



This project is part of the PRIMA Programme supported by the European Union

INTEL-IRRIS
Intelligent Irrigation Systems for Low-Cost Autonomous Water Control in Small-Scale Agriculture

FINAL EVENT

SAVE YOUR DATE!

MOROCCO May 22nd, 2024



Intel-Irris

INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

THE INTEL-IRRIS STARTER-KIT AND MAIN SCIENTIFIC RESULTS

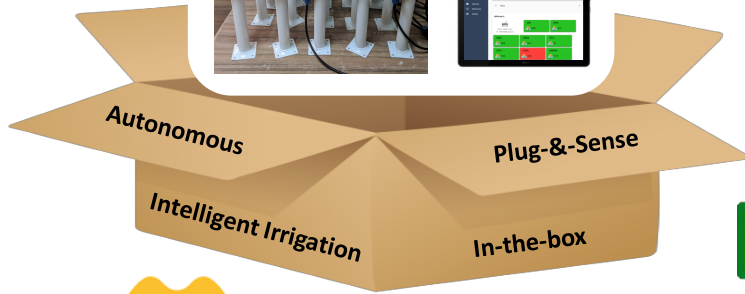
C. Pham, University of Pau, France

INTEL-IRRIS's starter-kit

From idea to reality!



Starter-kit



**Small-scale farms,
 Smallholder Farmers**



NO INTERNET ☹️

2 versions of the soil device



~ 30€

**SEN0308
capacitive sensor**


~ 60€

**Watermark WM200
Water tension sensor**



**A soil temperature
sensor can be added**

**Especially for
tensiometer**

A young green plant with several leaves is growing in a pot. In the foreground, a black irrigation tube is visible, partially buried in the soil. The background is a blurred, light-colored surface, possibly a table or a tray.

INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control
in Small-scale Agriculture

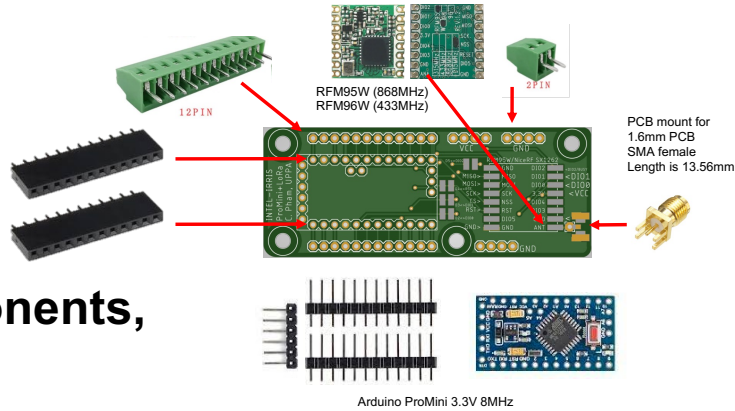
THE INTEL-IRRIS
STARTER-KIT v3

1 – the soil device

Low-cost design space

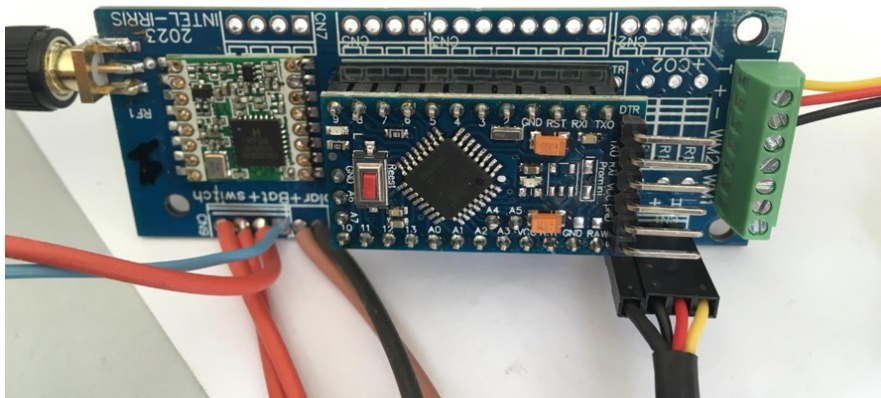
1

Simple design, off-the-shelves components, **100% DIY**



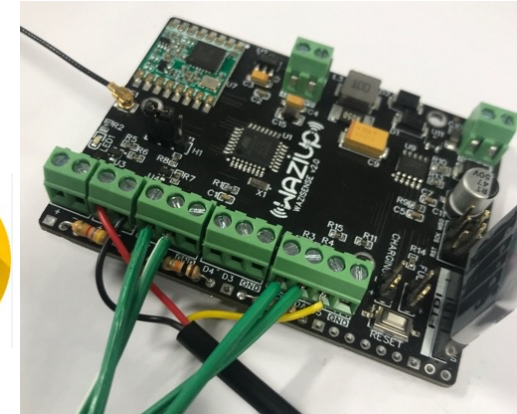
Simple design, off-the-shelves components, **low-cost support for solar panel, some components already soldered, mixed-DIY**

2



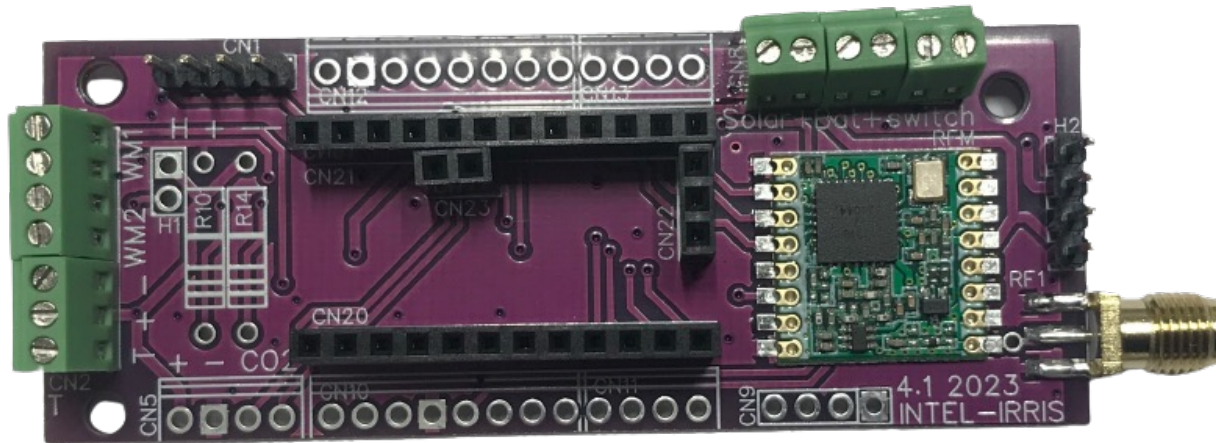
3

Integrated design, off-the-shelves components, **full support for solar panel, all components already soldered**



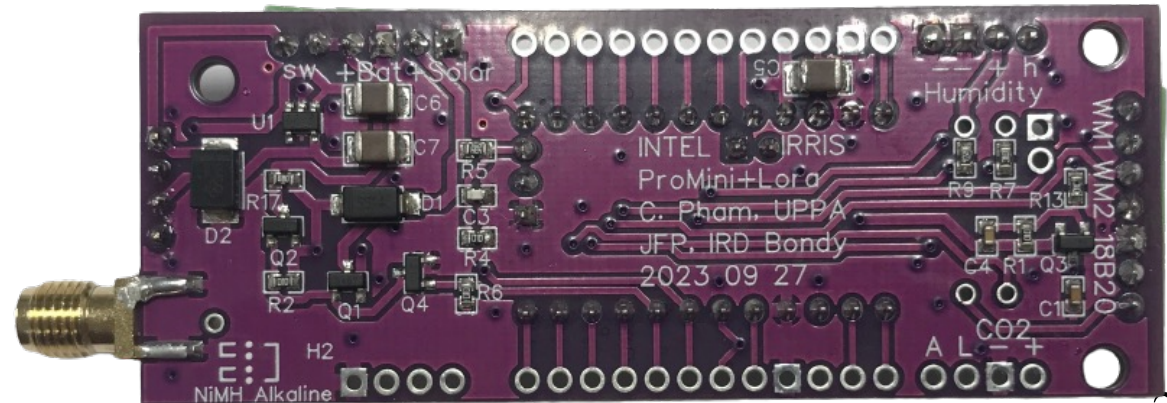
The latest INTEL-IRRIS sensor board

- ⦿ The PCB is already fully assembled, including the resistors for the temperature and watermark sensors (on the back side)



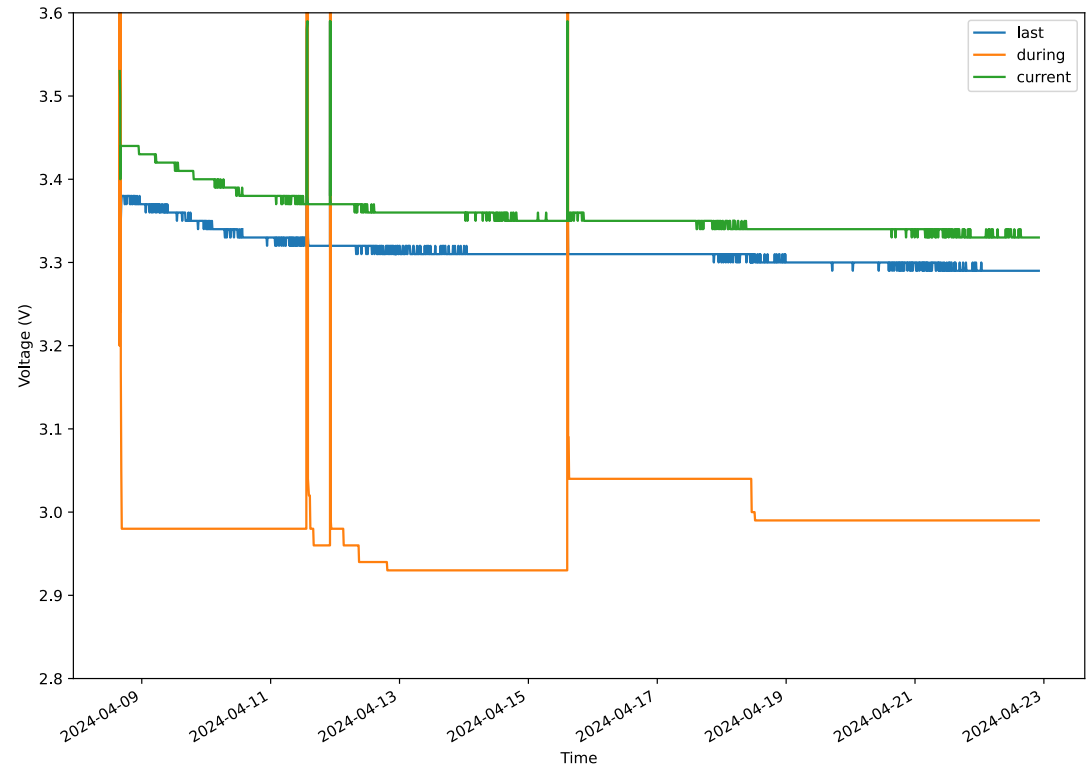
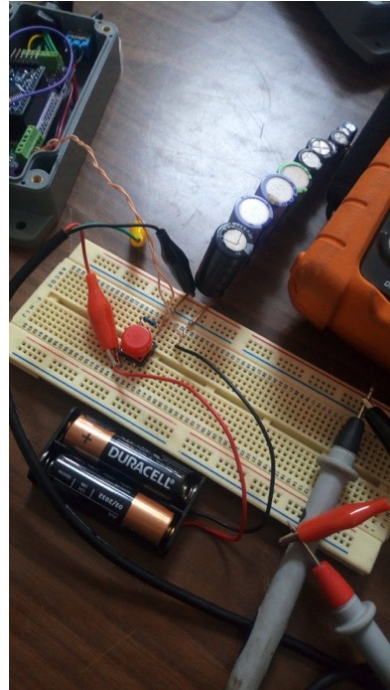
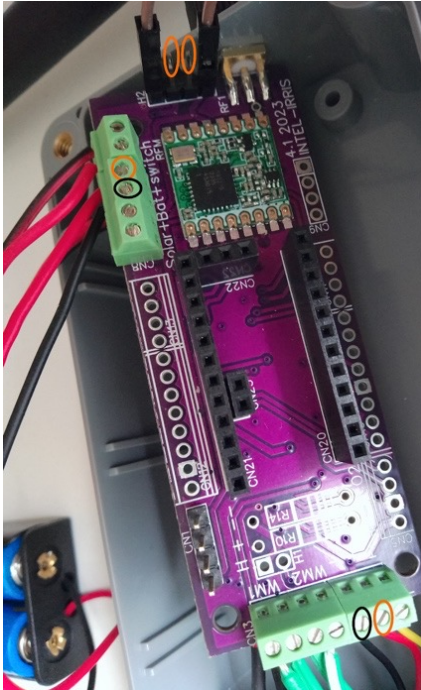
Radio module is already mounted, as well as connectors

