

# Building cost-effective, wireless sensors platforms for agroecology monitoring

Technology developed in



Capacity-building  
with **Erasmus+**



Deployed & Exploited in



Prof. Congduc Pham  
<http://www.univ-pau.fr/~cpham>  
Université de Pau, France



Congduc.Pham@univ-pau.fr



Wireless Sensors Made Simple  
for agroecology & sustainable agriculture

Powered by technologies developed in Intel-IrriS

# Erasmus+

EU programme for education, training, youth and sport

Home

About Erasmus+ ▼

Opportunities ▼

Programme Guide

Resources and tools ▼

Wt



Research & innovAtive Development International Offices  
networking for upscaling research capacities and  
encouragement of multidisciplinary studies

## Erasmus+ Enriching lives, opening minds

The new Erasmus+ starts here

[Explore the Erasmus+ programme](#)





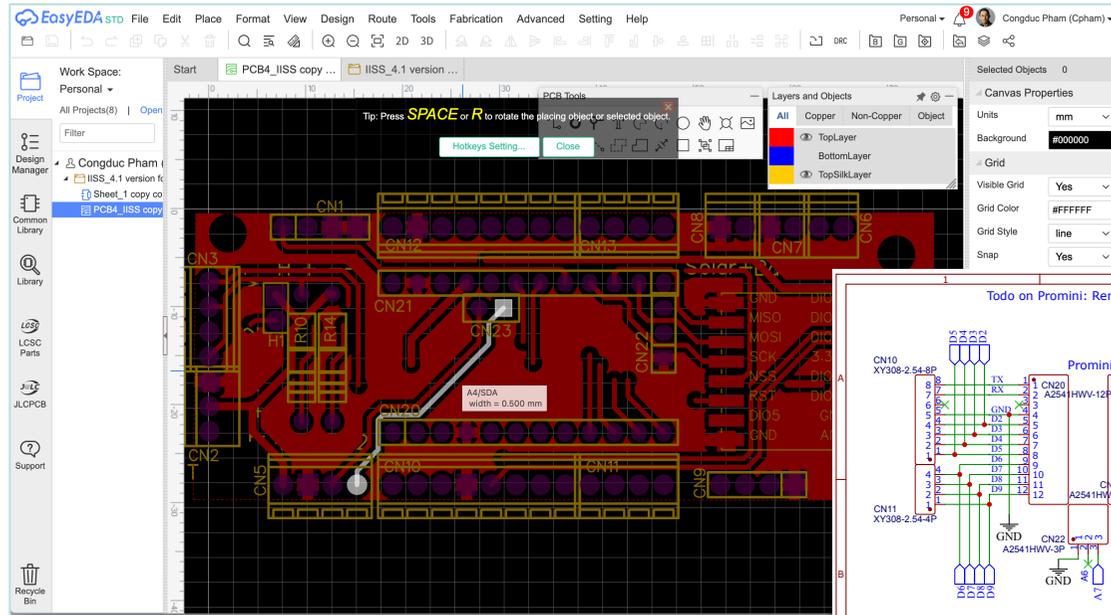
# BUILDING AN ECOSYSTEM OF SENSORS



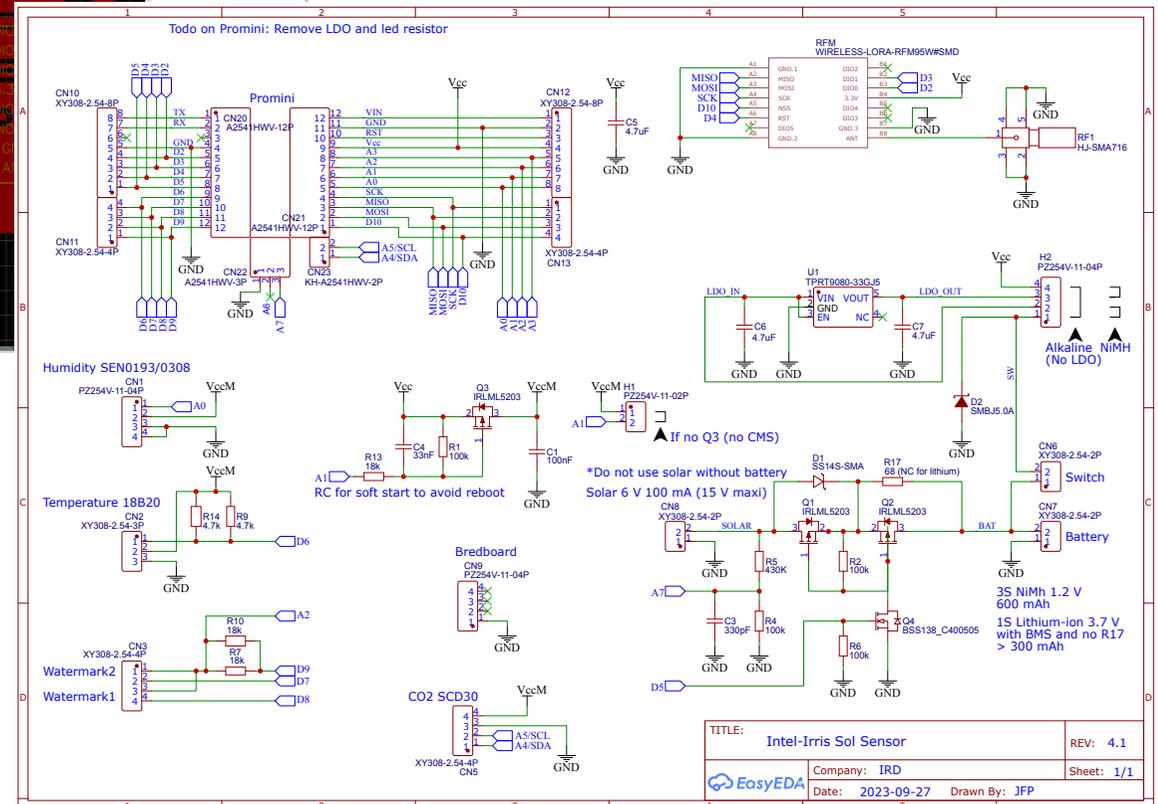
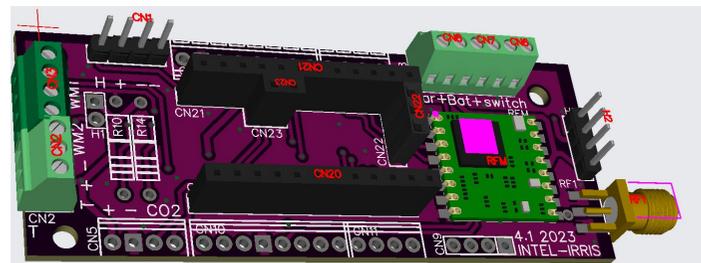
**Agriculture**  
**Agroecology**  
**Wildlife**  
**Biodiversity**  
**Environment**  
**Surveillance**



