

TOWARDS LOW-TECH-NIZATION FOR ENVIRONMENTAL SENSORS

IESTEC 2026
OCT. 21ST, 2026



IOT-SENSING-SYSTEM

Internet-of-Things and Sensing System Research Activities at University of Pau, France



La France au Panama et aux Bahamas

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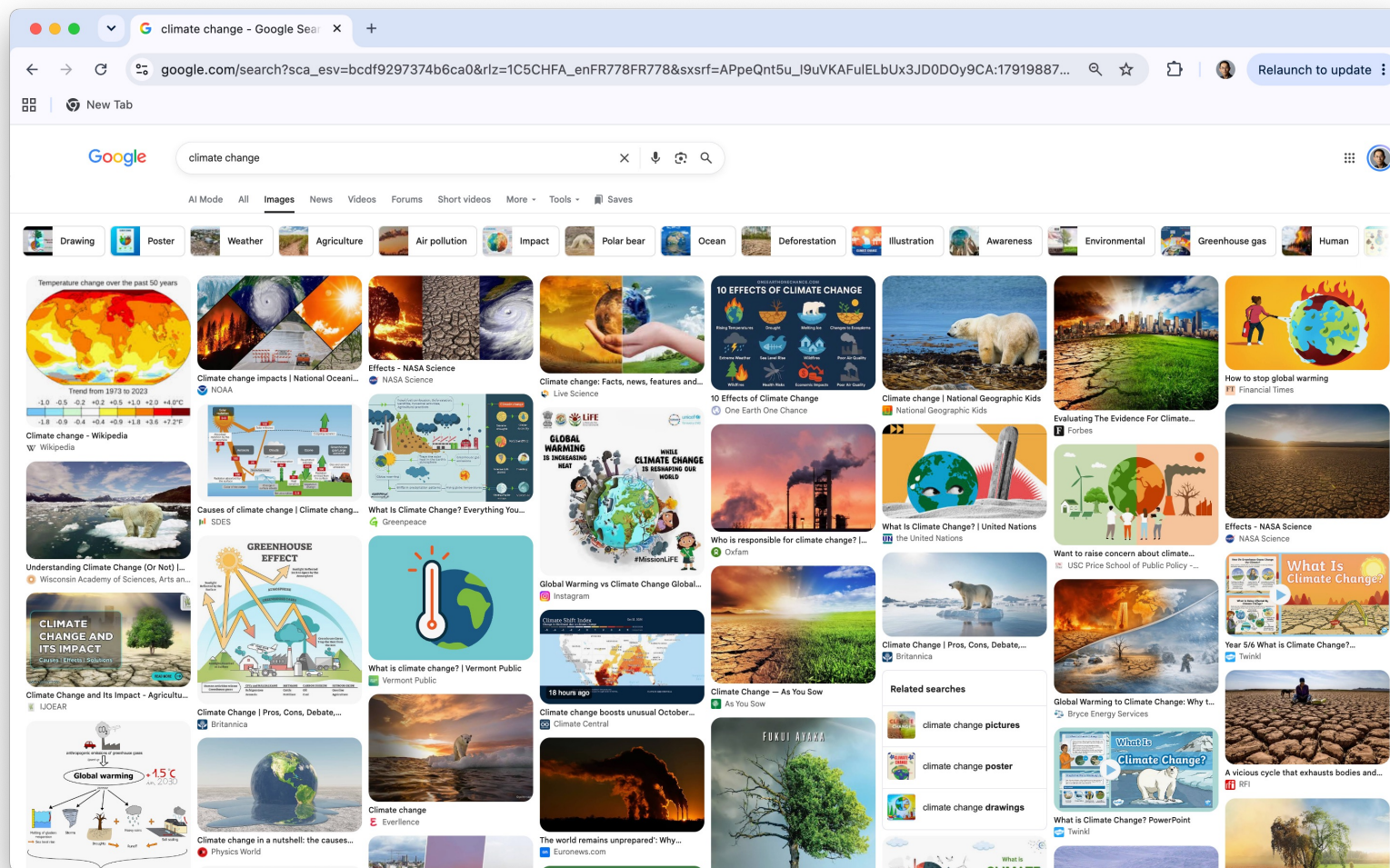
Horizon 2020
European Union funding
for Research & Innovation



