FENCELESS GRAZING SYSTEM

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

PROJECT TEAM

Client: Bechir Hamdaoui
Students:


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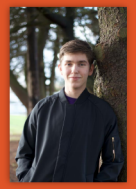
Danila Fedorin


Matthew Sessions

PROJECT INTRODUCTION

- Animal herding is a significant drain on resources, and has remained largely unchanged.
- At present, it requires the presence of farmers and herding dogs to keep animals within their containment area.
- The project was proposed by Bechir Hamdaoui to investigate ways in which the currently resource-intensive process of herding can be improved using long-range communication.
- The project took inspiration from invisible fences for dogs, which utilize a low-power shock collar to negatively reinforce leaving a particular area near the house.
- Due to the size of the area that can be roamed by livestock, GPS tracking is used to determined whether an animal is in an acceptable position, and stimuli such as sound and electric shocks are used to discourage the animal from leaving.
- To allow farmers to manage livestock remotely (as per the goals of the project), the Fenceless Grazing System includes an Android application capable of interfacing with the collars.
- Finally, to keep up with the data gathering demands of the modern world, the project also maintains a history of animal locations in an SQL database.

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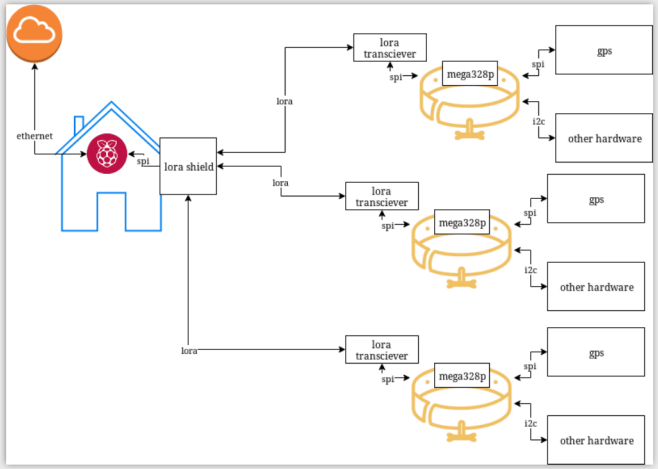

Figure 1: Project architecture diagram.

A large number of collar devices, built using a Atmega328p processors, 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 request 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 Grazeless 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.

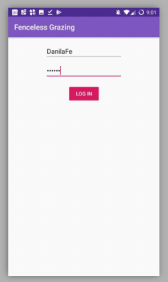

Figure 2: A user is required to log in to access data from grazing animals, and manipulate collar settings.

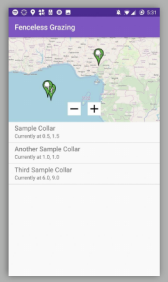

Figure 3: Android application displaying the locations of animals (using sample data).

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