# DESIGNING A CUSTOM PCB



We use EasyEDA, a free software to design electronic PCB





# ORDERING THE PCB

EasyEDA generates so-called Gerber files used to produce the PCB. We provide the Gerber files as free resources for research

PRIMA-Intel-IrriS / PCBs / 

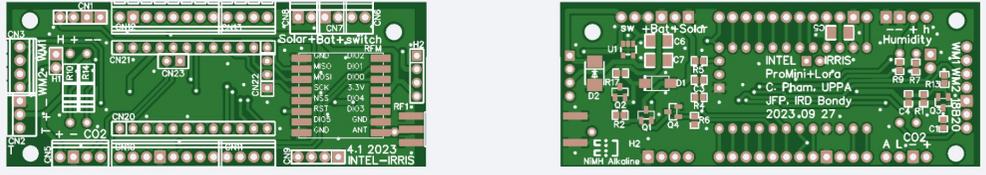
 CongducPham Update README.md

Name	Last commit message
..	
IRD_PCB_4_1	Update PCB files and tutorials
MySecondProMiniLoRaBreakout_2022-01-20.zip	Update PCB files
MySecondProMiniLoRaBreakout_RAK3172_2023-0...	Add new PCBs and update tutorials
MySecondProMiniLoRaBreakout_SX128X_2022-01-...	Update PCB files



 EUR ▼

Standard PCB/PCBA | Advanced PCB/PCBA | SMT-Stencil | 3D/CNC



← Back to Upload File Detected 2 layer board of 30.89x79.5mm(1.22x3.13 inches) [Gerber Viewer](#)

Base Material:  FR-4 |  Flex |  Aluminum |  Copper Core |  Rogers |  PTFE Teflon

Layers:  1 |  2 |  4 | High Precision PCB |  6 |  8 |  10 |  12 |  14 |  16 |  18 |  20

Dimensions:  \*

PCB Qty:

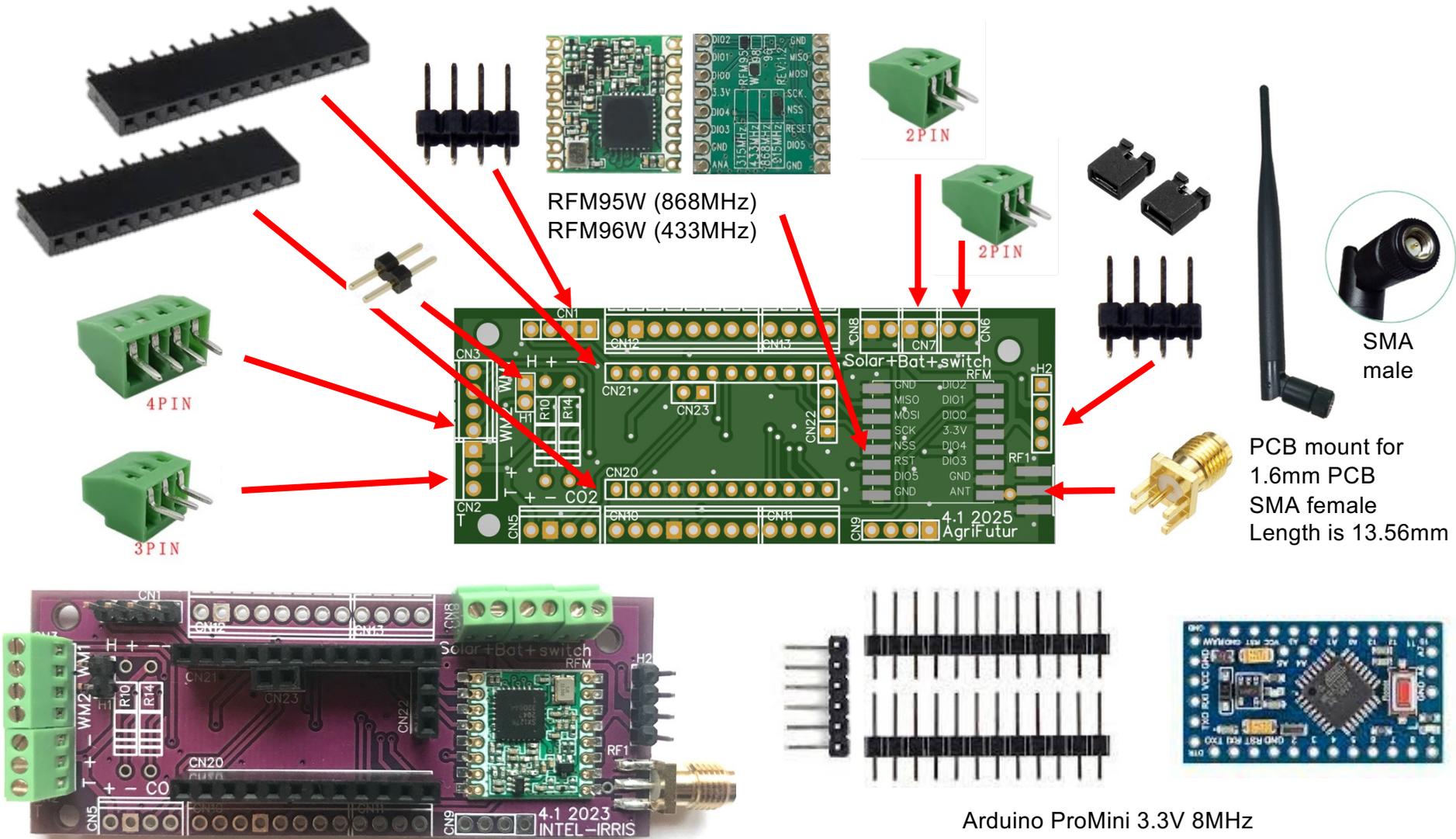
Product Type:  Industrial/Consumer electronics |  Aerospace |  Medical