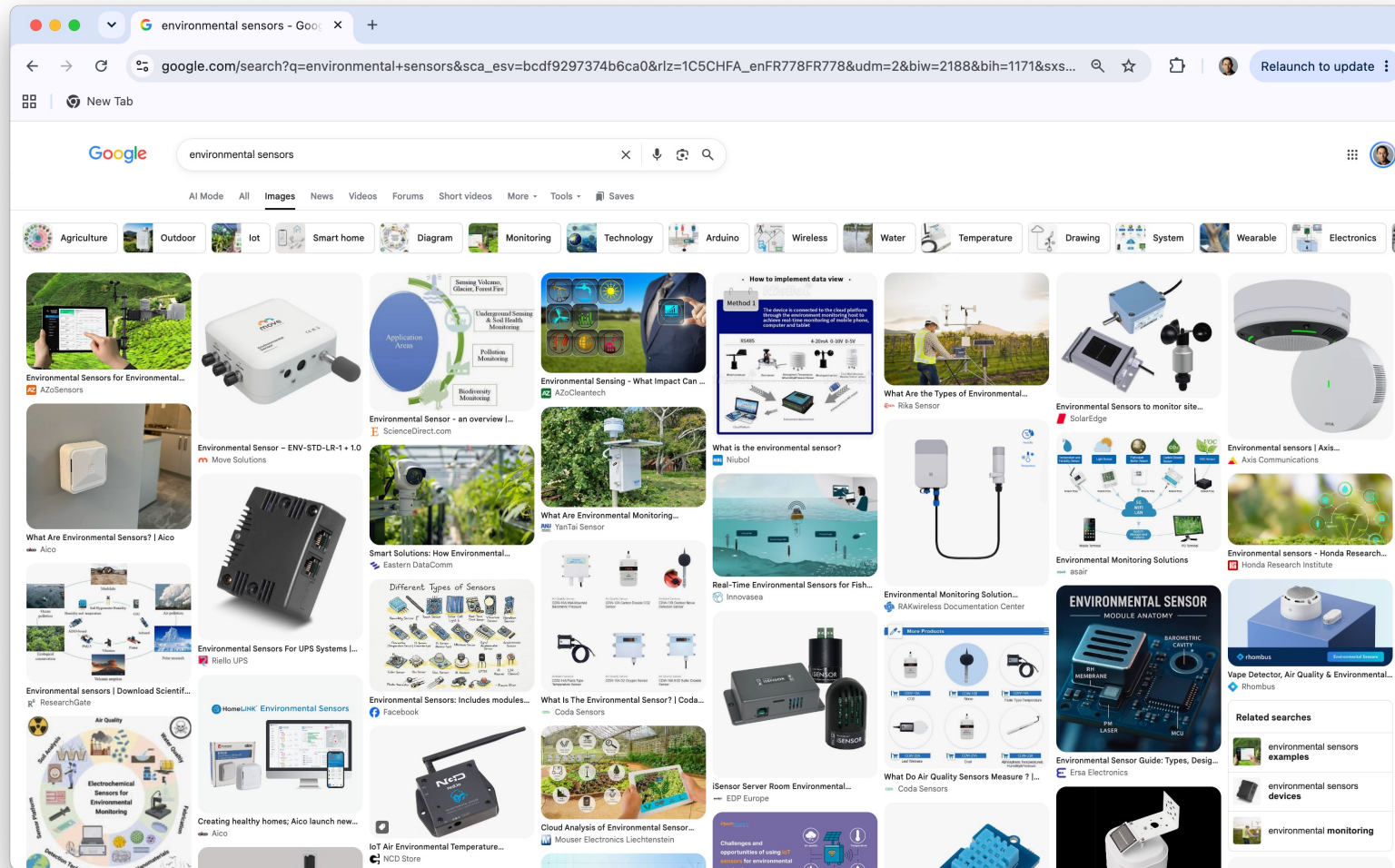
Paving for the next 10 years
of innovation in IoT and AI



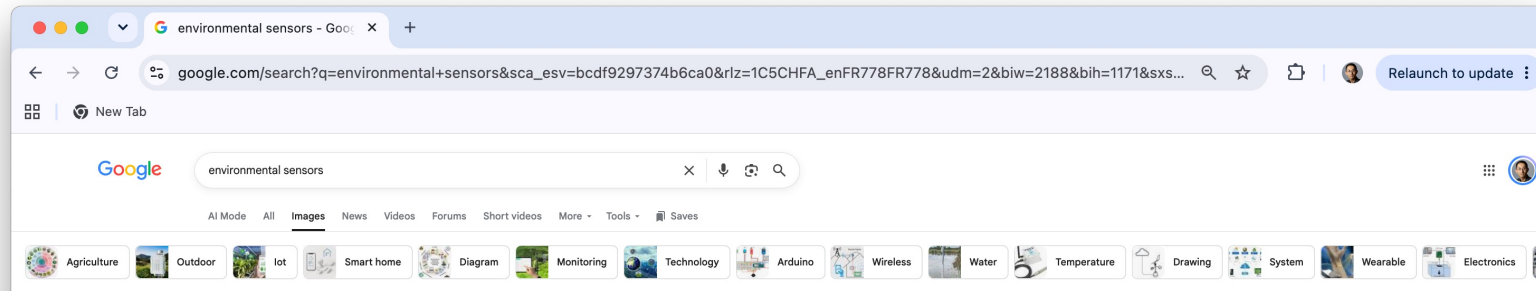
Searching for « Climate change »



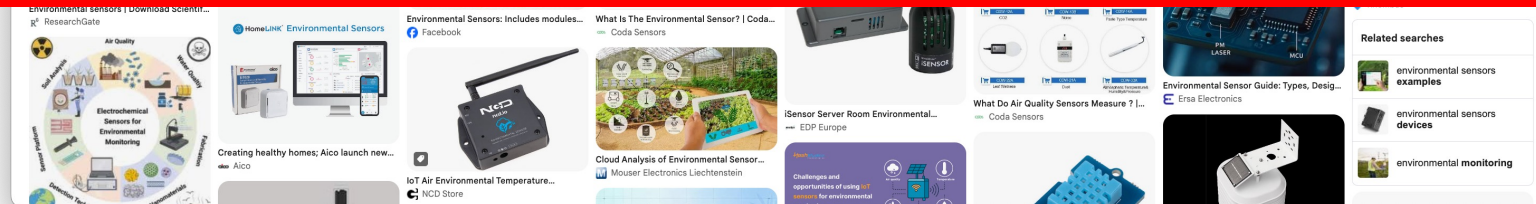
Searching for « environmental sensors »



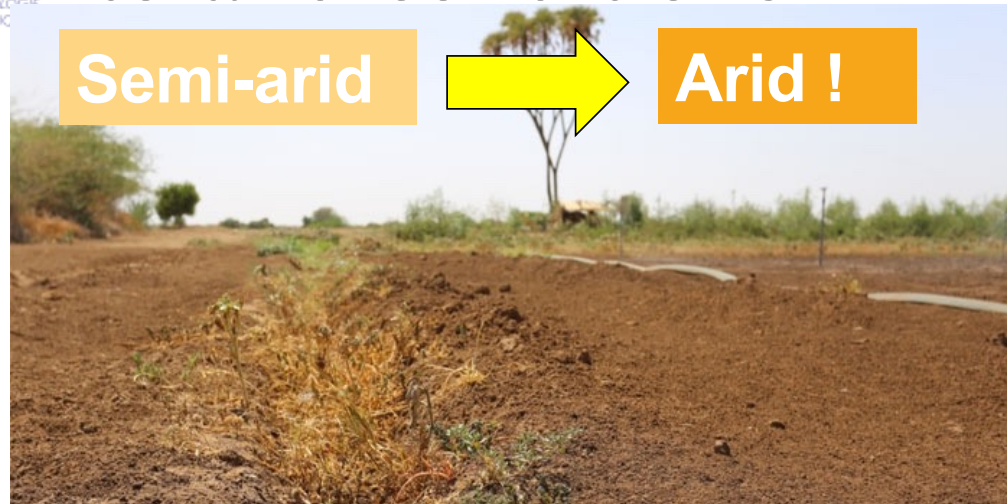
Searching for « environmental sensors »



