LM2: Internet of Things (IoT) and Earth Observation (EO) for Growing Farm Yield and Improving Resource Efficiency

1.1 Module objectives

"The primary aim of the module is to provide understanding, knowledge about Internet of Things (IoT) and Earth Observation (EO) and how they can be used in agriculture for growing farm yield and improving resource efficiency."

1.2 Learning outcomes

Smart Farming is a sector that relies many of its key business process on the Internet of Things (IoT) and Earth Observation (EO) technologies. In the upcoming Common Agricultural Policy (CAP), Precision agriculture and Smart Farming are integral parts, because their combined use leads to an optimal and sustainable production process while allowing the provision of advisory services based on facts. IoT and EO are proposed as the best tools for efficient implementation of the CAP. Until now, EO has been used for annual verification of subsidies claims. Recent technological improvements in big data, data management, available computing power and Copernicus Sentinel data (aerial imagery) allow for the continuous improvement in understanding agri-environmental information for selected agricultural parcels.

In this context, this course will provide an opportunity to students to recognise and learn about data sources (in situ IoT sensors, proximity sensors and soil scanners, EO/ Remote Sensing platforms etc) and efficiently use them to support decision making in agricultural practices. Through this course, students are expected to become familiar with the farming management concept in order to increase the quantity and quality of agricultural products while increasing the selective and effective use of inputs. To make this module more complete, a combination of case studies on "gaiasense" Smart Farming System (SFS) and high accuracy field-level weather forecasts will be shown. In that way, students will focus on real-life examples of how this SFS provides (IoT and EO) data-driven advisory services on fertilisation, irrigation and pest management in practice.

To summarise, the learning outcomes of this course are:

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- To provide an overview of IoT and EO technologies and their relevance to agricultural practices and overall production.
- To provide students with a set of skills that will enable them to manage the useful information gathered from IoT and EO devices, including a wide range of physical parameters, aiming to enhance cultivation practices with emphasis on irrigation, pesticides and fertilisers applications.
- To make students acquainted with the skills necessary for managing IoT and EO technology in order to increase farm growth and improve resource utilisation.

1.3 Course content

1. **Challenges and opportunities of IoT and EO technologies in farming**
   - Digitalisation – Role of Information and Communication Technologies (ICT)
   - Analysis of IoT and EO applications
   - Focus on unequal distribution of technology solutions
2. **Decision Support Systems**
   - Examples of DSS with application variability
   - Failure and success factors of DSSs
3. **Irrigation, fertilisation and plant protection technologies**
   - Earth Observation (Drone and satellite images)
   - Accurate Weather forecasting
   - Yield production data
   - Proximal soil and crop sensing data
   - Internet of Things (IoT)
   - GIS & GPS
   - Predicting models
4. **Case studies**
   - “gaiasense” Smart Farming System
   - High accuracy field-level weather forecasts

1.4 Mode of teaching

- Lectures
- Literature study
- Hands-on exercises
- Small group engagement in IoT and EO related projects
- Case study, and
- Presenting the results to the group

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1.5 Recommended study material

Selected examples of articles, book and online study material.

- Castrignanò et al., (2020). Agricultural Internet of Things and Decision Support for Precision Smart Farming. Academic Press.
- Poonia et al.,(2018)Smart Farming Technologies for Sustainable Agricultural Development. IGI GLOBAL.
- Ayaz M, Mohammad Ammad-uddin M, Sharif Z, Mansour A, Aggoune HM (2019) Internet-of-Things (IoT) based Smart Agriculture: Towards Making the Fields Talk. IEEE Access.
- Kalatzis N., Marianos N., Chatzipapadopoulos F, "IoT and data interoperability in agriculture: A case study on the gaiasenseTM smart farming solution," 2019 Global IoT Summit (GIoTS), Aarhus, Denmark, 2019.
- Marianos N.,Kalatzis N., Sykas D. (2018). "Earth observation for smart farming and cap performance" in "The ever-growing use of Copernicus across Europe's regions", NEREUS/ESA/EC.
- Theopoulos A, Boursianis A, Koukounaras A, Samaras T (2018) Prototype wireless sensor network for real-time measurements in hydroponics cultivation. 7th International Conference on Modern Circuits and Systems Technologies (MOCAST), Thessaloniki, 2018.
- Venkatesan R, Jaspher WKG, Ramalakshmi K (2018) Internet of things based pest management using natural pesticides for small scale organic gardens.Journal of Computational and Theoretical Nanoscience.
- Villarrubia G, De PazJF, De La IglesiaDH, Bajo J (2017) Combining multi-agent systems and wireless sensor networks for monitoring crop irrigation.Sensors.
- European Commission (2016) "The Internet of Things. Digital Agenda for Europe", EuropeanCommission" [Online] Available: https://ec.europa.eu/digital-agenda/en/internet-things.

1.6 Coordinator

NEUROPUBLIC SA / AgTech7 online platform

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