MIDDLE EAST TECHNICAL UNIVERSITY
NORTHERN CYPRUS CAMPUS

Project Proposal for CNG 476

Smart Agriculture Animal Tracking and Protection System

Project Members:

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Project Description:

The Smart Agriculture Animal Tracking and Protection System is an advanced IoT solution, prepared to transform monitoring and security protocols within the cattle farming industry. Through the integration of advanced GPS tracking, camera surveillance, and sensor technology into cattle straps, the system offers comprehensive real-time monitoring as well as real-time threat detection.

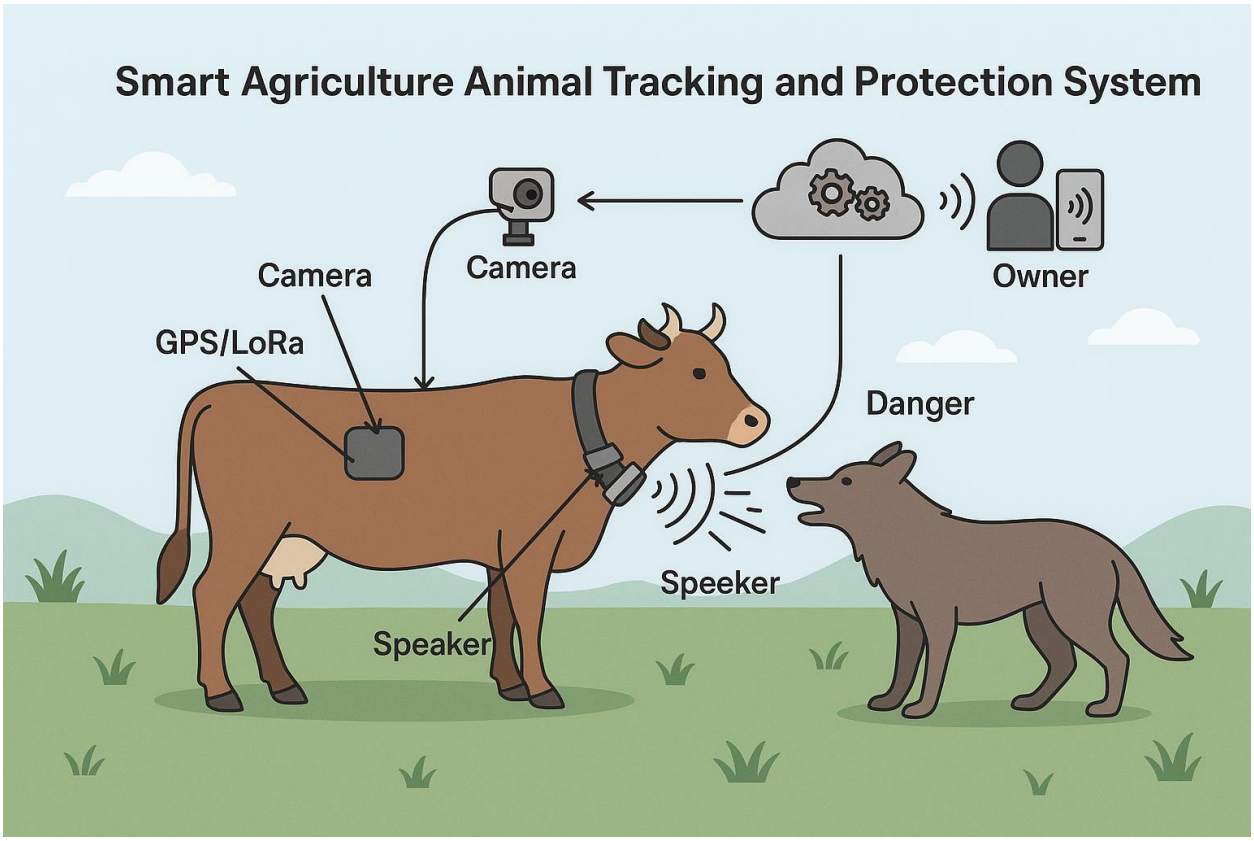

Figure 1 Smart Agriculture Animal Tracking and Protection System General Image(Canva)

