Using Arduino to Monitor an Home-made Energy Autonomous Platform

International Arduino Day – TEKTOS – Calais

Matthieu PUIGT

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Outline of the presentation

1. Motivation
2. Realization
3. Future work and discussion

Disclaimer

Work in the framework of a student project between:

- Dept. GIM, IUT Saint-Omer Dunkerque (`http://www.iut-gim-stomer.fr/` – students: Marcel ASSILA, Ryck BOUNGOINDZI),
- EILCO (`http://www.eilco-ulco.fr/` – students: Marc-Olivier CARETTE, Kimy CHIPAN, Alexandre DOUDELET).

Any question about this project should be sent to:

- Matthieu PUIGT (`matthieu.puigt[at]univ-littoral.fr`)
- Nicolas WALDHOFF (`nicolas.waldhoff[at]eilco-ulco.fr`)

Motivation

The department GIM

- Industrial engineering and Maintenance Dept. (GIM)
  - Knowing plural technologies (electronics, electrontechnics, physics, control engineering, etc)
  - Other activities (task planification, cost evaluation, report writing, team management, etc)
- Dept. GIM in Saint-Omer ➪ quality, safety, and environment

Motivation

The autonomous platforms

1. "small cottage": batteries charged by solar photovoltaic panels & one wind turbine, power supply to information screen & "big cottage"
2. "big cottage": hybrid (solar + electric) water heater

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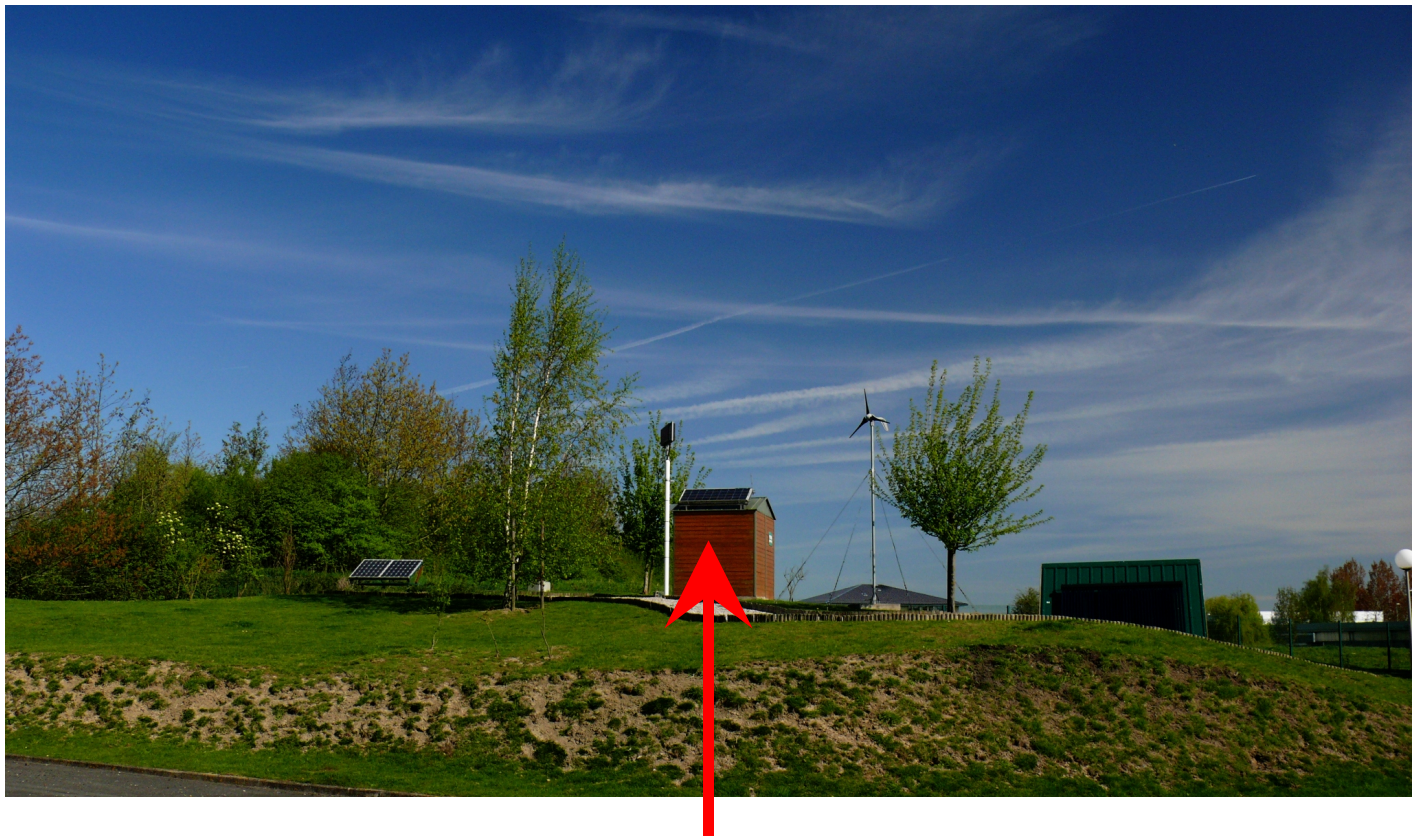