Solar charging is available and the solar circuit is on the back side

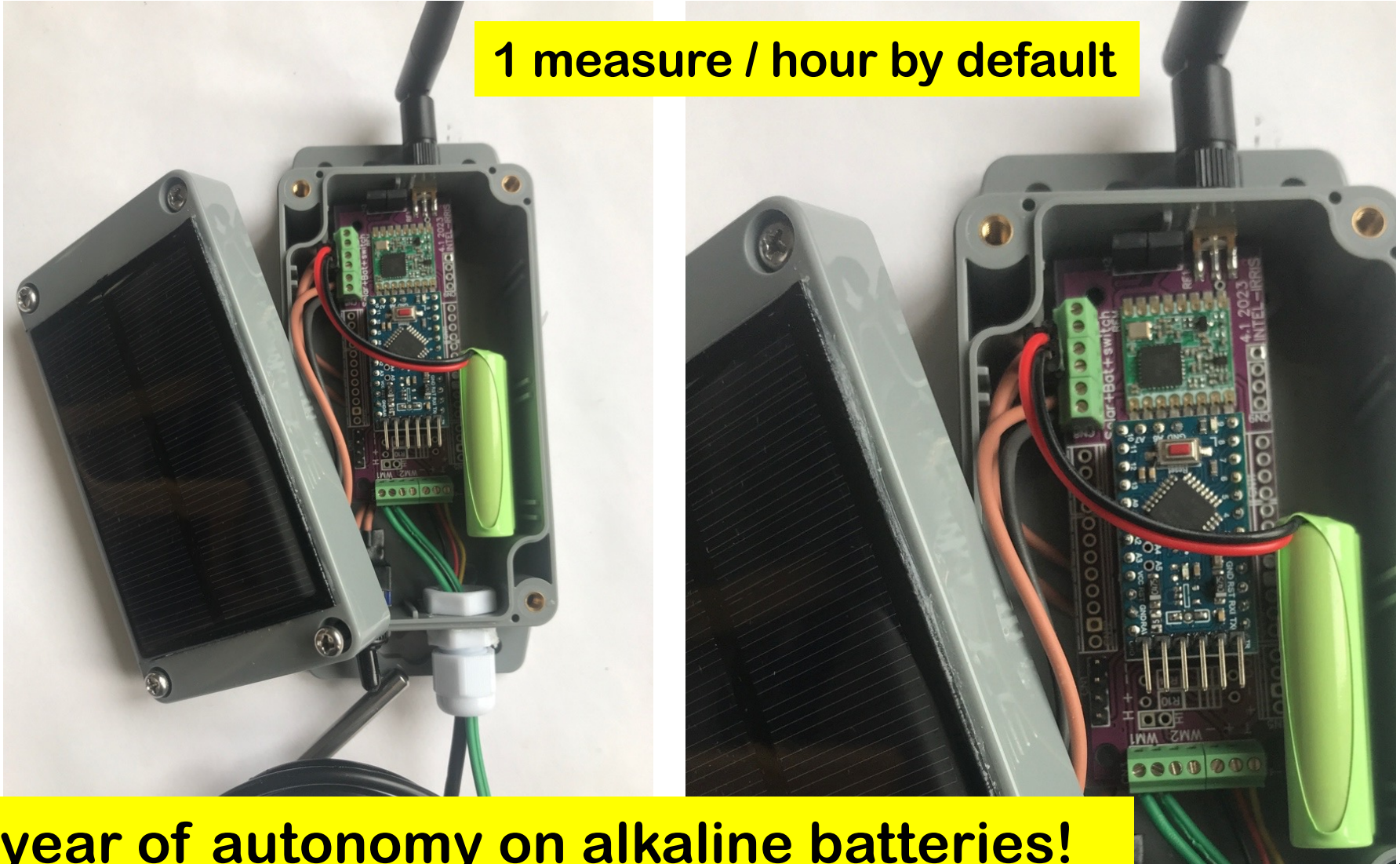


Energy management

- ⦿ A lot of efforts have been devoted to carefully measure energy consumption and to optimize energy management

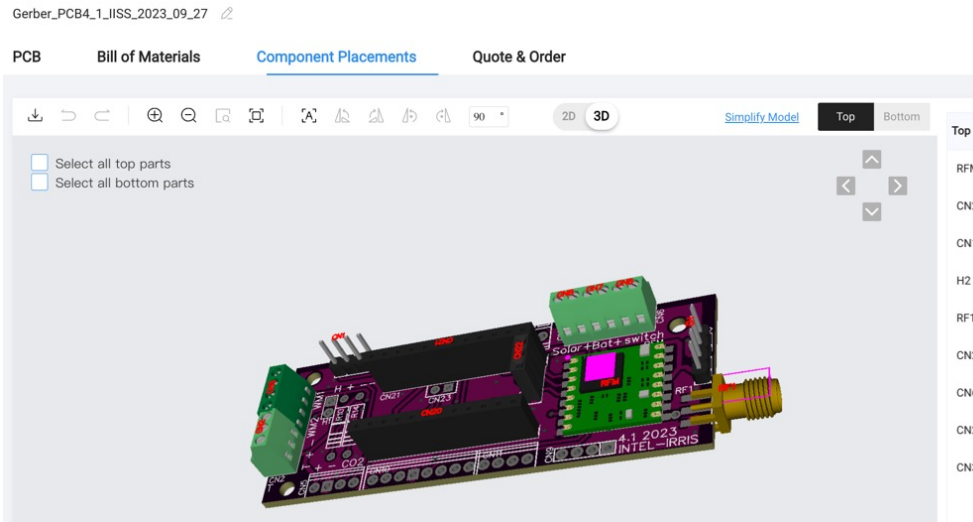


The INTEL-IRRIS soil device

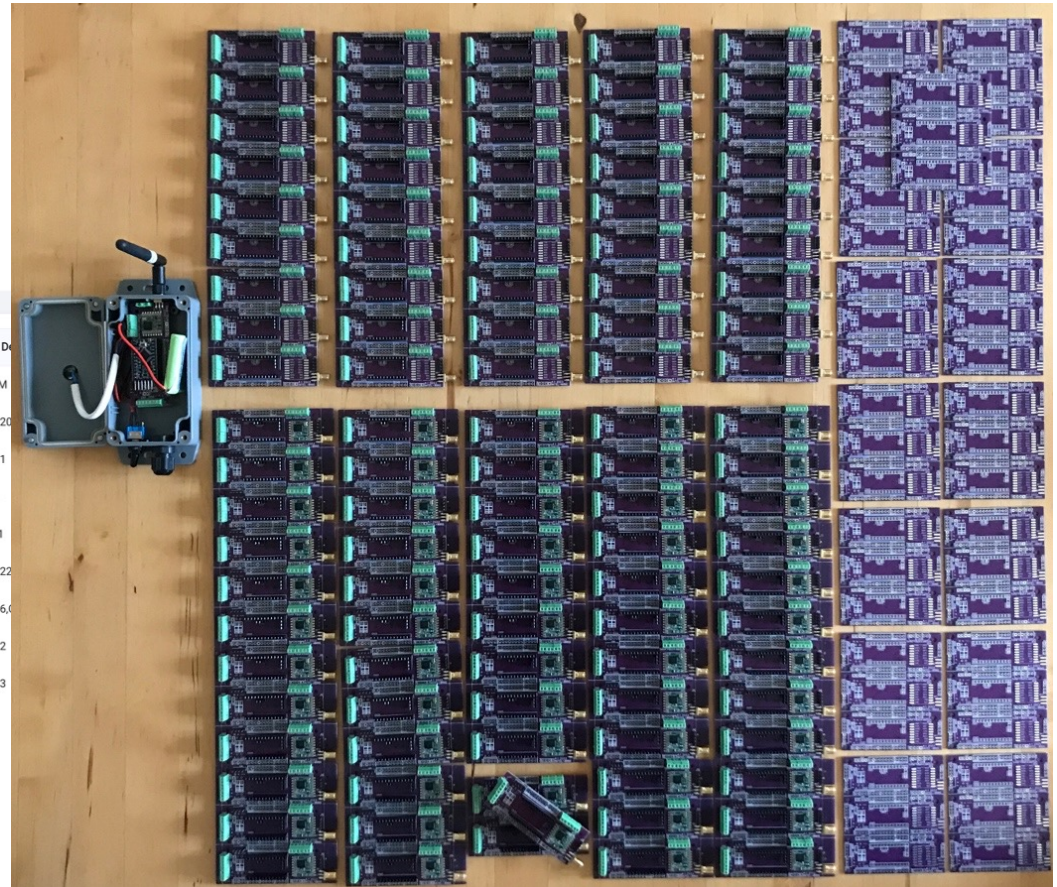


Ordering the fully assembled PCB

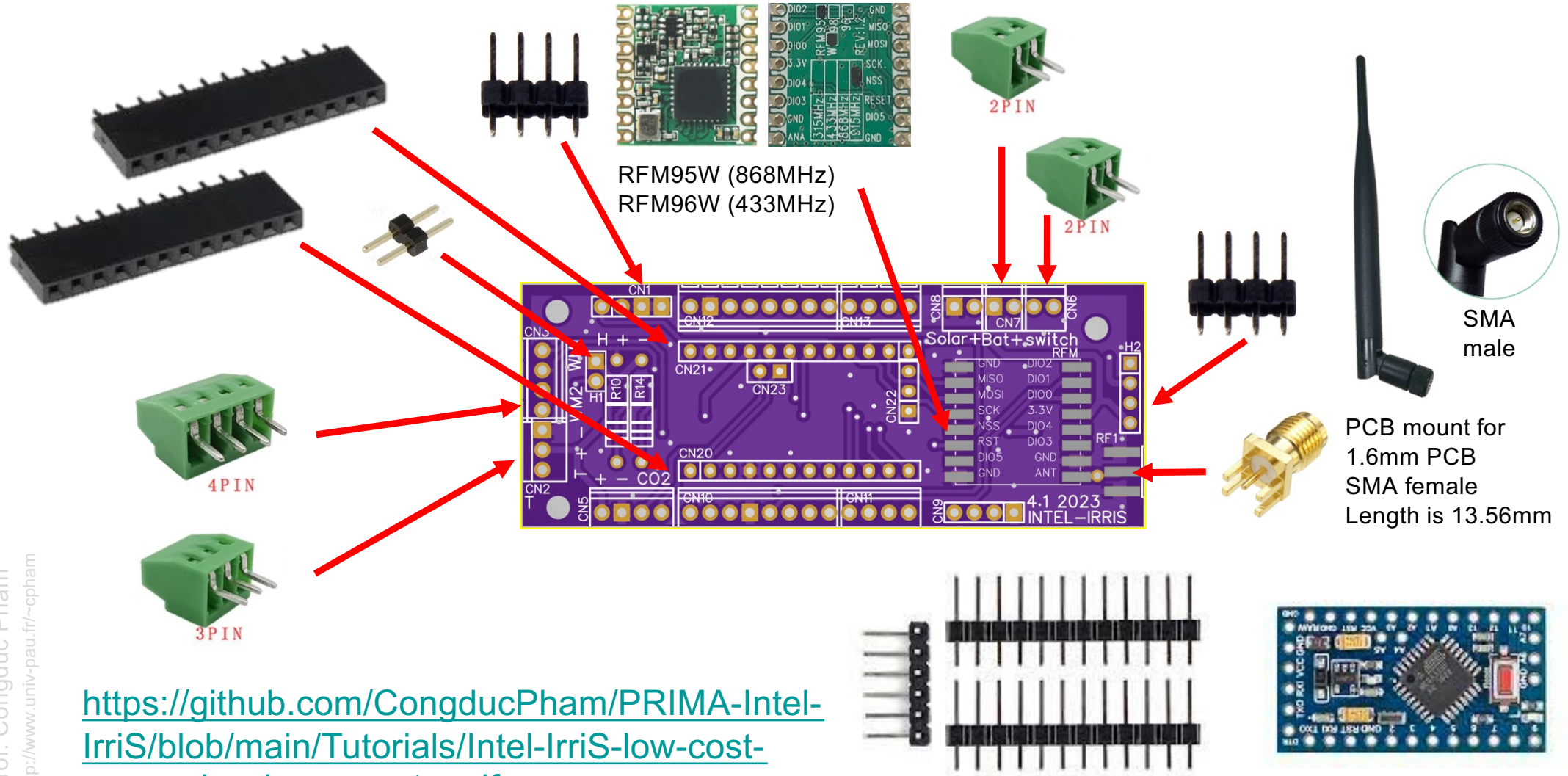
- Ordering the fully assembled PCB is very simple from PCB manufacturer
- Manufacturing files are freely available



~ 8€/piece if QT > 100



100% DIY is still possible!

