SPARROW

SGM 1/28

Needfinding

- Visited IKEA and Costco, and talked to employees about their inventory procedures
- Inventory arrives on trucks, item barcodes are scanned to verify counts. Pallets are put onto shelves using forklifts outside of store hours.
- Inventory taken every week (IKEA) or 2x a year (Costco) by pairs of people manually counting items.
 Benefit of drones: Huge potential savings (not paying 100s of workers overtime to work overnight)
- Potential problems for drones
 - Barcodes not visible, multiple barcodes per item, or handwritten barcodes
 - Shelves may have uneven heights
 - o Different items on a single pallet
- Common issue encountered by retail stores: Customers move and misplace items, making stock counts/locations inaccurate
- **Pain point**: Inventory counts in the system are not always up to date, especially during store hours, when customers can move items. Faster fix is needed for when customer requests a missing item.
- **Insight**: "Retail" stores/warehouses are less structured and prone to error due to customers as compared to "storage" warehouses. Each type of warehouse has its unique needs.



Inventory Stock Taking

- Counting of on-hand inventory often by hand
- Mostly periodic as required for auditing or verification
- Warehouses: forklifts, barcode scanners
- Goal: moving from a periodic inventory model to a continuous inventory model

Relevant Systems

- InventAIRy and DroneScan: automated mapping of warehouse environment and inventory identification via barcodes
- RFID reading drones for steel yards
- Kiva Systems (Amazon Robotics)
- Others

Software Market

- Warehouse Management Systems (WMS) market breaks down into four types of vendors
 - Application megasuite
 - Supply chain management suite
 - Specialists
 - Independent components
- SAP Extended Warehouse Management
 - Inventory tracking and management module



Overview of SAP

 Customers include Coca Cola, Nestle, Ikea, etc.

Settings for inventory management

- Storage warehouses
- Retail
- Ports

Logistics

- Philip & Karsten will help look for customers so we have playground to test our drone
- Buy first drone ourselves

Resources

- Aaron Williams, lead expert developer at the d. shop
- Karthik, computer vision & ML expert
- SAP Innovation Center

Trajectory of project

- Drone path planning and development
- Analysis of footage gathered by drone (computer vision)
- Inventory management system



- Narrowed down to Parrot, DJI, 3DR due to SDK requirement
- 3DR outside of budget constraints, nearing 2000 dollars

Parrot

- Pros
 - Resistant to crashes
 - Cheapest
 - SAP has used Parrots before (and has some we could use?)
- Cons
 - Low picture Quality
 - Low range (100m)
 - Can't navigate obstructed area

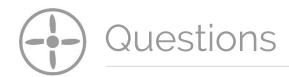
DJI

- Pros
 - o 3.2 mile range
 - HD camera
 - Supports payload
- Cons
 - More expensive, \$1,200ish
 - Danger in close quarters
 - Payload appx 200g



Next Steps

- Trajectory of project consists of 3 main areas of development
 - Drone path planning and development (may have to modify base hardware system and integrate open source flight control systems)
 - Analysis of footage gathered by drone (computer vision)
 - Inventory management system
- Visit storage warehouse
 - Goal is to determine our target environment
 - This will partially depend on Philip and Karsten's contacts
- Purchase a drone
 - Phantom, price range ~\$800



- Is there a hardware lab/electronics tools we can have access to in the loft? Or, a EE lab?
- As we look to brainstorm, at what level should we approach the problem space? Should we ideate exclusively under the constraints of drones in the warehouse setting?
- We are currently approaching the project with the goal of providing a proof of concept. For the VC pitch, should we present business value under the assumption that the drone solution is viable/feasible?
- If we don't hear back from liaisons, do you have ideas on storage warehouses that we may be able to visit?

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