Raising the Steaks

Long-Range RFID Sensing UAV System

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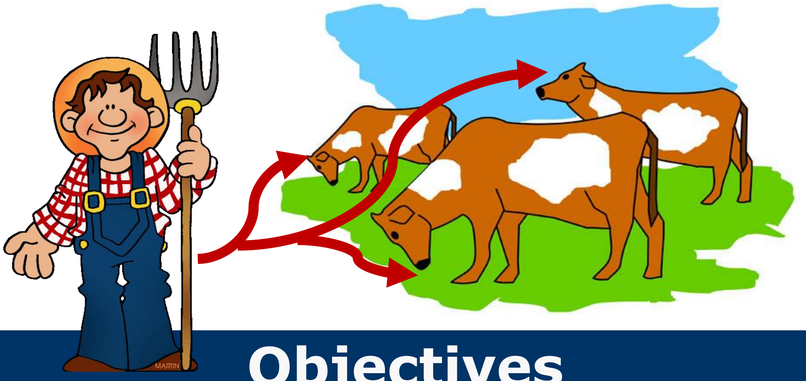
Sponsor: CattleTime | Advisor: Dr. Tentzeris

Background

- Manual labor is required to take inventory of herds of cattle in pastures
- Lost cows in larger herds can take hours to locate and identify
- Our sponsor CattleTime has designed UHF RFID cattle tags with cow information
- Current RFID technology featuring handheld RFID readers require ranchers to be within 1 [ft] of tag to read information



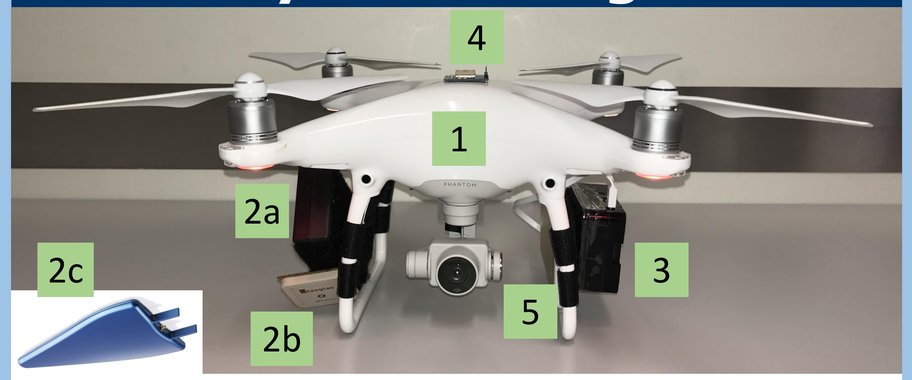
Objectives

- Design an **RFID sensing system** to reduce labor time and increase pasture knowledge
- **Automate** inventory process
- Incorporate **GPS reading** capabilities with cattle tag reads
- **Store tag information** in a readily accessible manner

Solution

- A drone mounted system that:
  - Reads UHF RFID cattle tags
  - Captures GPS location
  - Outputs information to a USB flash drive

System Design



Integrate RFID reader, battery and CPU on a UAV

1) **DJI Phantom 4**
   - Automated waypoints, collision avoidance, video feed
2) **ThingMagic USB Pro RFID Reader w/ Antenna**
   - **(a)** Reader with 30 [dBm] output, **(b)** 1 [dBi] circular polarized antenna or **(c)** 5 [dBi] linear polarized antenna
3) **RaspberryPi 2B**
   - Drives GPS module over UART; Java code operates reader and stores tag readings to a *.csv file
4) **Adafruit Ultimate GPS Module**
5) **Shinngo External Battery Pack**

Results

Lab Test

	Linear pol.	Circular pol.
Isolated tag	25 ft	6.5 ft
Tag on human	< 1 ft	< 1 ft
Isolated tag	5 ft	2 ft
Tag on human	none	none

Field Test

	Linear pol.	Circular pol.
Isolated tag	6 ft	N/A
Tag on Cow	10 ft	N/A
Isolated tag	5 ft	N/A
Tag on Cow	none	N/A

Legend

System without Drone	System with Drone

Conclusions

- A tradeoff exists where linear polarization allows **longer read range**, whereas circular polarization allows for **freedom of orientation**
- Cow ear movement can lead to **tag contact with body** which nullifies RFID transmission
- Therefore, system collected no reads while in flight due to orientation and tag-body contact

Future Work

- Field test circular polarization and alternative mounting schemes of linear polarized antenna
- Expand application to agricultural markets with additional RFID sensors (pH, temp, humidity)