Environmental Sensors Help Us Assess and Address Climate Change Challenges

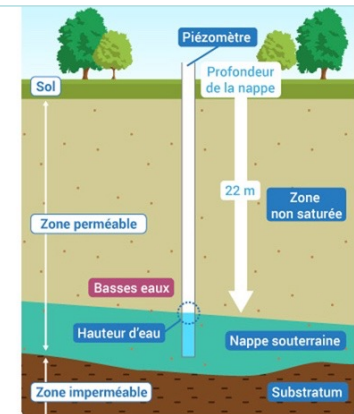
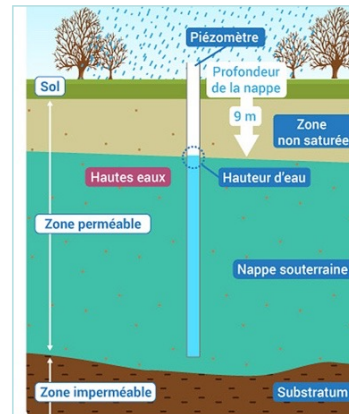
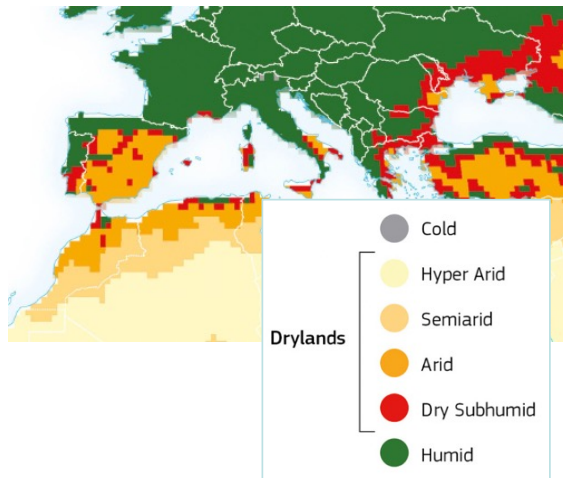
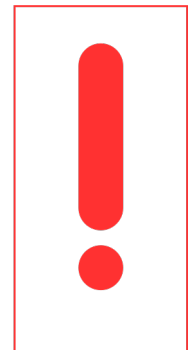
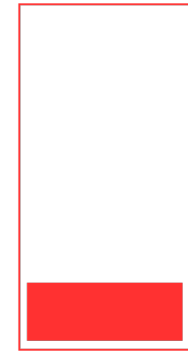


General shift from semi-arid to arid conditions



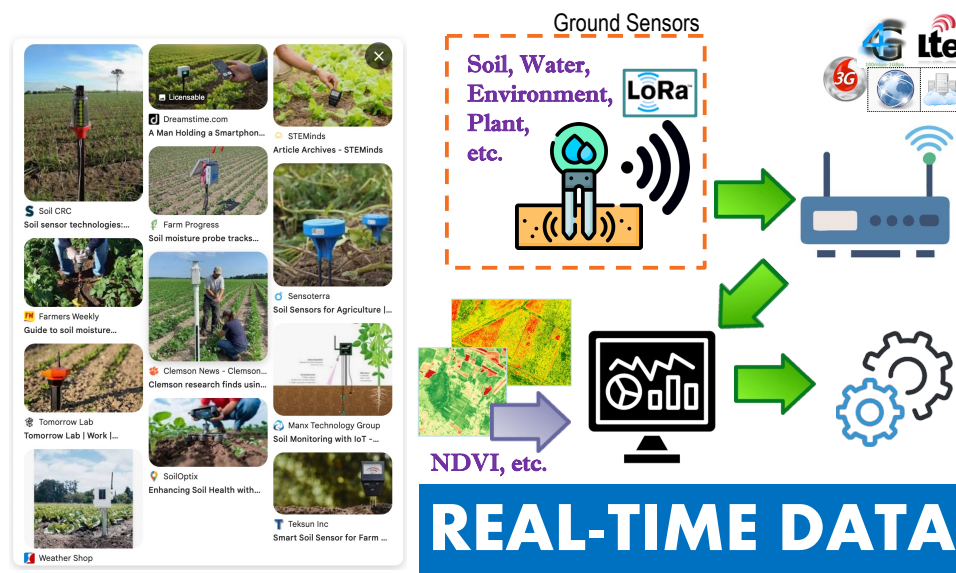
Semi-arid

Arid !



Can greatly improve use of resources

- E.g. about 70% of water is used for agriculture activities
- **Digital technologies** can help reducing and optimizing use of water, **but...**



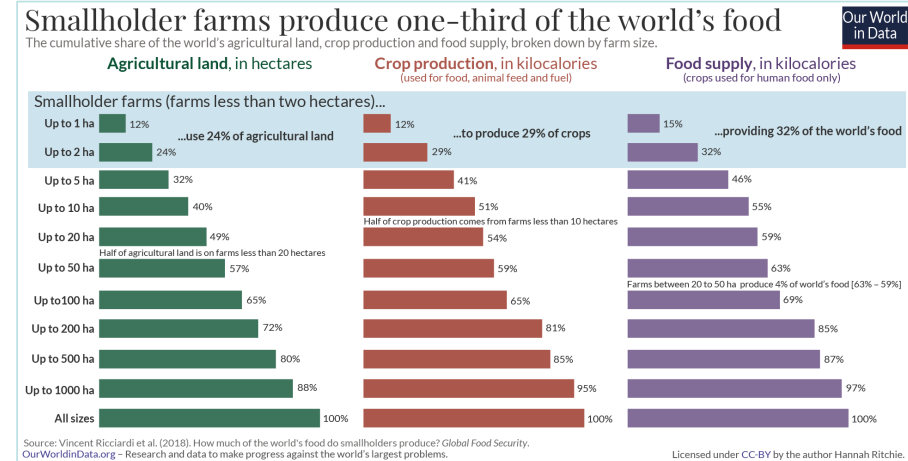
Possible for large farms



Out of reach for smallholders!

