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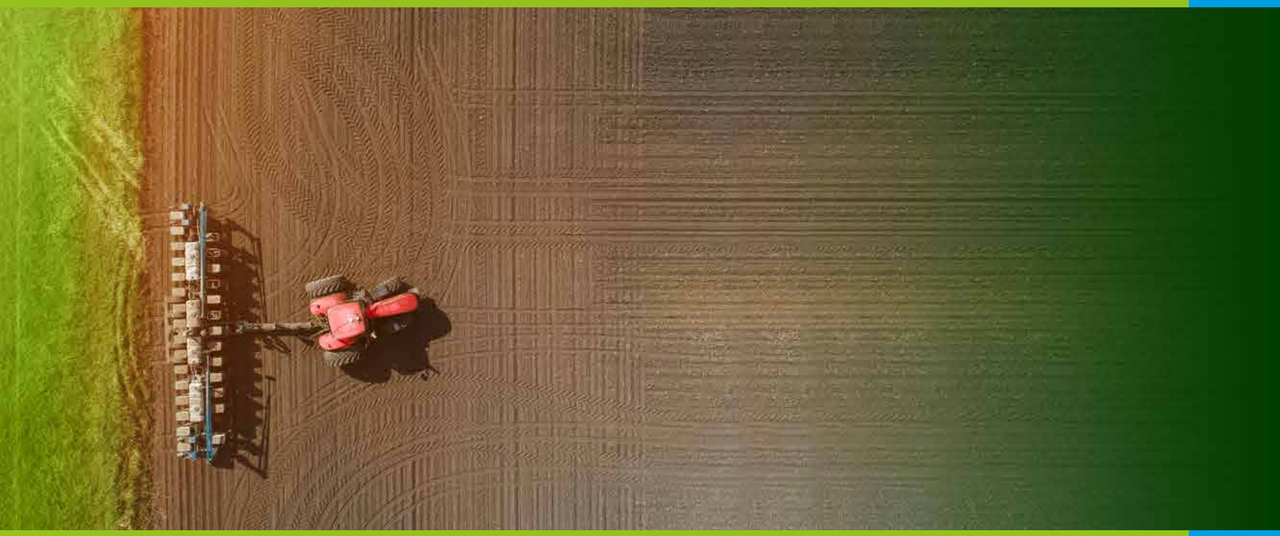
NEWSLETTER



afarcloud

aggregate farming in the cloud

INTRODUCTION

AFarCloud project (Aggregate Farming in the Cloud) started in September 2018. This yearly newsletter provides an overview of the project's latest development, as well as presenting project's demonstrators: three holistic and five local, located in different European regions.

PRAGUE INSPIRE HACKATHON 2020

Plan4all in cooperation with other organisations and H2020 projects is organising the Prague INSPIRE Hackathon 2020.
The hackathon is currently in its first stage out of three. In the first stage, we are looking for Digital Innovation Hubs (DIHs) that could serve as platforms for hackathon participants in the second and third stages of the hackathon.

PROJECT SUMMARY

AFarCloud aims at providing a distributed platform for autonomous farming, that will allow the integration and cooperation of agriculture Cyber Physical Systems in real-time in order to increase efficiency, productivity, animal health, food quality and reduce farm labour costs. This platform will be integrated with farm management software and will support monitoring and decision making solutions, based on big data and real time data mining techniques.

The AFarCloud project also aims to make farming robots accessible to more users by enabling farming vehicles to work in a cooperative mesh, thus opening up new applications and ensuring reusability, as heterogeneous standard vehicles can combine their capabilities, in order to lift farmer revenue and reduce labour costs.

The achievements from AFarCloud will be demonstrated in 3 holistic demonstrators: Finland, Spain and Italy, including cropping and livestock management scenarios and 8 local demonstrators: Latvia, Sweden, Spain and Czech Republic, in order to test specific functionalities and validate project results in relevant environments located in different European regions.

