# Autonomous RFID Drone For Inventory Tracking

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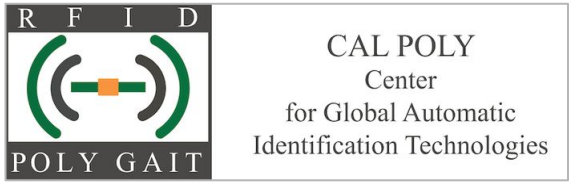
# Introduction

- **Problem:** with the global rise of e-commerce, warehouses are growing much larger in size
  - Warehouse managers need access to inventory data (location, quantity, ship date, etc.)
  - Traditional approach: manually count and record all inventory via barcode readers
  - Need an improved method of taking inventory that is faster and more accurate

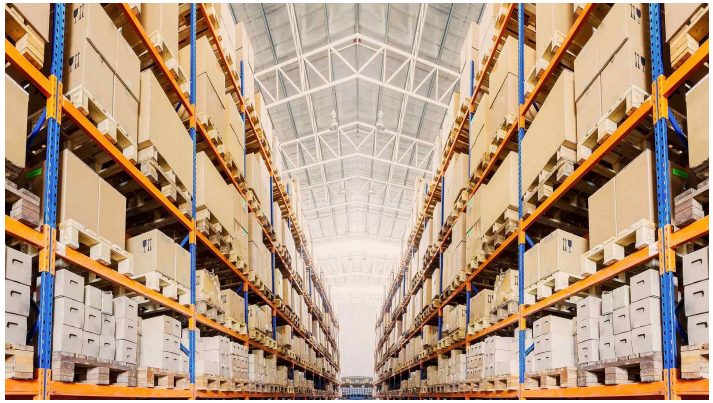
- **Solution:** autonomous RFID drone which can quickly and efficiently scan all inventory in a warehouse and then accurately display the locations of items on a three-dimensional map
  - Scan tall shelves and follow designated paths to avoid errors in counting inventory
  - Can also be used to track the exact locations and other data of cattle in a field



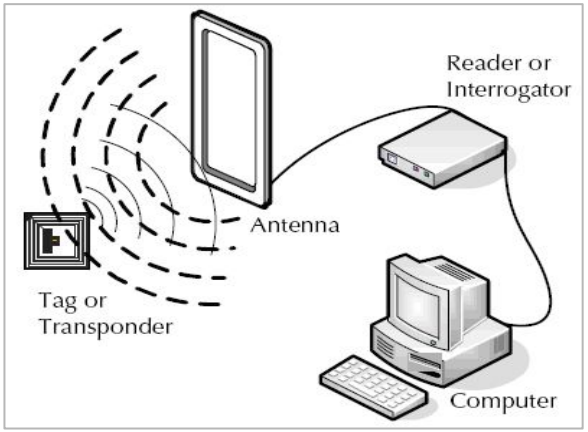


# Application 1: Warehouse Inventory

- Improve accuracy, increase frequency of stock taking, reduce labor costs
- Warehouse drone industry expected to grow $29 billion by 2026

