FENCELESS GRAZING SYSTEM

Reducing farming costs by automating animal herding using GPS, negative reinforcement, and the LoRa communication protocol.

Figure 1: Project architecture diagram.

A large number of collar devices, built using an Atmega328p processor, transmit GPS and other data to a Raspberry Pi over LoRa. This information is then delivered over the internet to the client application, in the form of an Android app.

GATEWAY SERVER

The gateway server is the central component of the Fenceless Grazing System. It is implemented using a Raspberry Pi miniature computer, minimizing the cost of the system and allowing it to be deployed even in areas without an internet connection: the system can be configured on a local network.

The gateway server repeatedly sends requests to each active collar, querying its location and status. Additionally, it exposes a REST API, which is used by services like the Android application to manage the collars.

LORA COMMUNICATION

LoRa (Long Range) is a physical networking protocol utilizing chirp spread spectrum over radio waves (915 MHz) created by the company Semtech. LoRa plays a very important role in the project, and is responsible for providing communication over vast distances while requiring very little power.

Each end-node needs to last for a long time before maintenance is required. As a result, battery life is the next most important thing after communication range. LoRaWAN, the MAC protocol on top of LoRa, provides scheduled communication between the end-nodes and the gateway, allowing for minimal communication which in turn extends battery life.

THE SYSTEM

- The Fenceless Grazing System provides three major components:
  - Smart Collar: the component of the Fenceless Grazing System that is placed on livestock. Each animal is equipped with a collar bearing a unique identifier, which is used to communicate with the Gateway Server. The collar spends a majority of time in sleep mode to conserve power, and communicates with the server when prompted.
  - Gateway Server: the database host and central communication hub for the Fenceless Grazing System. Rather than distributing data among the collars, all data is sent to the gateway, where it can be accessed through the Android Application.
  - Android Application: the main user interface of the Fenceless Grazing System. Users can use the Android application to view the locations of each collar, track the history of individual collars, and adjust grazing boundaries. The application can also send push notifications when an animal leaves the grazing area.

ACKNOWLEDGEMENTS

We’d like to thank Oregon State University’s College of Engineering for providing us with the funds necessary to complete this project, as well as for their prompt and helpful responses to all our inquiries.