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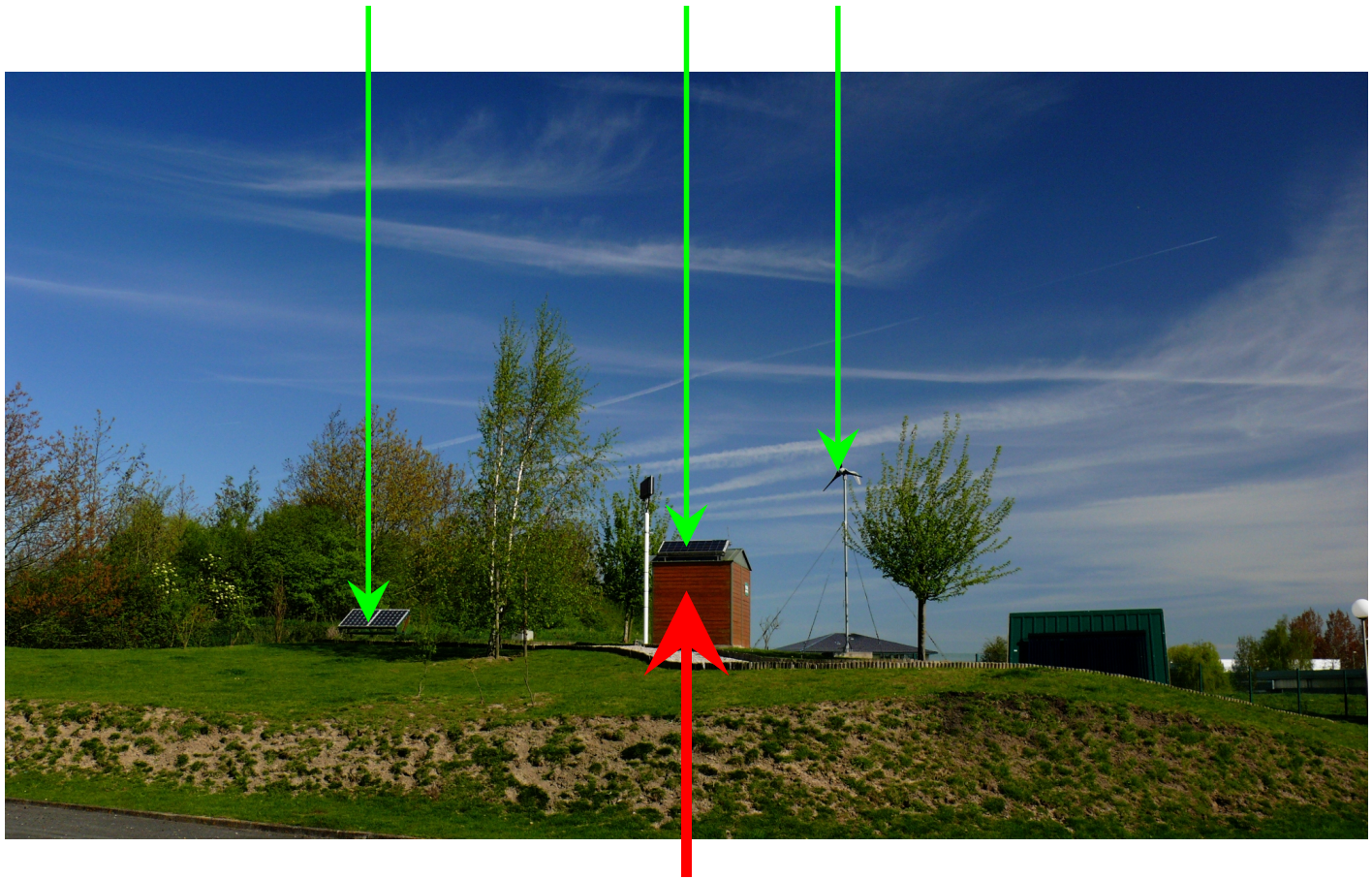