AFarCloud outcomes will strengthen partners' market position, boosting their innovation capacity and addressing industrial needs, both at EU and international levels. The consortium represents the whole ICT-based farming solutions' value chain, including all key actors needed for the development, demonstration and future market uptake of the precision farming framework, targeted in the project.

FIRST PROJECT YEAR EVENTS & ACHIEVEMENTS

During the first year of the project, the most effort was put into demonstration planning in order to define the architectural and user requirements and, as a result, fulfill the first set of requirements in the 1st holistic demonstrator, successfully integrating the AFarCloud platform core components.

The start of the project was held in Madrid with the Kick-off Meeting in September 2018. Afterwards, There were seven Technical Committee Meetings by videoconference and one Face-to-Face Meeting in Brussels in February 2019.

The first project General Assembly was held in Vienna, organized by the Vienna University of Technology (TU Wien) along with the project Coordinator — the Technical University of Madrid (UPM), during which intensive work was carried out to make progress on the demonstrators planning and coordination.

All the effort made in the first project year was presented during the AFarCloud First Technical review meeting in Ylivieska, Finland at the beginning of October 2019 together with the demonstrators, also in an open demo day formula.

PARTNERS

- Austria
- Czechia
- Finland
- Germany
- Greece
- Italy
- Latvia
- Nederland
- Norway
- Poland
- Portugal
- Spain
- Sweden

DEMONSTRATOR: COW NUTRITION MANAGEMENT

LOCATION: FINLAND

LEAD: CENTRIA

During the first project year, CENTRIA hosted the first demonstrator & review week of the project, providing well-functioning arrangements for more than 50 project guests around Europe. As part of the same demo week, also open demo day was held, where over 40 professionals of agrotechnology were introduced to AFarCloud, its targets and 1st year's outcomes. Many sensors and other contributions of other partners were hosted and tested in the demo farm since then on a long-term basis, which has given valuable experience to many partners of the winter conditions.

At the same time, CENTRIA has also developed a number of new digital innovations for the farm work during the 1st project year. The Finnish demo farm has been equipped with UWB-based cow indoor positioning system, enabling the farmer to locate the animal in a big barn. Moreover, CENTRIA has developed a unique solution for 3D-scanning the cow's paralumbar fossa area, i.e. "hunger groove", indicating the rumen fill level. This helps the farmer to monitor, how well each cow eats and to detect anomalies in their eating behavior.

DEMONSTRATOR: SAN ROSSORE PARK

LOCATION: ITALY

LEAD: CNR

Sustainable biological agriculture and livestock in protected natural park

San Rossore Park covers an area of about 24.000 hectares in the provinces of Pisa and Lucca (Italy). From the north to the south, the Park consists of coastal forests area of about 40 km, with a sea sandy shore and large inland marshes, with about 2.800 Ha reclaimed agricultural land and about 3.000 Ha olive groves, orchards and vineyards.
The crops have zootechnical use and are defined “consociation crops” or “synergetic cropping”, e.g. climbing pea and clover. During Y1 there were crops grown in autumn and winter (leguminous forage crop), next spring (Y2) sunflower crops will be planted for the first time.
To know better the land use, it was necessary to study chemical and physical soil conditions,

so during the first week of october 2019 (Y2), soil samples were carried out to evaluate: pH, K, P, N, $CaCO_3$, organic matter content [soil samples with similar texture, morphology, color, structure and common cultivation practices (tillage, fertilization, etc.)].
In this line, during Y2, in collaboration with the partner PDMFC, drone flight planning will be used to provide multi splectral image data for vegetation index analysis in order to resolve any impoverishment of nutrients, water, etc.

Another scenario is represented by livestock of Chianina cows and autochthonous cattle breeds. In this line of work, in collaboration with SENSOWAVE partner, the location of wild livestocks will be monitored by installing IoT collars to record movement and understand the cattle breeds behaviour during the summer time, especially, paths that the cows follow to get to the water during the summer time.

