Xplore New Automation Award 2018 – Documentation

French Team

Project: Monitoring of an irrigation campaign by a watering machine via SmartPhone
Educational Institution: Orleans University, University Institute of Technology (Indre - Chateauroux), Centre-Loire Valley national institute of applied sciences (Bourges).

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Project Members: Mr. Pascal Vrignat, Mr. Florent Duculty, Mr. Frederic Kratz, Mr. Othmane Affane, Ms. Mariela Ibarra, Mr. Mig Dolbert Pierre-ville, Mr. Abdelaziz Eddouy, Mr. Mohammed Majidi.

1. Introduction

Water is a vital socioeconomic limited resource. There is an increasing demand for domestic and industrial use purposes, which threatens the sustainability of groundwater. This situation has consequences for agriculture, forestry, industry and drinking water reserve. It is essential that water resources are managed in a strategic and sustainable way. It is in that actual context where we brought technical solutions to optimize water consumption in a watering system.

Figure 1 : Water Resource

The solutions we proposed to the farmer consist to bring technical assistance to his irrigation campaigns. This assistance will allow to avoid the over usage of the consumed water.

Figure 2: An irrigation campaign

Our client M. Stéphane Limousin (owner of an agricultural field) wants to change his irrigation control routines without uselessly moving with his car to the field and without overusing water.

Figure 3: Stephane Limousin - Solagri Berry : 14 Avenue de la foret, BOIS GUILLAUME - 36250 Saint Maur

The project was applied to one of the hose winders of M. Stephane Limousin for irrigation. This winder is capable to unwind in 670 meters a hose which will be powered by water with a pressure of 10,5 bars. The necessary power needed for the advancement of the winder (winding and watering) is brought by the water under pressure. It needs to spend 45k€ to acquire it.

