PhD Thesis Defense

On **Friday February 28th 2025 at 3.00 pm**, in the classroom **G**, Via Santa Sofia 100

Dominga Mancuso (XXXVII cycle)

Will discuss her PhD theses titled

MONITORING OF COW BEHAVIOURAL ACTIVITIES IN EXTENSIVE FARMING BY MEANS OF AUTOMATIC SYSTEMS BASED ON THE USE OF LOW-POWER-WIDEAREA TELECOMMUNICATION NETWORKS

Thesis Abstract

This PhD thesis investigates the application of advanced technologies in Precision Livestock Farming (PLF) to enhance the management of extensive grazing systems. The study focuses on validating devices equipped with accelerometers and GPS by using Low-Power Wide-Area Networks (LPWANs) for real-time monitoring of livestock behaviour. By tracking activities like walking, grazing, and rumination, these technologies generate information that can optimize livestock management practices, improve land utilization, and promote animal welfare. The use of LPWANs is crucial for devices developed for monitoring grazing animals, as these networks offer an optimal balance between power consumption and transmission range. Devices adopted in rural environments often operate in remote areas, far from power sources and with limited network coverage. LPWAN technologies, such as Sigfox and LoRa, enable data transmission over long distances with minimal power consumption, significantly extending device battery life. This ensures continuous, long-term monitoring of animals, reducing the need for frequent manual battery replacements and enhancing overall operational efficiency. The thesis is organized into several key sections. The first section provides an overview of current technologies used for monitoring grazing cows, highlighting their potential to automate and refine livestock management processes. The second section explores the use of triaxial accelerometers for analyzing animal behaviour and the methods adopted to establish acceleration thresholds for the automatic detection of various cow behaviours. The third section investigates the use of GPS technology to track animal movements highlighting point of strengthens and weaknesses of the use in rural areas of GPS systems based on LPWAN infrastructures. Field experiments have confirmed the effectiveness of these technologies and exploited challenges in their application such as data packet loss and battery life limitations. The final section addresses challenges and outlines ongoing efforts to improve LPWAN monitoring system reliability and precision when GPS and triaxial accelerometer data were acquired and elaborated to perform cow behaviour classification. The findings of this research are promising, demonstrating the technical feasibility and practical benefits of using IOT devices based on LPWAN for monitoring grazing cow. Despite issues related to data sampling frequency, and network coverage in remote areas, the results validate the effectiveness of these systems. LPWAN technologies provide an optimal compromise between transmission range and energy efficiency, facilitating long-term, maintenance-free monitoring. Real-time data transmission is essential for enabling farmers to make timely, informed decisions, thereby improving overall farm productivity and animal health. Further research is needed to optimize device performance, extend battery life, and enhance data communication, ensuring the long-term effectiveness and sustainability of these systems in practical applications.

Advisors:
Prof.ssa Simona Maria Carmela Porto

Co-advisor:
Prof. Giovanni Cascone

UNIONE EUROPEA
Fondo Sociale Europeo
Ministero dell'Università e della Ricerca
PON RICERCA E INNOVAZIONE
REACT EU