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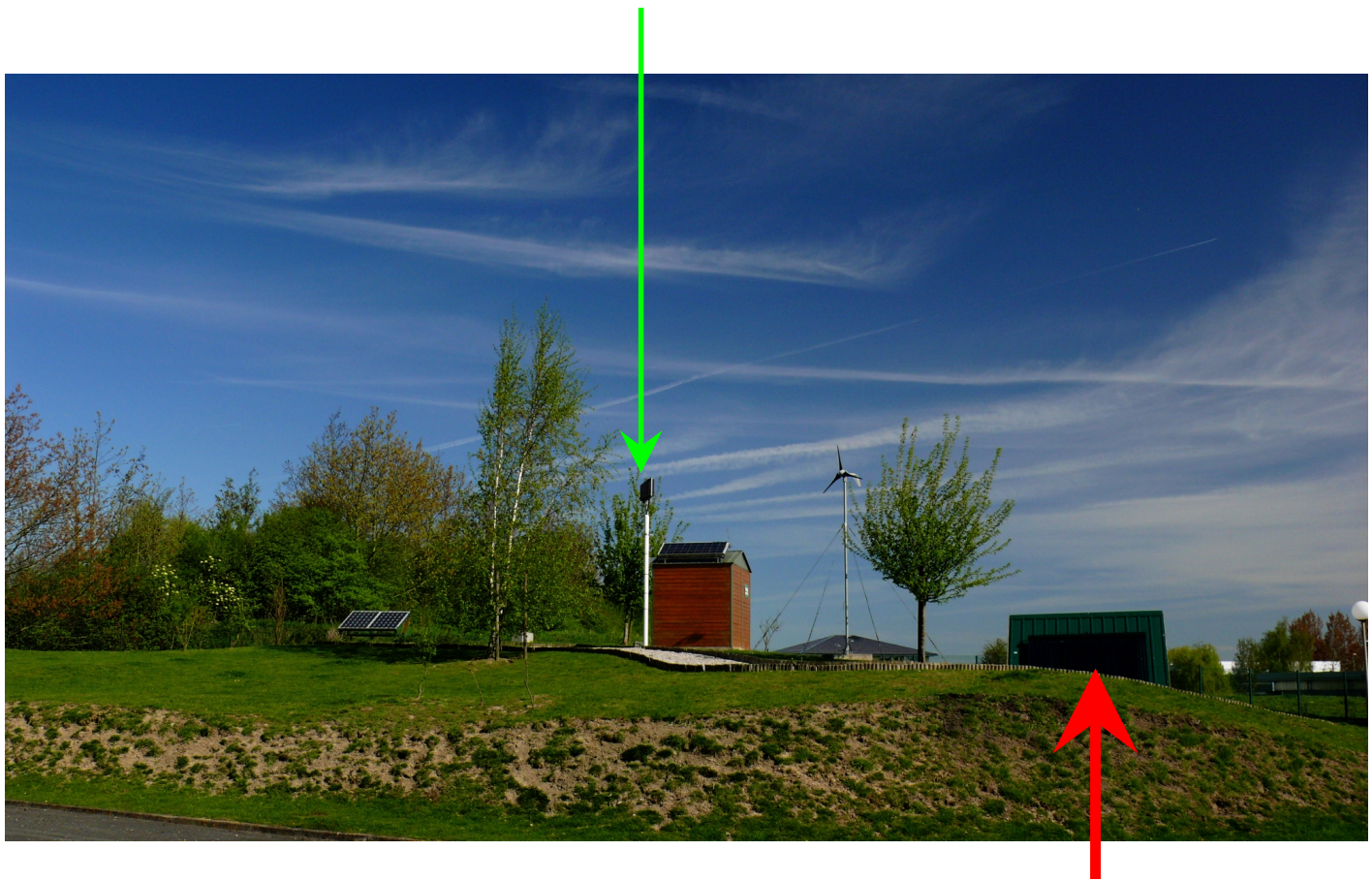

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➪ Energy production & consumption? Maintenance needed?

Motivation

What to do?

- Several preventive and corrective maintenance tasks
- Audit of the platform performance ⇨ improvements in order to be 24/7 autonomous? (empty batteries during the winter)
- Platform sensing, in order to get measures to compare with theoretical performances and prevent failures (maintenance)
- Too many tasks for GIM Dept students only...

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Dept. GIM

EILCO

Platforms

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⇨ The Gang

Marc-Olivier Kimy Rick

Marcel Alexandre

Realization

Choosing the device

- I am not going to talk about the performance audit nor the maintenance tasks
- I am going to talk about the platforms sensing!
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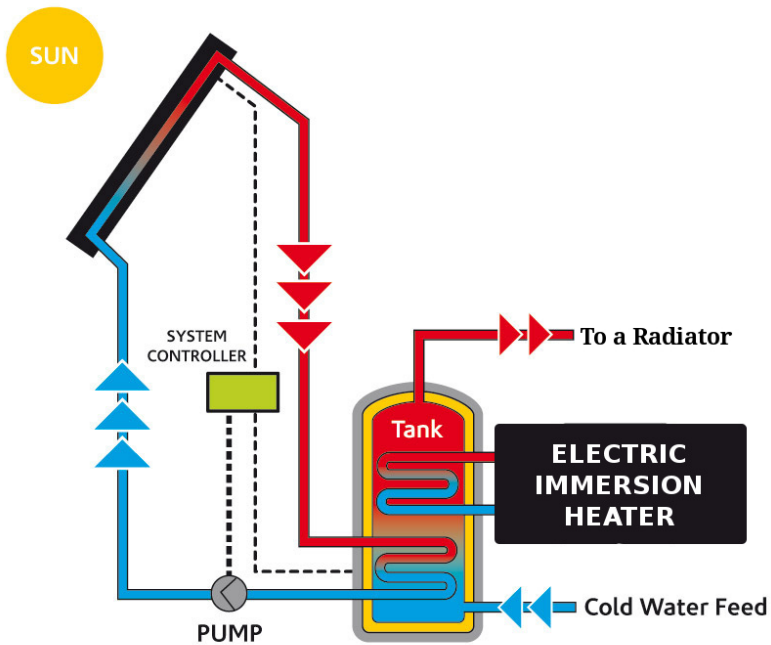

