The Deliveroid

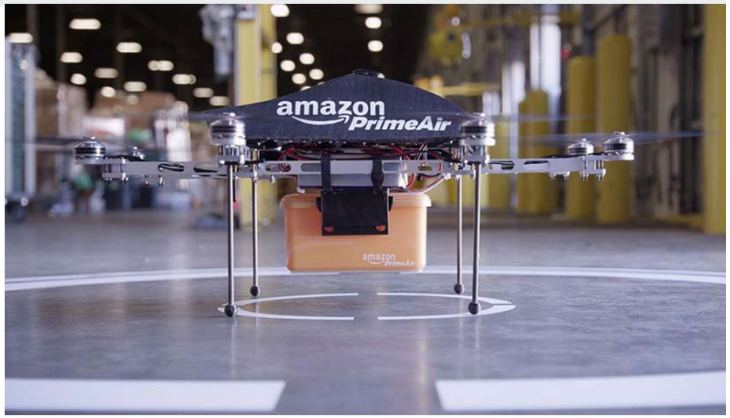
Conrad Blash, Shelton Allen, Jonathan Goberdhan

Background

- The field of personal robots is growing both in movement and intelligence

- Each bot differs in purpose but is optimized for what it is built for

- As the title would imply, personal robots are typically for leisure or helping people in need of assistance



Background

- Because of computers, document exchange is almost completely digital
- In an office setting, some documents must be transported by hand
- These documents can sometimes be numerous and a burden to transport all at once


FORM 9

EMPLOYMENT CONTRACT AMENDMENT


State of California

SECRETARY OF STATE

APOSTILLE

(Convention de La Haye du 5 octobre 1961)

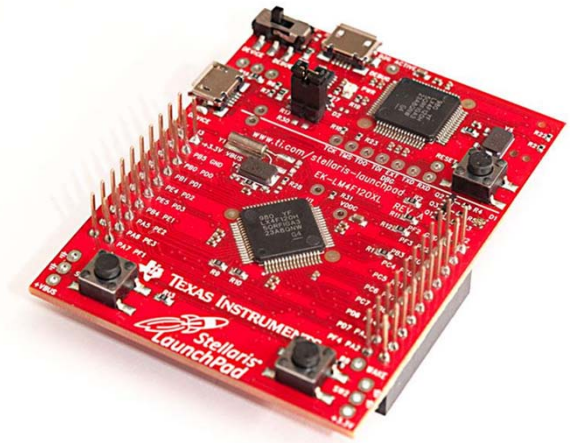
CERTIFIED

Problem Formulation, Definition and Objectives

- Target Users: Offices/ Workplace
- Problem Statement: Develop an autonomous exchange of documents and other items between departments and coworkers.
- Primary goal: Eliminate the tedious transfer of documents in the workplace and improve worker productivity.
- Long-term goal: Transport items between multiple rooms between different floors of a building
- Short-term goal: Transport documents from one office to another nearby

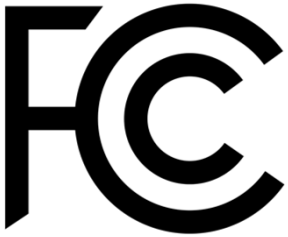
Constraints

- Sociocultural: Must look aesthetically pleasing in the workplace
- Financial: Total product cost should not exceed $200
- Intellectual: Limited knowledge of robotics programming
- Must use Texas Instruments (TI) microcontroller to enter TI competition.



Standards & Regulations

- **Federal Communication Commission (FCC) Part 15** for radio frequency devices
- **International Organization for Standardization (ISO) 13849-1** Safety of machinery -- Safety-related parts of control systems
- **International Electrotechnical Commission (IEC) 61000-4-2** Electrostatic Discharge Immunity Test



Design Requirements

- Able to transport from source to destination and vice versa for returns
- Able to recognize items too heavy to transport and notify user
- Able to avoid collision using some sort of collision detection
- Able to correct navigation in event of being off course
- Distinction between who is to receive which deliverable
- Small enough to not intrude upon those in the workplace.
- Quiet enough to not disturb those in an office space

