# EcoSen - LoRa Data-Loggers for environmental quality (Español abajo)

Environmental monitoring is essential due to the variety of ways in which it is threatened.

Usually recording environmental variables can be carried out by private data loggers. These devices, due to their high costs, or being of closed design, do not allow us to buy in quantity or build them.

Our proposal consists in the design and development of open hardware data loggers with LoRaWan technology for communication with devices for downloading data. The data loggers will be of two types: aquatic and terrestrial. Aquatics will measure relevant data for the determination of water quality such as turbidity, dissolved oxygen, conductivity and pH. The terrestrial, will measure bee activity variables in hive, biological indicators of environmental quality.

These data loggers are based mainly in the [Cave Pearl Proyect](https://thecavepearlproject.org/), but with adaptations to surface waters.

<img src="Images/image\_1.jpg" width="100%">

### Motivation

We want to bring to society the passion for monitoring rivers and lakes. Also with the plus of learning about open electronic projects with possibility of reproduce, modify and customize data loggers. The Open technology that we bring is associated with open data repositories that will make the environmental information accessible to everyone!

### The first steps

To begin recording environmental variables is necessary to develop some abilities measuring these. To do that we are gonna start making a [Coqui conductivity sensor](https://publiclab.org/wiki/coqui) of [Public Lab](https://publiclab.org/) website.

<img src="Images/Coqui.jpg" width="100%">

### Specifications & Technical Attributes

The specific attributes of the data logger you build will depend slightly on the type of sensors you buy for the system. The numbers shown below are for the full version of the data logger that contains exactly the parts that we suggest in our build documents and parts list. Below, you can see which parts could be changed for which spec upgrades.

| Attribute | Value [imperial] | Value [SI] |

| ---------- |:-----: | :-------------: |

| Weight | [lbs] | 1 [kg] |

| Footprint | [in] | 30x5 [cm] |

| Battery Capacity | 6800 [mAh] | 6800 [mAh] |

| Operating time | 3 [months](continual use)|3[months](continual use)|

| Approximate Max wireless communication | [] | 3 [km] |

| Communication (in this guide) | Arduino IDE (windows, mac, GNU/linux) | |

| Cost | ~ $350 | |

### The first steps

To begin recording environmental variables is necessary to develop some abilities measuring these. To do that we are gonna start making a [Coqui conductivity sensor](<https://publiclab.org/wiki/coqui>) of [Public Lab](<https://publiclab.org/>) website.

### Features

This data logger is designed to function similarly to the [Cave Pearl Proyect data logger](https://thecavepearlproject.org/category/diy-build-a-pro-mini-logger/) designs:

\* \_\_Autonomous:\_\_ this data logger has an autonomy of several months

\* \_\_Customisable:\_\_ Allows to choose what sensor you want for your data logger

\* \_\_Wireless communication:\_\_ Thanks to the LoRa connectivity this device can send a measurements to a server and get access to the information wherever you are.

We chose a Arduino pro-mini to be the "brain" of this data logger for its versatility, accessibility, simplicity, and ability to add and upgrade your own modifications. Any method with which you can communicate with a arduino pro-mini (bluetooth, WiFi, LoRa, etc) can be interfaced into the data logger to get from its.

[List of components](https://drive.google.com/open?id=1hyrhMyJMDih4w9r664UP0bz\_\_xZFTRils\_V-fsFg26g)

### Do you want to contribute to the project?

This project need people interested in contribute in different tasks. In order to collaborate with this project, you will need to have some experience in the following:

\* \_\_Coding arduino microcontrollers:\_\_ Although we are already working in the code for the full data logger, improvements of the code are always necessary the best code possible for the device.

\* \_\_Electronics:\_\_ This project uses components like sensors, different modules, and batteries.

\* \_\_Community management:\_\_ We need some expertise in the use of social networks and content production.

Most of the above are skills that you can learn and pick up fairly quickly from watching videos and doing research on the internet, and throughout the project we try to give supplemental information on some of these as well. See the build documents for more information.

## Getting Started

### Folder organization

![Rover build roadmap](images/folders.PNG)

The main /osr/ folder contains all of the documentation and information necessary for the project, broken down into the 3 main sections: Mechanical, Electrical, and Software. Each of these sections is meant to be relatively self contained and should be fairly parallelizable, meaning that they could be completed simultaneously by different groups. There is a README.md in each section to help you navigate the information in that section.

### Ordering parts

#### Parts Lists

The [Master Parts List](master\_parts\_list.xlsx) contains all the parts necessary to build the entirety of the robot as it is listed in our documentation. We recognize that you may want to change, add, and redesign some sections, so each of the individual build sections also contain a parts list for that corresponding section of the project. \*Note that these individual parts list recommend buying quantities necessary \_\_only for that section\_\_. Be sure to assess the quantities you need for common items (particularly screws, nuts, bolts, and other common hardware) if you are changing subassemblies.\*

##### Cart Share

In order to help this ordering process we have compiled a few links of a large number of these together already, if you wish to build exactly what is in our build documentation.

|[McMaster](https://www.mcmaster.com/order/rcvRtedOrd.aspx?ordid=5887891246&lnktyp=txt)|[Amazon](https://www.amazon.com/gp/registry/wishlist/3ELV1FY8J7ZYP/ref=cm\_sw\_em\_r\_z\_g\_\_wb)|[Pololu](https://www.pololu.com/wishlist/1J10953)|[Adafruit](https://www.adafruit.com/wishlists/460400)|

|---|---|---|---|

\*\*Digikey:\*\*

The Bill of Materials folder contains (currently just one) Bill of materials file for a specific vendor. We are searching for better ways to help with the ordering process, however for now the easiest way is to take the [Digikey Bill of Materials](Bill%20of%20Materials%20Files/Digikey\_BOM.csv) and upload it to [Digikey](https://www.digikey.com/). You can find the "BOM Manager" on their homepage and then start a new BOM, where you can upload this file.