DEMONSTRATOR: SUSTAINABLE LIVESTOCK FARMING

LOCATION: SPAIN

LEAD: SENSOWAVE

Demonstrator area in Avila

Mediana and Cabañas are where SENSOWAVE has its own living-labs in Avila, Spain, the first of two breeder livestock farms covering a total area of 1.100ha and 180 cows. During 1st year project 90 IoT collar devices were deployed to monitor location and behavior. The summer 2019 was very dry and affected with extremely hot temperatures. The dryness was affecting the quality of the field for food. The animals were under a heat stress, which was affecting the movement patterns, very imporatnt to study for AFarCloud results.
Also, this scenario was hosting drone partners to provide image data for analysis of grazing areas.

Demonstrator area in Girona

Carrera d'en Bas is an extensive beef farm with own hamburger production. The farm is hosting the Y2 holistic scenario and covers 500ha between arable fields, pastures, and forest areas, where 93% of the feeder is cultivated in our own fields: prairies, oats, ryegrass, sunflower and corn. During the first year, the farm was preparing the study of animal behaviour data. In this line the technology provided was: 1st hand the IoT collars and 2nd the cameras provided by Hi-Iberia to record movement and location to collect comparable data. With this approach it is covering both fattening and outdoors grazing cows to detect possible behaviour patterns with the application of Artificial inteligence algorithms.

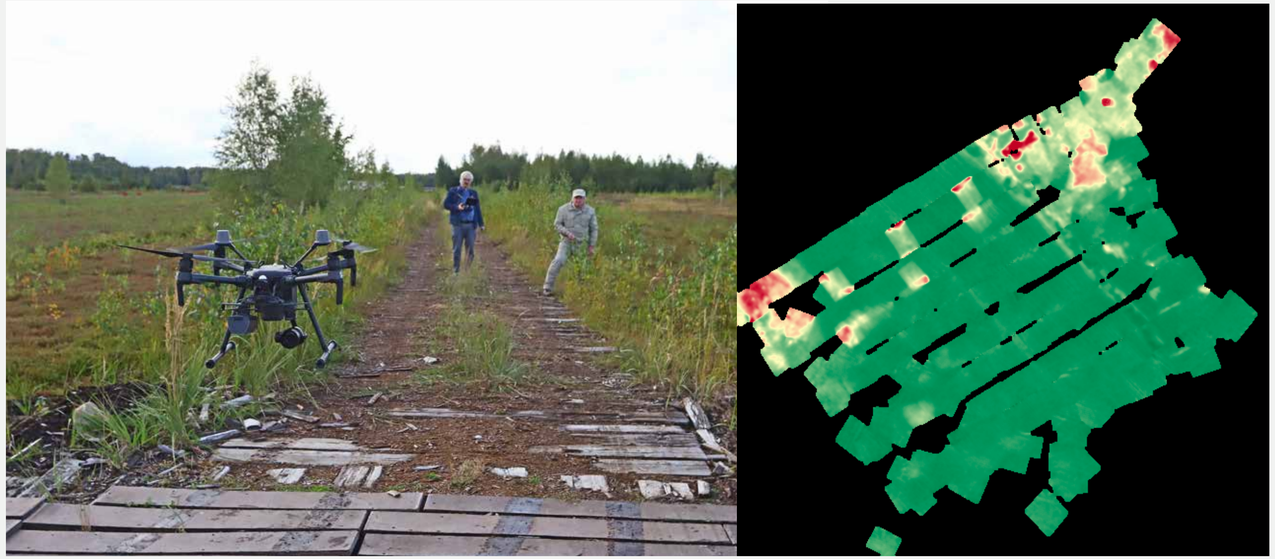
DEMONSTRATOR: DEMOSTRATOR FOR CRANBERRY PROTECTION (DCP)

LOCATION: LATVIA

LEAD: IMCS

In the first year IMCS main task were to prepare technology for survey tasks of the fields. Those field surveys are based on drone missions, which collect the images from the fields (with normal and multispectral cameras). They are used in demonstration for cranberry fields and in demonstration for maize and grass fields.
There were two sessions of field surveys:

On the 28th of August maize field survey



On the 19th of September cranberry field survey

Next step is to process the multispectral images in the format which reflects more information for agricultural tasks. See image of maize field with NDVI calculated.