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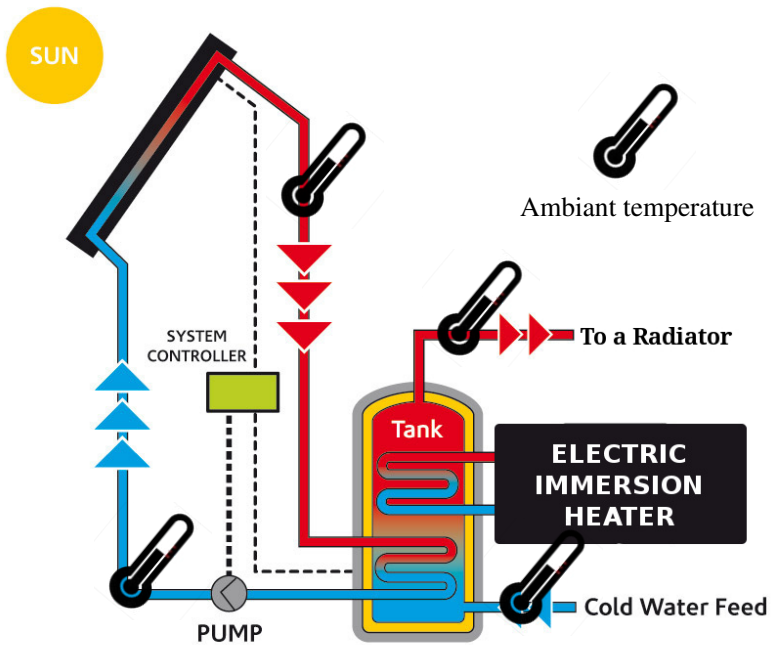

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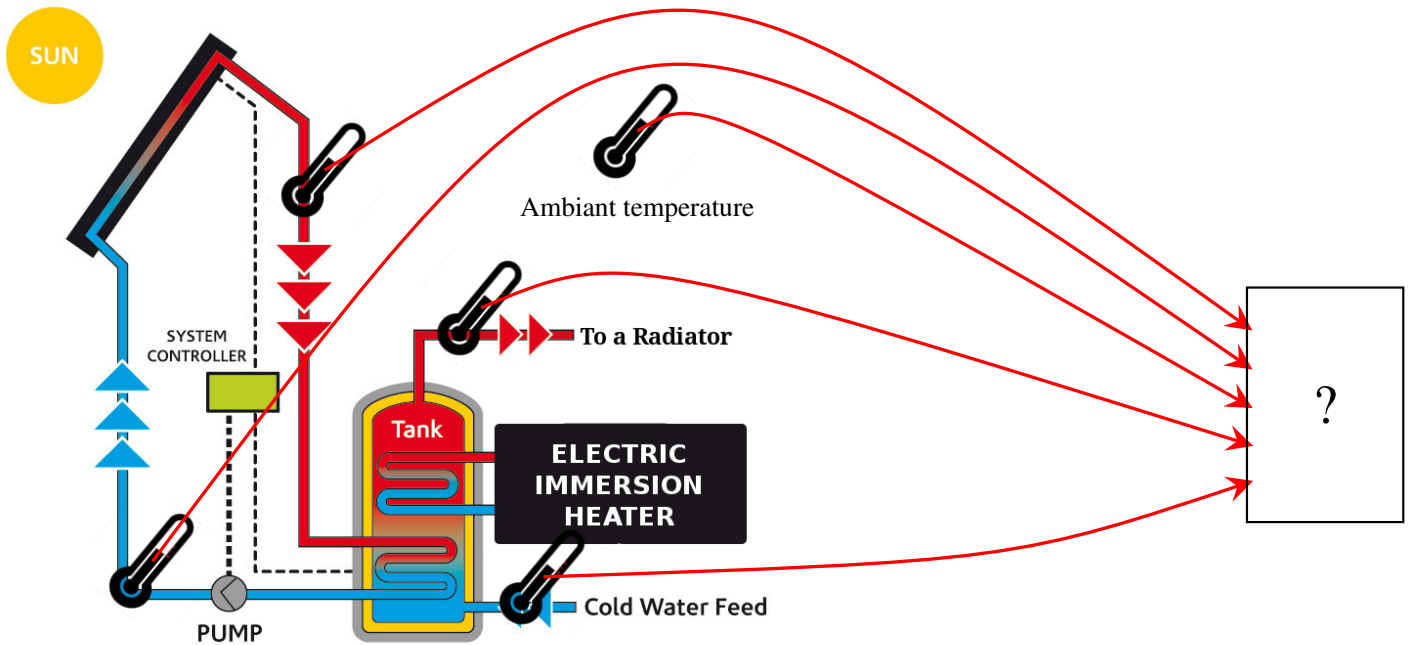