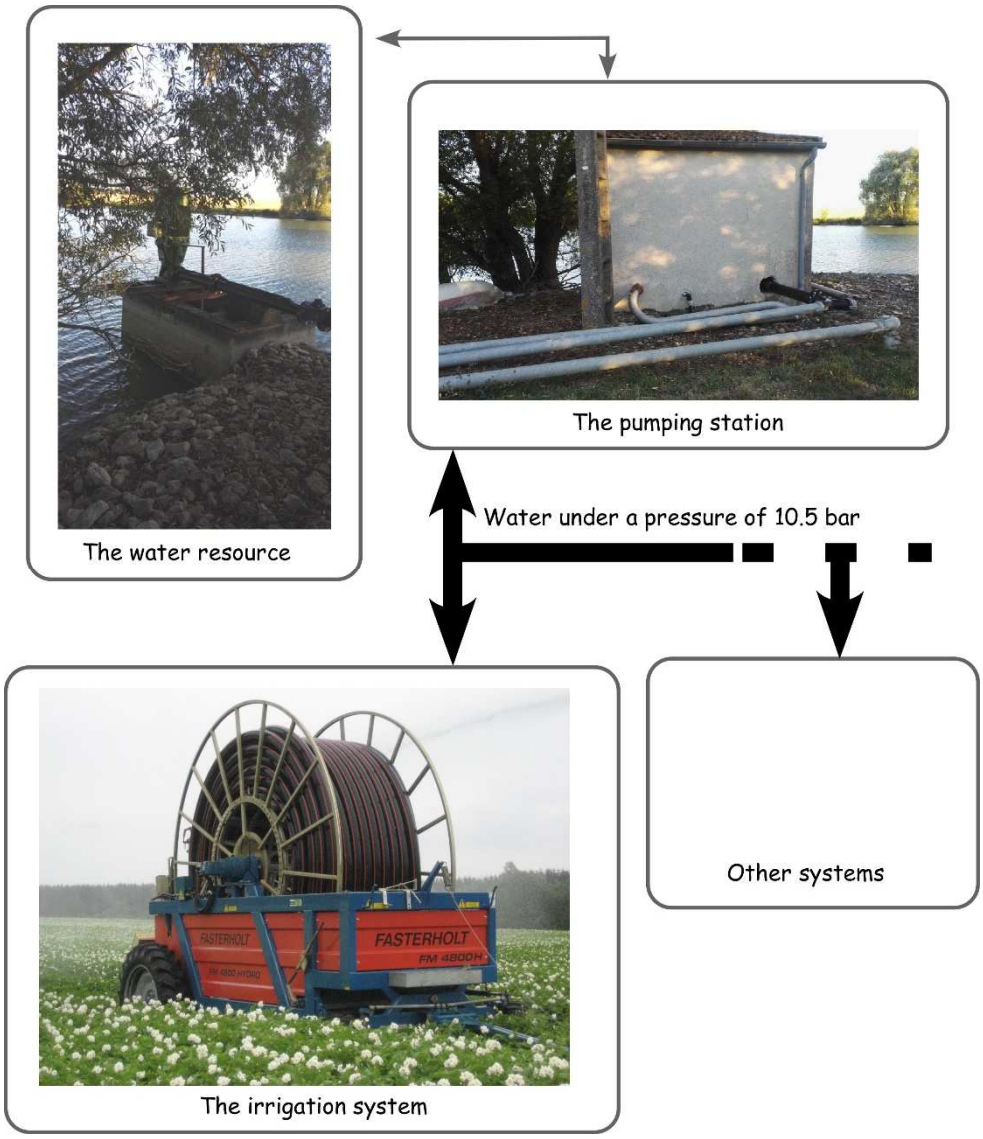

Figure 4: Irrigator hose winder (Fasterholt FM 4800)

2. Project Description

To satisfy the need, the implemented system sends SMS messages to the farmer, which allow to monitor the current status of the irrigation process (hose winding phase, watering cycle with detection of any malfunction (winding problem, bad progression, water pressure problem…)). The mobile application allows him to visit the current status of the process of irrigation (advancement speed, water pressure, the end of the irrigation cycle…) whenever he wants.

Figure 5: Real time history

A Programmable Logical Controller (PLC) is already installed by the manufacturer (Figure 6). This equipment currently manages the irrigation recipe (millimeters of water on a surface of ground). PLC also manages the hydraulic actuator. Our work does not change the existing installation. It is grafted high above.

Figure 6: Existing installed technology to manage an irrigation recipe

- Project actors and planning

The project was assigned to 5 students: 3 students in professional licence of the university institute of technology of Chateauroux and 2 students in their fourth year in the national institute of applied sciences at Bourges. The students were guided by 3 researchers-professors : Mr.

Pascal Vrignat, Mr. Florent Duculty and Mr. Frederic Kratz. This project has been realized respecting the rule: cost, time limit and performance.

- Mr. Othmane Affane (Professional Licence student) was in charge of the conception of algorithms and the PLC programming.
- Ms. Mariela Ibarra (Professional Licence student) was in charge of the cabling part, the electrical diagrams, the components nomenclature and the GSM router configuration.
- Mr. Mig Pierre – Ville (Professional Licence student) was in charge of the algorithms creation and Web panel programming. ***This student resigned from the training at the beginning of January 2018.***
- Mr. Mohammed Majidi and M. Abdelaziz Ed-Daouy (Engineering students – INSA Centre-Loire Valley) was charged to create a web interface to be able to consult the system status and implement the protection against cyber-attacks.
- Mr. Pascal Vrignat (Associate Professor in Automatic Control - Project Manager).
- Mr. Florent Duculty (Associate Professor in Automatic Control - Mentors) and Frédéric Kratz (Professor at the National High School of Bourges - Mentors).

The general planning of the project is presented in the Figure 7.

