2nd delivery

- The comments that you received during the 1st delivery and how you have addressed them (if you decided/managed to address them). You should justify your decisions.

- The main criticism of the previous project presentation concerned the use of the mesh network and the Telosb device as a sensor node. I received this criticism for the main reason of the Telosb programming difficulties. I also got the critique regarding the limited range of the Zigbee network, which is around a couple of hundred meters. This would mean that the Telosb closest to the fixed station is no more than a couple of hundred meters away and this can in some cases be too restrictive.

The advantage that the Zigbee protocol would have had instead would have been a certain autonomy and

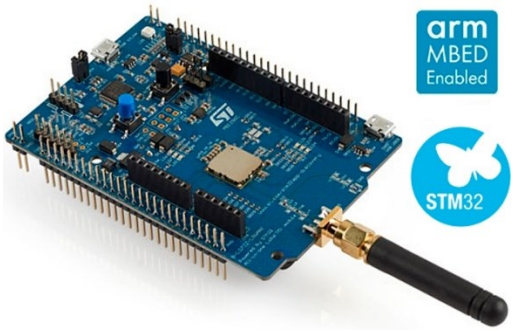
choral functioning as, given the conformation of some aquaculture facilities, they are mostly adjacent at distances of a few hundred meters and require communication between them. (e.g. oxygen, ph, pollution level data) can be self-regulated by exchanging local information between nodes and delegating certain functions to the single node edge instead of to the cloud. Furthermore, an advantage is the complete free of charge of this network, and greater security from external geographic attacks.

For these reasons it was finally decided to opt for the LoRaWAN network, purchasing b-l072z-lrwan1 as a LoRaWan module, and iC880A-SPI concentrator board with Gateway. The choice of the Gateway was made as it ensures that we can be connected to the network in any location, since

the Things Network gateways can be scarce on the coast.

- Changes made to your concept, architecture and evaluation plan since the 1st delivery. You should justify the need for these changes.
-

1) As stated before the architecture has changed since it is not used anymore the TelosB , but the sensor connected to STM32F401RE. In order to use LoRaWAN we have adopted as a final board b-l072z-lrwan.



2) This Small Solar Panel 55x70mm 0.5W is made of single-crystal material that performs high solar energy transformation efficiency. It has a fine resin surface and sturdy back suitable for outdoor environments.

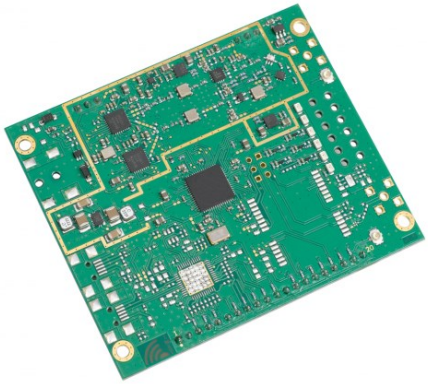
https://www.seeedstudio.com/0-5W-Solar-Panel-55x70.html

3) This is a very small, extremely lightweight battery based on Lithium Ion chemistry, with the highest energy density currently in production. Each cell outputs a nominal 3.7V at 400mAh! Comes terminated with a standard 2-pin JST-PH connector with 2mm spacing between pins. These batteries require special charging; do not attempt to charge these with anything but a specialized Lithium Polymer charger.

https://www.sparkfun.com/products/13851

4) iC880A-SPI

https://shop.imst.de/wireless-modules/lora-products/8/ic880a-spi-lorawan-concentrator-868-mhz?c=12.



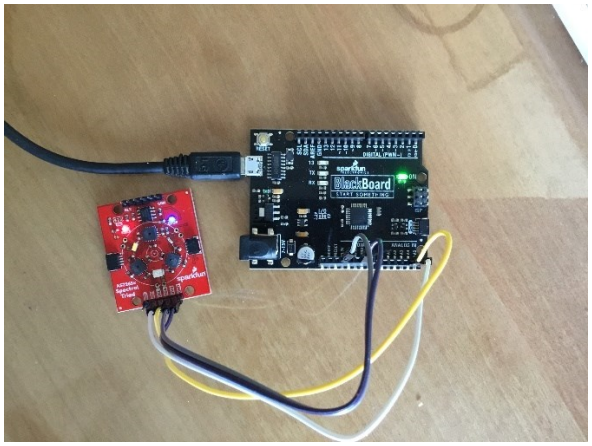
5) Buoy

- https://www.hackster.io/amerch92/lora-weather-buoy-9e739b

- Brief presentation of the technical work done since the 1st delivery.
-

- The work starting from the first delivery involved the development of an application for RIOT-OS that reads and displays the data of the spectrometer. I focused on the I2C interface mode that can be activated via menu commands from the shell command line. Interfacing with I2C is not complete. The readings of the spectrometer were however made possible through the libraries available for Arduino. So this last device was connected to the