[https://github.com/CongducPham/PEPR\\_AgriFutur](https://github.com/CongducPham/PEPR_AgriFutur)

Here we order from JLCPCB manufacturer

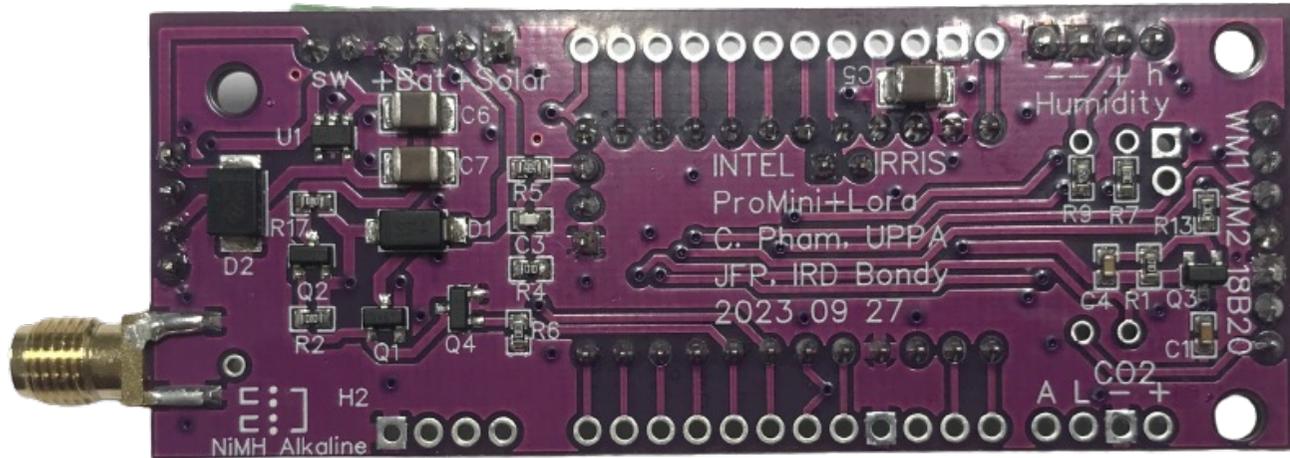


# DO-IT-YOURSELF APPROACH – RAW PCB



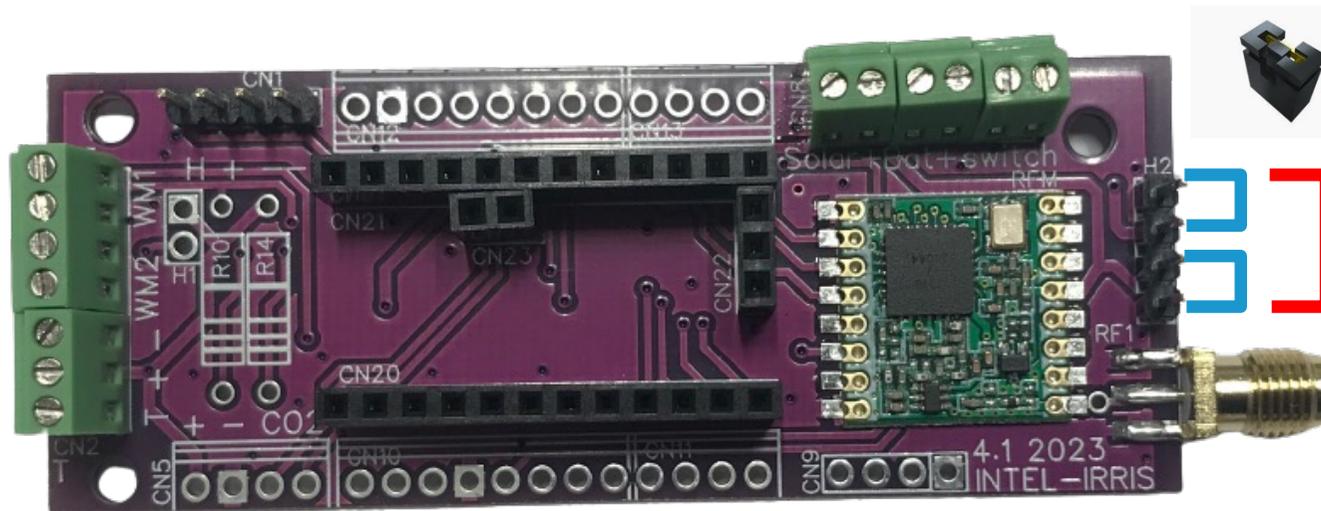


# ORDER THE FULLY ASSEMBLED VERSION

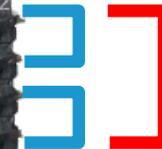
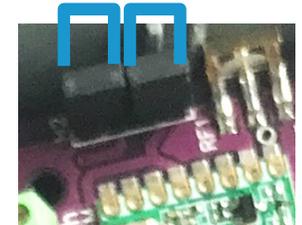


By providing the Bill of Materials (BOM) file, the manufacturer can produce the fully assembled version