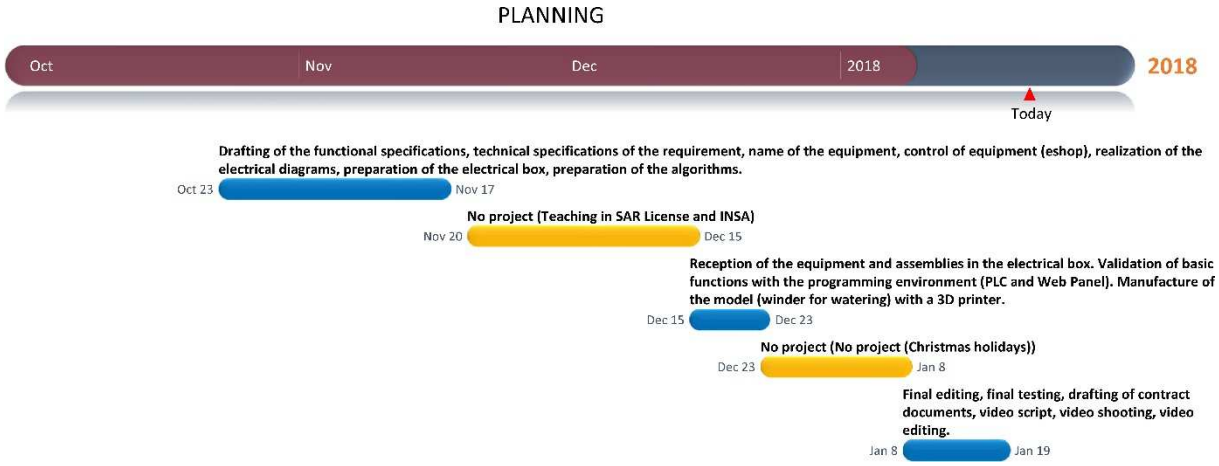

Figure 7: Planning

- Implementation

Different new technologies have been implemented in the system (Figure 8). In the electrical box, we have a programmable logic controller which is capable to diagnose the good progress or any system malfunction. The programmable logic controller handles different inputs/outputs. He also hosts a website (application for M. Stéphane Limousin). The programmable logic controller is also connected to a GSM or GPRS router (with a mobile 3G SIM card). This system allows to send SMS messages to a Smartphone. The web panel and his application allow to control locally the system.

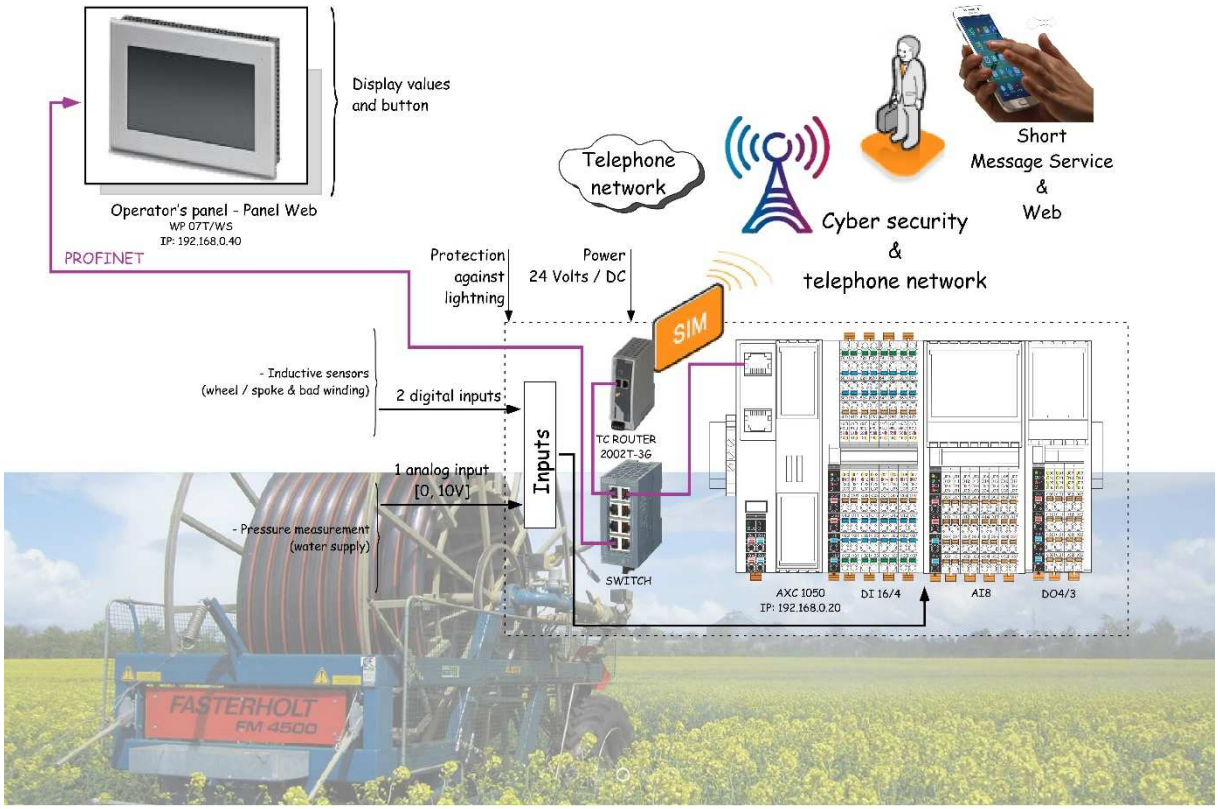

Figure 8: Hardware solution

The nomenclature of materials provided by Phoenix Contact for the challenge is presented in Table 1.