Current Status of Art

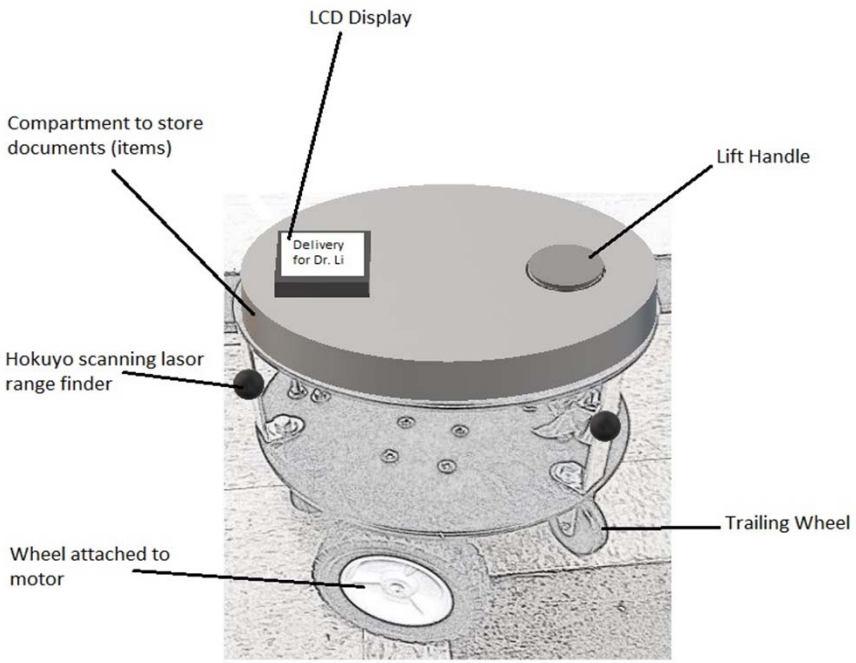
- Starship Technologies Delivery Robot:
  - Uses GPS - not applicable for our small-scale application
  - Uses cameras for traffic recognition

Piaggio's Gita:

Uses cameras to form 3D map of previously visited areas

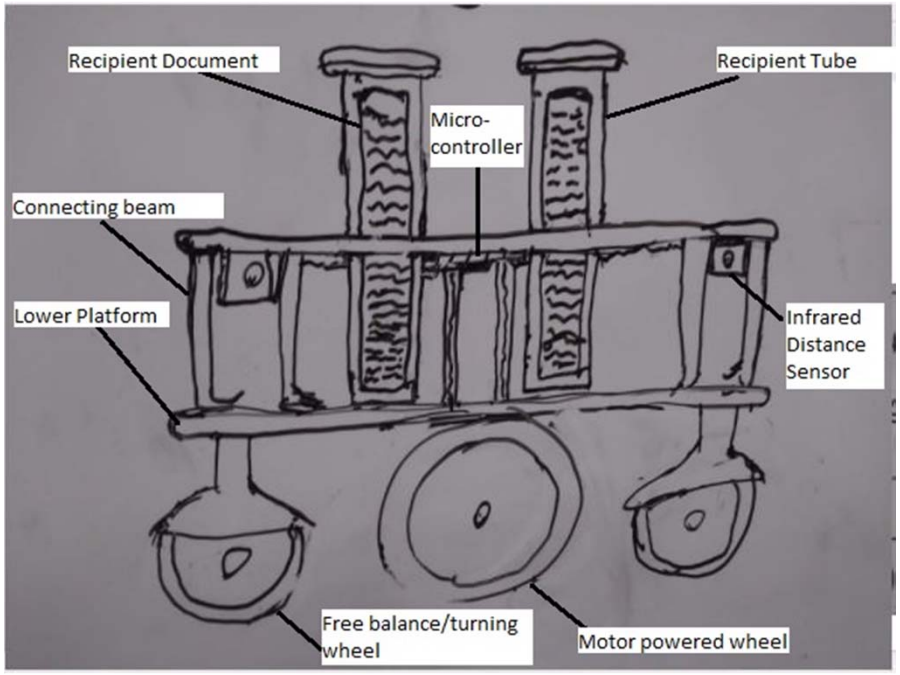
Primarily follows user around, not self guided