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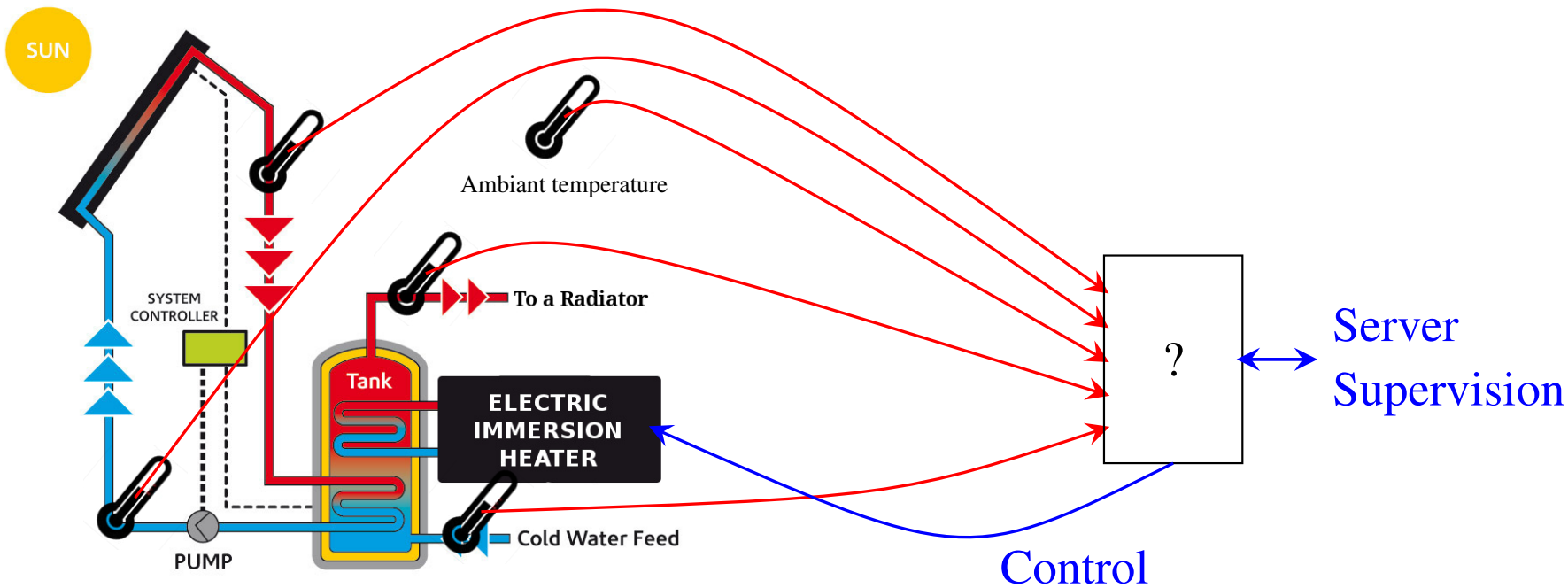

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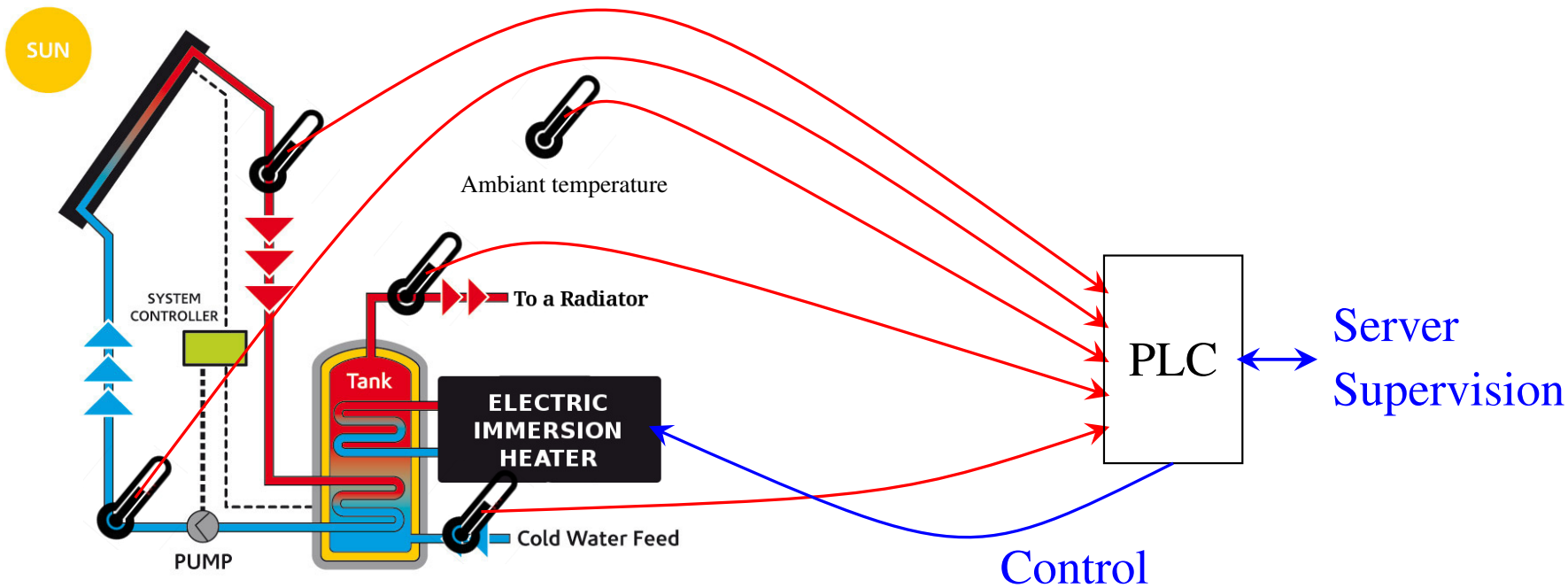