#### 3D printing and Laser cutting

In addition to ordering all of the parts on the parts list, we recommend that some pieces be 3D printed and laser cut. If you do not have access to a 3D printer or laser cutter, we've added some online services as examples for where you can get those manufactured and shipped to you. You'll find instructions on this in the [Body Build Doc](Mechanical/Body%20Assembly/Body%20Build%20Doc.pdf), [Corner Steering Build Doc](Mechanical/Corner%20Steering/Corner%20Steering%20Build%20Doc.pdf), and [Head Assembly Build Doc](Mechanical/Head%20Assembly/Head%20Assembly%20Build%20Doc.pdf).

#### Printed Circuit Boards (PCBs)

The main electrical system of this rover relies on a custom printed circuit board (PCB) that handles the routing between the majority of the electrical components. This board greatly simplifies the build process and eliminates the need for you to route all the wires yourself. You can find the PCB board files at [PCB Files](Electrical/PCB%20board%20files%20and%20schematics/Board%20files). These can be ordered at [JLCPCB](https://jlcpcb.com/) by dropping each of the .zip files (these .zip files contain "gerber" files, a typical file format for PCB boards).

### Rover Build Roadmap

![Rover build roadmap](images/roadmap.PNG)

Above is an example roadmap of how you can build the rover and which parts of the build are dependant on the other sections. It is broken down into 5 stages:

\* \_\_Stage 1:\_\_ Start getting all the parts!

\* \_\_Stage 2:\_\_ Once you have all the parts, everything in stage 2 can be completed in parallel. It is \*highly\* recommended to start on the electrical testing of components outside the robot before doing any electrical work inside the completed robot body. You can also work on the software at any stage between here and the end.

\* \_\_Stage 3:\_\_ During stage 3, the mechanical subassemblies should all be assembled and start to be integrated together. There should be some amount of testing done on the electrical system, as well as some progress on the software.

\* \_\_Stage 4:\_\_ The rover is mechanically built and all subassemblies integrated together. During stage 4, you begin the integration of the electrical components and the various power and data wires that run throughout the rover.

\* \_\_Stage 5:\_\_ Once the electronics are all powered and communicating, you need to test and calibrate all the motors in the system.

\* \_\_Stage 6:\_\_ After everything has been tested and calibrated and the software is up and running, the robot will be fully functioning and built!

\* \_\_Stage 7:\_\_ Add your own upgrades! We chose Raspberry Pi as the brain of the project so that it should be easy to add, change, and upgrade to build exciting things on top of this already cool robot. Some upgrade ideas to get you brainstorming: sonar for collision detection, IMU for orientation / closed-loop driving / obstacle mapping, camera for object identification and tracking, sensor packages (temperature, pressure, humidity), solar panels, or even a robotic arm!

## Building the Master Parts List

Anytime parts are changed in the build docs, you must rebuild the master parts list by running the `init.sh` script, which in turn runs the `build\_parts\_list.py` script after installing the necessary dependencies. This script will create a new `master\_parts\_list\_raw.csv` and `master\_parts\_list.xlsx`, both of which need to be committed when making changes to the parts list.

When updating the build docs, make sure all parts have a part reference number (S1, E20, etc). If you are adding a new part, be sure to also add it to the `parts\_list\_reference.csv`. That file is the source of truth for the name of the part, and also contains information like the price, model, manufacturer, and link to the part. In that file, you can also override the quantity to order for the project in case the quantities in the build documents aren't representative of the total number of parts required (for example, some electrical components like resistors or capacitors are inexpensive and are also prone to failure, so we use the override to recommend buying a couple extras).

## Happy building!!

If you have any questions or run into problems during your build, please search for answers and/or reach out on the [forum](https://create.arduino.cc/projecthub/alejobonifacio/ecosen-lora-data-loggers-for-environmental-quality-9dffba).

## Releases

The rover has undergone some major changes since its initial release. The resources and information in this repository (on the master branch) will always be the most up-to-date information about the rover. However, if you are interested in older versions of the rover, you can see legacy releases of the OSR at https://github.com/nasa-jpl/open-source-rover/releases

## Project Team

### Project Lead:

Michael (Mik) Cox

### Development Team:

Eric Junkins and Olivia Lofaro

### Special Thanks To:

Magdy Bareh, Michelle Viotti, Tom Soderstrom, Dave Gallagher, Jim Rinaldi, Molly Bittner, Christine Fuller, Billy Allen, and Charles Dandino

## Additional Projects!

We recognize that there might be a some individuals, hobbyists, and groups that might be hesitant or unable to build the Open Source Rover due to skills/tools necessary, or budgetary constraints. We'd like to give the information to a similar project that was designed by someone who was inspired after participating in our open source rover beta group to design one for around $500, and heavily utilizing 3D printing. We think this project would be especially great as a hobby project, and appropriate for those just getting into some of these areas, or someone looking to spend a little less money.

https://hackaday.io/project/158208-sawppy-the-rover

https://github.com/Roger-random/Sawppy\_Rover