The full assembled version comes with the solar charging circuit on the back side of the PCB



Connect for SOLAR with NiMh

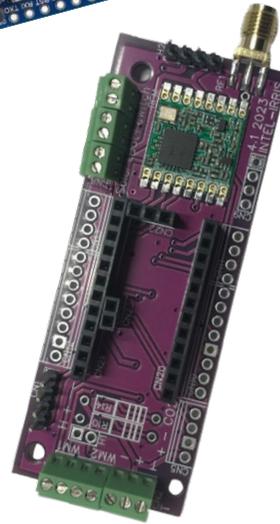


Connect for alkaline batteries





# CASING AND INTEGRATION



For SOLAR



For 2xAA  
alkaline  
batteries



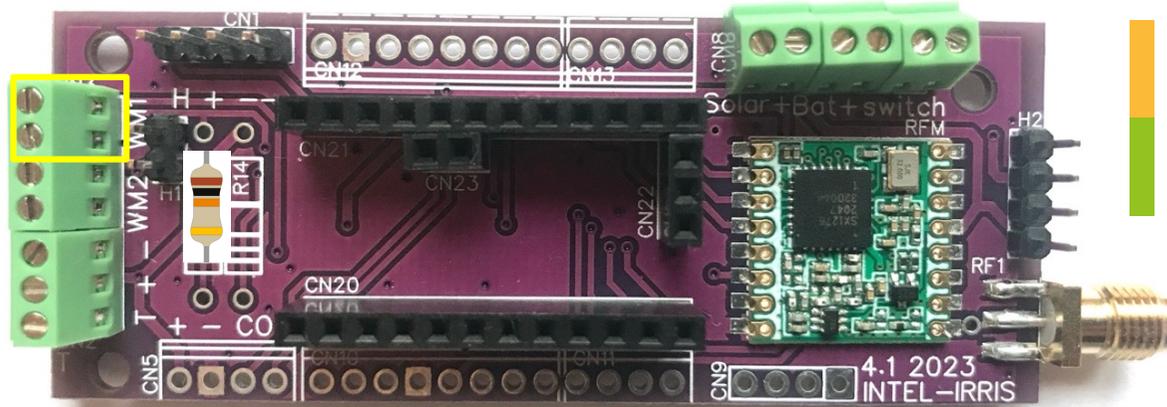
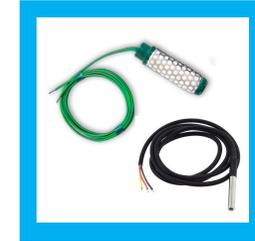
For SOLAR with  
NiMh battery



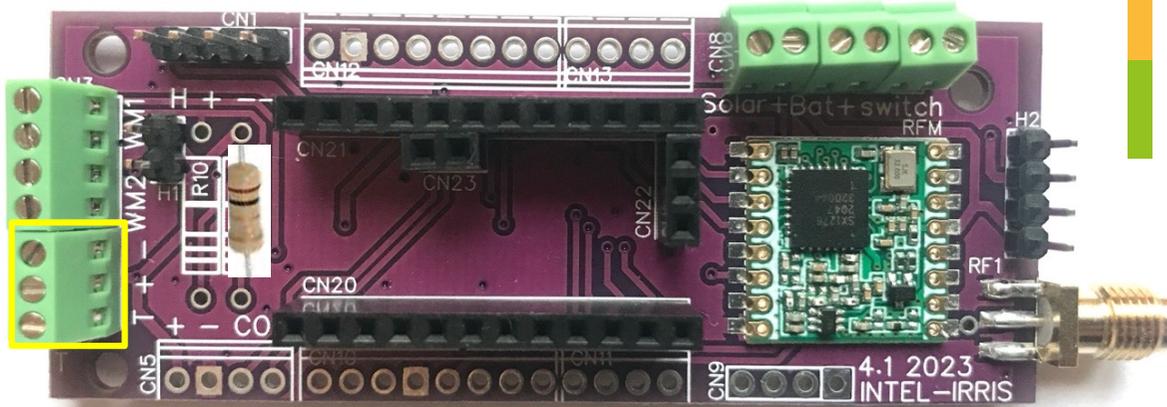
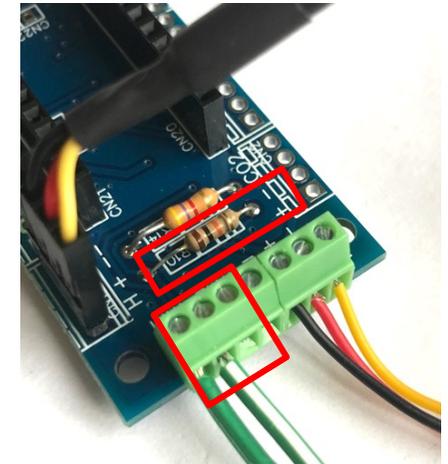
SMA  
male



