SHEEP_LINK

TEAM 1034A

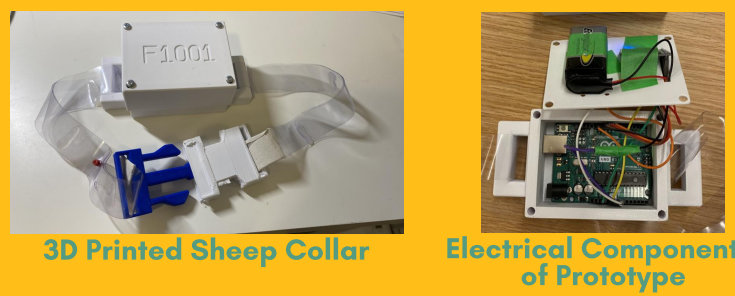### Arielle, Ethan, Yiqun, Emre, Tabitha

Our team's aim is to address the issue of **locating wandering sheep** in the town of Mthatha, South Africa.

I. STAKEHOLDERS

Sheep owners of Mthatha, shepherds, sheep, and us!

Hardware (Collar Case CAD Model)

The User Interface

II. PROTOTYPE PROGRESS

3D Printed Sheep Collar

Electrical Components of Prototype

- One fully functional **follower tracker**: a **case**, an **adjustable belt strap,** and **concealed electronics**.
- Bluefruit Microcontroller **(follower tracker)** sends the stored sheep IDs to **Bluefruit app (leader tracker)** via UART when it receives a request message from the leader.
- Use the Bluefruit app to check the **GPS location** and send a string containing all the follower IDs and the GPS location to the backend database using Bluefruit Microcontroller.
- The database uses a mixture of **python** and **SQL**.
- Algorithm detects missing sheep in all edge cases and interacts with the user through a user interface available in both **English** and **Xhosa** localizations.
- **Cost** of the **prototype**: Arduino UNO R3 ($24.95) + Adafruit Bluetooth ($17.50) + Battery ($3.7) + 3D printed tracker case and collar strap($3.50) = **$49.65**

III. DESIGN CONCEPTS
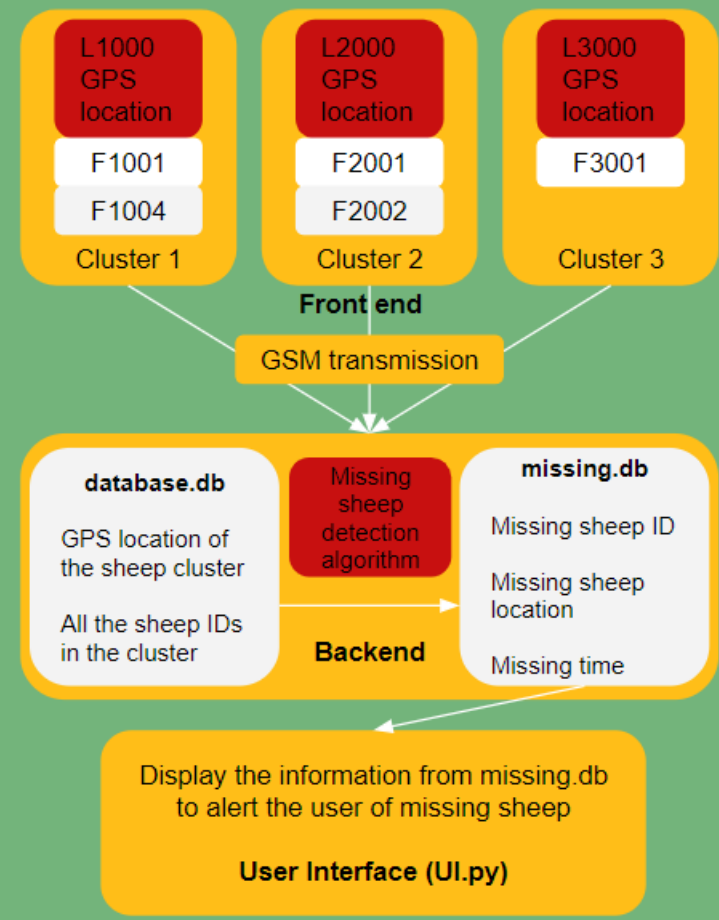
1. Each tracker stores a **unique sheep ID**
2. Two types of sheep trackers: **leader** and **follower**
   a. **Leader**: ID starts with **L**, has **GPS** + **Bluetooth** transceiver
   b. **Follower**: ID starts with **F**, only has **Bluetooth** transceiver
3. Sheep information update:
   a. Leaders "**ping**" nearest followers based on the **Received Signal Strength Indicator** (RSSI), and followers respond by **sending their ID** to the leader, then leader **stores all IDs**.
   b. All leaders **send** their **current cluster GPS location** + stored **follower IDs** to the backend database.
   c. Backend **Clustering algorithm** will send **missing sheep alerts** through User Interface **whenever missing sheep is detected**.

IV. HIGHLIGHTED FEATURES

ACCESSIBILITY

Uses **inexpensive** Global Systems for Mobile Communication (**GSM**) for transmission.
Flexibility in balancing between location accuracy and cost: allows users to choose # of leaders (Global Positioning System (GPS)).
Offered in both **English** and **Xhosa**.

EFFECTIVENESS

Locates the sheep and **notifies** the shepherds once they go **missing.**
Prototype **battery life** is **24 hours, which can be made rechargeable and longer lasting.**

DURABILITY

Waterproof, **dustproof**, and **dropproof**.
Withstands the harsh conditions in the use case.

SAFETY

Safe for both the **sheep** and **human** users, **electrical hazards** are taken care of by enclosing the components in a case

PORTABILITY

Physical prototype is **small, lightweight and uses battery power.**

V. FUNCTIONALITY EVALUATION

✓ **Detecting and Notifying When Sheep is Missing**
When a follower leaves their cluster, the leader no longer finds it. 20% missed alert due to bluetooth connectivity issue.
The Clustering algorithm detects both missing leaders and followers. 0% missed alert based on the testing results.

✓ **Accuracy of Leader and Follower**
GPS Location accuracy of the leader is within 1m, follower locatio nuncertainty depends on number of leaders:

% of leader sheep	16%	20%	30%	40%	50%
Cluster radius	14.5m	12m	8.7m	7m	6m

✓ **Differentiating Sheep**
Sheep can be differenciated from different owners' by looking at their customized collar color and the engraved unique sheep ID.