- Programmable Logic Controller: expensive and proprietary

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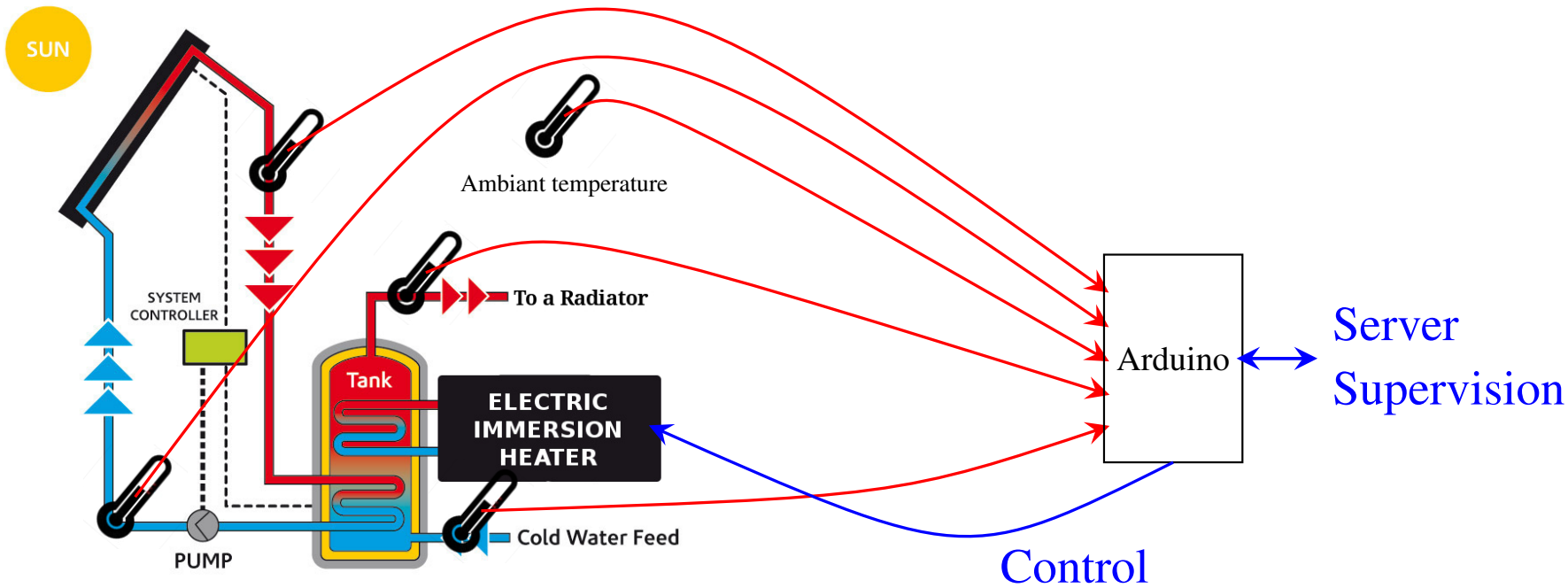

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➪ Open-source and cheap solution: a μ-C Arduino

Realization

Choosing the network architecture

Questions?

1. Transmission of the data?
2. Power supply of the Arduino?

Possible solutions:

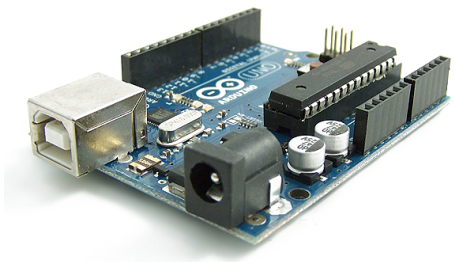
- Wireless communication (WI-FI or Xbee).
  - ✔ simple and elegant
  - ✗ not reliable for that project: wireless communication strength bad when chip is hot (Boano *et al.*, 2014)—e.g., in Summer—and in Winter, we cannot guarantee cottage batteries will work 24/7

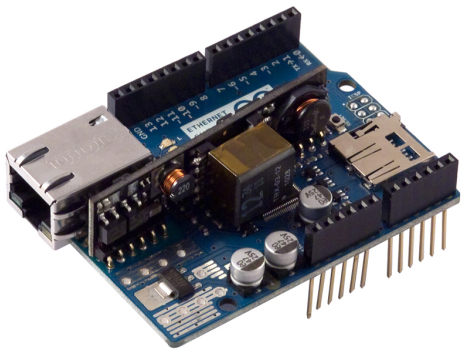
➪ TCP/IP communication with PoE supply: no connectivity issue and current voltage through the Ethernet cable

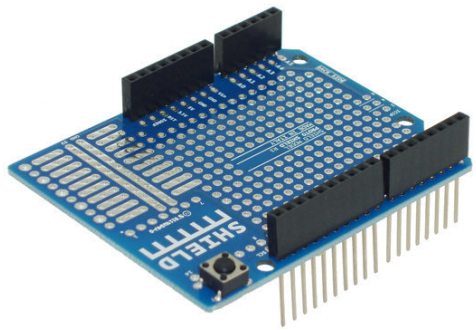
Realization

Selected equipment

- Arduino Uno
- Ethernet communication: Arduino Ethernet shield, with a PoE module
- Screw-block proto-shield
- Temperature sensors: DS18B20 (accurate, waterproof, Dallas "one-wire")
- PoE electric injector in the IUT server room