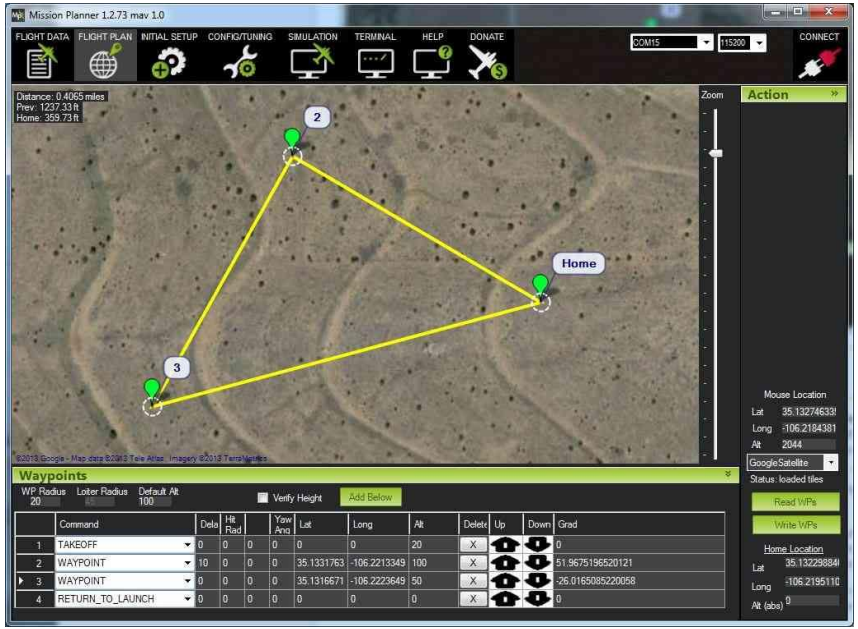


A typical warehouse in which the RFID drone would take inventory




Data transmission in a RFID system, from tag to computer via antenna and reader

# Application 2: Cattle Tracking




Autonomous flight plan in Mission Planner software

RFID drone doing a test flight at the Cal Poly airfield

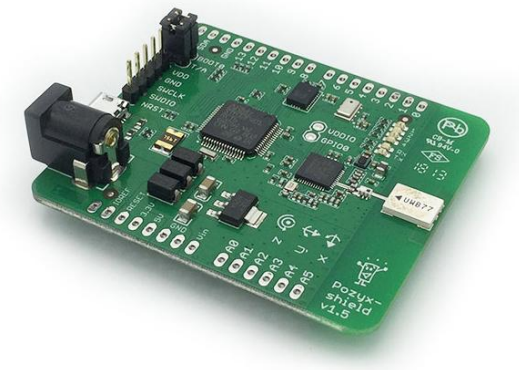
# Drone Flight Tests

- DJI S900 and CPPG drones
- Autonomous flight mode
- Redesign to meet weight limit: 16.3 lb to 7.5 lb

# Core Technologies

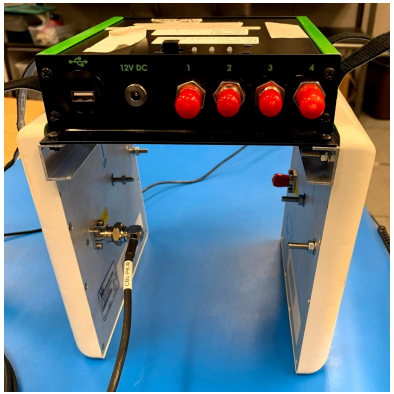
## Pozyx Positioning System

- Indoor positioning system with tags and anchors
- Up to 10 cm of accuracy
- Low power consumption using UWB technology



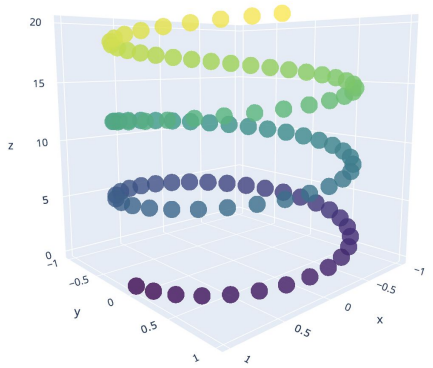

## MiniStock RFID Reader

- Reads passive tags while connected to antenna
- Maximum range: 12 ft
- Saves the tag IDs and timestamps to a CSV file



