2024 Project Progress Report:

Technology to Manage Livestock Location Within RANGE and REALITY

(By Dev Shrestha)

RESULTS for 2023:

TITLE: Technology to Manage Livestock Location Within RANGE and REALITY.

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BACKGROUND: Barbed-wire fencing remains the primary method for managing livestock worldwide, despite numerous technological advancements. While effective, traditional wire fencing can fragment landscapes, harm wildlife, and impose significant costs on ranchers. Virtual fence systems, on the other hand, offer remarkable management flexibility, reduce annual maintenance, and remove barriers for wildlife. The concept of wireless virtual fencing emerged several decades ago, combining location-based communication technology with an aversive stimulus delivered to animals crossing a virtual boundary. However, current off-the-shelf technologies rely on GPS systems, which consume significant power, making the units bulky and requiring them to be worn around the animal's neck. This design increases the risk of the harness catching on something and makes the device difficult to put on the animal.

To address these issues, we have been developing a radio-based system for ranging and providing feedback to animals through audio cues and electrical stimuli. Our recent demonstrations showed that ear-based electrical stimuli triggered by a beacon radio could effectively stop cattle from approaching a bale of hay as a positive reward. We are utilizing a communication system with return-time-of-flight (RTOF) technology and trilateration to locate cattle within a virtual pasture and deliver aversive stimuli at the boundary. However, the cost of radios capable of ranging varies widely, from $6.00 to $90.00 per radio. We propose to test the accuracy and reliability of these radios using Little Endowment funding, aiming to develop a more efficient and cost-effective virtual fencing system. This innovative approach could revolutionize livestock management, enhancing both economic and environmental sustainability for ranchers.

OBJECTIVES:

The objective of the proposed work were:

1. Test accuracies, reliability, and effect of RF interference to design a radio network to establish virtual boundaries in real-world settings, including forested rangeland and open pastures.
2. Continue development of the ear-borne device to minimize weight and size.
3. Finish initial firmware and interface development and launch beta-testing of ear tags for exclusion zone applications, examining the effectiveness of exclusion, device longevity, and user interface.
4. Develop efficient algorithms to reduce power requirements and increase the speed of animal location.

PROCEDURES: We developed a board that houses both the Nanotron radio ($90/unit) and Semtech's SX1280 radio ($6/unit) onto a single board.

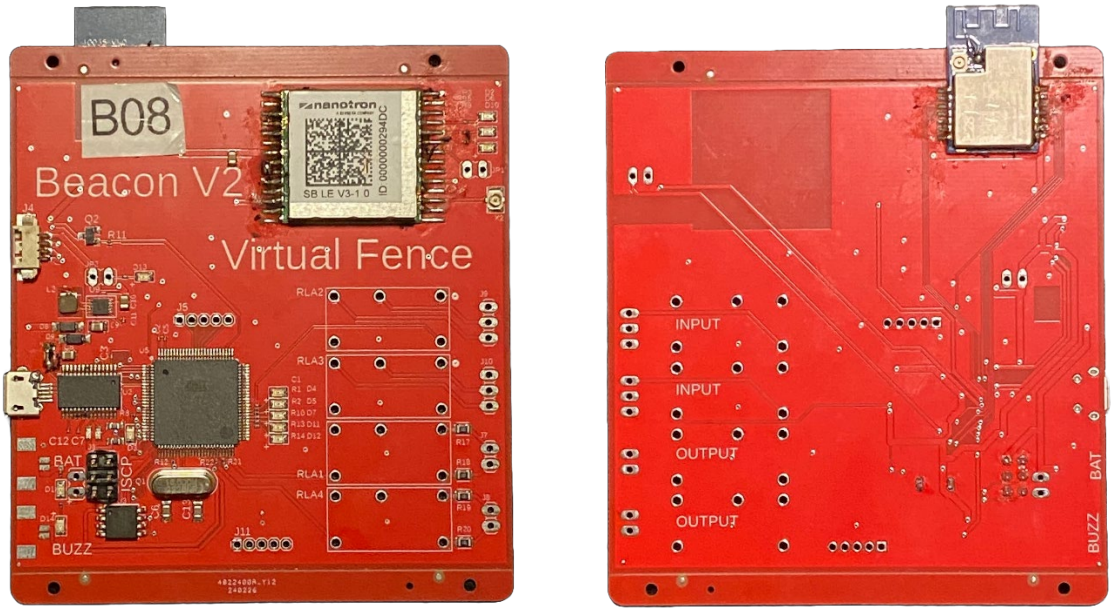

Figure 1: The radio test board with Nanotron radio on front (left image) and back with Sx1280 radio.

Each radio was connected with a 2.4GHz Dipole Swivel Antenna with 3dBi gain. We programmed one of the boards as a beacon and five others as tags. The beacon would poll the distance from each of the five tags in sequence and log the data every second into a flash memory. The five tags were placed around the area as shown in figure 2.

Figure 2: The location of test tags and beacons. Red star is beacon, yellow starts are tags in Guy Wicks Field.

ACCOMPLISHMENTS or RESULTS: The data from this test clearly showed that Nanotron radios were more accurate in distance measurements compared to SX1280 radios. The Nanotron radios were accurate within one meter of the actual distance, whereas the SX1280 radios varied up to five meters. In poor weather conditions, the distance coverage was not as reliable.

The test is still ongoing using the scarecrow system, which was developed by computer science Ph.D. student Mary Everett in Coeur d'Alene to monitor agricultural data remotely. We hope to conclude the test by the end of the spring semester.

PUBLICATIONS or OUTPUTS: Not yet from this work.