



Deliveroid Solution Design

Ileana Bocage
Noah Drakes
Aaron Gibbs
Chrisserge Pierre-Louis

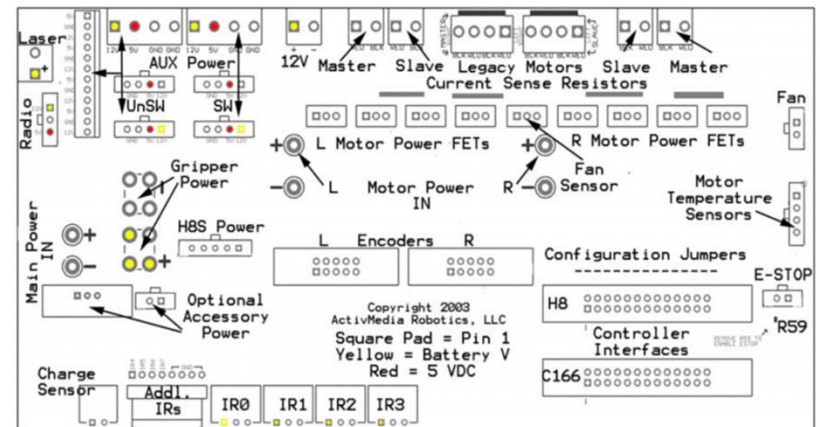
Background



Project Goals

Goals:

- Validate motor controls (Reverse Engineering)
- Establish Arduino-based control system
- Establish Http Communication Protocol
- Implement Navigation and Object Avoidance Algorithms



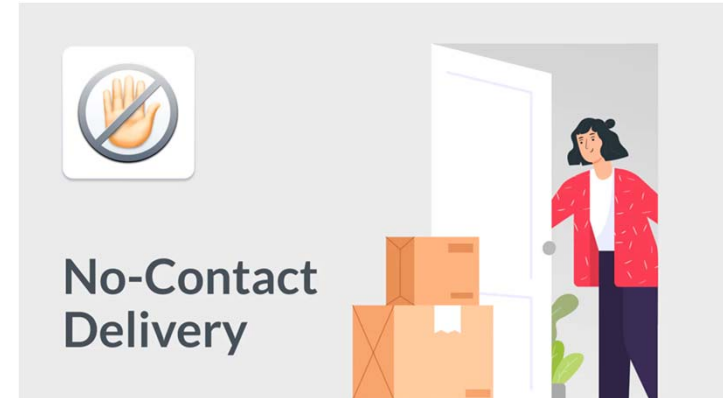
Needs and Benefits

Dissatisfied Conditions:

- Overcrowded Cafeterias
- Too many orders at given time
- Too few people to fulfill requests.
- Contact food delivery to Covid Patients poses a health risk

Benefits:

- Convenience of no longer having to leave your room to get food
- No-contact delivery of food and items due to Covid
- Increased Efficiency
- Increased accessibility to cafe food for on-campus students will encourage more purchases, increasing profit.





Problem Statement

The need of Howard University given the contact delivery health risks posed by the Covid-19 pandemic as well as overcrowded cafeterias, too many food/package orders and too few people to fulfill these requests is to efficiently provide convenient contactless delivery to students on campus so that the cafeteria can maximize its profits and mitigate overcrowding.



Design Requirements

Product Specification

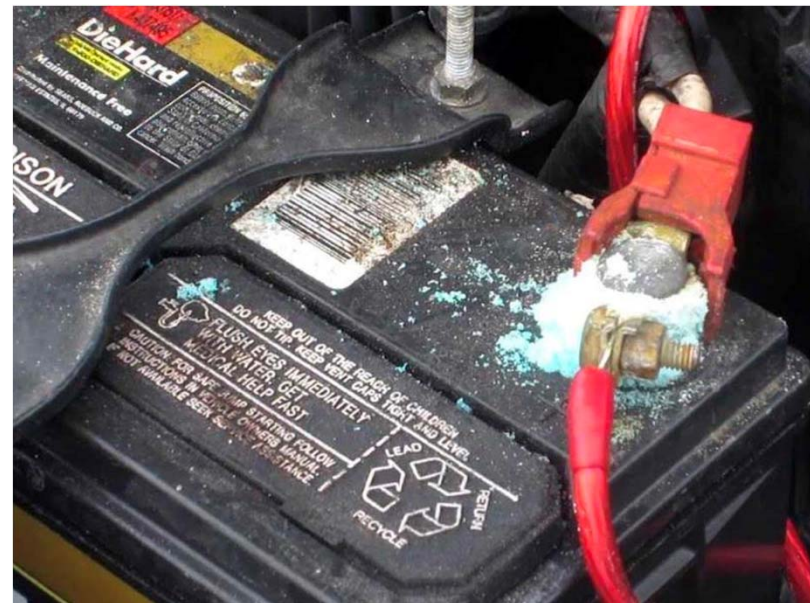
- AC Input Voltage - At least 5V (or 12V)
- Weight of the final product - 12 kg
- Response Time - Roughly 1 ms
- Dimensions - 277 x 508 x 497 mm
- Speed (Max Forward/Backward) - 0.7 m/s Max
- Performance - 2-4 hours (w/ 3 batteries)
- Battery - 3 Batteries Capacity: 7.2 Ah each