DEMONSTRATOR: CATTLE HEALTH AND BEHAVIOR MONITORING

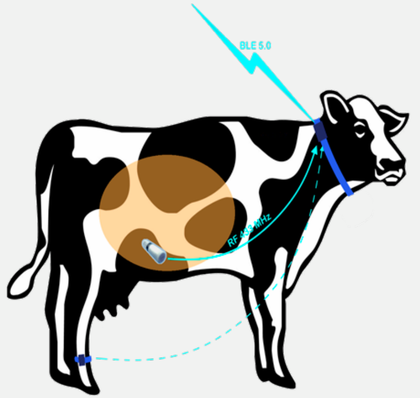
LOCATION: CZECH REPUBLIC

LEAD: IAS

The local demonstrator includes facilities of the Institute of Animal Science Prague (IAS) and the company Lesprojekt (LESP) in the Czech Republic. The demonstrator´s goal is to increase the use of farm animal health and behavior monitoring systems to predict and prevent health and performance issues.

Experimental farm of IAS, Czech Republic

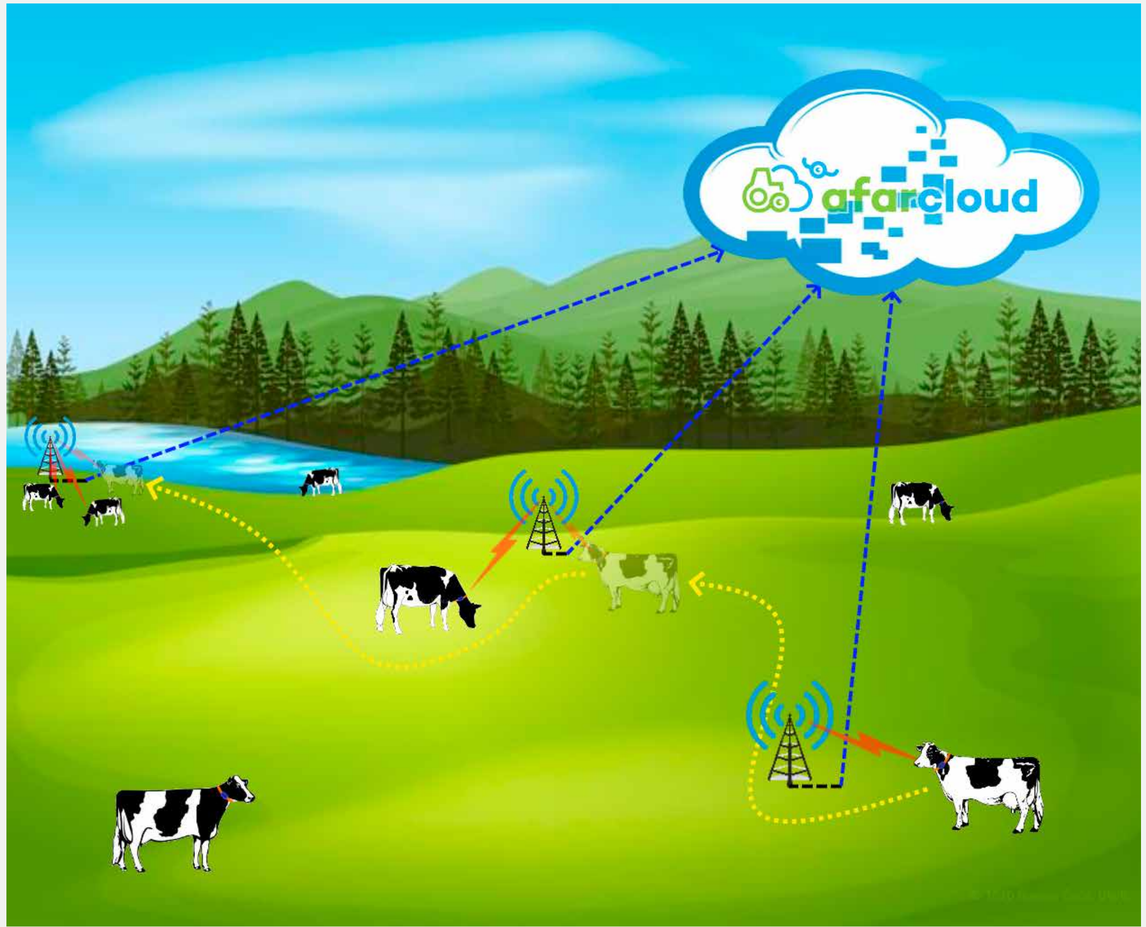
For the Y1 deployment, the innovated AFarCloud ruminal probes were not ready yet. Therefore University of West Bohemia (UWB) provided its previous version of ruminal probes with updated firmware. Ruminal probes produced simulated data but the goal was to test and demonstrate the complete data flow in final form from data production point to the data storage. The wireless probe data were received by an RF plug-in card and gathered by Lesprojekt AgroNode and forwarded to cloud storage. In the next period, a new version of ruminal probes will be presented, with key improvements — a collar device serving as a data buffer and re-transmitter that will be inserted into the communication chain between the ruminal probe and stationary gateway. In this way, the problematic RF transmission from a liquid rumen environment will be overcome and replaced with an air-to-air link with a significantly longer range and better efficiency. Another contribution by UWB is the central data storage for the demonstrator based on the SensLog solution. SensLog is capable to receive and publish sensor data over REST API. The REST API is used by other partners for further data processing and for visualization.