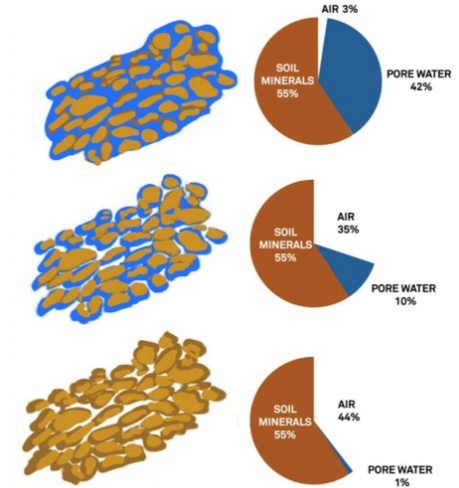
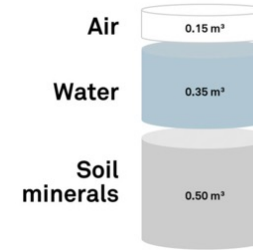


<https://github.com/CongducPham/PRIMA-Intel-IrriS/blob/main/Tutorials/Intel-IrriS-low-cost-sensor-hardware-parts.pdf>

Arduino ProMini 3.3V 8MHz

Capacitive sensor

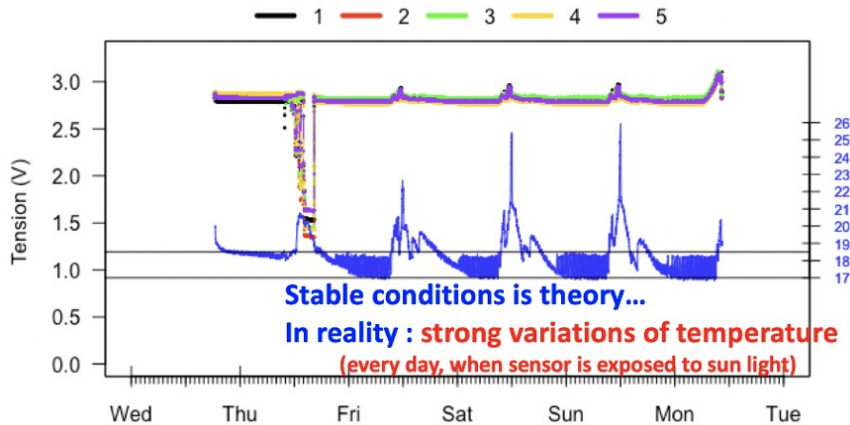
- Capacitive soil moisture sensors usually measure volumetric water content
- Soil density & soil texture are important parameters



From METER group



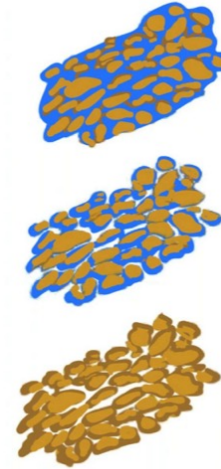
Impact of temperature ?



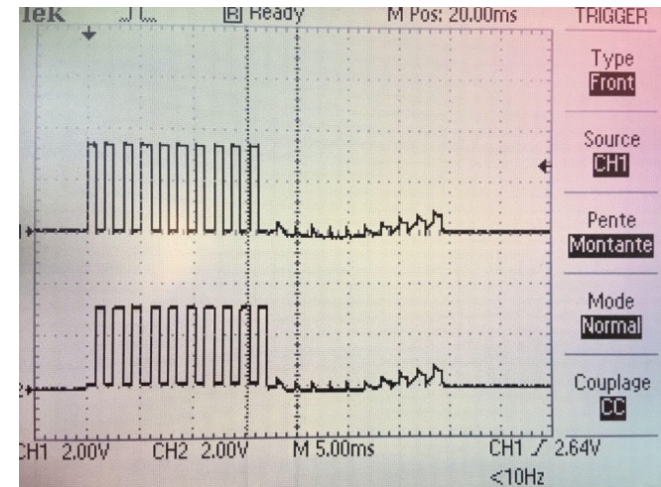
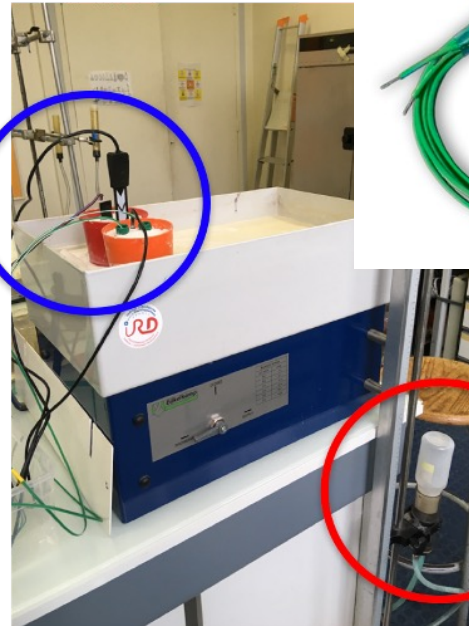
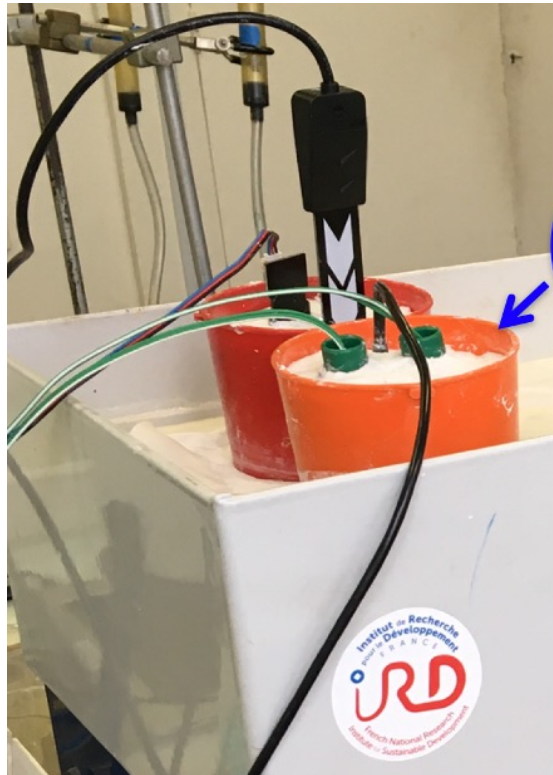
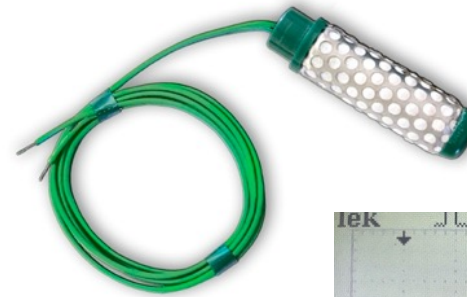
IRD in conducting extensive test on the accuracy and the stability of the low-cost SEN0308 capacitive sensor

Water tension sensor

- Water tension sensor measures the amount of force required to extract water from soil's pores



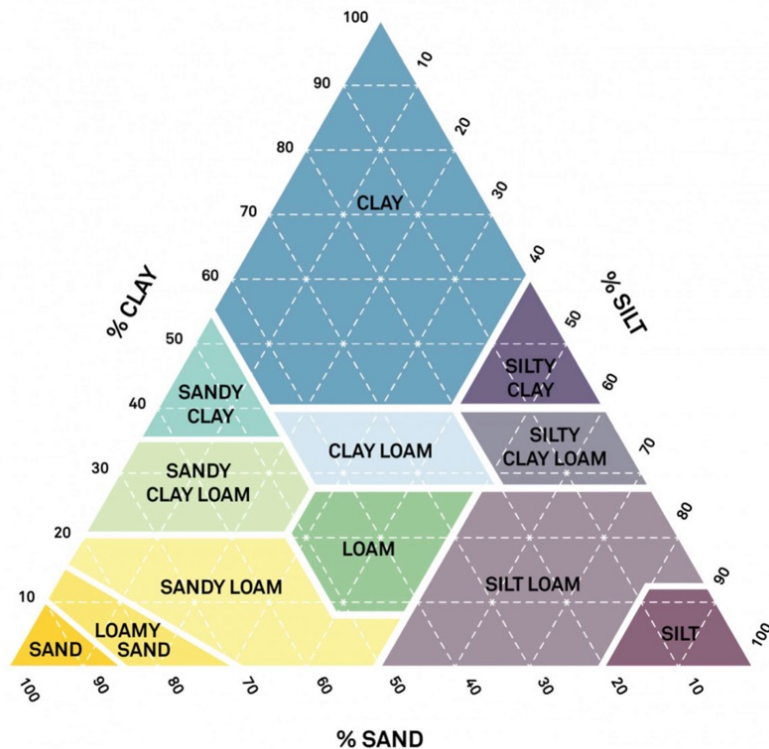
From METER group



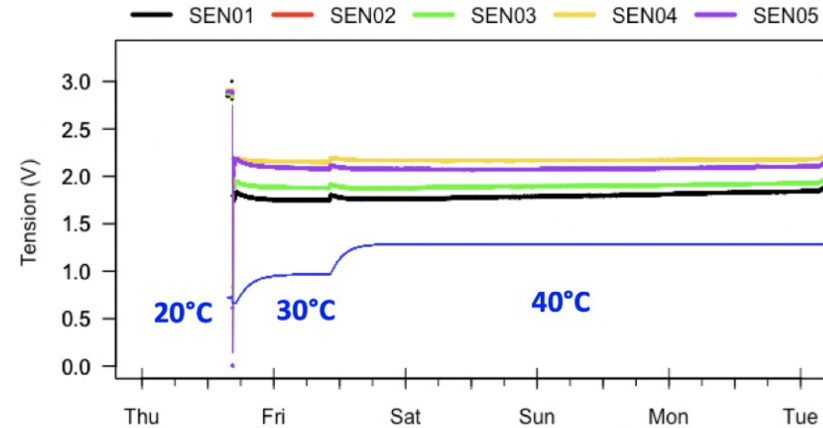
IRD in conducting extensive tests on the stability & suitability of microcontroller-based usage of the Watermark water tension sensor

Calibration

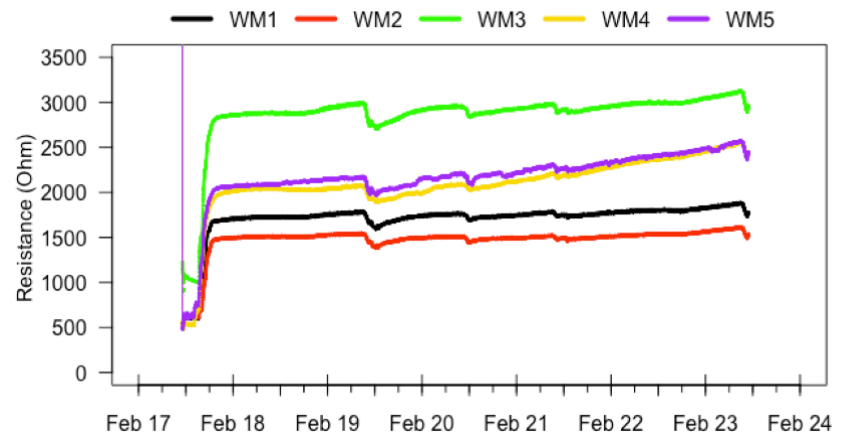
- Soil-specific calibration
- Impact of external "noise"



SEN 0308




Ambient air emperature has low impact, except...



Tests in controlled environments





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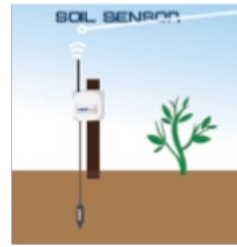
THE INTEL-IRRIS
STARTER-KIT v3

2 – the IoT gateway

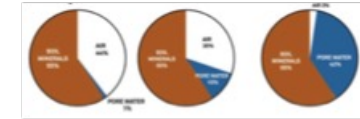
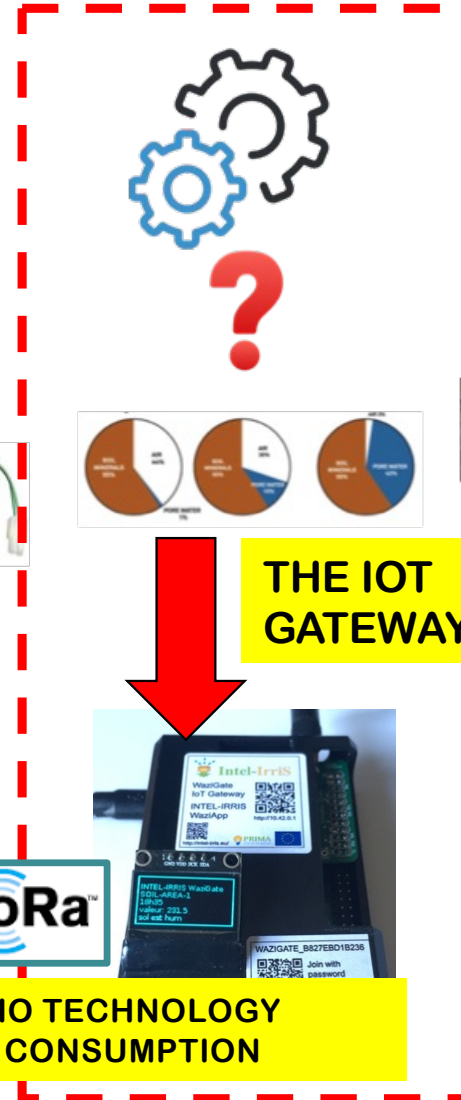
Towards Plug-&-Sense