Smallholders – up to 2ha

- Most (84%) of the world's 570 million farms are smallholdings
- Provide about 32% of world food supply, on about 24% of agriculture land



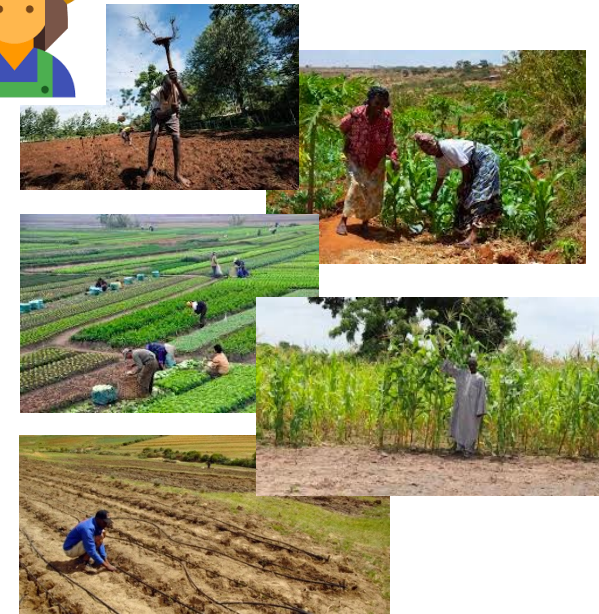
<https://ourworldindata.org/smallholder-food-production>



Technologies

Too expensive
Too integrated
Highly specialized
Difficult to customize
Difficult to upgrade

Not only the cost barrier...



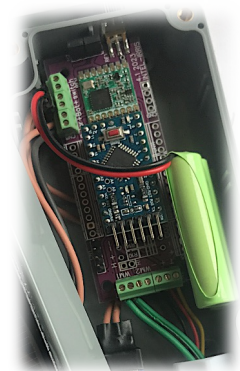
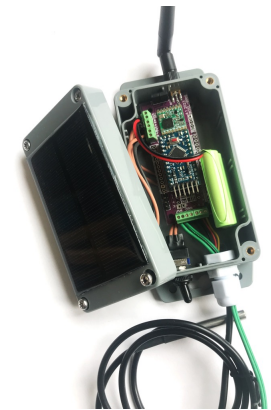
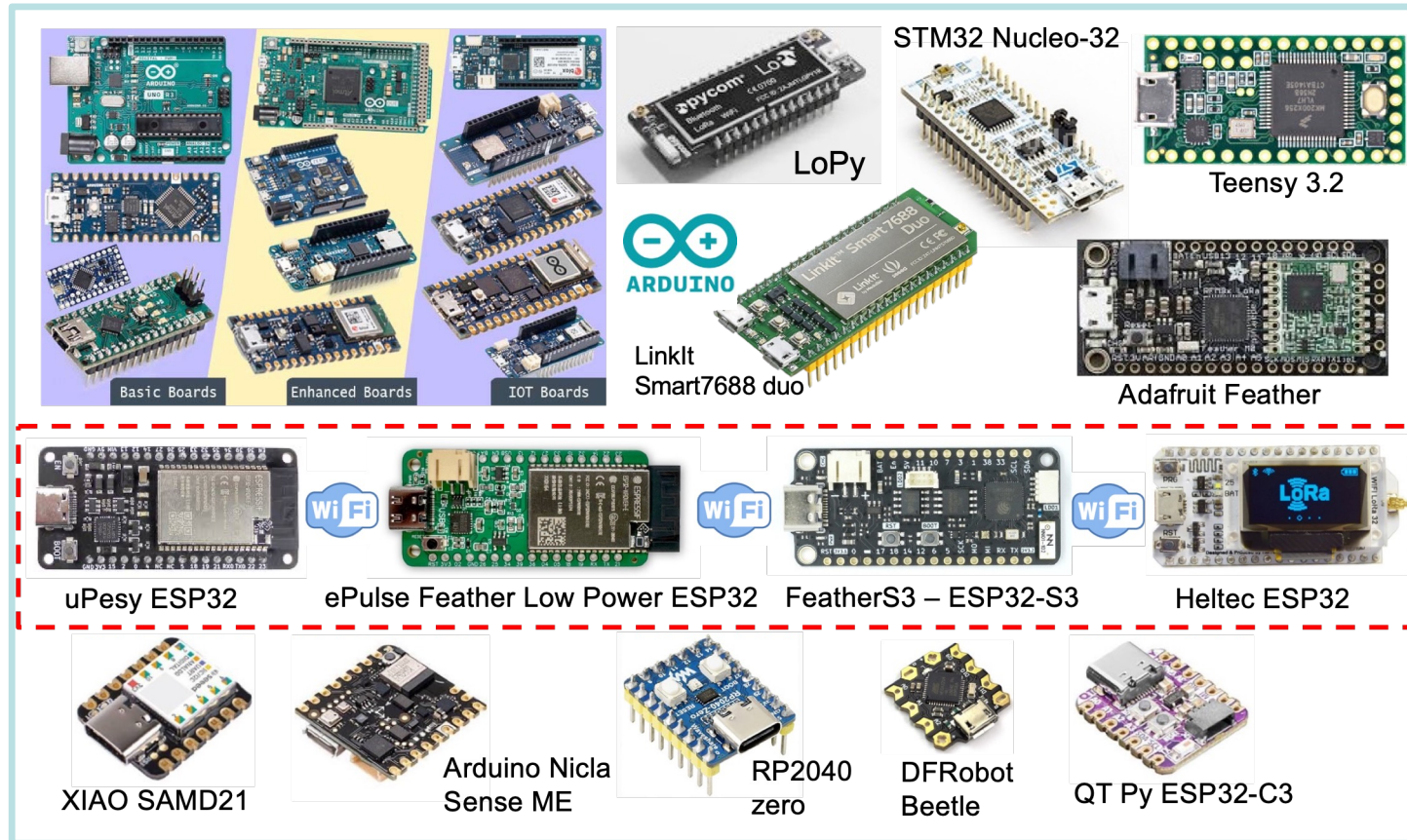
High acceptability
of technologies,
even complex ones

Very low acceptability
of technologies
because too complex!

