





Engineering and Industry 4.0 for the agricultural and farming industry

Carlos González Sánchez IoT Week – Aarhus 17/06/2019

#### Aplifisa SL - Introduction

**APLIFISA SL**, based in Salamanca (Spain) is a company focused on software development, innovation and research in all scientific branches where IT can be applied.

- Development of technological solutions for management, invoicing, CRM and ERP.
- Growing R&D department → Innovation towards biomedical engineering.
- Aplication of IT solutions for agriculture and farming industries based on industry 4.0







### IoT Milestones

- Establishment of the first LoRaWAN communication systems in Castilla y León.
- Development of ultra-low consumption Bluetooth 5.0 communications systems with coverage of more than 4.500 meters.
- LoRaWAN gateway with coverage areas of more than 20 kms.
- Development of own sensors: Soil water content sensors, radiation sensors, movement sensors, electronic "tongue" for chemicals measurement.
- Organization of IoT Makeathons.



### **SMART IoT Makeathon**





### Projects being currently developed





# Real-Time flow sensors for efficient hidric resources management.

Measuring water use in real time is a key part of irrigation communities.

- Real-time consumption measurement.
- Easy to install in systems already implemented with pulse output.
- Real time notifications of consumption per farmer.
- Water theft detection.
- Ability to manage the distribution of cuts.
- In development phase: Measurement of water volume in open ditches.



# Sensors for the measurement of edaphoclimatic parameters

Development of precision sensors for the measurement of environmental parameters with ultra low power consumption and long-range real-time wireless connectivity.

- Parametrization of water available in soils and EC index.
- Electronic "tongue" sensor for the measurement of instantaneous chemical variables (pH, Nitrate, Ammonium, Phosphate, Potassium, Calcium...).
- Sensors for real time sap analysis.
- Precipitation and wind sensors with no mechanical parts (based on RADAR and / or ultrasound technologies).



# System for measurement of toxic gases in intensive farming.

Prototype system under development:

- System for intensive livestock farming.
- Measurement of variables: organic volatile, methane, carbon dioxide, hydrogen sulfide, ammonia, temperature, relative humidity.
- Improve animal welfare indices.
- Improve economical viability of farms.







#### **Challenges of extensive farming**

- Difficulties for animal tracking (Counting, animals dead, lost, stolen...).
- Need for veterinary monitoring.
- Increased labor risks.
- Increased costs.
- Energy requirements for standalone systems.











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#### **Vision for developed solution**

- Increase animal well-being.
- Non-Invasive.
- Cost effective solution.
- Reusable.
- Battery powered.
- Help development of rural areas.





#### **Technological solutions**

- Position tracking  $\rightarrow$  (Global Navigation Satellite System Gallileo).
- Non-Invasive physiological variables monitoring
  - Heart rate / Heart rate variability.
  - Breathing rate / Breathing rate variability.
  - Temperature measurement.
  - Inertial measuremet unit.
- Pattern recognition → AI for identification of Sleep cycles / Feeding / Labor / Sickness...
- Low power devices /communications. → Sigfox / LoRaWAN
- Real time notifications for the user









#### Capacitive sensors for physiological signals monitoring

González-Sánchez, C.; Fraile, J.-C.; Pérez-Turiel, J.; Damm, E.; Schneider, J.G.; Zimmermann, H.; Schmitt, D.; Ihmig, F.R. *Capacitive Sensing for Non-Invasive Breathing and Heart Monitoring in Non-Restrained, Non-Sedated Laboratory Mice.* Sensors **2016**, 16, 1052.

González-Sánchez, C.; Fraile, J.-C.; Pérez-Turiel, J.; Damm, E.; Schneider, J.G.; Schmitt, D.; Ihmig, F.R. *Monitoring System for Laboratory Mice Transportation: A Novel Concept for the Measurement of Physiological and Environmental Parameters.* Electronics **2019**, 8, 34.



#### **Technological solutions**

System for movement data management - Identification of behaviaoural anomalies in animals.



Capacitive sensing for monitoring of phisiological signals











### **Technological solutions**

Configurable ARM Cortex M4 processor and wireless Bluetooth 5.0 transmission for up to 4.500 metres.



### Some pictures







### Thanks for your attention! - Contact

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