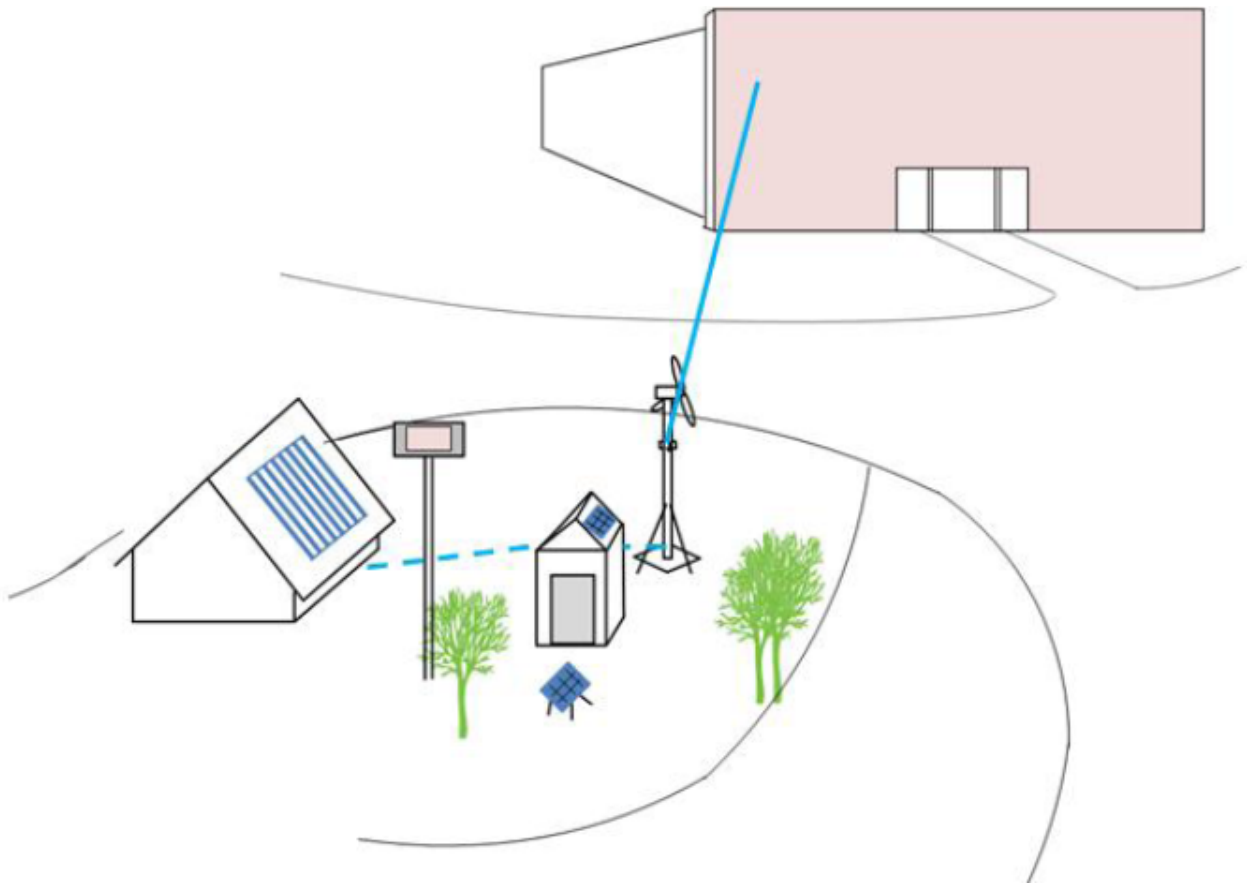




Realization

Ethernet cable and Arduino integration

- Students designed an underground solution and an aerial solution
- Cost, maintenability, and time constraints ➪ Aerial solution



