

Towards a Socio-Psychological Cyber Physical System for the Health and Wellness of Dairy Cows

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Key Contributions

Developing a sensor-based system to monitor cattle's **physiological, inertial, and location** data for assessing **socio-psychological behaviors**.

Creating an innovative method to assess and analyze **social behavior in animal herds** by integrating **interaction patterns and dynamics**.

Scientific Impact

This work bridges **Cyber-Physical Systems (CPS)** research with **practical agricultural applications**.

Advancing technology is key to **integrating location, interaction, and biometric data**.

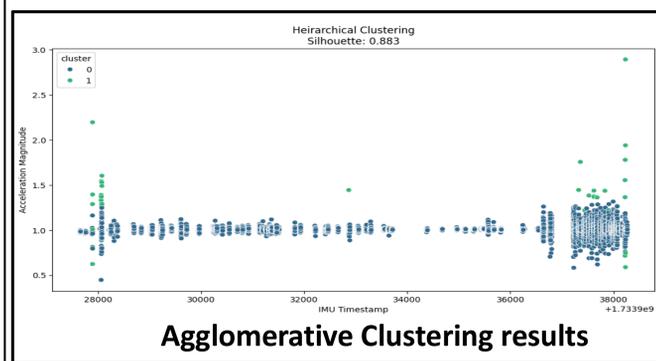
Developing algorithms for **early detection** of animal **health, stress, and wellbeing issues**.

Challenges

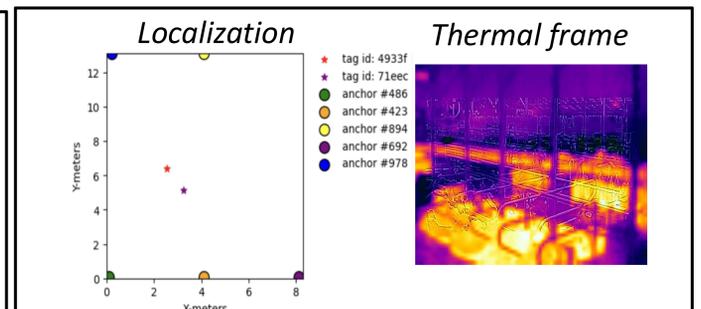
- **Real-time** data collection faces challenges like **limited device sensing, harsh environments**, and data collection settings.
- Ensuring **accurate and reliable health and wellness data** is difficult.
- Current sensing devices lack comprehensive **behavioral and physiological insights**.

Evaluations

Developing real-time scalable cattle movement detection using Agglomerative Clustering on acceleration and gyroscope features.



Two distinct clusters (movement vs. no movement) were formed with a Silhouette score of 0.883.



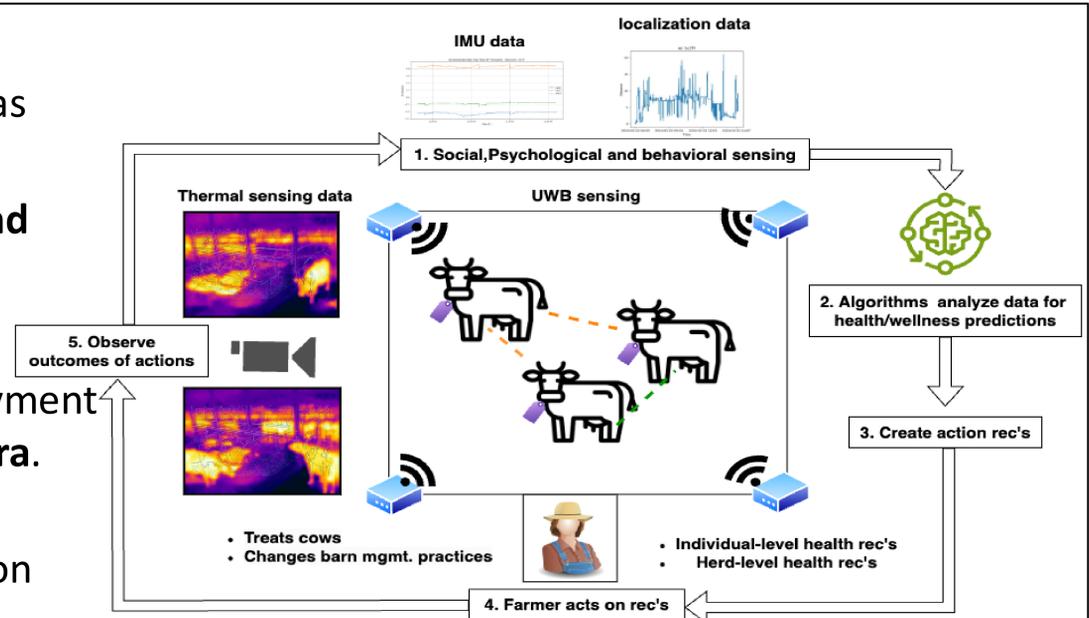
Time Difference of Arrival (TDOA) algo. was used for the real-time localization of two cows

Solutions/Technical Approach

- Farmer-identified **health events** will be used as **ground truth**
- The proposed algorithm will **identify social and psychological properties** of interest
- **Work so far:**

Multiple 1-week-long data collection and deployment of **localization sensors, IMU, and thermal camera**.

Algorithms are being developed to detect cattle movement patterns, enabling scalable localization and social behavior assessment.



Societal Impacts

The study analyzes socio-behavioral patterns in cattle herds to benefit the dairy industry, offering actionable recommendations for farmers.

Education and Outreach

Supported two PhD students
Plans to **involve students from agriculture and/or high school students** with animal experience once more data is collected

Metric:

- Milk production
- Number & severity of adverse health events
- Farmer surveys
- Prediction accuracy