2026: CONVERGENCE OF TECHNOLOGIES!

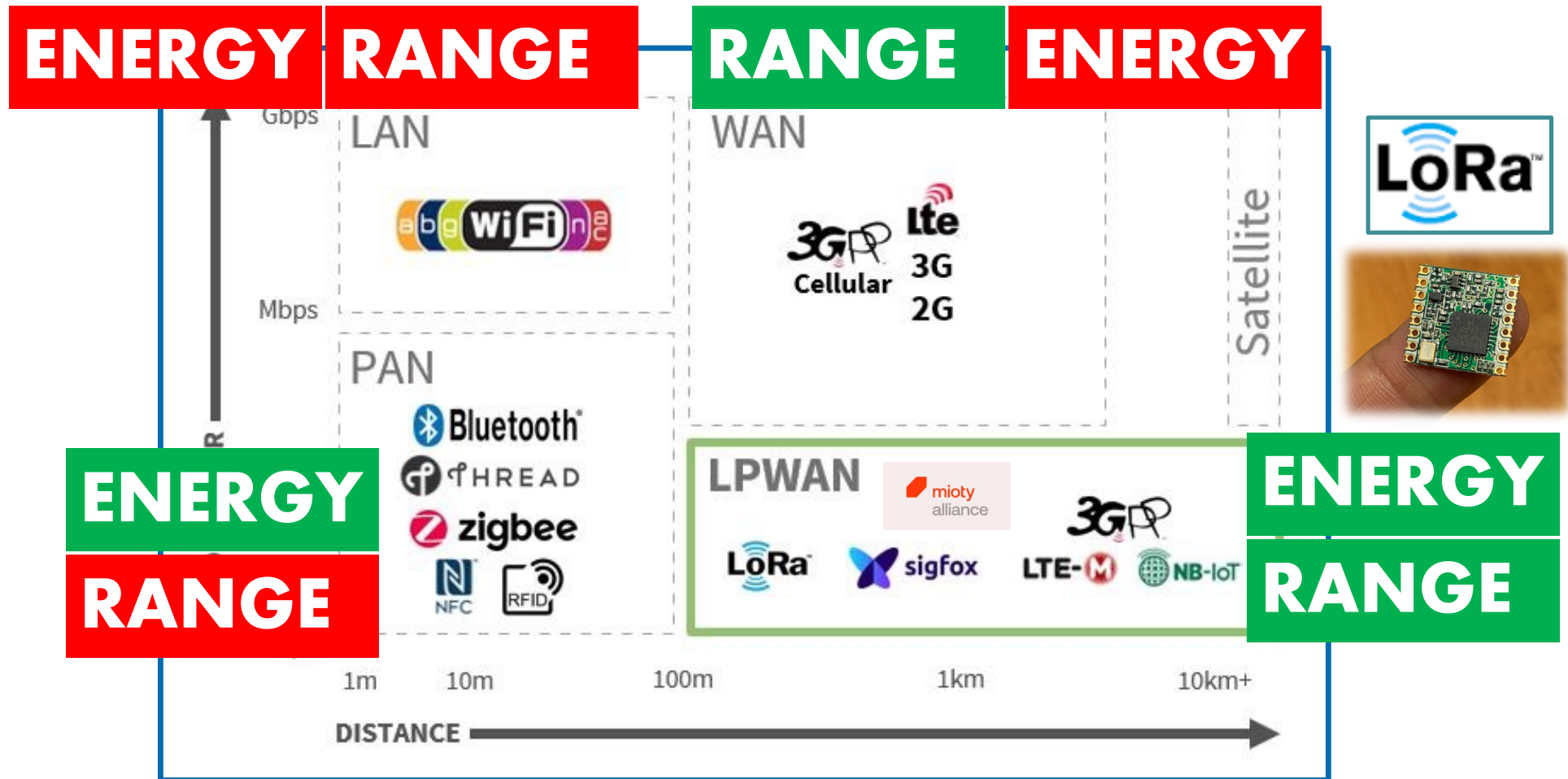


More and more powerful microcontrollers!