Constraints

Environmental Constraints

- Lead Acid Battery
- Proper Sensors

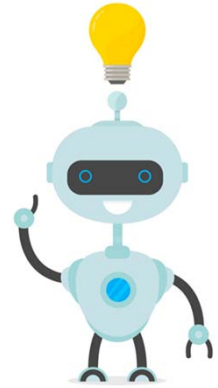


Constraints

Socio-Cultural Constraints

- Robot may not injure a human being or, through inaction, allow a human being to come to harm.
- A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Source: 3 Law of Robotics - Isaac Asimov's - "Handbook of Robotics, 56th Edition





Constraints

Compliance (Rules, Regulations, and Standards)

- Testing for FCC Compliance
- Testing for IEC Compliance

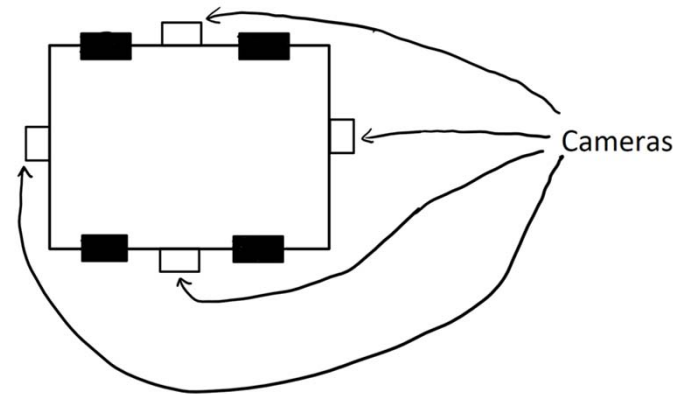




Individual Designs

Ileana's Idea

- 4 cameras for object avoidance
- Video surveillance stored in Dropbox
- Controlled via app which uses Bluetooth
- Battery pack to power the microcontroller and its peripherals





Pros and Cons

Pros:

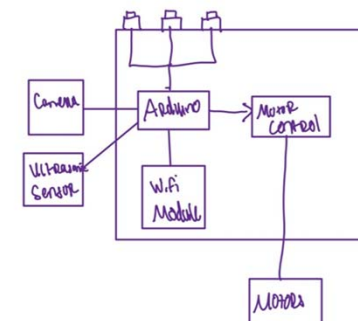
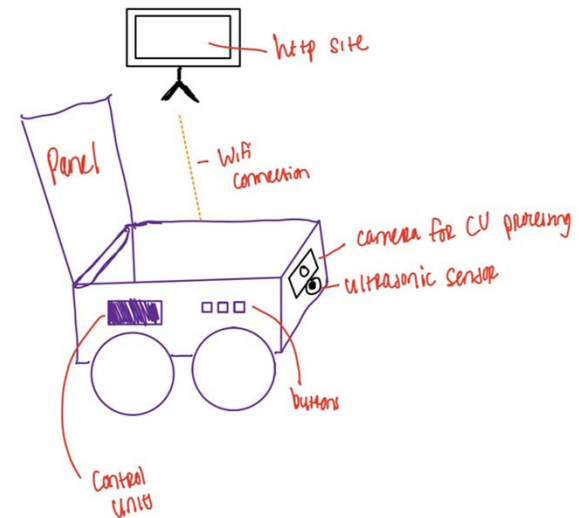
- Camera adds an additional dimension of safety and surveillance.

Cons:

- Cameras can be easily obstructed making it difficult for consistent surveillance.
- Hours of camera footage needs to be uploaded in order to be observed.

