Engineering Grand Challenge: IoT Cattle

Jaedo Han, Rey Punao, Nate Tjepkema
Peter Livingston, Chris Lupo

Abstract

This project represents the initial phase of developing a product that will give ranchers live updates on the whereabouts of their cattle.

Introduction

Our goal is to come up with a device and platform for ranchers to use that is affordable, easily manageable, and user friendly. There are two main aspects of this project, hardware and software. The focuses of each are as follows:

HARDWARE: Determine a device that could send GPS data while consuming low power and maintaining a long battery life

SOFTWARE: Manage and visualize the data

Problem Definition

aws Working Backwards Process

IDENTIFY → INNOVATE → IMPLEMENT

How Might We?

Improve the ability of ranchers to manage their remote rangeland resources in order to maximize their cow/calf output under variable conditions

What are the Customer's Needs?

-NEPA Challenges
-Weather (adaptive management capabilities)
-Better Ability to "manage land" and cattle that are hard to track

What is the impact we are trying to have?

Improve the rangeland and resource to maximize output overtime

Who is the Customer?

End Customer: Gerald the Multi-Generational Rancher *(smallholder)*

Secondary Customer: BLM Bob *(regulator)*

Chosen Use Case to Address:

The ability to monitor the body temperature and location of a "Lonesome Bull" and "Daisy (momma) Cow" anywhere on the range

COMPUTER ENGINEERING
CAL POLY // SAN LUIS OBISPO

Hardware

Goal: Advanced board capable of sending numerous types of sensor data, including GPS data, over tens of miles at 300kbps.

- Wemos TTGO T-Beam
  - Semtech SX1272 Transceiver
  - GPS unit by U-Blox called the NEO-6M
  - ESP32 microcontroller.
- Minimize power by shutting ESP 32 down internally
  - Board draw current for the ESP32 co-processor when idle
  - Collect and send data hourly
  - Run 8 to 12 months on a single 18650 battery cell.

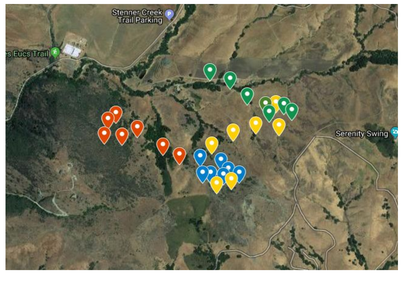
Software

- Visualize the data from LoRa device using a web application, Django Framework
- AWS EC2 instances and by connecting to PostgreSQL server hosted by AWS RDS services
- Using Django's REST library's serializer, parse JSON data to compatible data to be stored in PostgreSQL
- Retrieve data by deserializing which transformed data into JSON format again for consistency
- AWS QuickSight and D3.JS to locate cattle
  - time and heatmap
  - analyze how ranchers utilize the land over time.

Lonesome Bull + LoRa, et. al. = Gerald

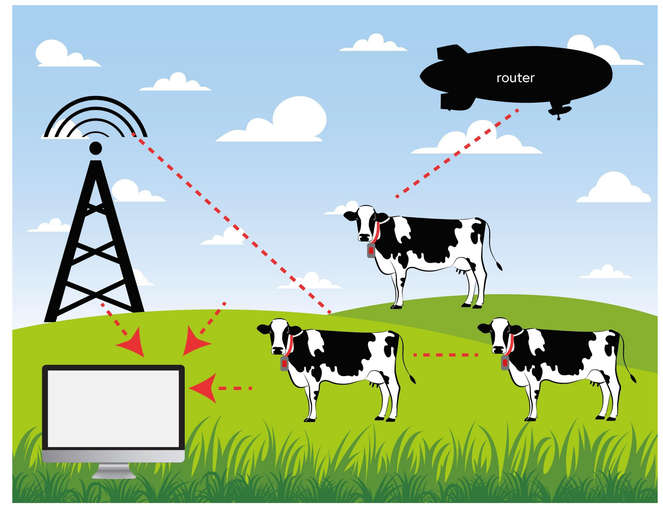
Testing

- Four bulls moving around range wearing TTGO T-Beam boards and sending data to server



Conclusion

1. LoRa works through trees, but not mountains
2. Add a relay tower or hang relay equipment from a balloon



Future Directions

Potential applications of this project are listed below:

- Collect data on temperature and heart rate of cattle
- Collect health and location data on dairy herd
- Applying technology to household pets
- Applying machine learning techniques to location data

Acknowledgments

DX Hub
Amazon Web Services
Cal Poly CENG
Computer Science Department
BioResource and Agricultural Engineering Department

BRAE bioresource and agricultural engineering