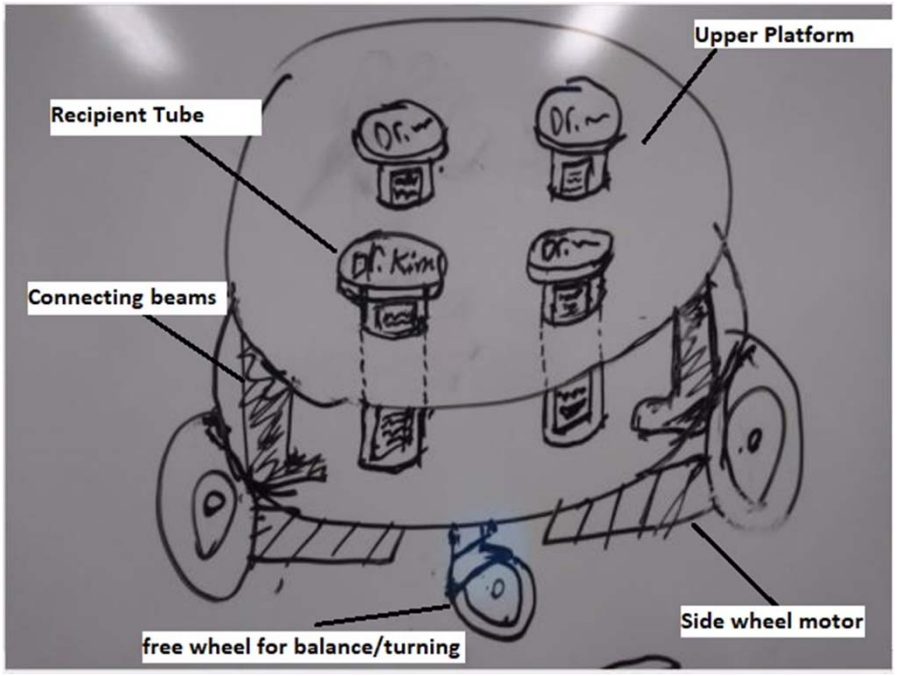
Design Ideas - #1



- Also included in design:
  - Encoders for odometry sensing
  - Raspberry Pi
- Design Methodology:
  - Using Robot Operating System (ROS) Navigation stack to navigate area.
  - Uses ROS slam_gmapping to create 2-D map
  - Uses ROS rviz and laser scanning to localize the robot and set goals on the map.