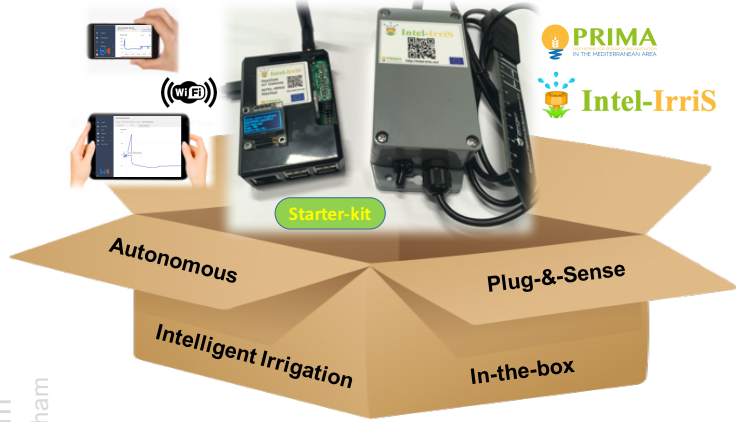
NO INTERNET ☹️



**LONG-RANGE RADIO TECHNOLOGY
VERY LOW POWER CONSUMPTION**



THE IOT GATEWAY

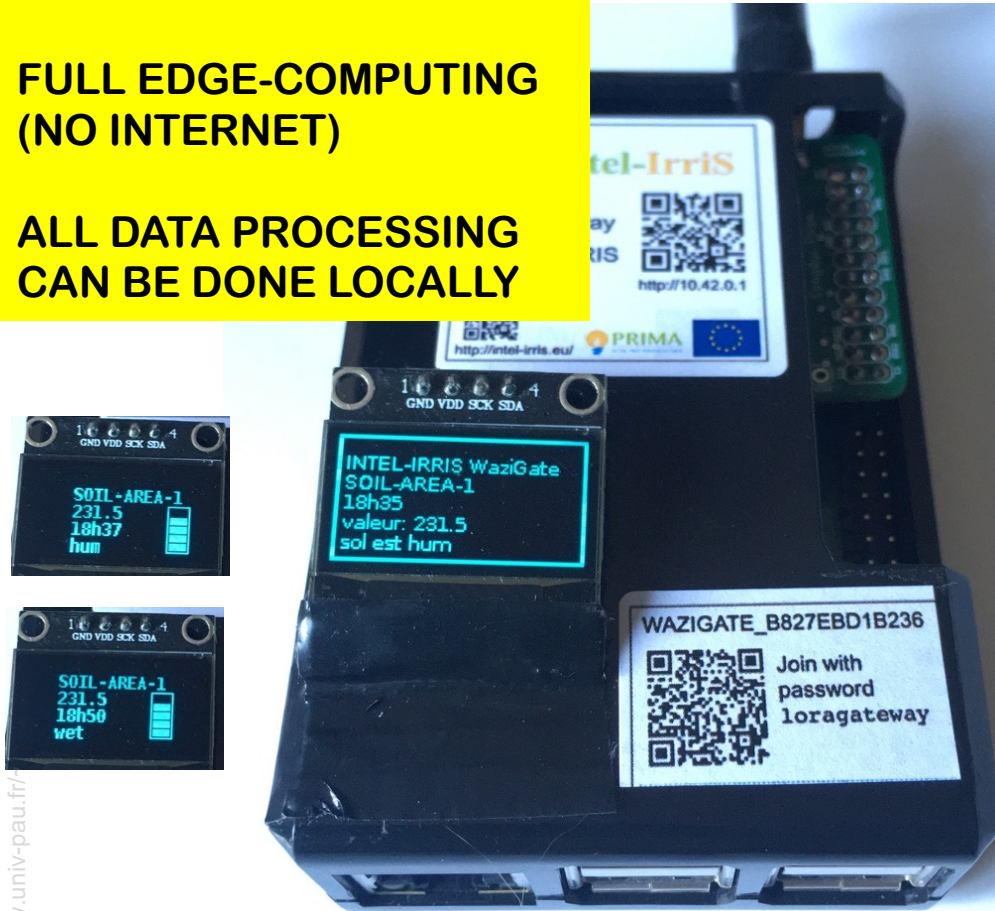


Gateway: collect sensor data

WAZIGATE GATEWAY

**FULL EDGE-COMPUTING
 (NO INTERNET)**

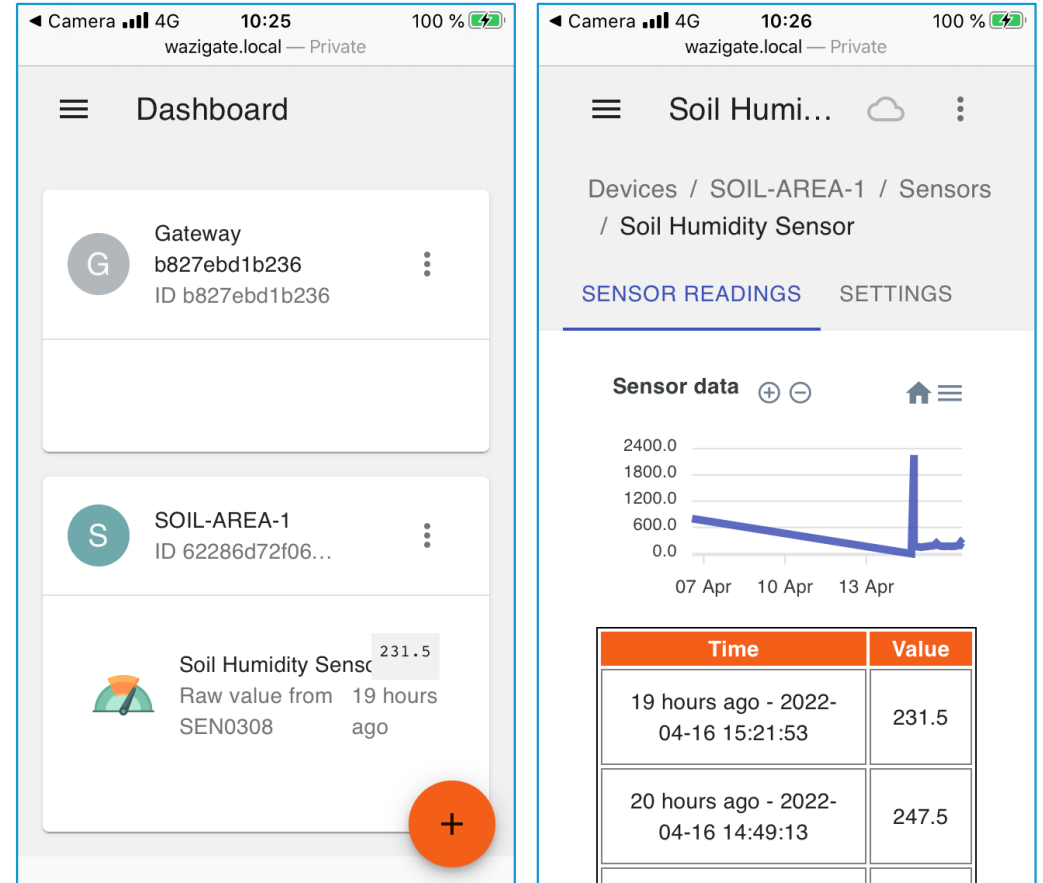
**ALL DATA PROCESSING
 CAN BE DONE LOCALLY**



**1 GATEWAY HANDLES
 SEVERAL DEVICES**

< 50€

EMBEDDED WEB INTERFACE


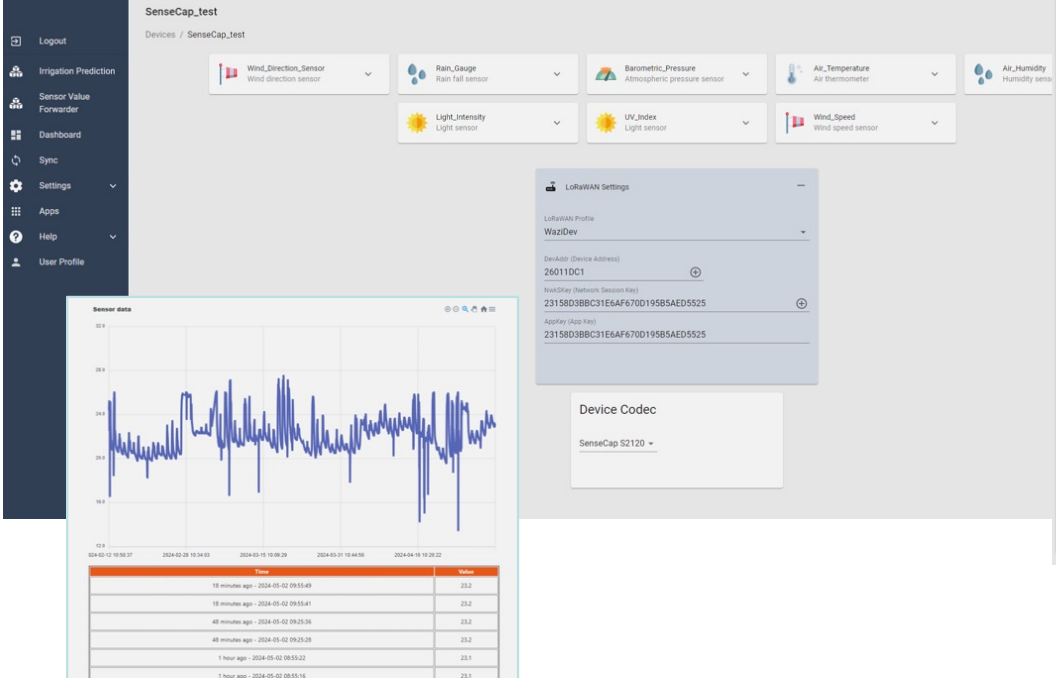


EASILY ACCESSED FROM A SMARTPHONE

Integration of other sensors

- ⦿ The gateway dashboard can be extended to receive, decode and display data from third-party sensors
- ⦿ e.g. the SenseCAP S2120 8-in-1 LoRaWAN Weather Sensor

<https://github.com/Waziup/WaziGate-SenseCap-S2120-integration>

The dashboard displays the following sensor data:

- Wind_Direction_Sensor: 14 °
- Rain_Gauge: 0 mL
- Barometric_Pressure: 98420 P
- Air_Temperature: 23.2 °C
- Air_Humidity: 45 %
- Light_Intensity: 0 lx
- UV_Index: 0 lm
- Wind_Speed: 0 m/s

The LoRaWAN Settings section shows:

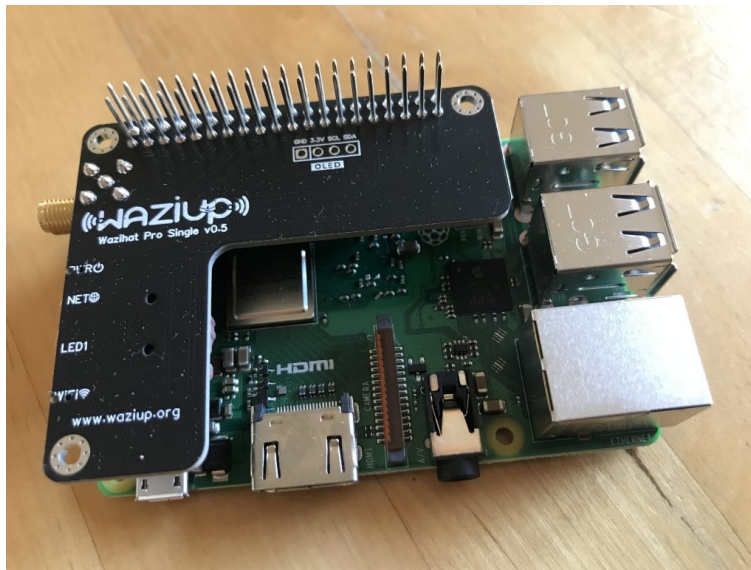
- LoRaWAN Profile: WaziDev
- DevAddr (Device Address): 26011DC1
- NwkIDKey (Network Session Key): 23158D3BBC31E6AF670D19585AED5525
- AppKey (App Key): 23158D3BBC31E6AF670D19585AED5525
- Device Codec: SenseCap S2120

The sensor data graph shows a fluctuating signal over time, with a table below it:

Time	Value
18 minutes ago - 2024-05-02 09:55:49	23.2
18 minutes ago - 2024-05-02 09:55:41	23.2
48 minutes ago - 2024-05-02 09:25:36	23.2
48 minutes ago - 2024-05-02 09:25:28	23.2
1 hour ago - 2024-05-02 08:55:22	23.1
1 hour ago - 2024-05-02 08:55:16	23.1

The latest gateway version

- ⦿ New LoRa radio hat
 - ⦿ With embedded Real Time Clock for full edge-mode operation
 - ⦿ On-board OLED connectors
 - ⦿ LED indicator for Internet connectivity
- ⦿ New casing with open-source 3D design