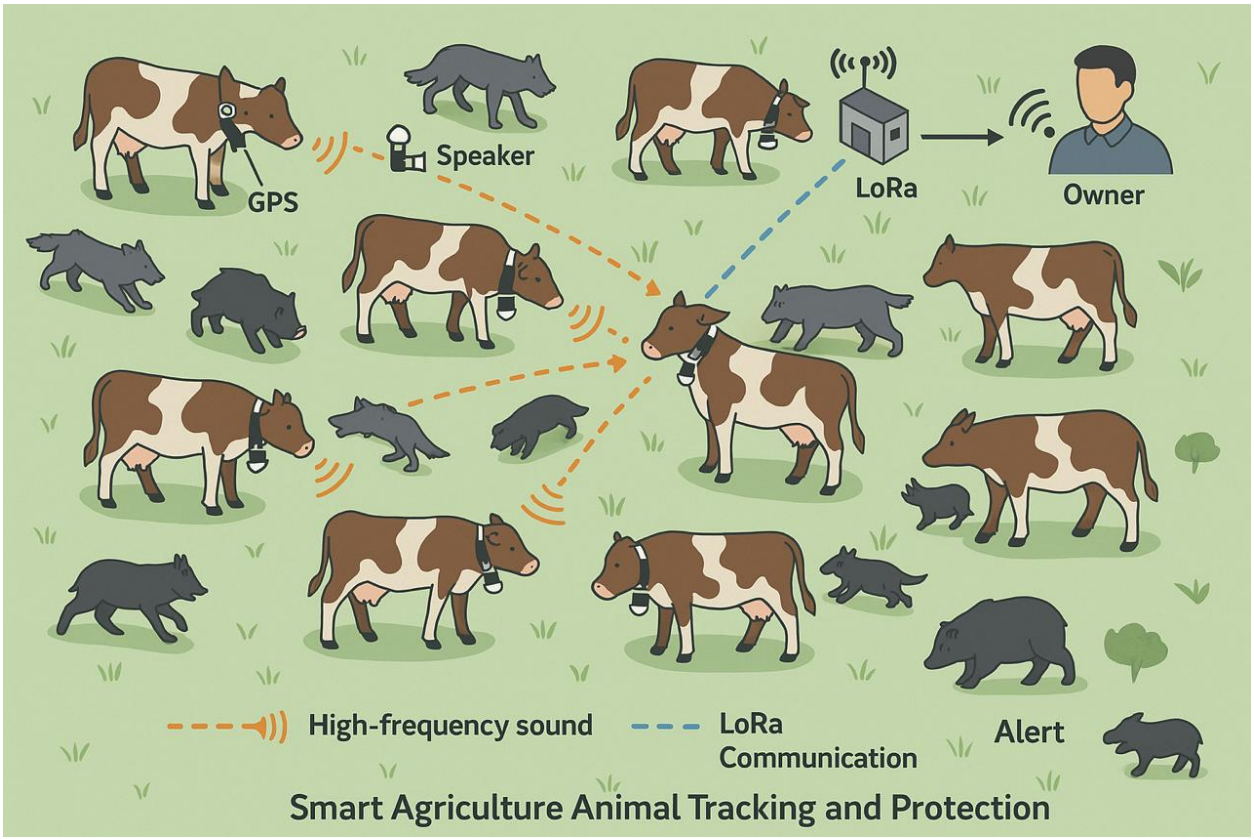

Figure 2 Smart Agriculture Animal Tracking and Protection System General Image with Herd of Cattles and Predators.