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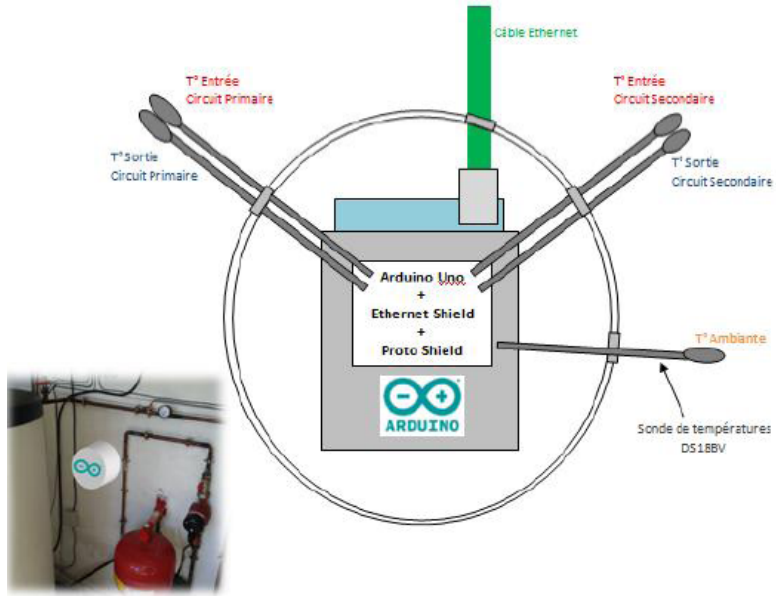
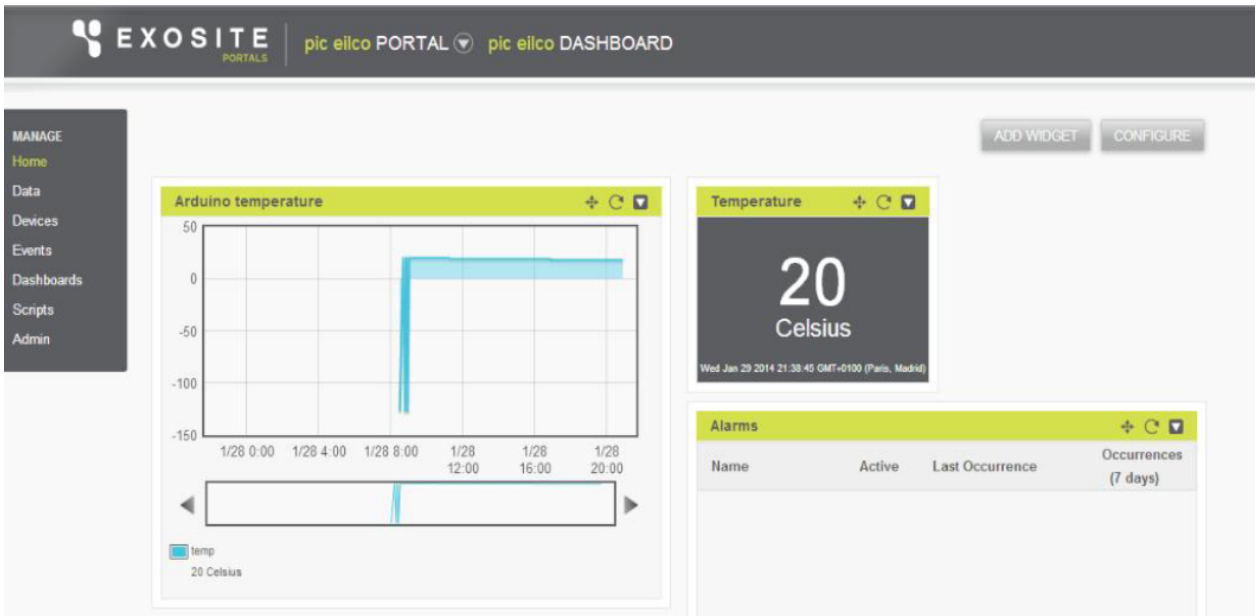
- Home-made case for the arduino system in the cottage (re-used hermetic & transparent candies box)



Realization

Data sent to the cloud

- In order to get a rapid validation, the students directly sent the data to a cloud service (Exosite)
- Worked well (simple to use) but...



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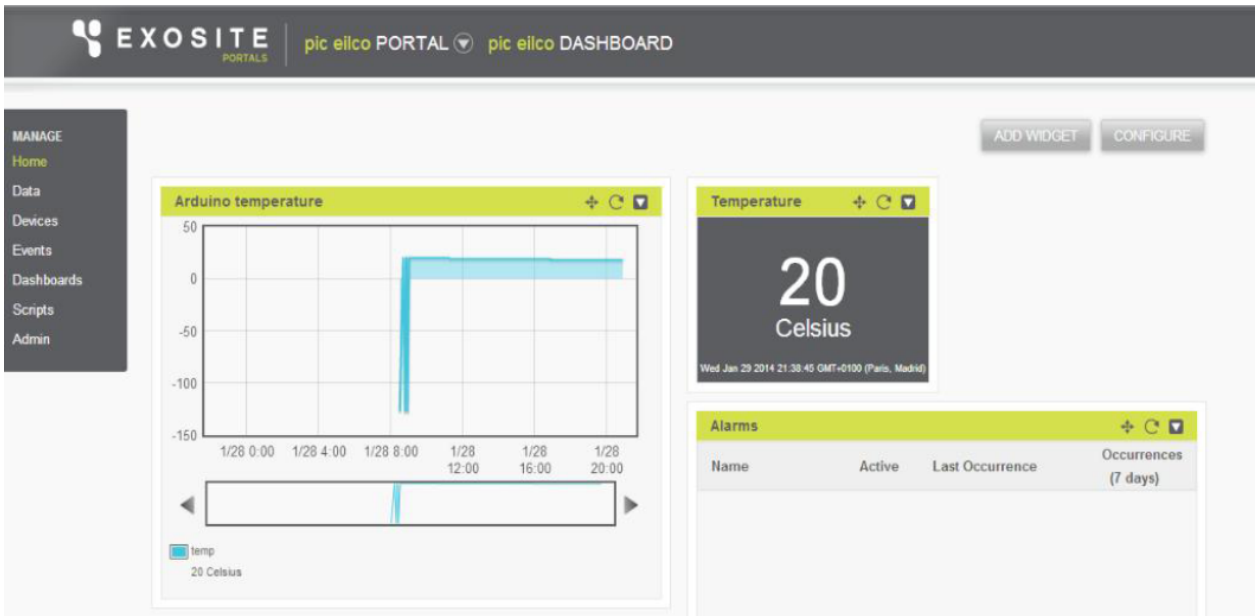

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Arduino codes?

- Available (once cleaned) upon request
- But nothing complex: find, copy-paste and merge available codes

Conclusion

- Fast introduction to an Arduino project
  - Temperature sensing and sending to the cloud
  - Arduino power supply through a PoE injector
- Next steps:
  - Sense the small cottage
  - Optimize the data exchange path (arduino $\rightarrow$ server $\rightarrow$ “SCADA”)
  - Control the heater in the big cottage

Thank you for your attention