Order No.	Type	Description	Order quantity
2702531	TC ROUTER 2002T-3G	Router	1
2702273	TC ANT MOBILE WALL 5M	Antenna	1
2700307	WP 07T/WS	Touch panel	1
1403929	NBC-R4AC/2,0-94Z/R4AC	Network cable	3
2700988	AXC 1050	Controller	1
2688022	AXL F DI16/4 2F	I/O module	1
2702068	AXL F DO4/3 AC 1F	I/O module	1
2688064	AXL F AI8 1F	I/O module	1
2320034	QUINT-PS/24DC/24DC/ 5	DC/DC converters	1
2905223	PLT-SEC-T3-24-FM	Type 3 surge protection device	1
1206421	NS 35/ 7,5 ZN PERF 2000MM	DIN rail perforated	5
2701190	SD FLASH 2GB APPLIC A	Program / configuration memory	1
3240278	CD 30X40	Cable duct	20
3209510	PT 2,5	Feed-through terminal block	50
3022218	CLIPFIX 35	End clamp	50
3071401	CGSA 50	Cable routing system	1
3071400	CGS 50	Cable routing system	1
3071410	CGS-AH 50 SET	Cover	4
1567364	SAC-4P-10,0-800/M12FR-3L	Sensor/actuator cable	4

Table 1: Nomenclature of materials provided by Phoenix Contact

The Figure 10 and Figure 10 technically present the solutions that have been implemented to control the good performance or the dysfunction of the winder.