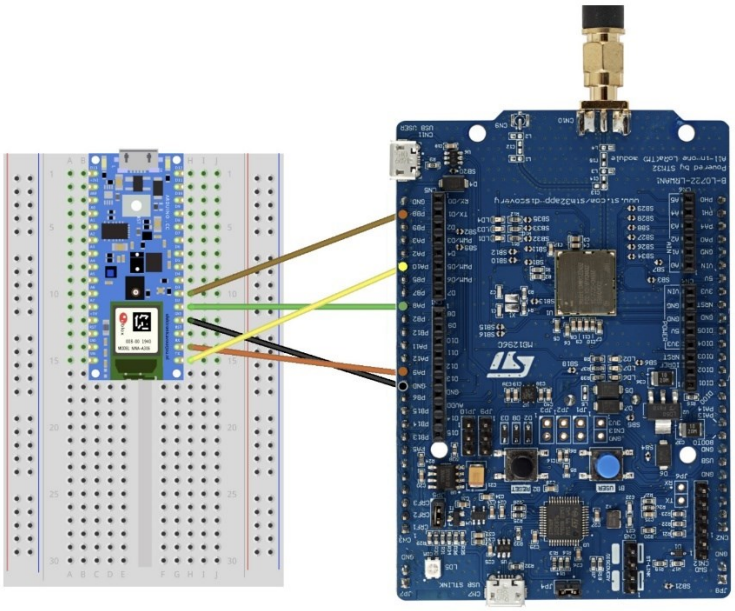
sensor and repeated scanning tests of water samples were made.



1) Arduino connected to spectrometer sensor

- Arduino will be used as long as the application interface is not prepared on Riot-Os. Therefore until that moment the Arduino data reading module will be connected with the Nucleo-64 module or the b-l072z-lrwan1.

In order to communicate between Arduino e b-l072z-lrwan1 please follow https://github.com/2ni/lorawan_modem/ .



It can paired with Artemis machine learning.

https://www.sparkfun.com/artemis

https://www.sparkfun.com/products/15444

https://www.amazon.com/SparkFun-Development-Connector-Microphone-TenserFlow/dp/B07YCVB6LL

The library In c++ can be written by using these templates.

https://github.com/sparkfun/SparkFun_AS726X_Arduino_Library/tree/master/src

From the comments of as726xx

I set up this sensor with an STM32F103 controller. So the 1st thing you need to do is write the functions needed to communicate. There are only 4 registers - the device address, status, read, and write. That is were the quirkiness starts. To read or write you need to read and write to those registers and provide a "virtual register" address to get to the register you want. This is the only device I've seen that does this. There is some example code in the data sheet, which is helpful. If you are not using this with an Arduino you need to download the AS726X header and implementation files (.h and .ccp) from the link provided. Use these as a guide to write your functions.

I made a light table setup with a diffraction grating and lens and set the device at the focal point and moved it through the color bands. I found that I got the highest response on Orange and Green - not what I expected but on reflection that could be just the characteristic of the lamp I was using - a 60 W equivalent LED bulb (UtiliTech) I got from WalMart. I think of this as another "quirk".

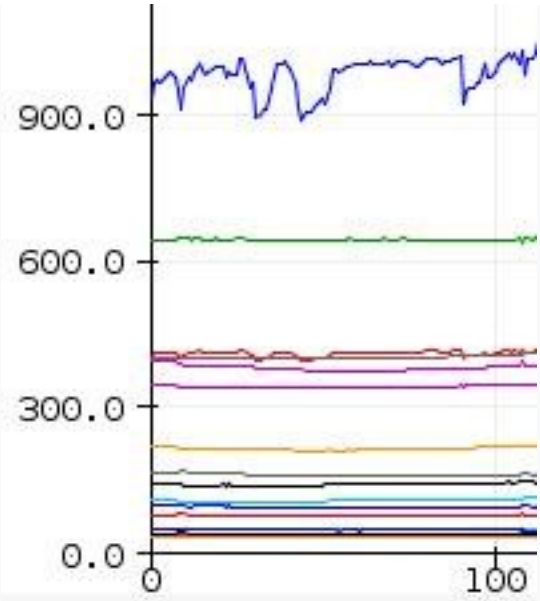
Bottom line. This is an interesting device, it works fine, and I'm still learning how it behaves. If you are considering using this device, you really need to think about what the values you measure really mean and how you want to use them. This will depend on your particular setup and light source. I'd like to eventually use it as a spectrometer for measuring light being absorbed by solutions or to take elemental spectra. So I'm not sure how to take the output and use it quantitatively. Still working on that.

- A brief list of the functionality that is still missing and will be done till the final delivery.