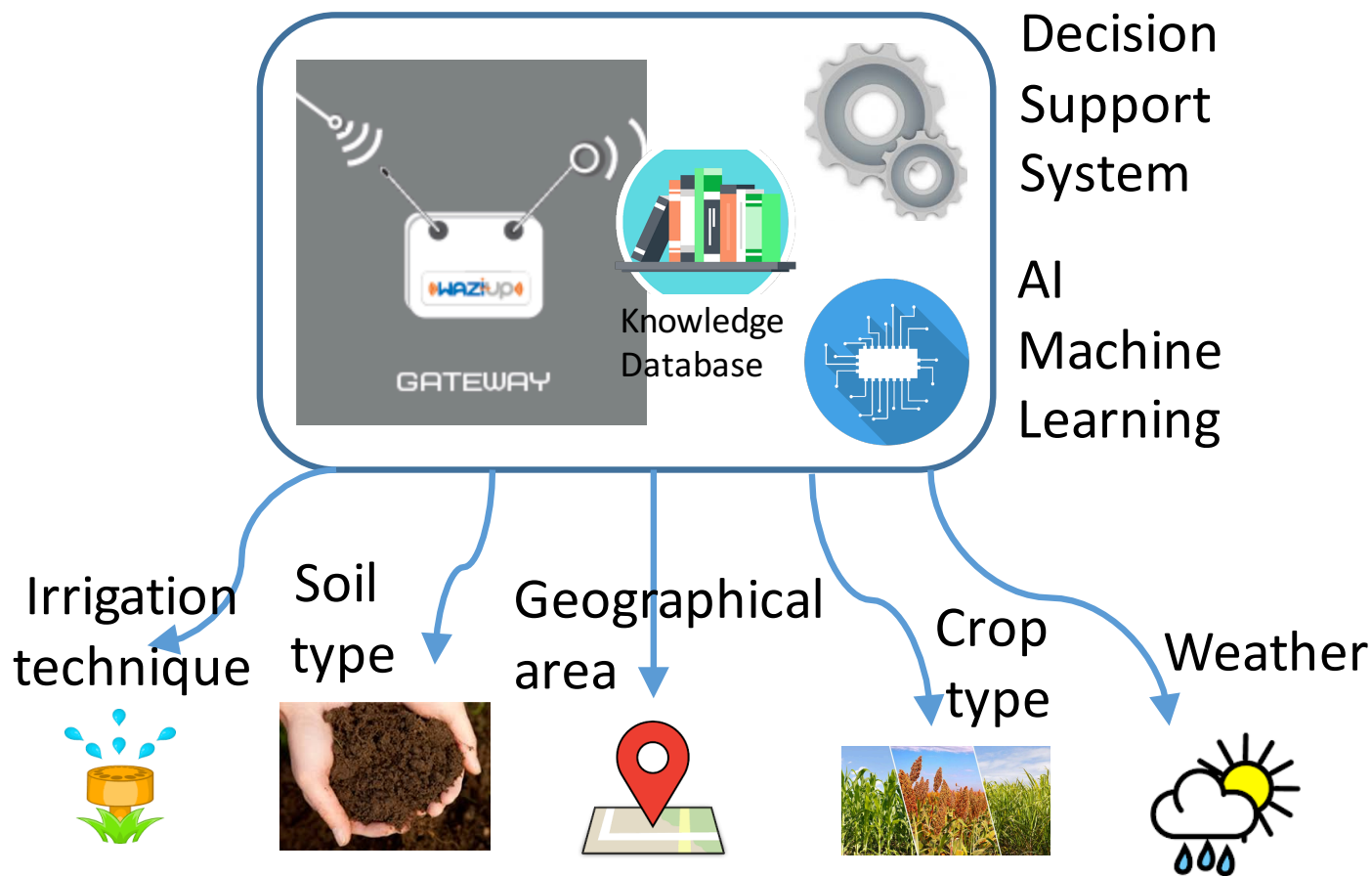
A young green plant with several leaves is growing in a field. In the foreground, a black irrigation pipe is visible, with a small droplet of water on its surface. The background is a blurred field of similar plants and soil.

INTEL-IRRIS

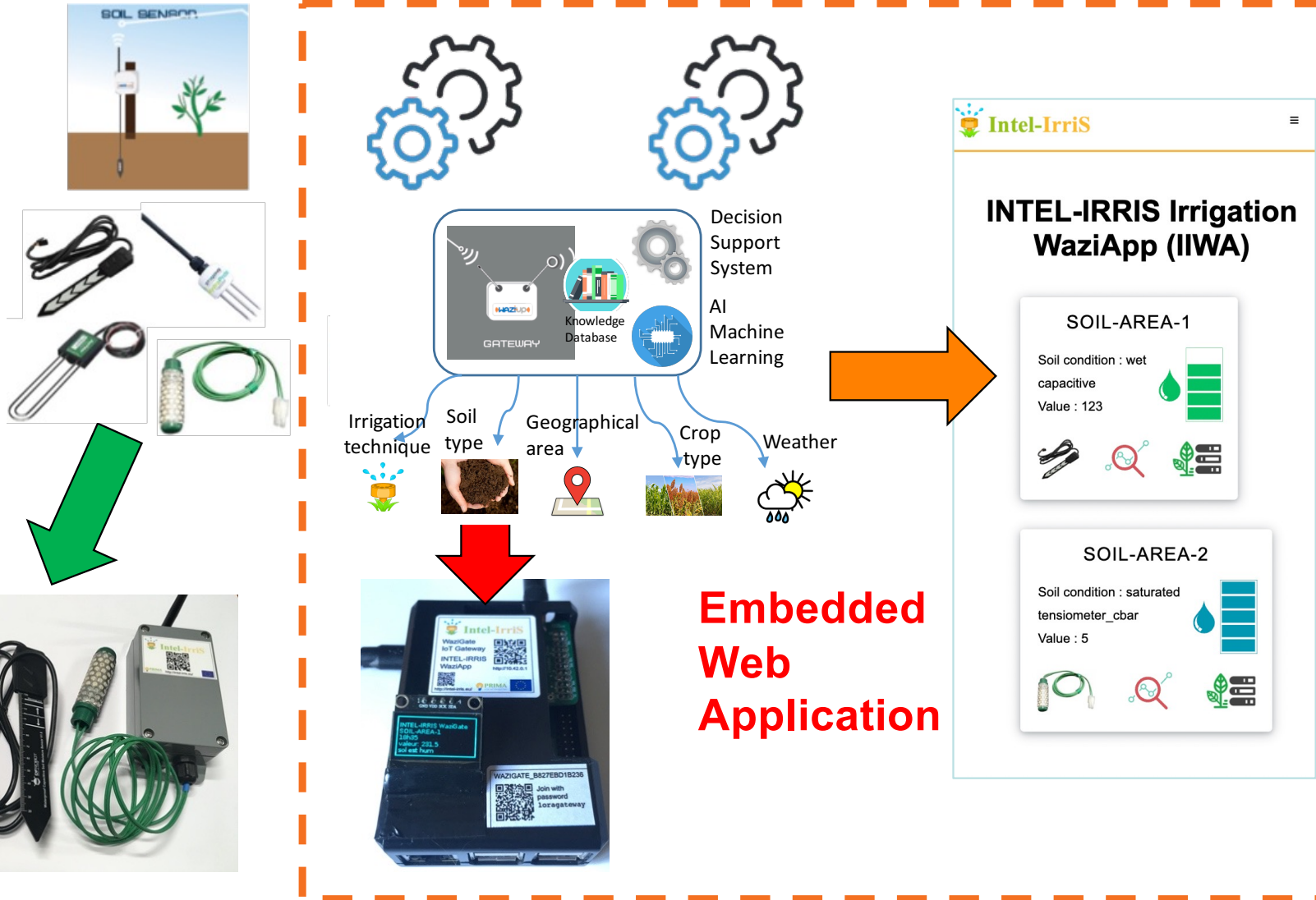
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MAKE IT SMARTER?

Added value: embedded intelligence!