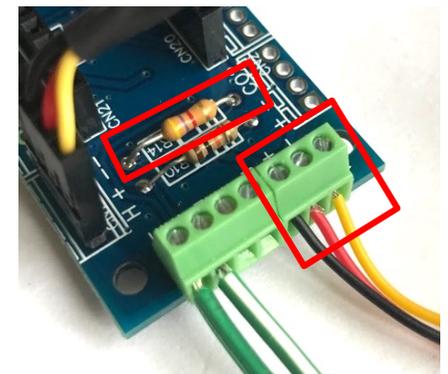
# ADDING PHYSICAL SENSORS. EX:



Add a 10kOhms resistor for raw PCB.

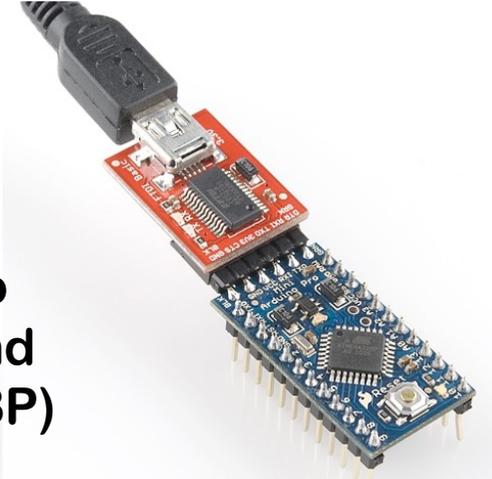
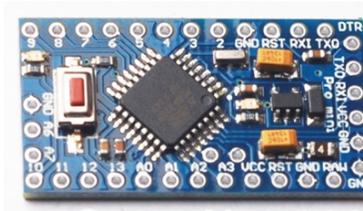


Add a 4.7kOhms resistor for raw PCB.





# ADD THE MICROCONTROLLER



We use an Arduino Pro Mini at 3.3V and 8MHz (ATmega328P)



We develop and provide the code (Arduino) for the microcontroller

Technology developed in



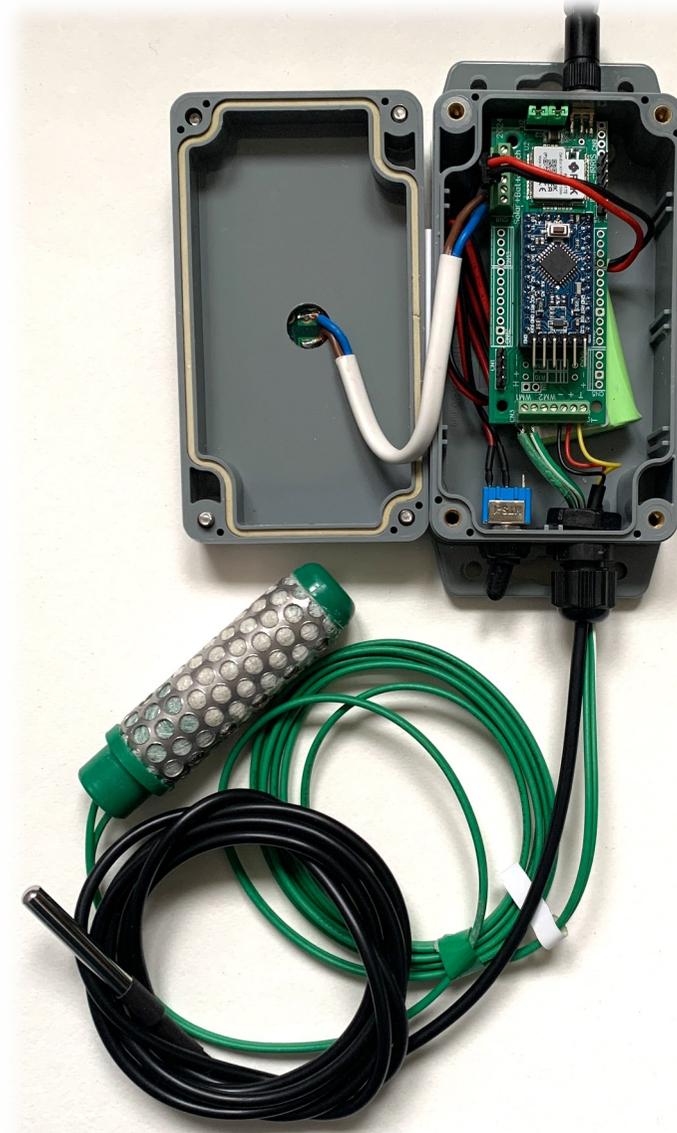
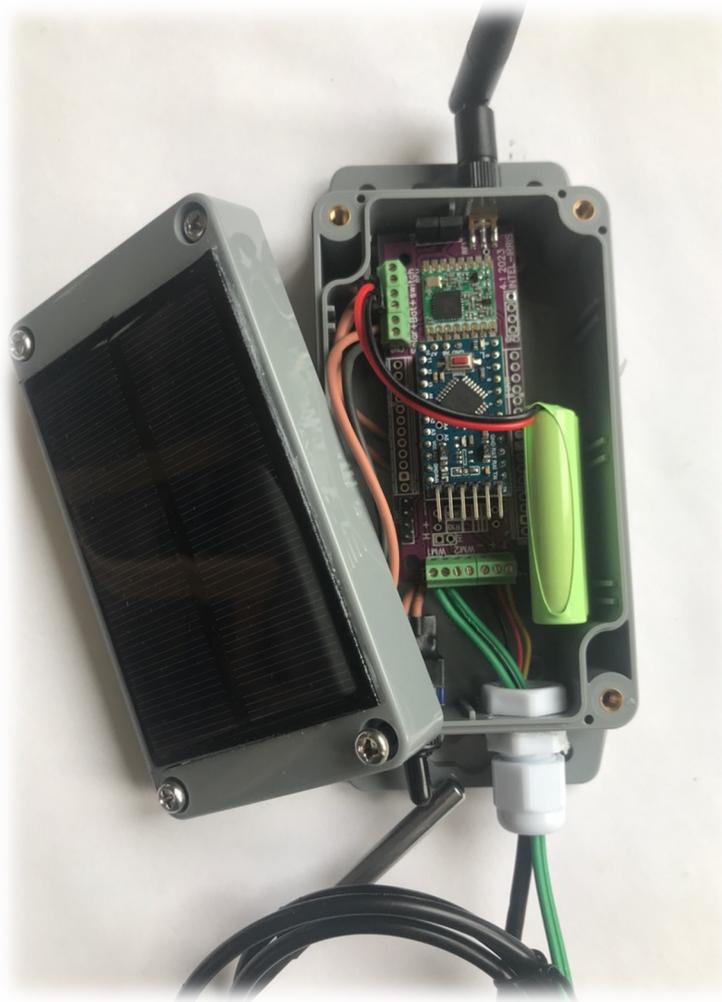
Capacity-building  
with **Erasmus+**



