PROVATO: A Data-Centric Edge-AI Architecture for Precision Livestock Monitoring Using IoT

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Abstract

This work presents PROVATO (PRecisiOn liVestock monitoring with AI and IoT tOols), an edge AI and IoT-powered platform for real-time livestock monitoring. The system enables farmers to track animal health and behaviour, ensuring scalable data processing and AI inference at both the edge and the cloud. This approach supports decision-making, reduces resource waste, and improves animal welfare.

1. Introduction

Livestock farming faces growing challenges related to sustainability, productivity, and regulatory compliance. Traditional systems remain reactive and lack real-time, high-resolution data. PROVATO addresses these limitations through a distributed, edge-aware architecture (Figure 1) that integrates IoT and AI to enable real-time, high-resolution monitoring and decision-making. By leveraging data from wearable sensors, environmental sources, and external services, PROVATO delivers actionable insights to farmers.

2. System architecture

The architecture of PROVATO (Figure 1) is structured into four distinct layers as follows.

- **Device layer**: IoT sensors collect data on animal physiology, behaviour, and environment.
- **Edge layer**: Smartphones perform local data preprocessing and analysis using lightweight and efficient machine learning models.
- **NGSO layer**: Non-GeoSynchronous Orbit satellite constellations enable data transmission and edge computing in the absence of traditional connectivity.
- **Cloud layer**: Supports large-scale model training, centralised data storage, and interactive visualisations for farmer decision-making.

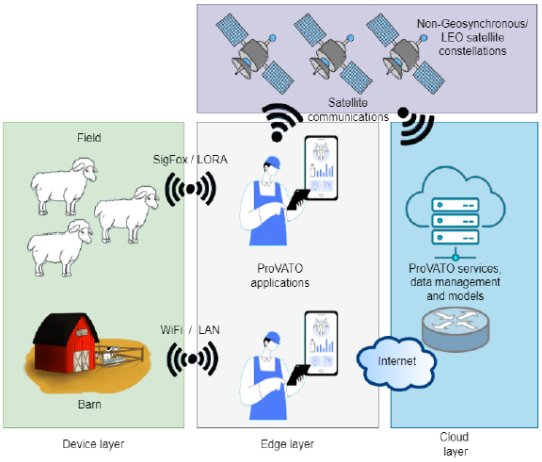

Figure 1. An overview of the PROVATO architecture

3. Impact

PROVATO complements the AGRARIAN project[3] by extending livestock monitoring to diverse herding practices through AI tools. It acts as an external proof of concept for the value of edge computing and NGSO connectivity in livestock farming. The PROVATO project aims to promote sustainability through early detection of health issues, optimised resource usage, and reduced emissions. Located in a region where agri-food and ICT are strategic priorities, PROVATO fosters regional innovation, supports ethical farming, and offers practical benefits for farmers, including improved productivity and income through AI-powered decision-making.

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