LESP deployed environmental sensors inside the barn and outside in the meteorological station. These sensors are managed by AgroNode solutions and they send data over LoRa network to the central data storage. Lesprojekt integrated the receiver of ruminal probes to the AgroNode solution to provide these data over a variety of transfer technologies.

IMA developed own cloud Azure Web Server for data processing and data transmission to the third parties and developed cloud-based application for data visualization. IMA deployed environmental LoRa Temperature and Humidity sensors inside the cowshed and outside in the meteorological station on the IAS farm. Data from environmental sensors are transmitted via LoRa WAN to IMA cloud, where they are pre-processed, stored in the SQL database and transferred via REST API into SensLog (UWB) and HLAF (CUNI) for further processing and visualization.

CUNI has developed and integrated the first version of the visualization framework (which is part of the High-Level Awareness Framework). This visualization framework (denoted as HLAF in the demonstrator architecture) allows for drill down in the data from environmental and ruminal sensors. The visualization framework targets highly customizable visualizations for experts. The visualization framework comes with a connector through which it is integrated with SensLog to periodically gather and index sensor data.



DEMONSTRATOR: FARMING BASED ON PERMACULTURE PRINCIPLES

LOCATION: ITALY

LEAD: CNR

The farm Podere Campaz is located in Emilia Romagna Region, Italy. The main farming activities are the permaculture principles based on the conscious design and maintenance of agriculturally productive ecosystems. In less than 10ha, Podere Campaz is dedicated to vineyards, apricot and peaches trees, berries, vegetables, aromatic herbs, olive trees. Its production is strictly organic without needs of agrochemicals and synthetic fertilizers. It has a greenhouse of about 200 square meters for vegetables crop.
Essentially, the local demonstrator represents two scenarios: vineyard and greenhouse.
The vineyard scenario is useful to monitor the climatic condition. In this line during Y1, Italian partners has installed sensor units — along the vineyard rows — to monitor air temperature and air humidity and soil sensors to evaluate the moisture content useful to study any water stress/vigour. During Y2,