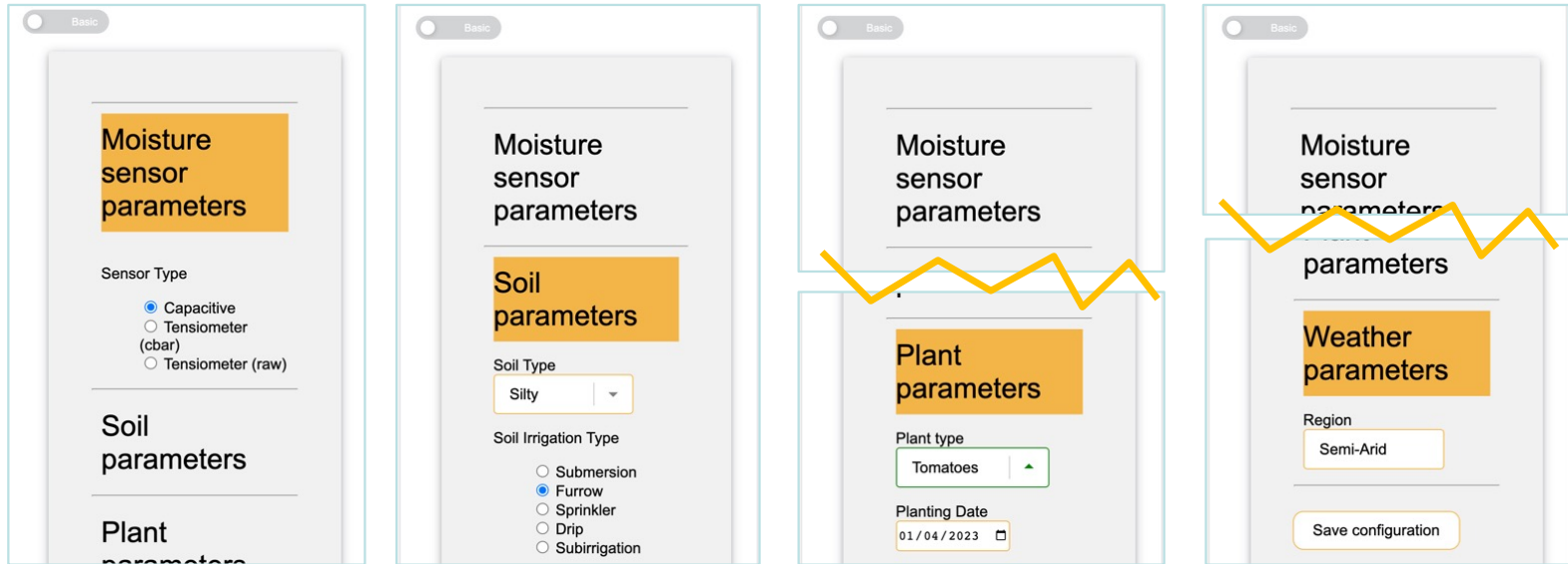


INTEL-IRRIS: add intelligence

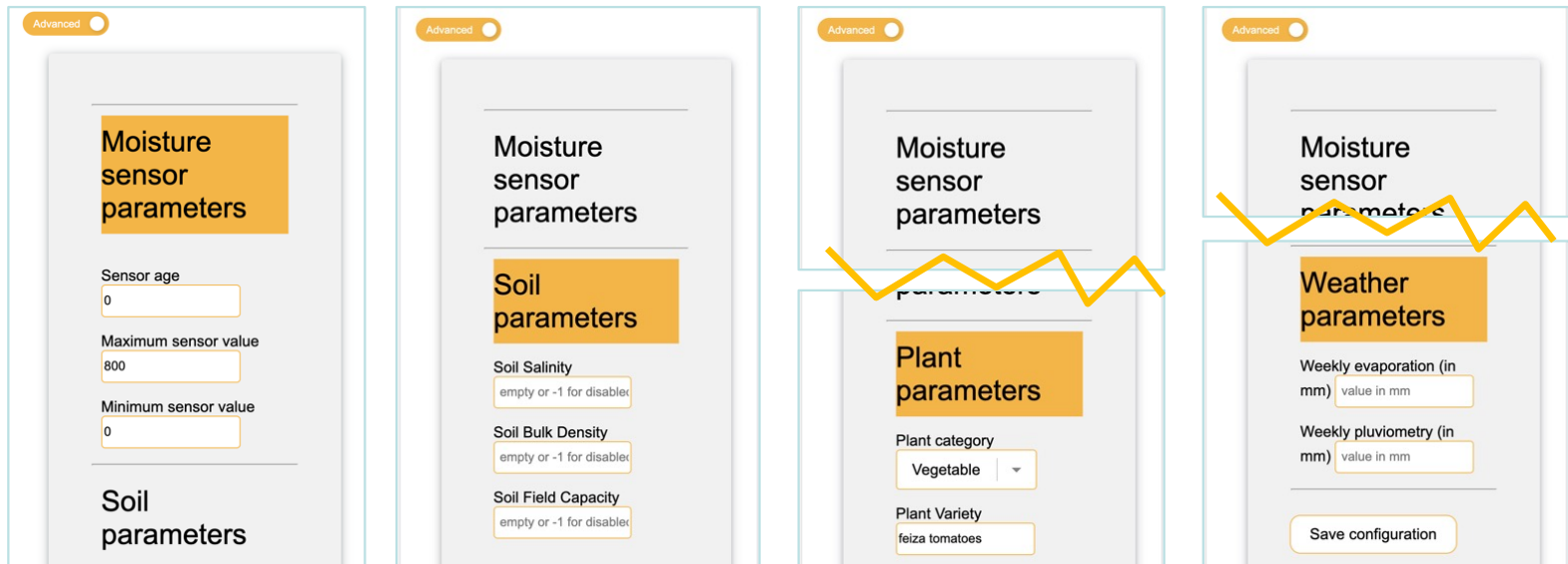


IIWA advanced parameters

Basic

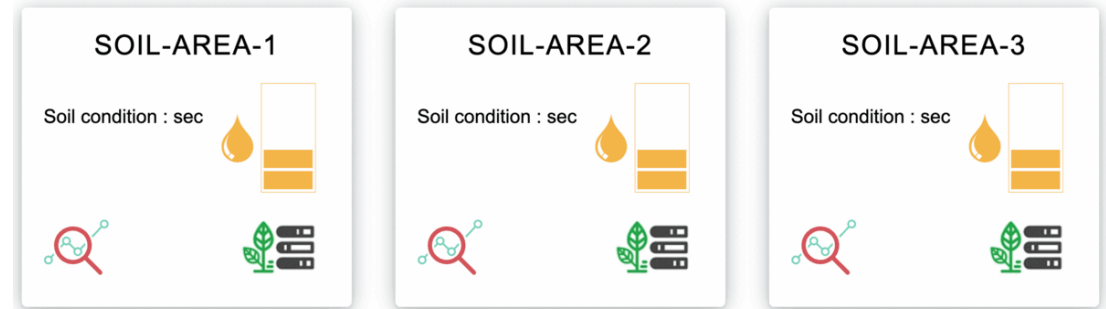


Advanced

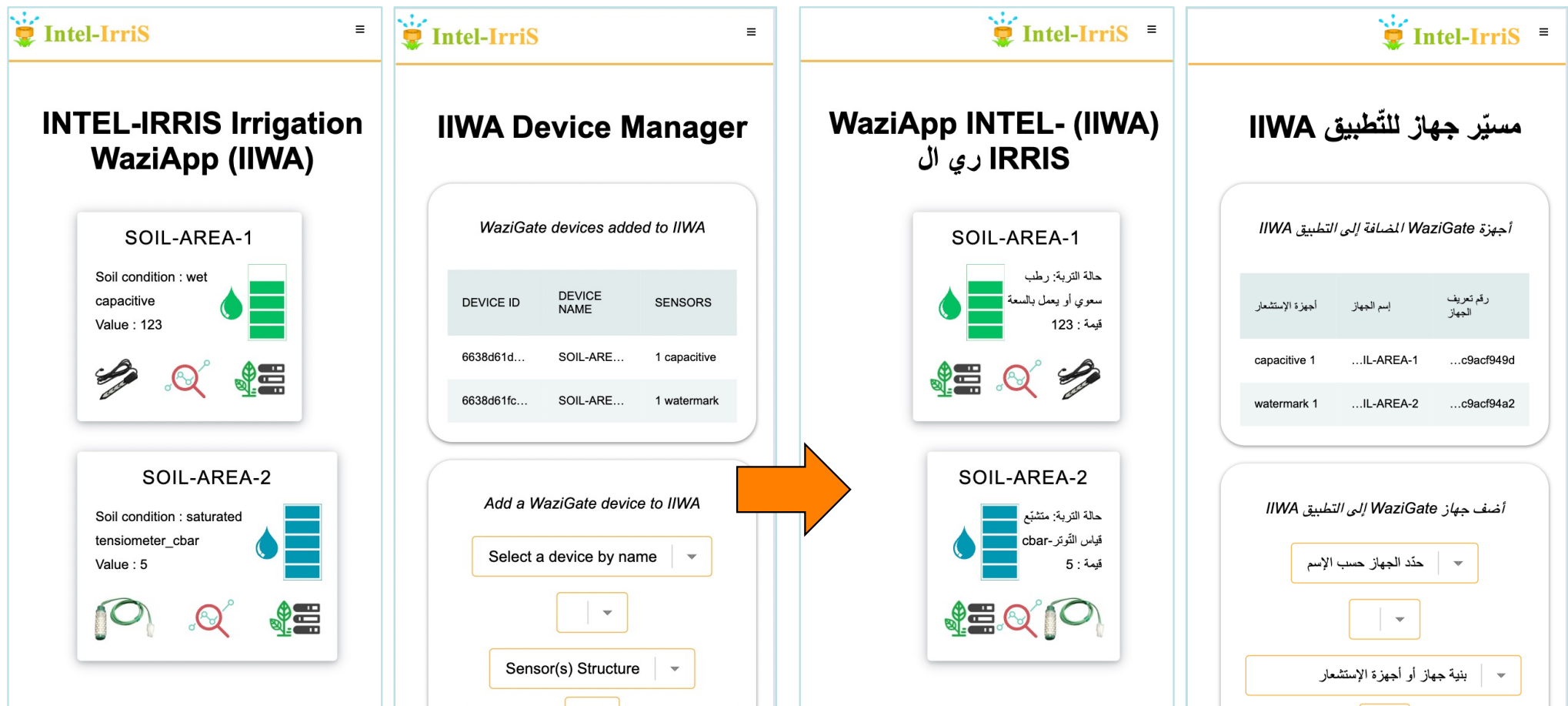


First IIWA demo at Mostaganem event

- March 7th, 2023
- Real-time demo of soil sensor + IIWA



NEW! Arabic language is supported in IIWA!



The image displays four screenshots of the Intel-Irris WaziApp (IIWA) interface, illustrating the transition from English to Arabic. An orange arrow points from the English version to the Arabic version.

English Version (Left):

- INTEL-IRRIS Irrigation WaziApp (IIWA)**
- SOIL-AREA-1**: Soil condition : wet capacitive, Value : 123
- SOIL-AREA-2**: Soil condition : saturated tensiometer_cbar, Value : 5
- IIWA Device Manager**: WaziGate devices added to IIWA

DEVICE ID	DEVICE NAME	SENSORS
6638d61d...	SOIL-ARE...	1 capacitive
6638d61fc...	SOIL-ARE...	1 watermark

- Add a WaziGate device to IIWA**: Select a device by name, Sensor(s) Structure

Arabic Version (Right):

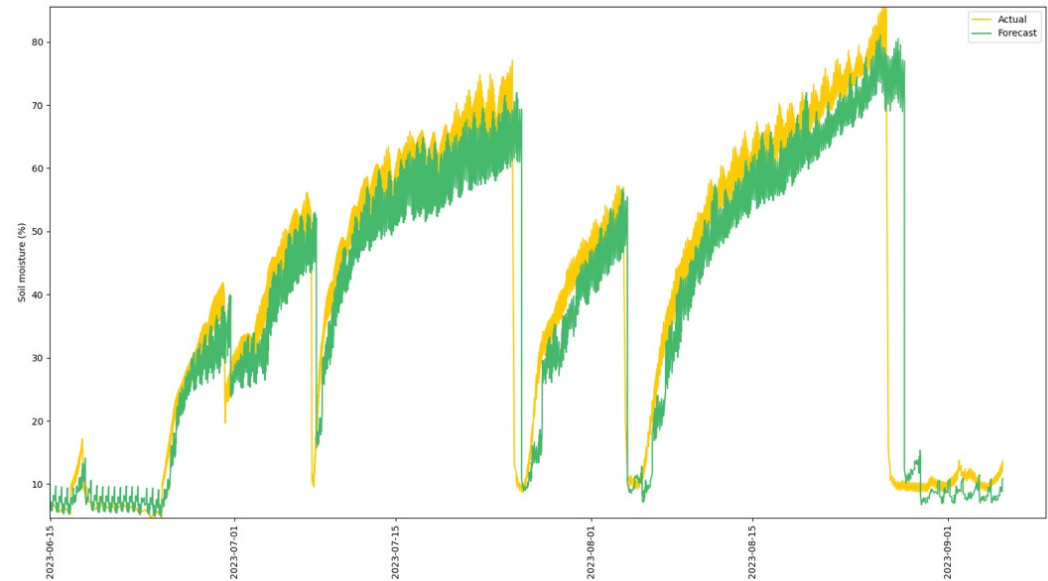
- WaziApp INTEL- (IIWA) ربي ال IRRIS**
- مسير جهاز للتطبيق IIWA**: IIWA WaziGate المضافة إلى التطبيق IIWA

رقم تعريف الجهاز	اسم الجهاز	أجهزة الاستشعار
...c9acf949d	...IL-AREA-1	capacitive 1
...c9acf94a2	...IL-AREA-2	watermark 1

- أضف جهاز WaziGate إلى التطبيق IIWA**: حدد الجهاز حسب الاسم, بنية جهاز أو أجهزة الاستشعار

Embedded AI forecast

- The INTEL-IRRIS gateway can embed advanced AI processing on real-time sensor data
- **Current techniques:** sliding windows pre-treatment and LSTM Neural Networks (Long Short-Term Memory)





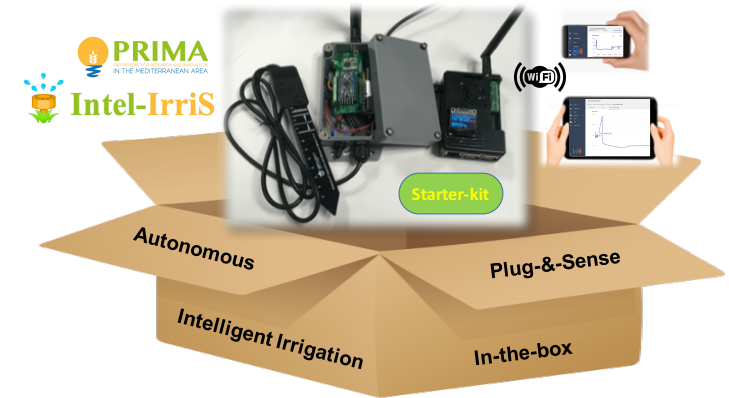
INTEL-IRRIS

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PILOTING WITH FARMERS & USERS

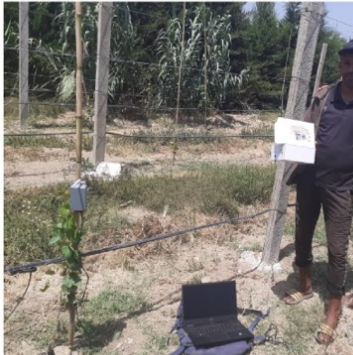
Smallholder Piloting Program

- ⦿ Participatory approach to co-design & test the innovative solutions in fields
- ⦿ Benefit from smallholders' expertise to improve efficiency of the irrigation system
- ⦿ Take into account region-dependent technical, agricultural, social, climatic and environmental aspects
- ⦿ Will run for 24 months to ensure that the proposed irrigation systems are well tailored for the specificities of the regional context



Piloting farms, visits, deployment, ... Intel-IrriS





A young green plant with several leaves is growing in a field. In the foreground, a black irrigation pipe is visible, with a small droplet of water on its surface. The background is a blurred field of similar plants and soil.

INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control
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**CAPACITY-BUILDING
& TRAINING**

Tutorial materials

INTELLIGENT IRRIGATION SYSTEM
FOR LOW-COST AUTONOMOUS
WATER CONTROL
IN SMALL-SCALE AGRICULTURE



Building the Intel-IrriS LoRa IoT platform
Part 1: soil sensor device



INTELLIGENT IRRIGATION SYSTEM
FOR LOW-COST AUTONOMOUS
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Building the Intel-IrriS LoRa IoT platform
Part 2: edge-enabled gateway (WaziGate)



INTELLIGENT IRRIGATION SYSTEM
FOR LOW-COST AUTONOMOUS
WATER CONTROL
IN SMALL-SCALE AGRICULTURE



Building the Intel-IrriS IoT platform
Annex-1: ordering PCBs



INTELLIGENT IRRIGATION SYSTEM
FOR LOW-COST AUTONOMOUS
WATER CONTROL
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Building the Intel-IrriS LoRa IoT platform
Part 3: the INTEL-IRRIS starter-kit



Centre Régional de la Recherche Agronomique de Tadia
Unité de Recherche : Système de Production en Irrigué

Irrigation : concepts et état des lieux



Présenté par : **Dr. BOUZZAMA Bassou**
Chercheur et Ingénieur en Génie Rural
Bassou.bouzzama@irra.ma

Webinaire (1^{ère} édition)
Irrigation : concepts et état des lieux
Intel-IrriS

L'eau dans le sol et les contraintes de l'irrigation
Pr BENKHELIFA Mohammed (UMAB)

Build the LoRa IoT microcontroller platform for the PRIMA IN...
Watch later Share

THAT'S ALL THE BOARD IS READY FOR
NOW LET'S MOVE IT INTO OUTDOOR ENCLOSURE

Watch on YouTube

Build the outdoor LoRa IoT soil sensor for the PRIMA INTEL-I...
Watch later Share

CONNECT THE WIRES ACCORDINGLY

Watch on YouTube

Wire the soil humidity sensor and test LoRa transmissions to...
Watch later Share

NOW LET'S PROGRAM THE BOARD

Watch on YouTube

The INTEL-IRRIS soil sensor device & WaziGate framework f...
Watch later Share

Watch on YouTube

LES CAPTEURS FAIBLE COÛT POUR
MESURER L'EAU DANS LE SOL:
CONTRAINTES, LIMITATIONS ET
PERSPECTIVES



Dr. Christian Hartmann
M. Jean-François Printanier
M. Mamadou Gueye
M. Lotfi Smaili



INTEL-IRRIS's interview video presenting the project and ben...
Watch later Share

Barriers to IoT Solutions

- Technology Cost
- Internet Challenges
- Vendor Lock
- Complexity of Deployed Solutions

Intel-IrriS and Edge-Computing Technologies

Watch on YouTube

Intel-IrriS
Technologies de capteurs de mesure de l'humidité du sol pour le pilotage de l'irrigation:

Principe de fonctionnement, Calibrations et Performances

EL Aissaoui Abdellah (Ing. PhD)
Institut National de La Recherche Agronomique
Centre Régional de La Recherche Agronomique de Séttat
Laboratoire des Agroéquipements et Energie