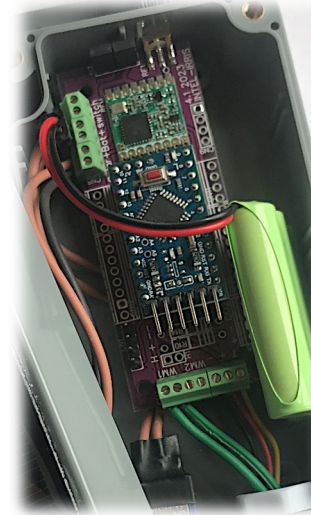
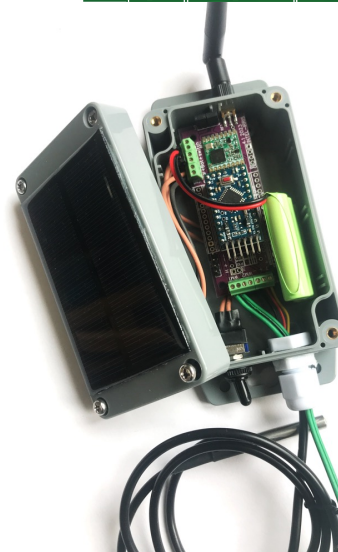
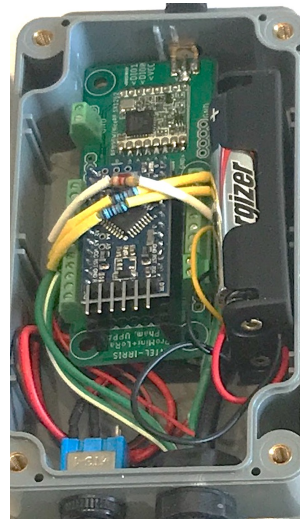
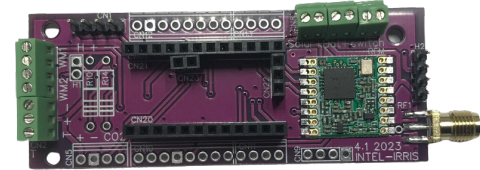
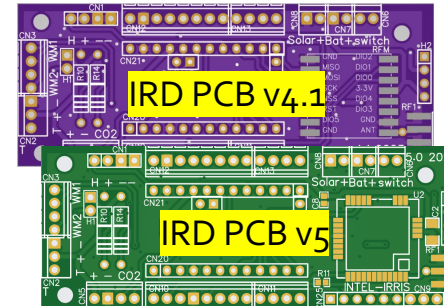
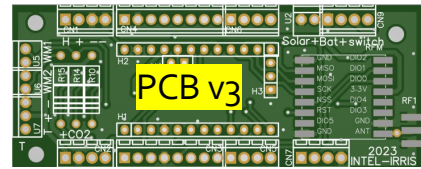
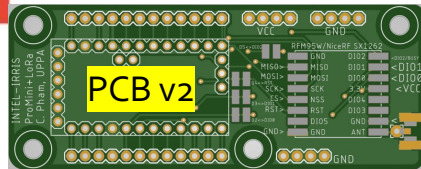


Cost-effective LPWAN!

Low Power Wide Area Network



Enabling Do-It-Yourself IoT!



1 measure / hour by default



~ 2 year of autonomy on alkaline batteries!

Example: INTEL-IRRIS's *starter-kit*

<https://intel-irris.eu>



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



Intel-Irris

June 1st, 2021 – May 31st, 2024



PRIMA
IN THE MEDITERRANEAN AREA

Intel-Irris



Small-scale farms,
Smallholder Farmers

NO INTERNET
FULL EDGE
MODE 😊



FROM IDEA TO REALITY!