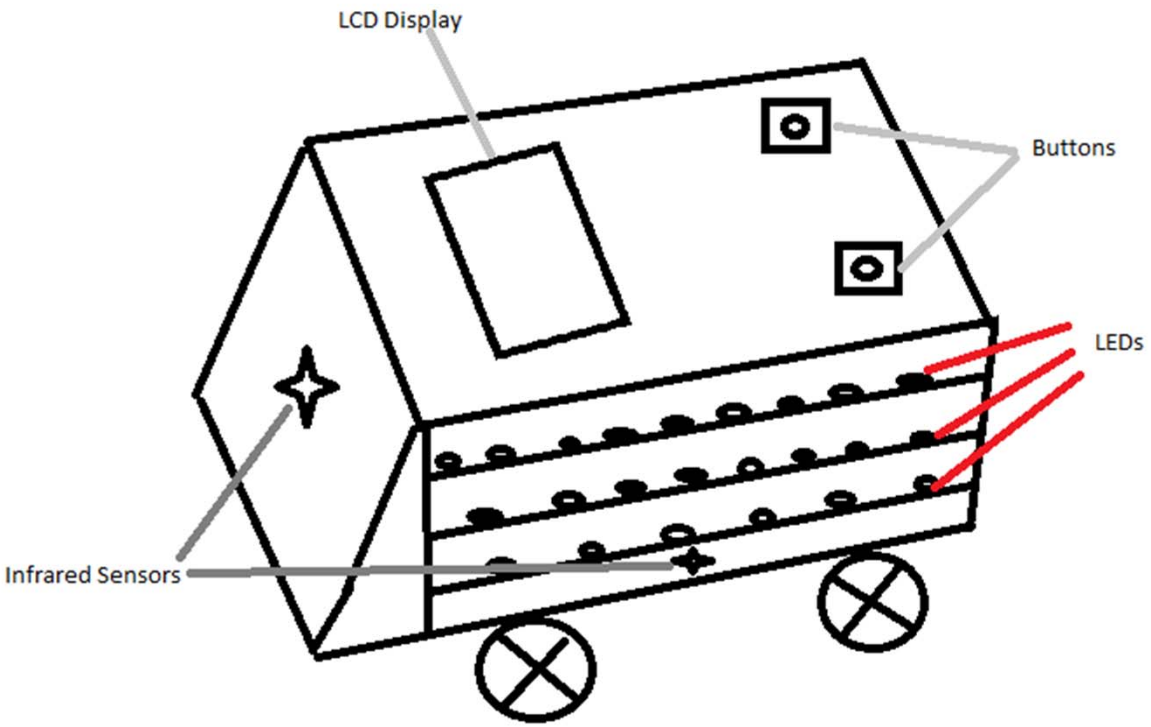
Design Ideas - #2





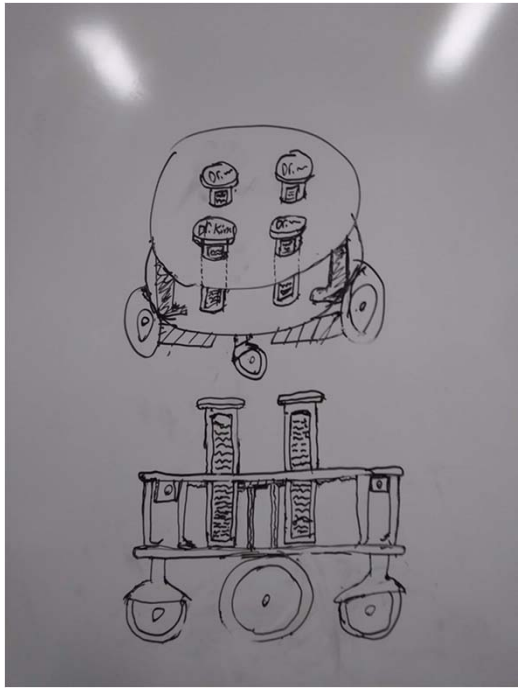
- Communication is done through microcontroller wireless receiver to signify source and destination locations and delivery confirmations.
- Selection of recipients is done manually by the user labeling capsules

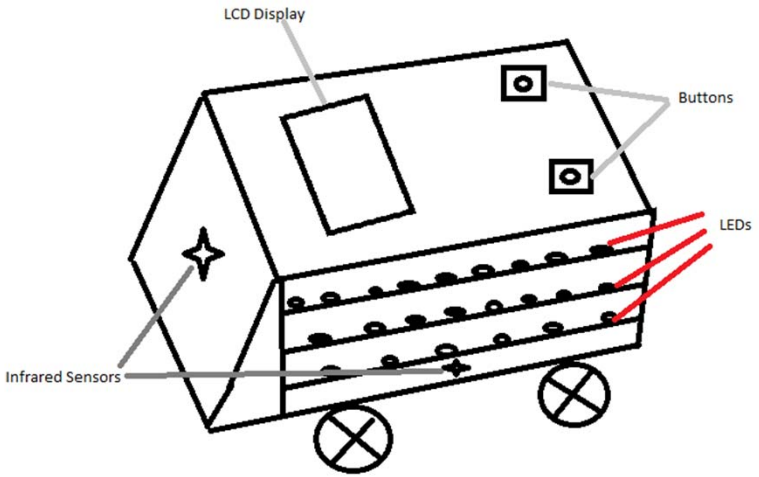
Design Ideas - #3



2 Chosen Conceptual Designs

- Designs #2 and design #3 best fit design requirements





Design #2 Pros and Cons

Pros	Cons
Size: Small and Compact	Load: Only can transport small amount items
Papers are transported in protective capsules	Capsules cannot transport non-foldable items, Like envelops
Currently in possession of frame	Frame does not accommodate paper shape
Deliverables are clearly labeled	Extra work for user to gently roll document and insert in capsule