30 Mars 2022

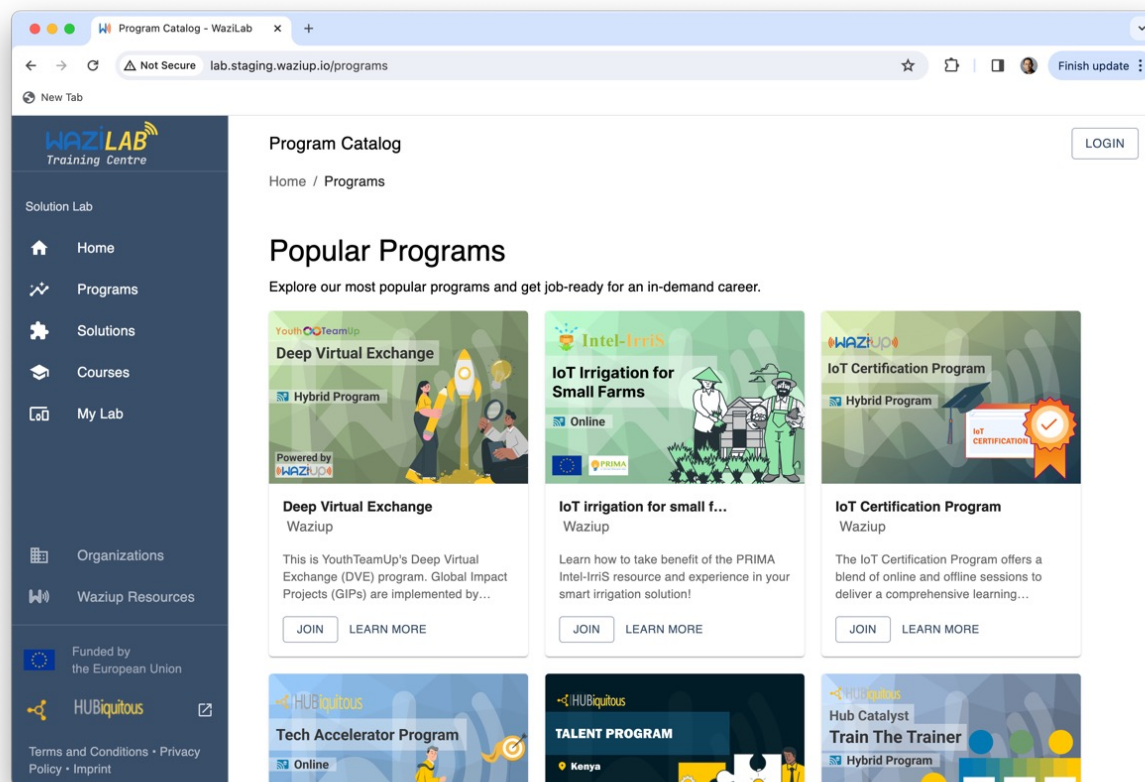
Prof. Congduc Pham

Training & capacity-building sessions



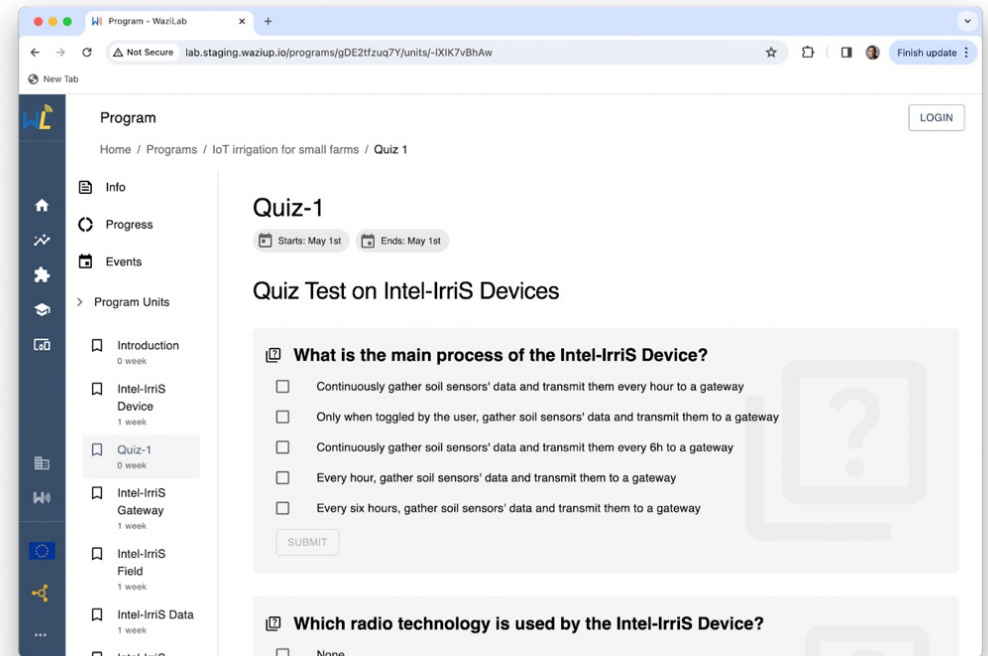
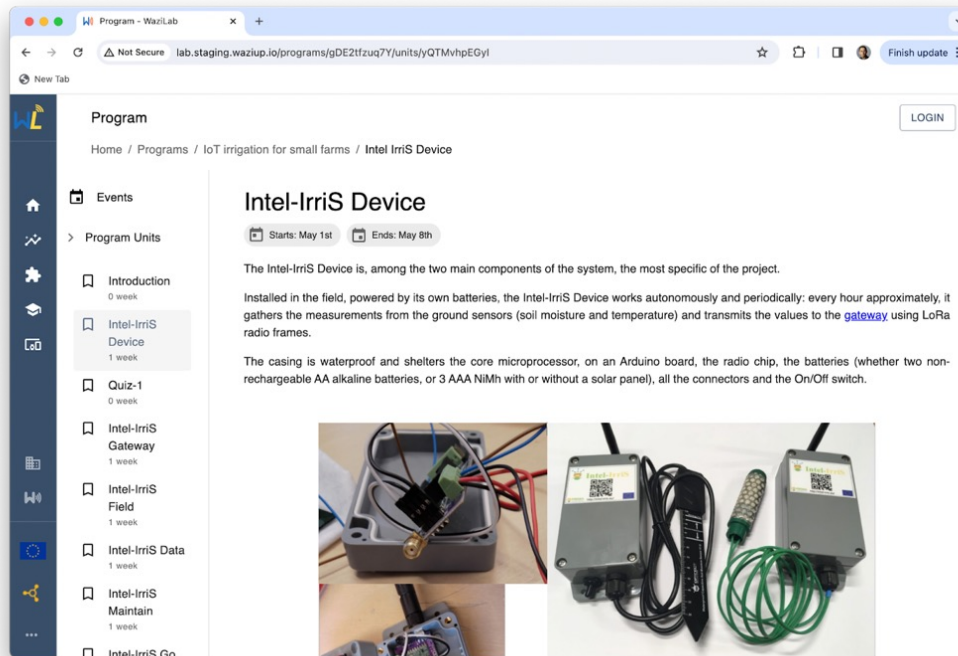
Capacity-building program

- ⦿ Integrated into the WaziLab Training Center platform
 → testing phase: <http://lab.staging.waziup.io/programs>



Learn & validate competencies

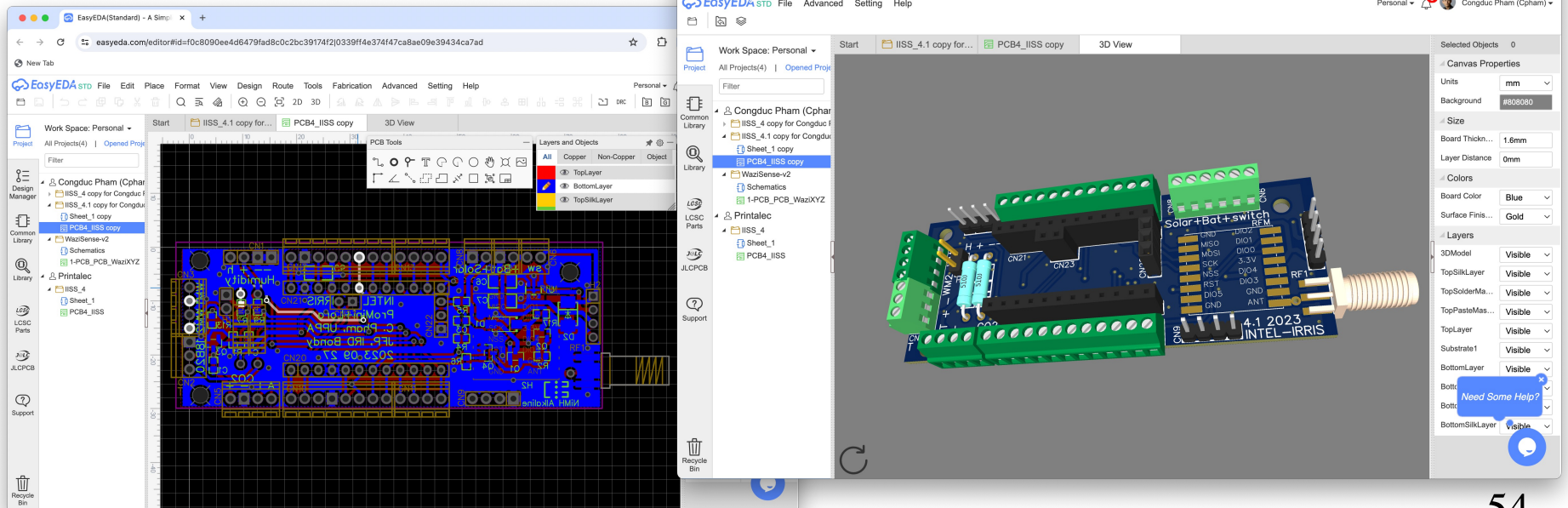
🕒 At your own pace!

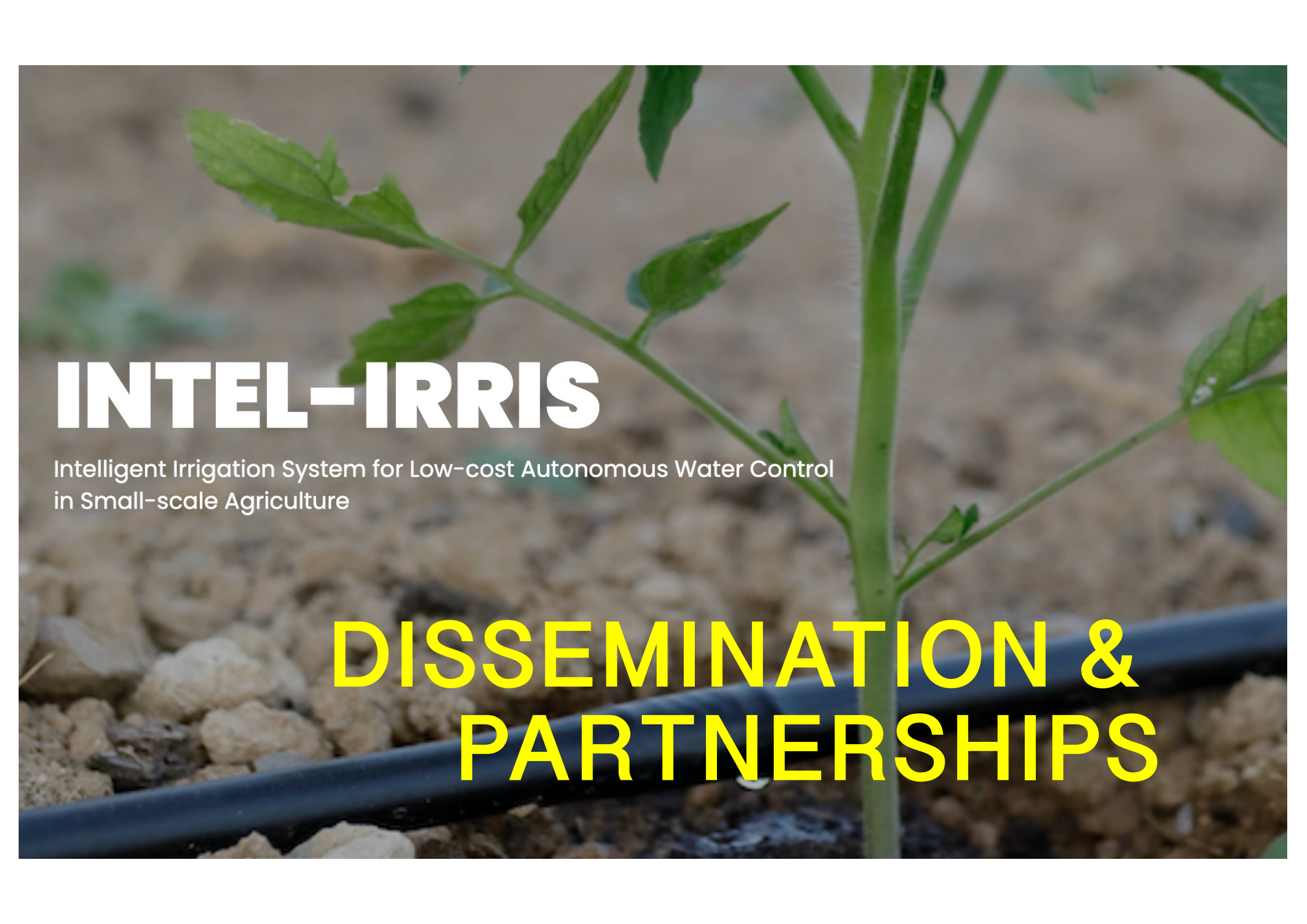


Capacity-building in PCB design

- ⦿ A workshop took place on May 14-15, 2024 in Oran, animated by J.-F. Printanier from IRD
- ⦿ The INTEL-IRRIS PCB will serve as a use-case

Workshop on Electronic and Starter kit Assembly for the INTEL-IRRIS project
(Atelier sur l'assemblage de kits électroniques: application aux kits de démarrage pour le projet INTEL-IRRIS)
 Le 14 et 15 mai 2024
 Organisé par le Laboratoire en Informatique Industrielle et Réseaux (RIIR)
 Université d'ORAN1, ALGERIE
 Lieu : Salle de réunion - Auditorium du Campus Taleb. Mourad





INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control
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DISSEMINATION & PARTNERSHIPS

Dissemination & partnerships

- for testing/using starter-kit
- scientific collaborations

- ⦿ **Collaboration with PRIMA projects:** WATERMED 4.0, OurMED, NatMED, MED-WET, DROMAMED, ReCROP
- ⦿ **"spin-off" projects:** S2IEA PNR Algeria
- ⦿ **Collaboration with research organizations/institution:** INDICATIC AIP Panama, IICA Panama, iEES Paris, NECTEC Thailand, U. Laos Vientiane, CNRS GRDI CompactSol, U. Angers – IPPN network, U. Côte d'Azur – Satellite LoRa
- ⦿ **Collaboration with companies:** CALESA Panama, NTPC – Nam Theun 2 Laos, MounoyDev Laos, MakerBox Laos, EGM France, Senseen France,
- ⦿ **Participation in project consortiums:** HE ZepoBox, HE NureBox, HE LEAAF, PRIMA S1 AgriMedWise, PRIMA S1 NexMed



- 🔗 <https://intel-irris.eu/publications>
- 📅 2 journals, 4 international conferences

INTEL-IRRIS
June 2021-2024

A PRIMA 2020 project developing

Intelligent Irrigation Systems for Low-Cost Autonomous Water Control in Small-Scale Agriculture

Cutting-edge technologies Made simple for smallholders

Low-cost sensors **Edge-Computing**
Advanced calibration **Edge-IoT**

Agricultural knowledge **Embedded AI**

Smart Irrigation Application **Machine Learning**

Deployment of starter-kits for the Smallholder Piloting Program

PRIMA, Intel-Irris, and various partner logos are listed at the bottom.