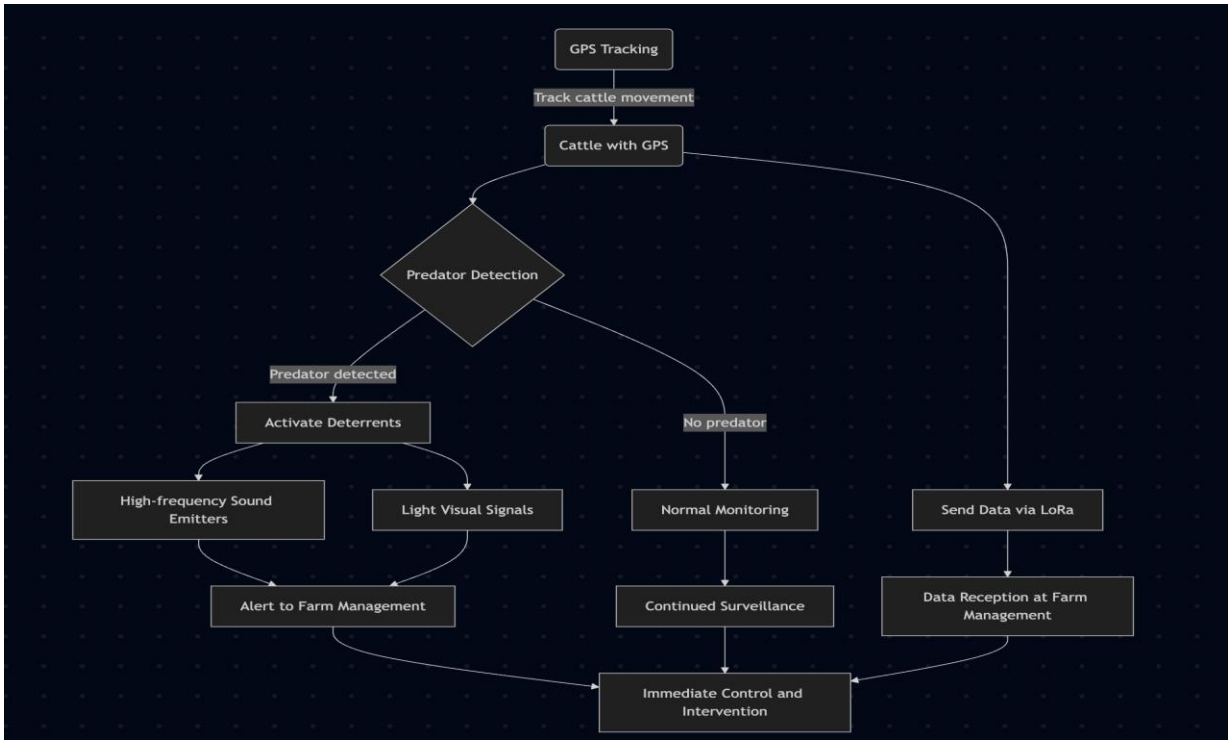

Figure 3 Smart Agriculture Animal Tracking and Protection System General Flowchart

Background and Challenges:

Cattle farmers can lose significant revenues because of predator attacks, especially wolves, which are prevalent in most pastoral regions. Researchers have found that such incidents have far-reaching economic consequences, such as livestock mortality, reduced productivity, and high management expenses (Smith et al., 2020). Solving such problems efficiently requires innovative approaches that provide real-time surveillance along with precautionary threat management.

Objectives:

1. **Enhanced Real-Time Monitoring:** It aims to apply GPS technology in real-time monitoring of the cattle as they move through the grazing fields. Its goal is to ensure that all the animals remain in safe areas, thus preventing them from wandering into hazardous areas.
2. **Advanced Threat Detection and Response**: The system incorporates sensors and cameras into the cattle straps, allowing them to recognize the presence of predators and other dangers. Upon such identification, the system automatically triggers the activation of particular deterrents, such as high-frequency sound emitters and, as necessary, light visual signals aimed at scaring away the

predators. Concurrently, it sends real-time reports to farm management for immediate control and intervention.

3. **Proactive Defense Mechanisms**: The goal is to integrate harmless defense mechanisms in the cow straps that activate automatically as soon as dangers are detected, promoting the safety of the animals without causing harm to either the animals or the predators.

Technologies and Implementation:

- **LoRa Communication**: Use LoRa technology to enable efficient long-distance communication needed for real-time data transmission over large rural areas (The Things Network, 2025).

- **OMNeT++ and FLoRa Framework**: Model and test the sensor and network communications of the system with the OMNeT++ framework that has the FLoRa tool integrated, which is utilized to simulate LoRa-based networks (Aalto University, 2025).

Simulation and Modeling:

- **Random Number Generation and Monte Carlo Simulation**: Model random cattle movement and potential predator approaches to determine system responsiveness and accuracy of detection.

- **Probability and Stochastic Models**: Apply Poisson models in predator encounter frequency prediction and stochastic processes in sensor data analysis for predictive accuracy improvement and system reliability.

Assumptions:

- **Sensor Accuracy**: Assume high accuracy of sensors with minimal false positives or negatives in predator detection to focus on system response efficiency.
- **Environmental Factors**: Simulate under ideal environmental conditions; factors such as weather or terrain that might affect sensor performance are not considered.
- **Predator Behavior**: Assume typical predator behavior patterns. Eat, drink, move, sleep, and run.

- **System Components Reliability**: Assume all system components (GPS, sensors, cameras) function optimally without hardware failures.

Expected Impact and Benefits:

The use of this system should considerably decrease the attacks of predators on farm animals, because of that minimizing economic losses greatly. Furthermore, the system encourages animal welfare and improves farm management by providing efficient monitoring and protection tools.

References:

- Smith, J. K. et al. (2020). Economic impacts of predator attacks on cattle farms. Journal of Agricultural Economics, 65(2), 485-500.
- The Things Network. (2025). What is LoRaWAN?. Retrieved from https://www.thethingsnetwork.org/docs/lorawan/what-is-lorawan/
- Aalto University. (2025). FLoRa: Framework for LoRa. Retrieved from https://flora.aalto.fi/
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