Design #3 Pros and Cons

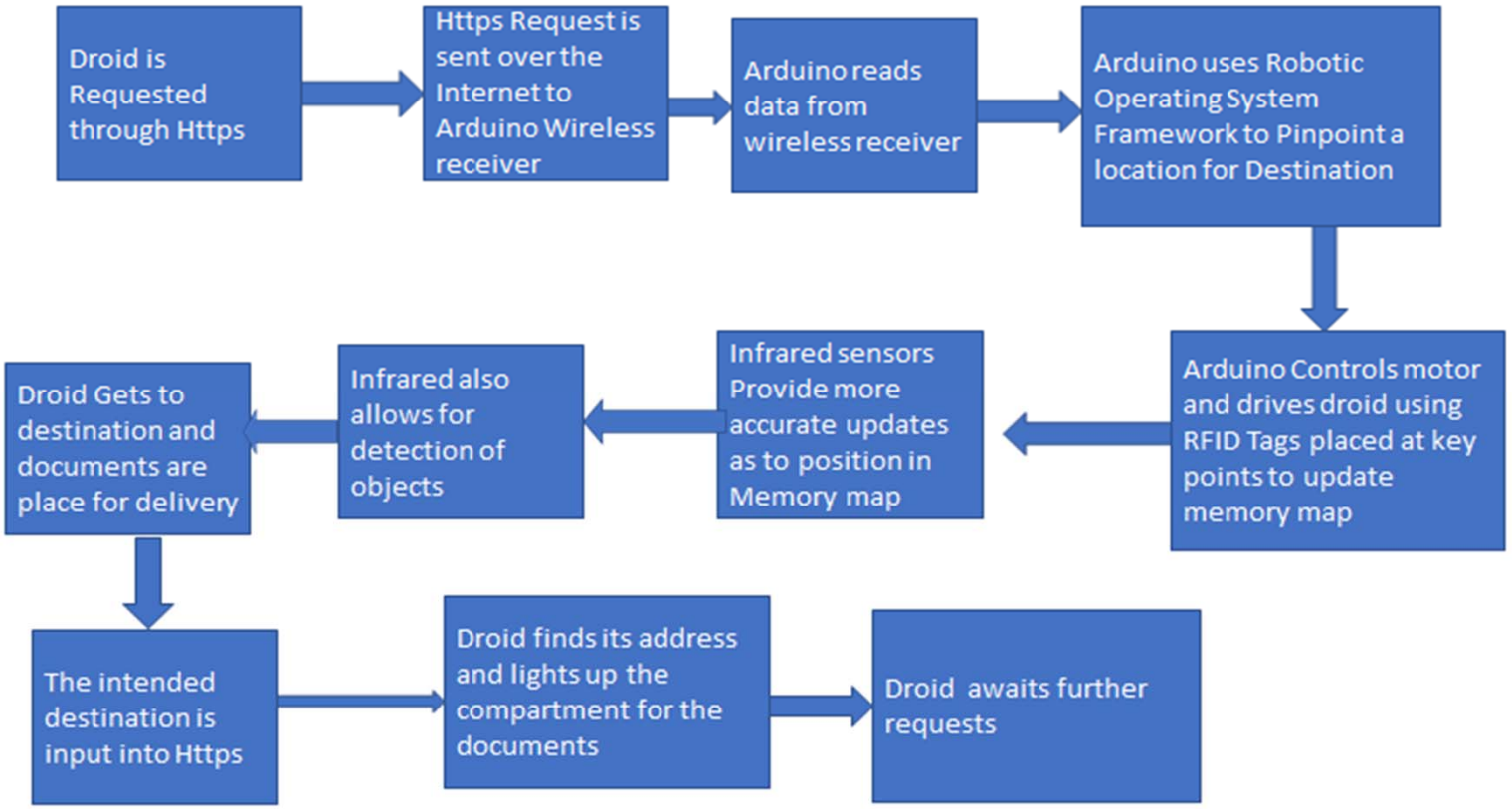
Pros	Cons
Size: Small	Costs more to manufacture as it requires more parts/components.
Easy insertion for sending and easy retrieval with automatic sliding drawers	Additional microcontroller connections and power consumption
Load: Can carry a large amount of items or a single large item (laptop).	Items must be flat in shape in order to fit into drawers
Weight sensor to limit load to set amount	Additional programming of microcontroller needed for more components
LEDs and LCD allow for superior aesthetics	

Design Matrix

	Cost	Aesthetics	Size	Practicality	Efficiency	Total Score
Weight	4	3	1	2	5	
Design 2	4	2	4	3	3	
Aggr. Score	16	6	4	6	15	47
Design 3	2	3	4	4	5	
Aggr. Score	8	9	4	8	25	54

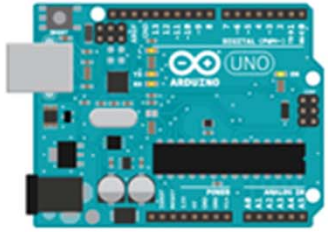
Top Solution: Design #3

Software Block Diagram



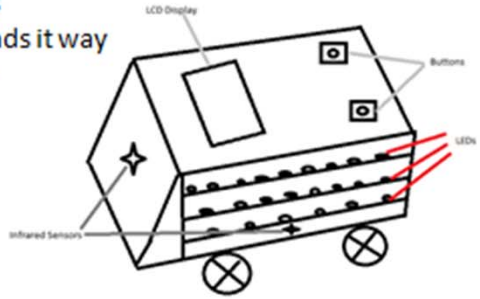
Hardware Implementation and Working product

Request Deliveroid through web and it wirelessly connects to droid



Destination input
through web

Using IR, Memory Map
and RFID tags
Deliveroid finds it way
to requester



Place items to be delivered in a slot

Conclusion

- While we did not use the frame originally given to us, we believe that this design is more efficient and a better fit for our design requirements.
- Our previously defined frame was more optimized for transporting random items while this one is for an office setting
- While this may incur more costs we believe this design will still be within our budget