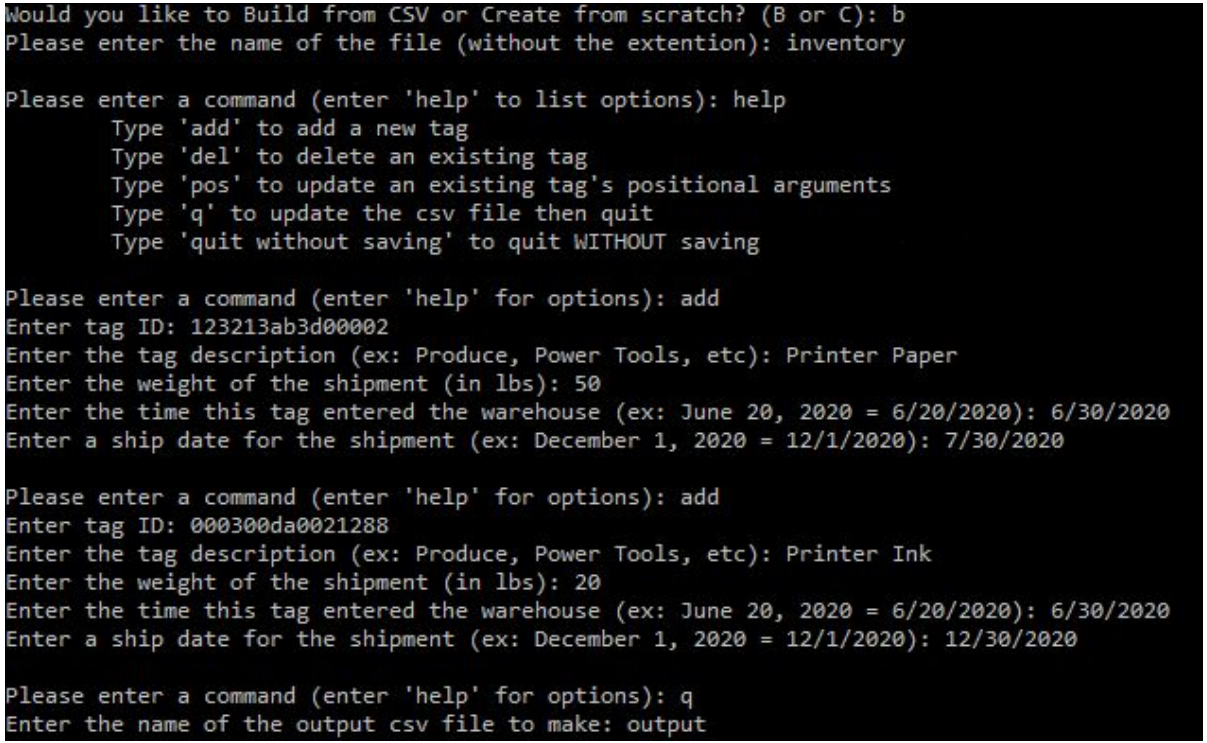

## Plotly Python Library

- Open source Python graphing library
- Support for interactive 2D and 3D scatter plots
- Highly customizable



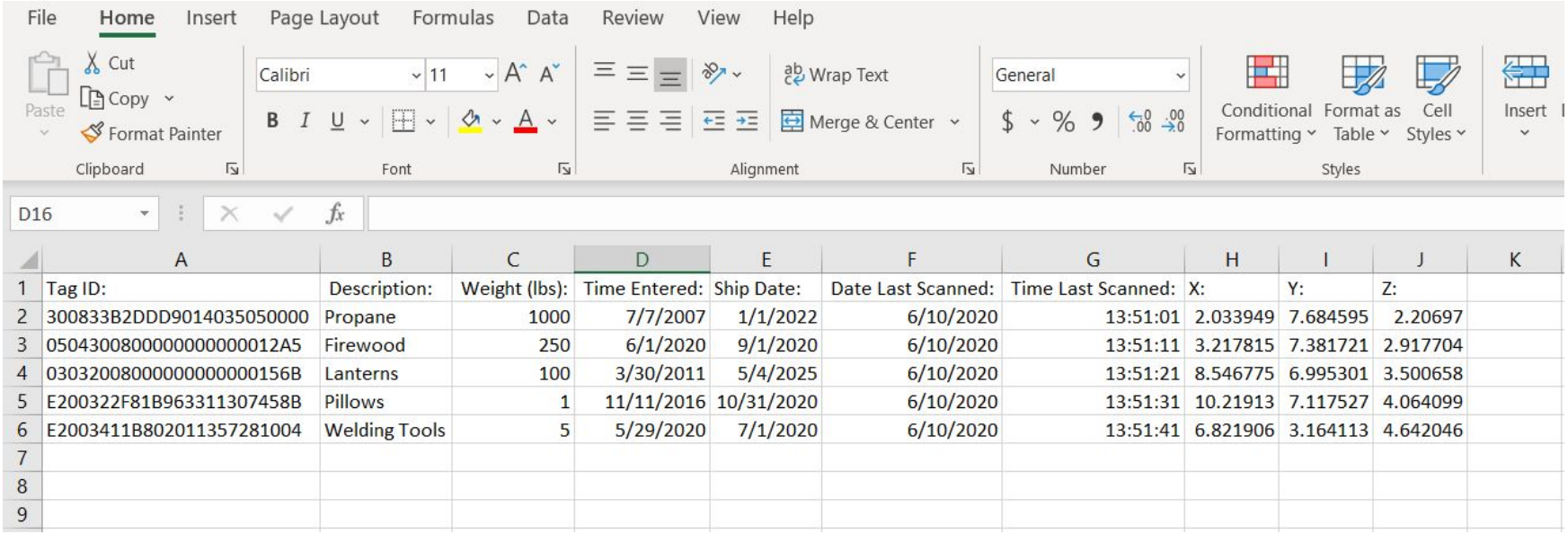
# Accompanying Software

Using Python, we designed software that allows a warehouse worker to document incoming and outgoing inventory.



