by developing and transforming a code into an application included in the ruling hardware.

Following Free & Open Source Software guidelines, for each new weather station Open Design, the following should be provided to the Meteorological Department:

- 1. The humanreadable codes included into a humanreadable electronic file format
- 2. The FOSS software used to transform the code from (1) into executing software
- 3. If different, the FOSS software used to upload the executable file/software into the weather station
- 4. Electronic data storage with all the above, including an operational manual.

Quality Control of final product

Following receipt of such data storage, a test should be conducted internally to a weather station of intended Open Design, and accepted if all steps included in the manual provide effectively a full control on the weather station software side maintenance.

Implementation of the weather station

This last part is of structural importance, and may vary greatly according to the type of durability and redundancy required (if at sea, for example). A simple Bill Of Material should be sufficient in most cases, as for steel/concrete works required by the Open Design. In the event of particular needs requiring plastic casing or other specifically manufactured support element/structure, appropriate Open file format of the element/structure as specified by most the common fabricating machines is required. For plastic moulding/pressurised extrusion, etc. an open 3D file format is required of the mould used for plastic moulding.

Press Cover



Conclusions

- The Open Source Mobile Weather Station has a web page with more information, including a building manual. This is found at http://www.iwmi.cgiar.org/resources/mobile-weather-stations/
- At this point in time, the National Climate Observatory proposal coordinating body (www.costi.lk) is involved in final negotiations with private partners before submitting to the Government of Sri Lanka for implementation.

References and Acknowledgements

References

[1] Y Chemin, N Sanjaya, and PKNC Liyanage. An open source hardware & software online raingauge for real time monitoring of rainwater harvesting in sri lanka. Symposium on Mainstreaming Rainwater Harvesting as a Water Supply Option, page 13, 2014.

Acknowledgements/Credits

Neil Palmer for the photos of the weather station.
OSHW rain gauge design (Niranga, scion.lk).
Arduino weather shield production (Thilina, A&T Labs