Deployed & Exploited in



# FINAL RESULTS



Prof. Congduc Pham  
<http://www.univ-pau.fr/~cpham>

Technology developed in



Capacity-building  
with **Erasmus+**



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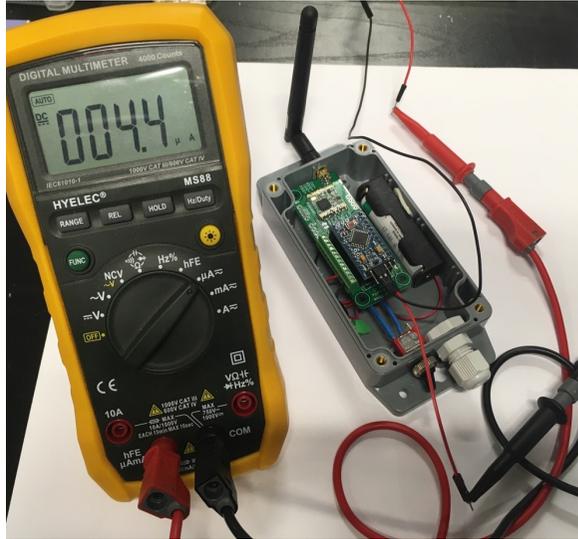
# DEPLOYMENT & PILOTING