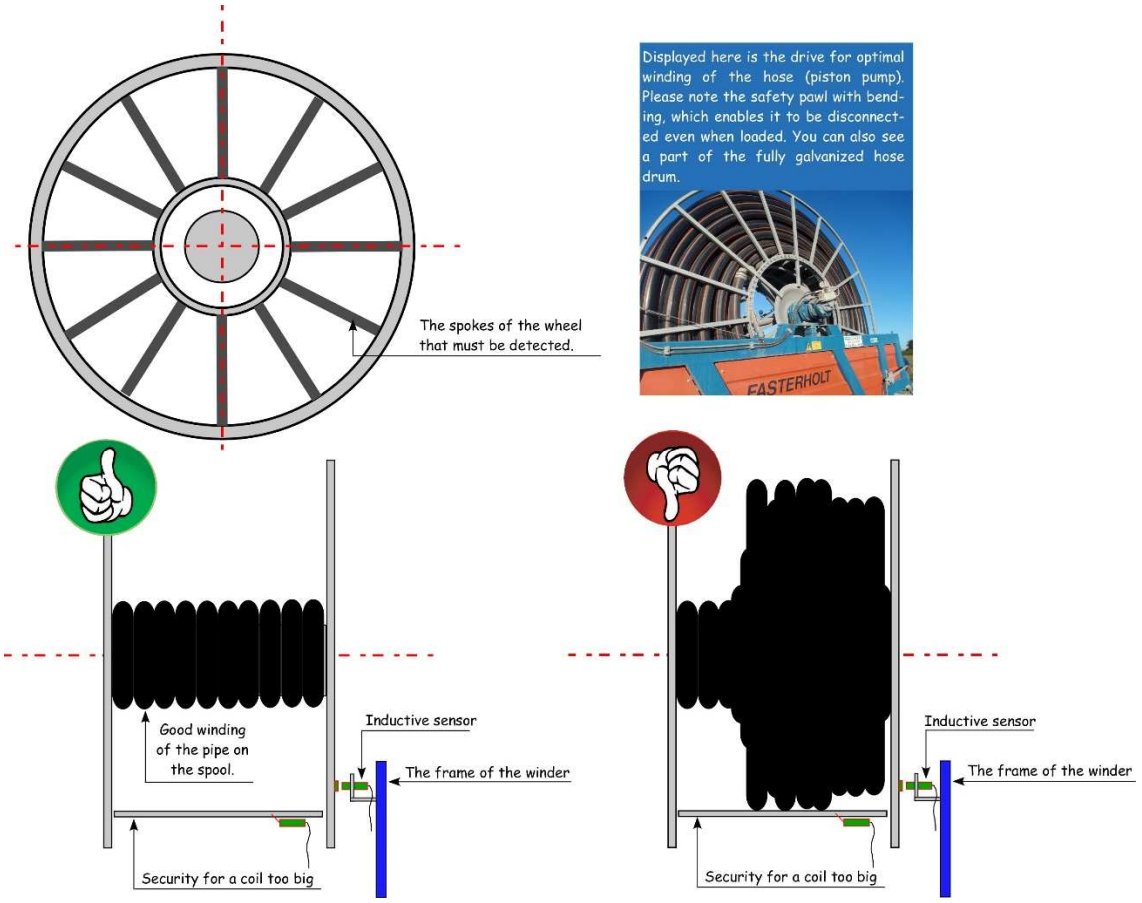

Figure 9: Hardware solution with inductive sensors

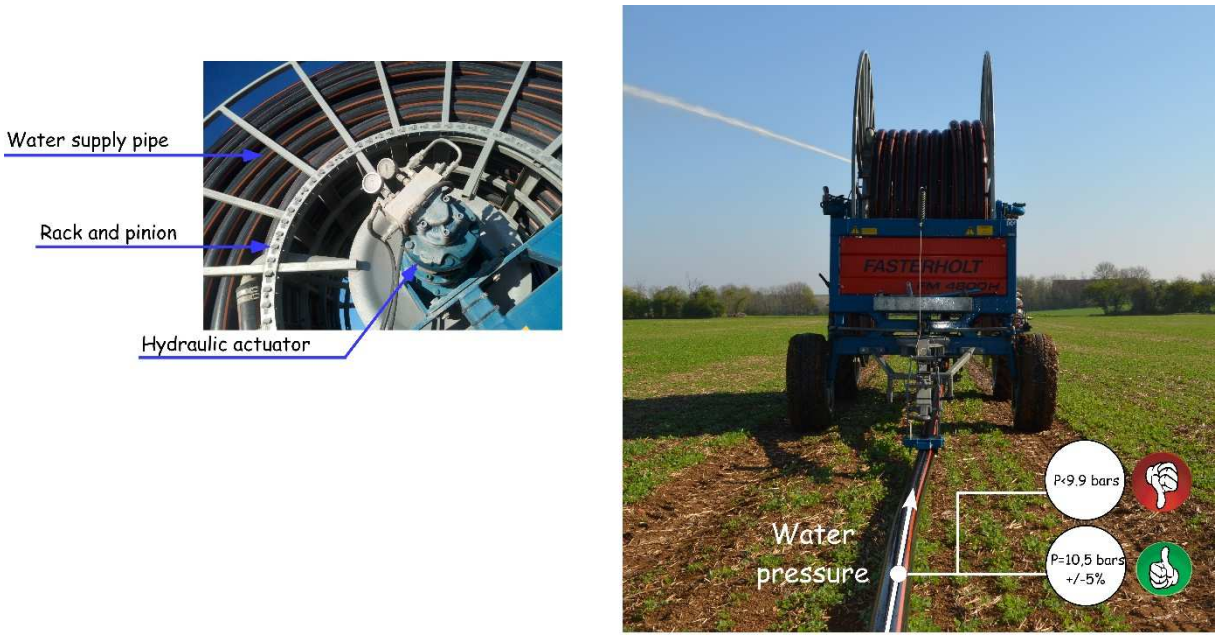

Figure 10: Hardware solution with pressure sensor

Some of the results examples are shown in Figure 11, Figure 12: Examples of results and Figure 13. They show some pages of the web panel application (PLC hosted website), some SMS messages reception, the electric box…