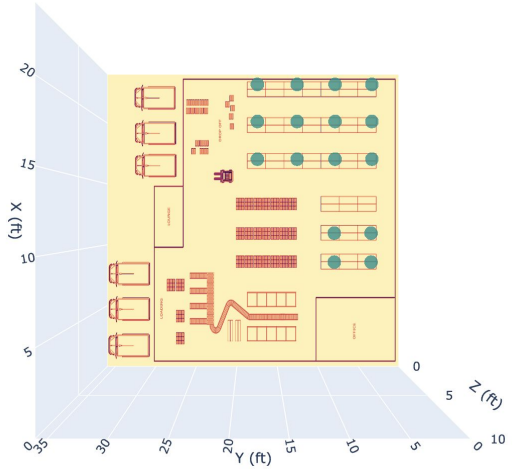
# CSV/Excel Spreadsheet

A warehouse worker can input new inventory information into the system, then the drone flight will update positional data for each piece of inventory.

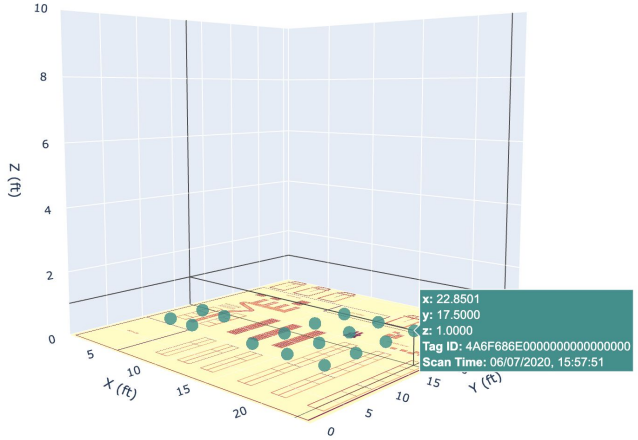



| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tag ID: | Description: | Weight (lbs): | Time Entered: | Ship Date: | Date Last Scanned: | Time Last Scanned: | X: | Y: | Z: | |
| 2 | 300833B2DDD9014035050000 | Propane | 1000 | 7/7/2007 | 1/1/2022 | 6/10/2020 | 13:51:01 | 2.033949 | 7.684595 | 2.20697 | |
| 3 | 0504300800000000000012A5 | Firewood | 250 | 6/1/2020 | 9/1/2020 | 6/10/2020 | 13:51:11 | 3.217815 | 7.381721 | 2.917704 | |
| 4 | 0303200800000000000156B | Lanterns | 100 | 3/30/2011 | 5/4/2025 | 6/10/2020 | 13:51:21 | 8.546775 | 6.995301 | 3.500658 | |
| 5 | E200322F81B963311307458B | Pillows | 1 | 11/11/2016 | 10/31/2020 | 6/10/2020 | 13:51:31 | 10.21913 | 7.117527 | 4.064099 | |
| 6 | E2003411B802011357281004 | Welding Tools | 5 | 5/29/2020 | 7/1/2020 | 6/10/2020 | 13:51:41 | 6.821906 | 3.164113 | 4.642046 | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |

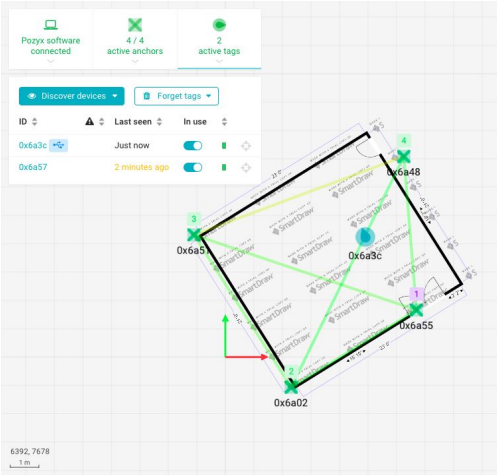
# Pozyx/Plotly Demo




Top Down Plotly Warehouse Image




Side View Plotly Warehouse Image




Pozyx Positioning Software

# Reflection/Conclusion

- Achieved results
  - Flying the Cal Poly drone autonomously via GPS
  - Scanning and reading tags with the MiniStock RFID reader
  - Developing Python software for a warehouse worker to input inventory data
  - Integrating the Pozyx system with Plotly to visualize tag locations

- Due to COVID-19 and the closure of the RFID lab, our team was unable to run an indoor test flight or fully integrate all components into a single product

- It is hoped that our work can be continued by future senior projects and will help spur the adoption of autonomous RFID drones in inventory management