نظام ري ذكي - النموذج الإبتدائي-

PRIMA Intel-Irris

إقرأ رمز الاستجابة السريعة (QR) لشبكة WiFi المعروض على شاشة WaziGate

يتم تسليمها مع بوابة واحدة ومستشعر سموي أو مقياس رطوبة التربة

لم اقرأ رمز الاستجابة السريعة (QR) الموجود على لوحة القيادة التي تعرض بيانات المصنع الأصلية لأجهزة الاستشعار

عرض آخر قيمة مستلمة وحالة رطوبة التربة

المشترك المزيد من الميزات مع تطبيق INTEL-IRRIS IRRIGATION WAZIGATE! الذي تم تشويحه على

نظام ري ذكي - النموذج الإبتدائي-

PRIMA Intel-Irris

عرض آخر قيمة تم رطوبة التربة

يتم تسليمها مع بوابة واحدة ومستشعر سموي أو مقياس رطوبة التربة

تفسير القيم المقاسة وعرض أوضاع التربة

255 : بدون جهاز استشعار

0 - 83	مُرْتَوِي	0 - 10
84 - 166	رطب	11 - 30
167 - 249	رطب	31 - 60
250 - 333	جاف	61 - 100
334 - 416	جاف	

نطاق الري المعتاد

نطاق الري المتعد

المشترك المزيد من الميزات مع تطبيق INTEL-IRRIS IRRIGATION WAZIGATE! الذي تم تشويحه على

المشترك المزيد من الميزات مع تطبيق INTEL-IRRIS IRRIGATION WAZIGATE! الذي تم تشويحه على

<https://www.irrometer.com/basics.html#using>

المهتجة

للإتصال بنا

www.intel-irris.eu
@Intel_Irris
congduc.pham@univ-pau.fr

سيتطور مشروع INTEL-IRRIS أجهزة استشعار رطوبة التربة منخفضة التكلفة مع إجراء معايرة متطورة لزيادة دقة القياس. الأخذ في الحسبان العلاقة المعقدة بين الماء والتربة والنبات والطقس مبرمج لتوسيع مواءمة التوصيات.

Consortium

PRIMA, Intel-Irris, and various partner logos are listed.

Intel-Irris
INTELLIGENT IRRIGATION SYSTEM FOR LOW-COST AUTONOMOUS WATER CONTROL IN SMALL-SCALE AGRICULTURE

الأهداف INTEL-IRRIS

توفير نظام تحكم أمثل للري بتكلفة منخفضة، متخفضة، وتوفير بكل بساطة إنتشار التقنيات المتطورة جدًا وإدماجها بكل سلاسة في أنظمة الري المتبعة حاليًا

يتم اقتراح نظامًا جاهزًا للإستخدام باستخدام تقنيات متقدمة جدًا مثل إنترنت الأشياء (IoT) وأنظمة إتخاذ القرار والذكاء الاصطناع (AI). يسمح بإستخدام تقنية من نوع "EDGE" للمعالجة الكمية وإمكانية الحصول على مجموعة بوابية -مستشعر مستقلة تمامًا وقادرة على العمل حتى بدون الإتصال بالإنترنت.

تجدير التعاون والتبادل بين المتعاملين وتعزيز الإبتكار على المستوى المحلي.

تجديد مصادر البيانات المتعددة والنظر فيها سيجعل من الممكن تكيف التوصيات على أفضل وجه مع الظروف والممارسات المحلية، وأنواع المحاصيل ومراحل تطورها المختلفة.

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Open-source, GitHub

- ⦿ All PCB resources & all software

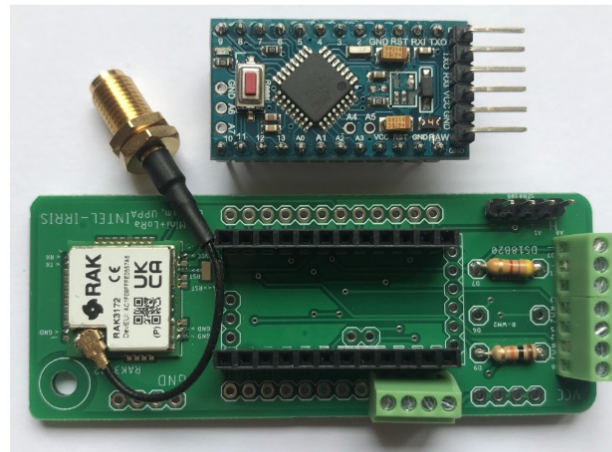
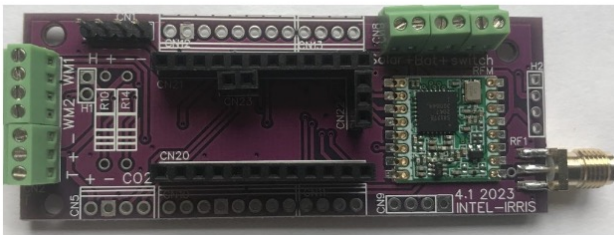


[INTEL-IRRIS GitHub](#)

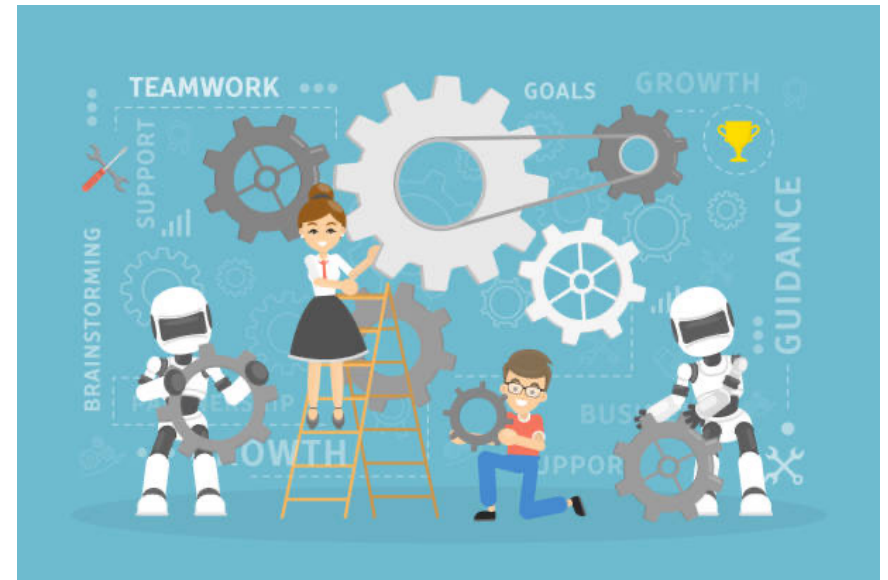
this is where all the source code, the Gerber files for the PCBs and all the tutorials slides can be found to build your own INTEL-IRRIS platform!



INTEL-IRRIS GITHUB



- Provide access to technologies developed by INTEL-IRRIS
SolutionLab = FabLab + INTEL-IRRIS's technologies
- Hardware + all software frameworks
- Learn, Prototype, Develop, Improve, Innovate & Tests



IT IS A TEAM WORK!



AUA:
Agricultural
University of
Athens



Greece

T. Bartzanas
D. Giannopoulos
G. Chatzipavlidis
A. Giakoumatos
S. Fountas

ENSA-Safi:
National School
of Applied
Sciences – Safi



Morocco

K. Baraka
O. Chabouni

INRA: National
Institute of
Agronomic
Research



Morocco

T. Benabdelouahab
A. El Assaoui
A. Harkani
Y. Bouchiar
A. El Mghari
H. Lionbui

IRD: Institute
for Research &
Development



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C. Hartmann
J-F Printanier

UMAB:
University A.
Benbadis



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S. Nemmiche
L. Kradia
A. Gacemi
A. Toiti
M. Bouamrane
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UORAN1:
University of
Oran 1



Algeria

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A. Dahane
R. Benameur
B. Zahia
H. Haffaf
A. Benyamina
Y. Bidai

UPPA:
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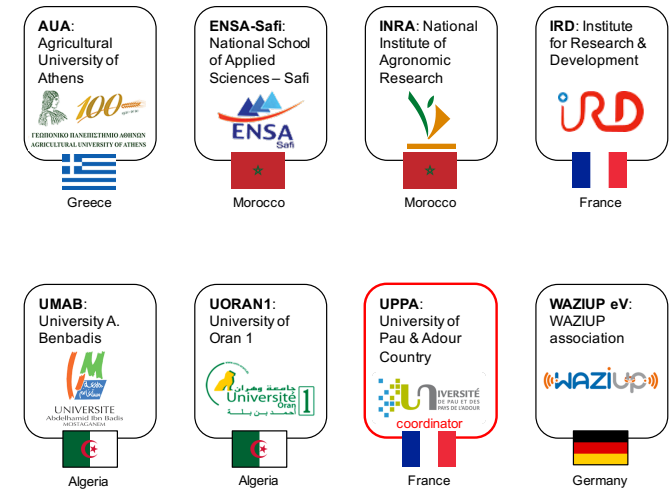
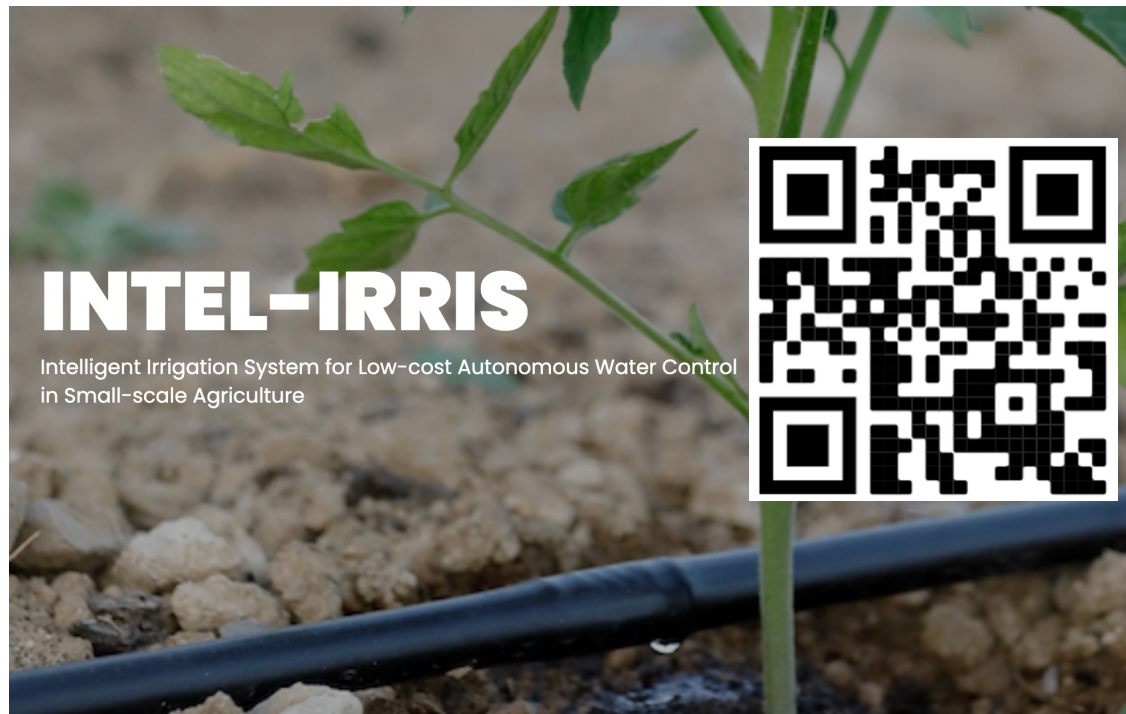
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Chambre d'Agriculture de la Wilaya d'Oran
L'Association des irrigateurs des eaux traitées de la Wilaya d'Oran
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Chambre d'Agriculture de Mostaganem
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