Italian partners will develop an algorithm to detect if vineyard plant receives enough water and the study will be completed through the interaction of data sensor detection, meteorological forecast, vegetation index on multispectral images, and so on.
The greenhouse is the second scenario, useful to monitor climatic condition and field water content through the installation of climatic and soil sensors in indoor solution. The climatic sensors to detect air temperature, air humidity and solar radiation; the soil sensors to measure the soil moisture content. During Y2, Italian partners will improve the technology of two multi-sensor nodes to monitor soil moisture, air temperature, air humidity, and monitor the greenhouse sanitization. Investigate the possibility of connecting actuators to multisensory nodes, to control timed irrigation in the greenhouse or an actuator system for smart irrigation (remote control) assessing the water consumption and integration with middleware. Finally, will be validated a deep learning neural network engine able to analyze images of leaves to detect presence of illness.

The Italian partners involved in local demonstrator: UNIPR, UNIVAQ, ROTECH, ESTE, ARCHA, STM, CNR

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DEMONSTRATOR: VINEYARDS MONITORING

LOCATION: SPAIN

LEAD: ACC

The demonstrator is located in Villaverde de Medina, Valladolid (Spain). Caserío de Dueñas is a singular state of almost 300 hectares of vineyard in one of the highest quality zones of the Rueda Designation of Origin. The objective of this scenario is to improve existing techniques and working conditions of the people in charge of the vineyard and to carry out a watering optimization in order to ensure the final product quality.
The main goals to improve the quality of the vineyard are to monitor the water content, water stress and the vigour of the vines. The content of water is being analysed using soil sensors installed by different partners of the project that measure in real-time: soil humidity, soil water content, soil conductivity, soil temperature and soil conductivity, sending the data via LoRaWAN, GSM and 3G.

In addition, this information will be complement with the data gathered using multispectral sensors, onboard on drones. Specific algorithms have been developed within the project in order to generate, automatically, the orthomosaics using the collected image datasets. Different vegetation index will be calculated to analyse the vigour of the vines.

In the first year of project running, with the aim to estimate the water stress, a thermal camera onboard on drones has been used to take images to calculate the Crop Water Stress Index. This index could be a criterion, which allows generating an alert about the irrigation needed. Further development of the monitoring system is being continued.

DEMONSTRATOR: ENVIRONMENTAL MONITORING FOR SUSTAINABLE CROP PRODUCTION AND LIVESTOCK WELFARE

LOCATION: SWEDEN

LEAD: RISE SICS EAST

In Sweden, the leading partner established contact with a big milk producing farm (1500 milk cows and more than 2000 ha arable land for feed).
At the test bed, tests were performed to build a data base with topographic maps, soil maps, nutrient content maps and installed several wireless soil probes to measure important components in the soil during the cultivation season. A weather station was also installed to measure percipitation (rainfall) and temperature, wind and solar influx and other parameters, to be able to analyse the need for irrigation or other actions. Further, the feed for the cows was measured and analysed with respect to water content and nutrients, as to advice in the composition of full rations for the cows. A system for analysis of ecological footprint from the husbandry of animals was also tested.

Analysis of growing crop has been prepared with a system for rout planning of Unmanned Aerial Vehicles (UAVS/Drones). Initial experiments was made with Infrared (IR) and RGB cameras as well as Hyper-spectral sensors for inspection of health and growth of the crops.
UAVs was also tested with different sensors to find and count animals in the fields, to ensure that some did not escaped or were wounded. The method was also used to identify deer fawns, hiding in the grass or cereal fields. Fawns usually do not escape from a tractor, but stay on the ground and are in many cases killed from the cutting machine. Besides the ethical perspective, this is dangerous for the milk cows, as they can get diseases, like botulism from the remains of the cadaver.

Transponders on cows have been tested with the purpose to analyse moments of the animals and eventually anomalies in that pattern as an indicator of illness or other behavior. Transponder has also been used on tractors to aid in logistic support system to reduce driving time, distances and fuel consumption.

To save and transmit the data, a local server was installed and connection to global servers was established with LoRAN, WiFi and mobile, as well as wired Internet.

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