~ 30€

SEN0308
capacitive sensor

~ 60€

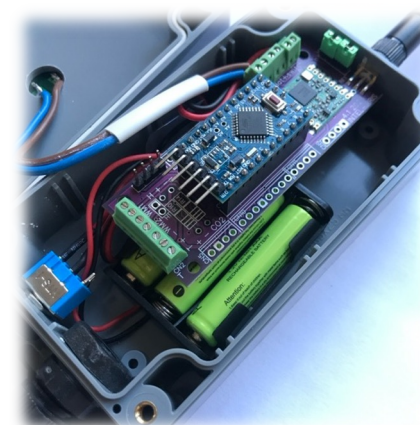
Watermark WM200
Water tension sensor

Low-cost soil moisture device



SEN0308
capacitive sensor

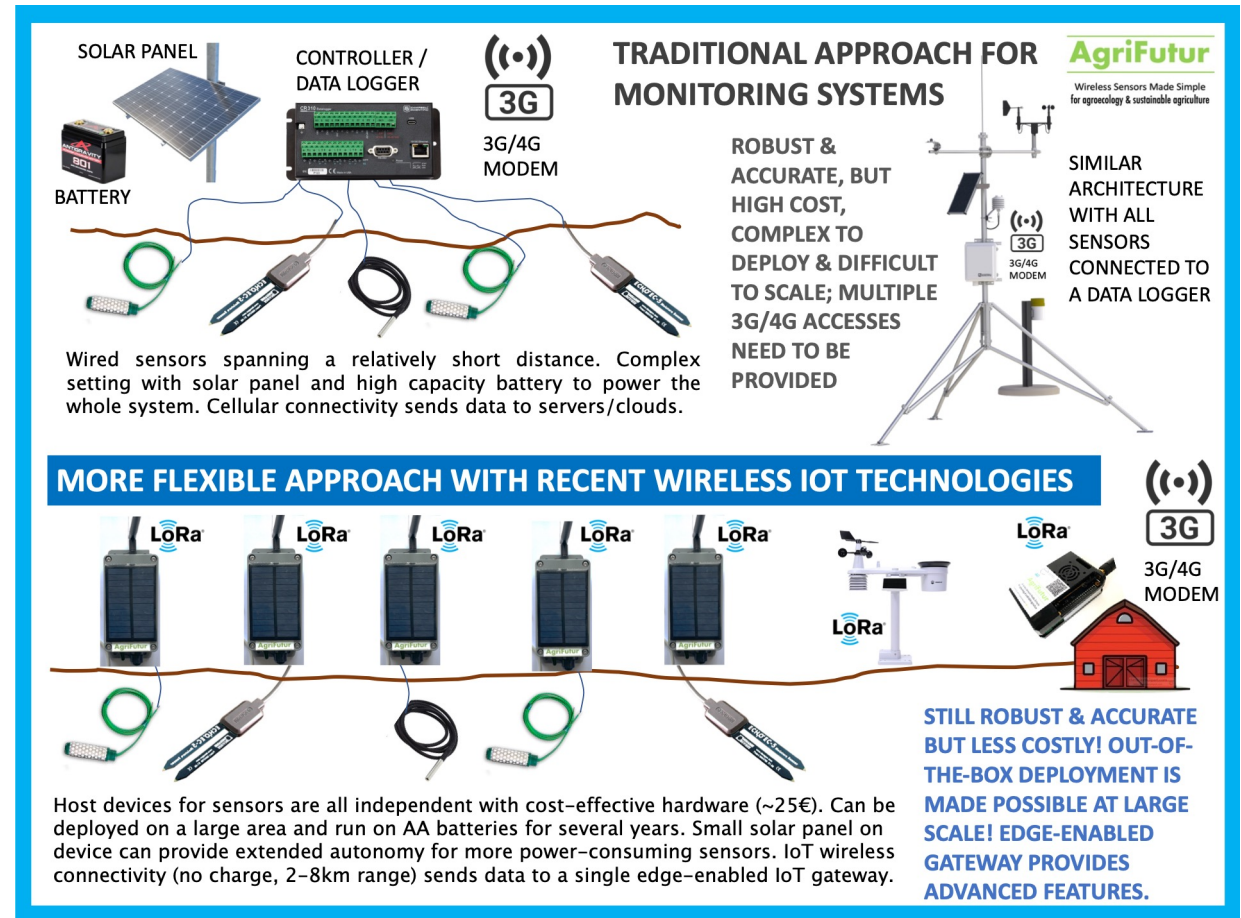
Watermark WM200
Water tension sensor



Towards “low-tech-nisation”

**ACCURATE SENSORS BUT
COSTLY TO DEPLOY →
FEW MEASURE POINTS**

**LESS COSTLY SENSORS
BUT ALSO LESS
ACCURATE → MORE
MEASURE POINTS**



Going beyond irrigation

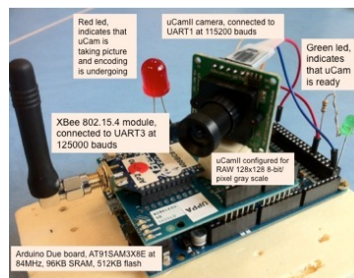
- Use the same approach of cost-efficiency and out-of-the-box deployment, expanding the sensor ecosystem
- Complementarity & Adaptability: high-end, low-end, innovative, ...
- Target **Agroecology, Nature-Based Solutions & sustainable agriculture practices**
- With the objective to better Qualify & Quantify the impact of these new practices
- More data = more correlation in agroecological system**



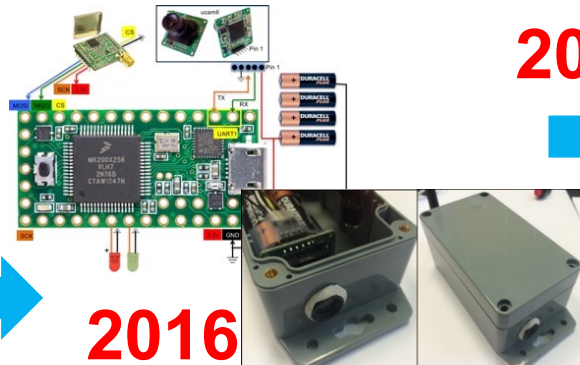
More Advanced Sensing Systems?



Many applications need visual information → Image Sensing IoT

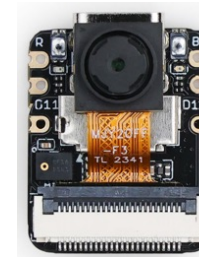


2012



2016

2024

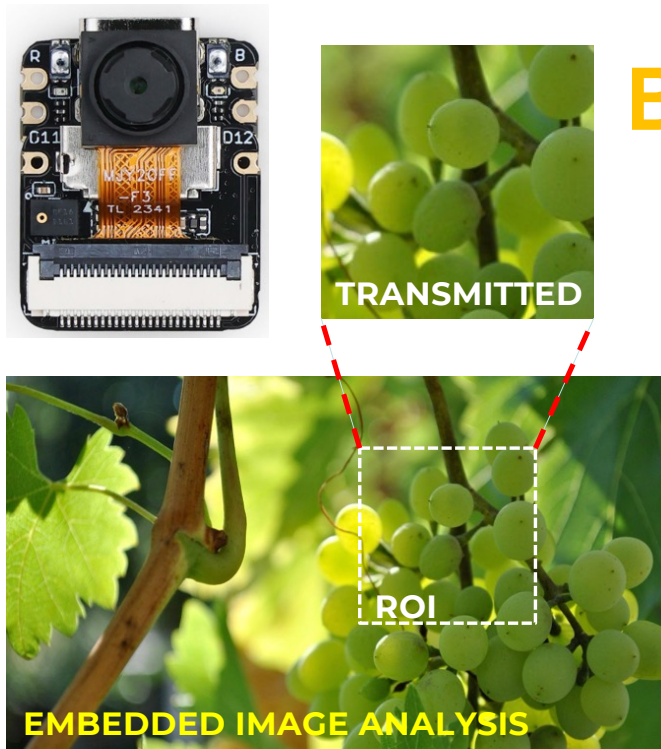


ESP32S3 32-bit, dual-core, up to 240 MHz

XIAO ESP32S3 Sense



Image Sensor? Quite a challenge!



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

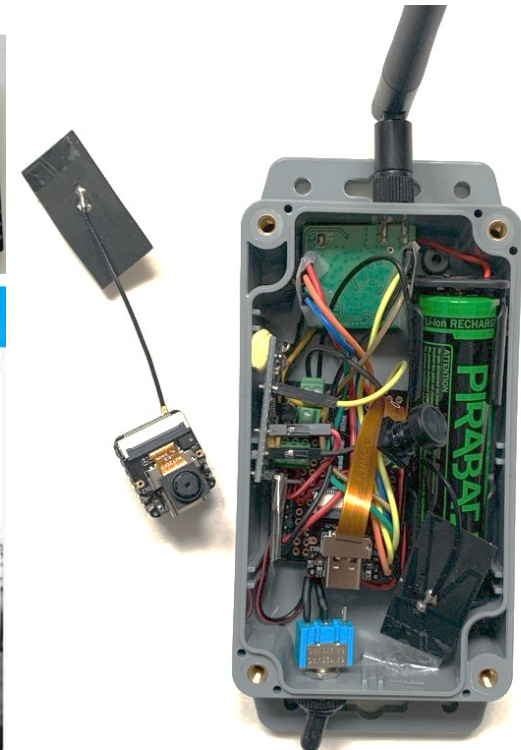
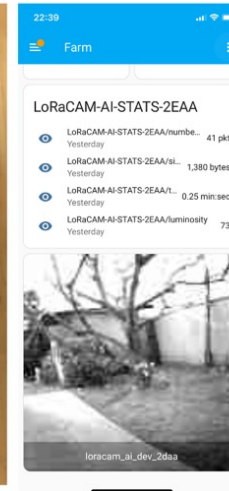
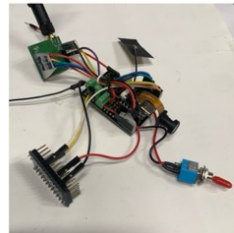
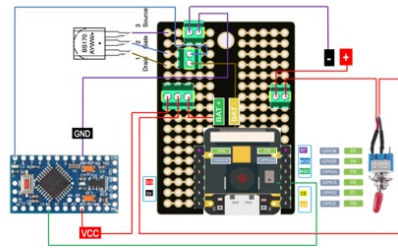
Low Power **Surveillance**