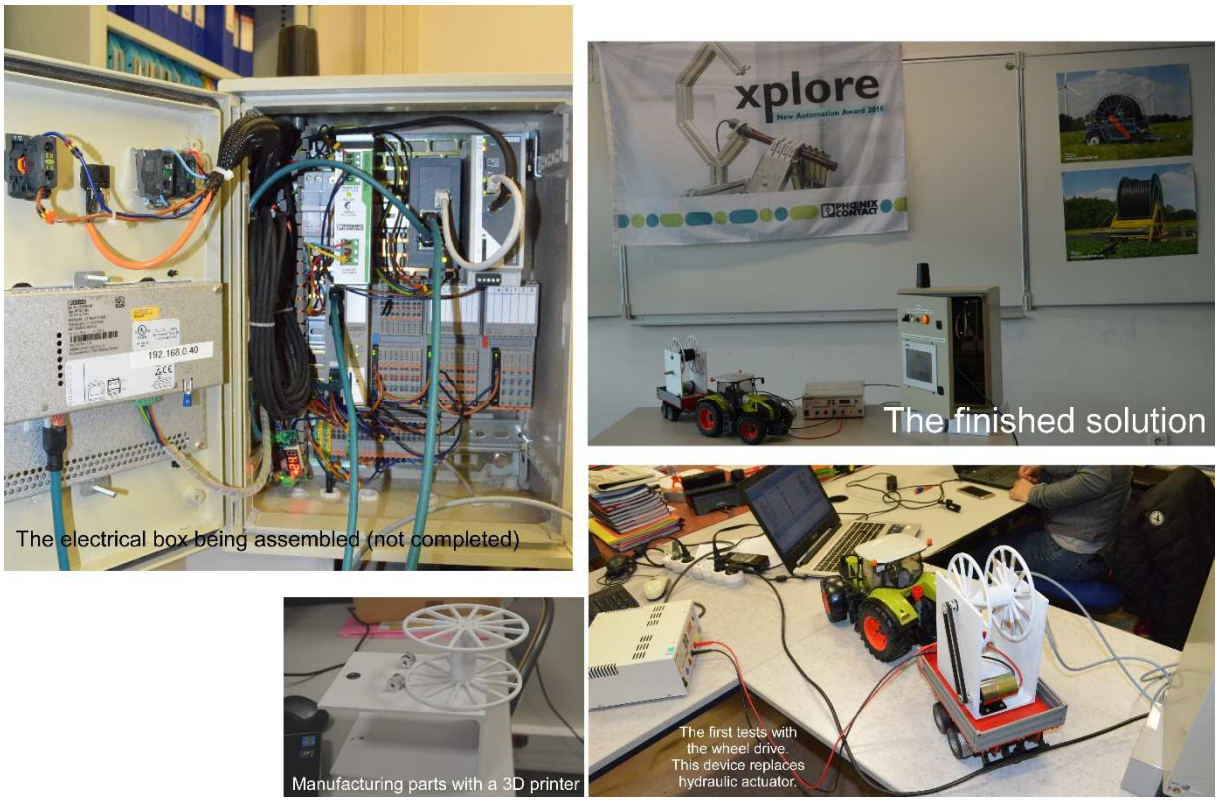

Figure 11: Examples of results

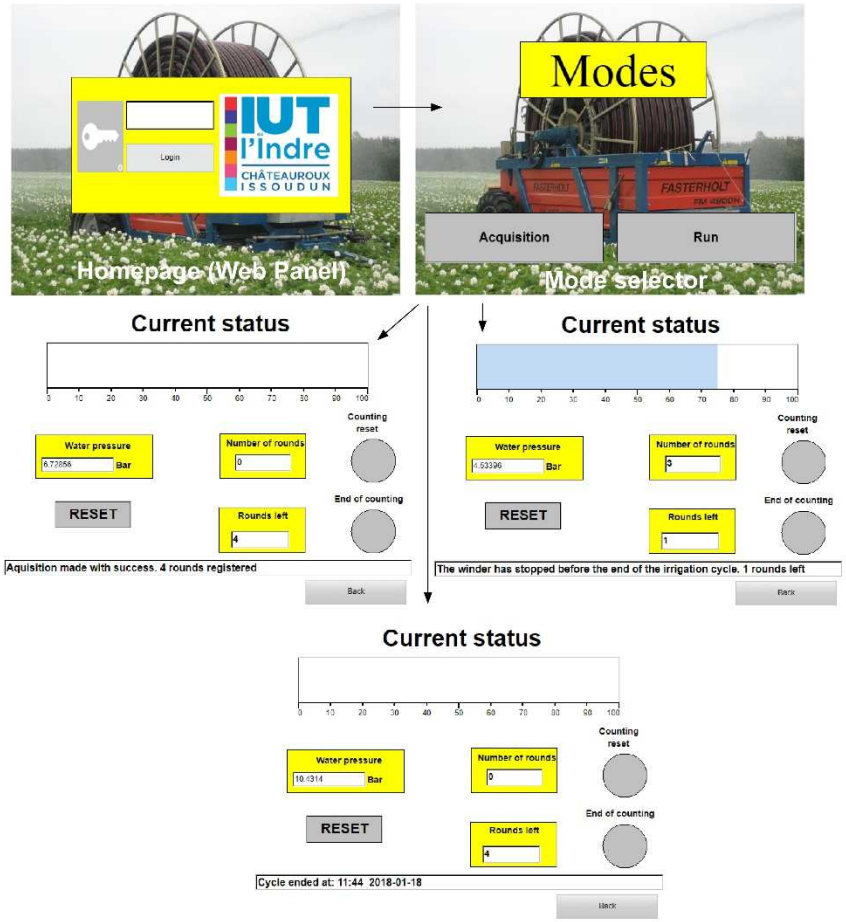

Figure 12: Examples of results

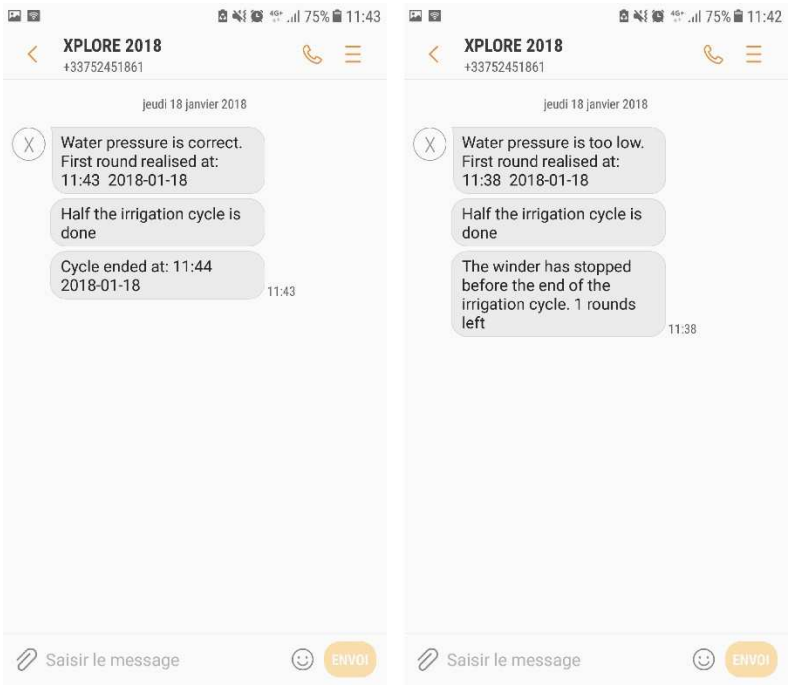

Figure 13: Examples of results

3. Conclusion

The work that started the end of September 2017 has been completely validated at January 2018. This technological and human collaboration led us to federate a student team in learning phase, mentored by their teachers. We had to do this work for a short time (Figure 7).

Once again, we learned from this project that new technology (when it was used appropriately) brings a huge benefice to preserve the vital resources of our planet. Bringing the right amount of water to a plant without wasting is vital.

Our submitted video to the jury shows in details our system with the obtained results.

We thank Phoenix Contact for trusting us and we are proud to represent France for this international challenge. We also thank M. Stéphane Limousin for his trust. We are thankful to our researchers-professors for their coaching.

The solution will be set up in the real machine in 2018's spring.

We warmly thank you:

- Mr. Stephane Limousin (Solagri Berry)
- Ms. Elisabeth Ferreira (Channel Marketing Manager - Phoenix Contact France)
- Mr. Michel Schneider (Application Automation Support Engineer - Phoenix Contact France)
- Mr. Noel Malacher (Technical Sales - Phoenix Contact France)
- Ms. Jana Kim Brockmann (Xplore Organization Team – 2018)
- Mr. Thierry Larigauderie (Audio-Visual technician - Orleans University, University Institute of Technology (Indre - Chateauroux))
- Apprentice Training Center (Centre-Loire Valley University)