Noah's Idea

- Sensors
 - 1 Camera (Front)
 - 3 Proximity Range Lidar Sensors (Sides and Back)
- Communication
 - Wifi Module
 - Http Server
- Arduino
- Testing
 - LED Indicators
 - Push-Up buttons





Pros and Cons

Pros:

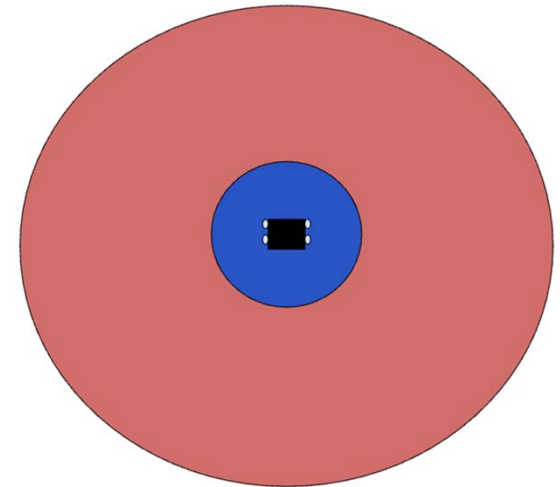
- Test buttons can be really useful for debugging.
- The camera sensor coupled with the ultrasonic sensor will dramatically improve the object detection algorithm.

Cons:

- Front Camera -> Blind Spots
- Wi-fi connection -> Connectivity Range

Aaron's Idea

- Two Types of Sensors:
 - Long Range Sensor
 - Short Range Sensor
- Made for better reaction time and in case of emergency



Pros and Cons

Pros:

- Multiple Sensors adds robustness
- Response Time increases with multiple sensors

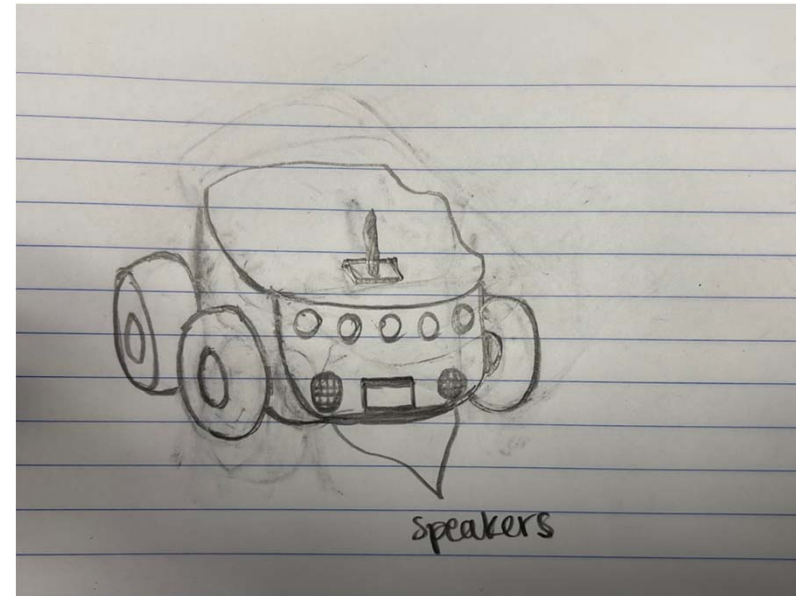
Cons:

- Type of sensor not stated
- Pure Distance sensor may not be enough for detection



Chrisserge's Idea

- Incorporate a speaker which will be used for pickup and drop off notifications.
- Additionally, there can be music playing during delivery as a way to keep people aware and out of the way of the robot as it is passing through.





Pros and Cons

Pros:

- Sound can help visually impaired users be notified of when the robot is in close range.
- It can alert users and pedestrians

Cons:

- Music can be considered noise pollution



Decision Matrix

Chosen Solutions:

Ileana and Noah

Attribute	Weights	Design 1(Ileana)	Score	Agg Score	Design 2 (Noah)	Score	Agg. Score
Functionality	5	4 Cameras Phone Application Video Surveillance	8	40	1 Camera 4 Ultrasonic Sensors Test Buttons 4 Led Indicators Panel for storage	7	35
Connectivity	4	Phone App connected via bluetooth	6	24	Http Site connected via Wifi	8	32
Power	2	Power Source: Battery Pack Power Intensity: Very Intensive (4 cameras)	9	16	Power Source: 9V battery Power Intensity: Not very power intensive	5	10
Practicality	3	Time Intensive Tasks: Computer Vision Algorithm, Phone App Development, Video Surveillance Implementation	4	12	Time Intensive Tasks: Computer Vision Algorithm.	7	21
Cost	1	Expensive Items: Cameras, MCU	5	5	Expensive Items: MCU	7	7
Total				97			105




Our Final Choices

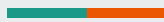
Final choice was Noah's design because...

- Implements a wifi connected website tracking user requests and robot position
- Design has less time intensive tasks which meaning more time for testing the robots functionality and efficiency.




Concluding Statements

- This semester we focused on problem formulation, design requirements and solution generation.
- We explored the needs and benefits of the Deliveroid robot to determine design requirements.
- Individual solutions were generated and the top two were chosen based on the pros and cons.
- Top solution was selected based on the decision matrix.
- Next semester we plan to understand the motors, the motor power board and also reverse engineer the robot.



Any Questions?