- Low Power
- Plug-and-Sense, out-of-the-box
- Embedded AI processing
- Versatile AI learning framework
- Application-specific AI models
- Robust image encoding against losses
- Long-range radio transmissions
- Efficient usage of radio resources

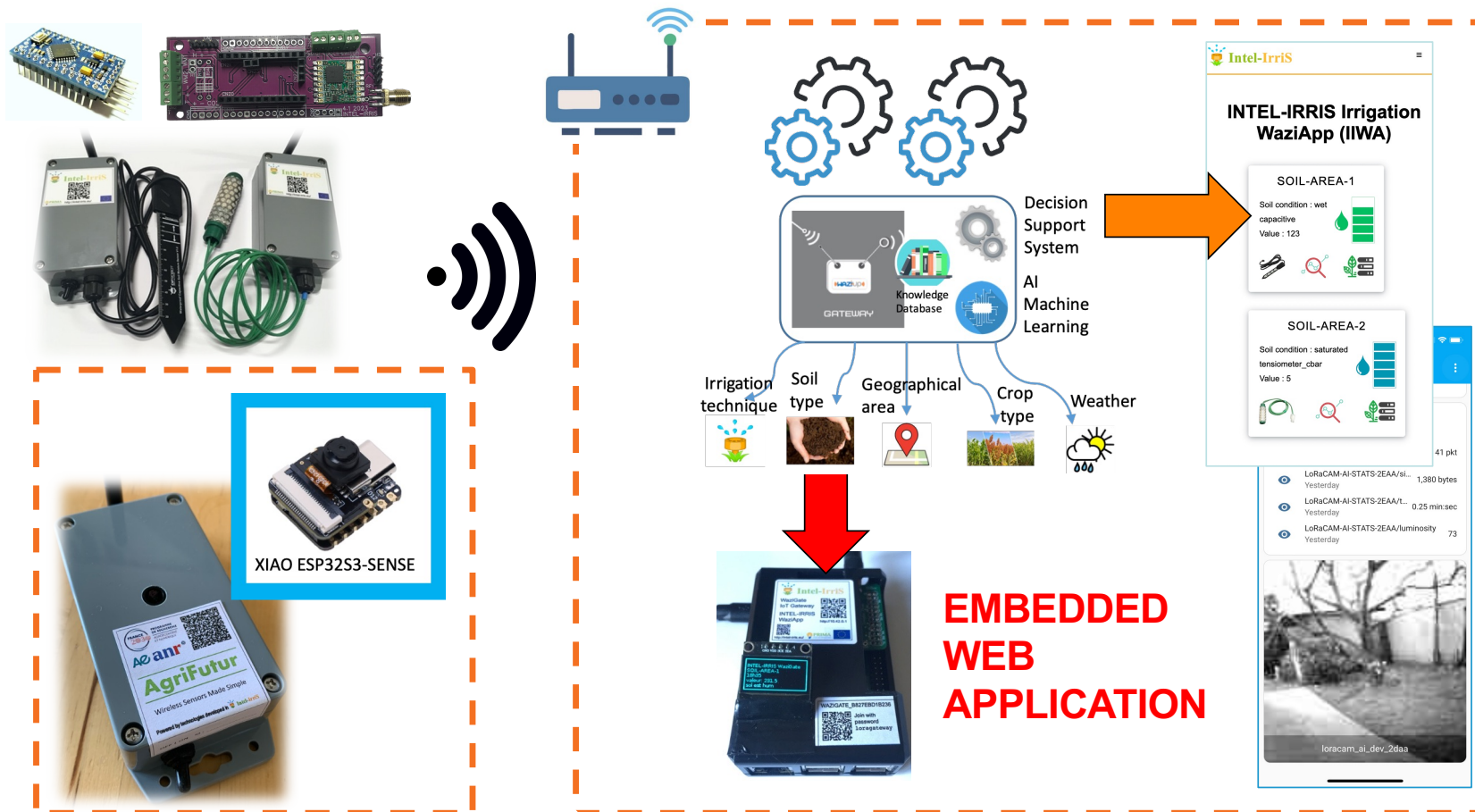


Proof-of-concept: LORACAM-AI

UPDATED VERSION IN 2025 FOR THE PEPR AGRIFUTUR PROJECT



INTELLIGENCE AT THE EDGE



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

Conclusions

- ⊙ There is real need for dedicated working groups addressing the challenges of “**environmental sensing**”
- ⊙ With **multidisciplinary** and **transdisciplinary** contributions!
- ⊙ Low-tech-nization is made possible with low-cost hardware
- ⊙ Innovative applications can be deployed with open technologies
 - ⊙ Collaboration between devices in P2P & mesh
 - ⊙ Hybrid and continuity of access: multi-radio, terrestrial, non-terrestrial, ...
- ⊙ **Ad-hoc** deployments with **application-specific mechanisms** in **agriculture, agroecology, environment, wildlife, ...**