Prof. Congduc Pham  
<http://www.univ-pau.fr/~cpham>

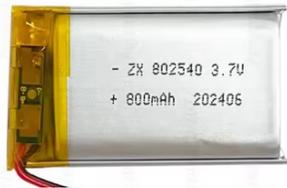


# ENERGY EFFICIENCY



Measured below 5uA in deep sleep, between 2 active periods with transmissions

Expected autonomy with 1 transmission / hour is over 2 years with 2 AA batteries



Li-ion or LiPo = 3.7V



1xAA 14500 3.6V



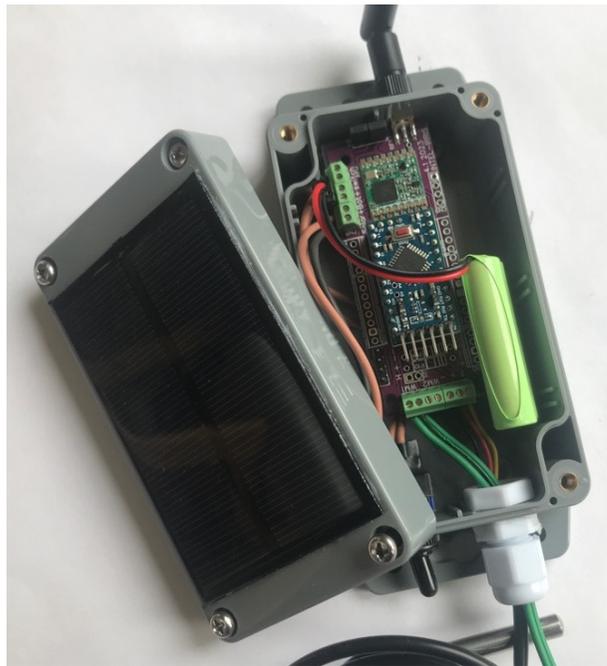
1 x 18650 = 3.7V



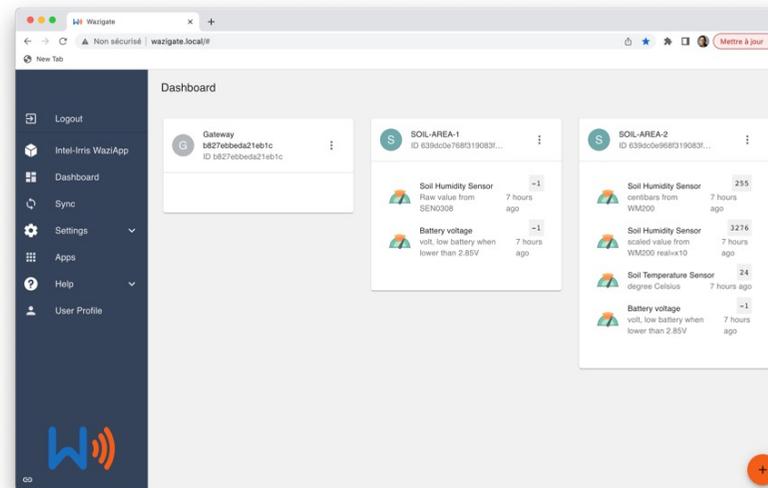
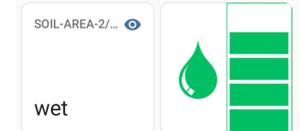
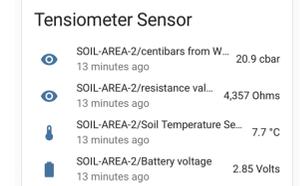
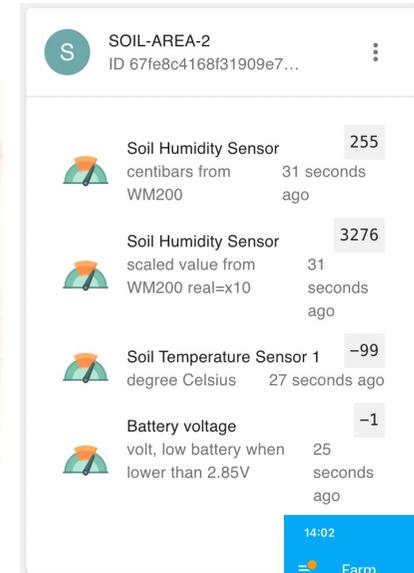
3xAA ~ 4.8V



# DATA TRANSMISSION TO GATEWAY



**LONG RANGE  
RADIO, 3-10KM**



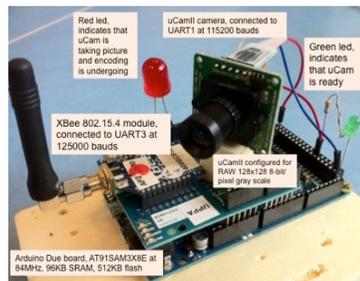
Limited LoRaWAN  
SF12BW125  
868.1MHz  
ABP mode  
Dev addr is 26011DAA  
1 msg/60mins  
1 sensor  
XLPP data



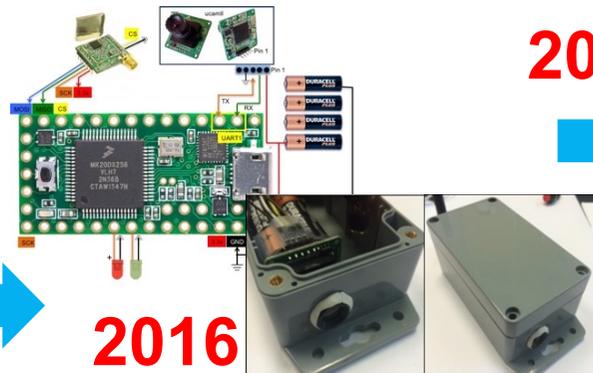
# ADVANCED SENSING SYSTEMS



Many applications need visual information → Image Sensing IoT

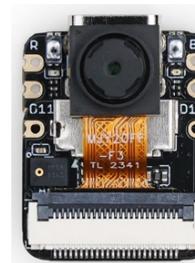


**2012**



**2016**

**2024**



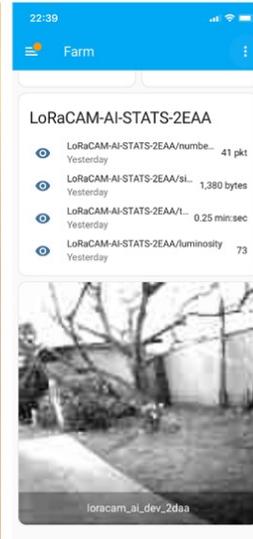
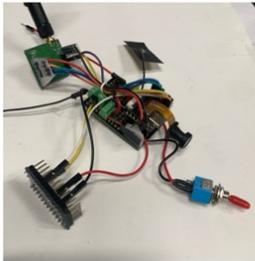
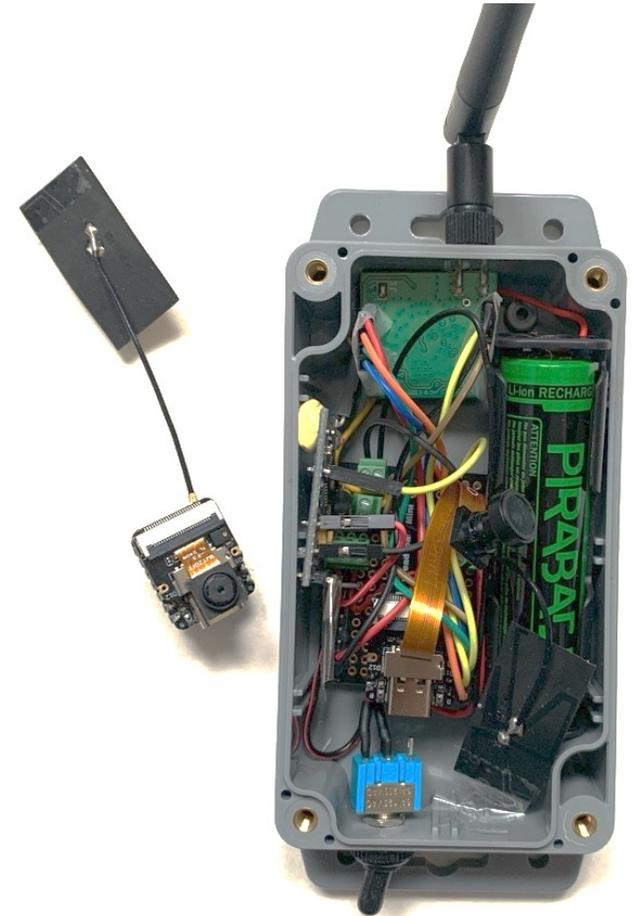
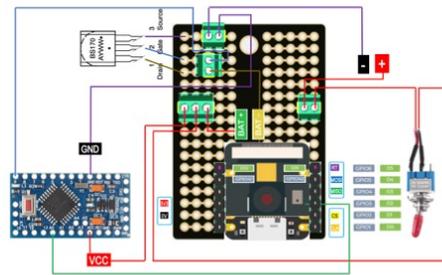
ESP32S3 32-bit, dual-core, up to 240 MHz