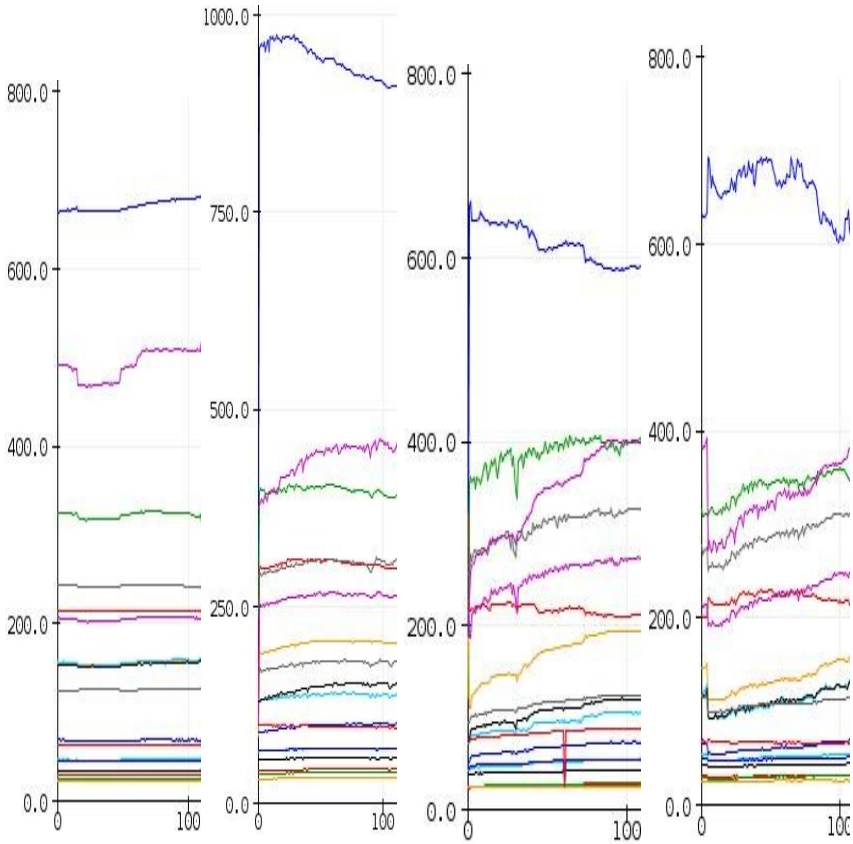
- Missing features for final delivery is the completion of the data reading program in Riot -os. In fact, Arduino is currently used and then it is connected to the LoRaWan module to send data to the concentrator or Gateway. It is therefore necessary to implement the connection to The Things network and transfer the data to the amazon cloud where they can be viewed in a dashboard. This last module has already been realized in the first assignment.

- Brief presentation of the evaluation conducted since the 1st delivery.

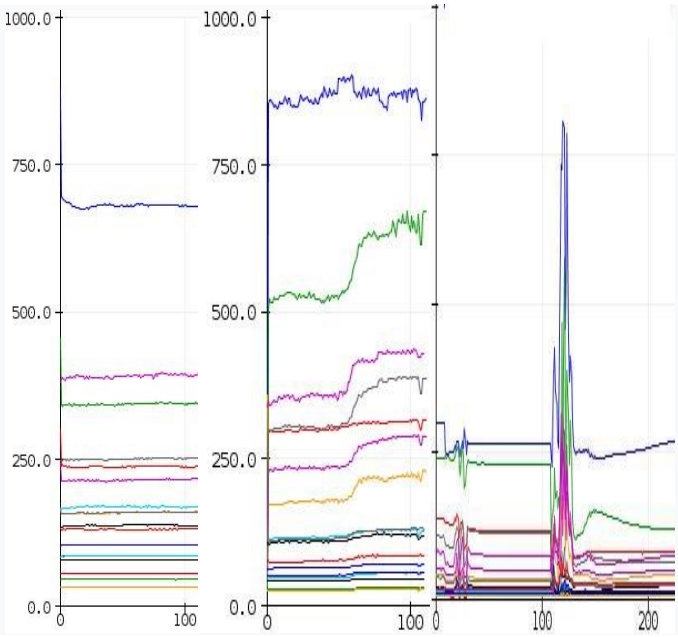
- So far, experiments on the spectrometer have been carried out thanks to the Arduino libraries. The goal was to do feasibility tests on the spectrometer's ability to make real-time measurements directly in water. Obviously it is assumed that the spectrometer can be inserted directly into the water to measure the quantities of interest. The approximation was to subject water samples added with additives to test the ability of the spectrometer to identify unknown samples in the composition and percentage of presence of substances harmful to the life and development of fish and the surrounding environment.
- Some of the experiments carried out are shown below.



- Figure 8 Sample of pure drinkable water



- Figure 9 water with salt added
- Figure 10 water with dejections added
- Figure 11 water with oil, dejections, salt added
- Figure 12 water with oil, dejections added



- Figure 13 water with oil added
- Figure 14 water with salt, dejections, bicarbonate added
- Figure 15 with bicarbonate added during measurement

- It would be desirable to complete the data collection and the construction of the neural network model for the recognition of unknown water samples but it is believed that this is beyond the scope of this project.