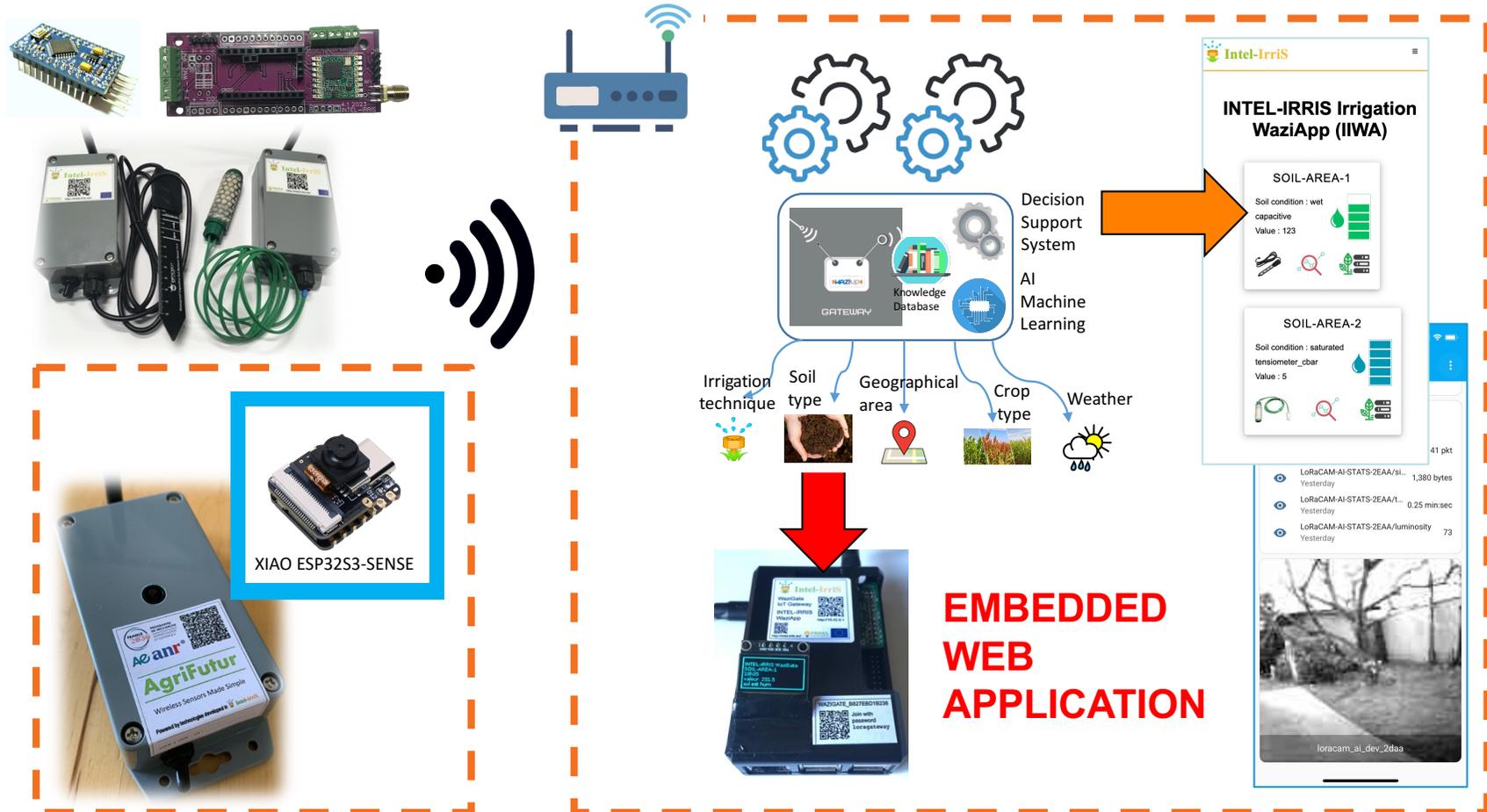
# PROOF-OF-CONCEPT: LORACAM-AI

## UPDATED VERSION IN 2025 FOR THE PEPR AGRIFUTUR PROJECT





# INTELLIGENCE AT THE EDGE



TinyML, TensorFlow Lite,  
 CMSIS-NN, Edge Impulse, etc