Deliveroid Enhancement

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Background

- Deliveroid enhancement from last year’s project
- Purpose of deliveroid is to deliver food across campus
- Dissatisfied condition: deliveroid is not autonomous
- Our goal: make necessary enhancements to allow autonomous delivery

Problem Statement

- Problem: current robot is not able to drive automatically or detect/avoid obstacles
- Approach to problem: equip the robot with cameras and program in obstacle avoidance algorithms.
    - This will allow the robot to drive on its own smoothly and avoid obstacles.

Problem Statement

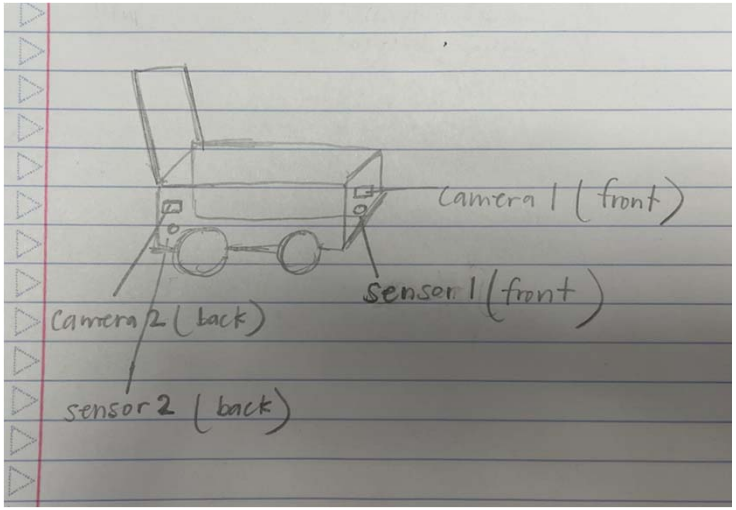
- Primary Objective: Automate this delivery process with a small robot to be able to move around and avoid obstacles.
- Short-Term Goal: Have the deliveroid move around and capture pictures.
- Long-Term Goal: Have the deliveroid to be able to move around varying sizes of groups of students without interrupting them while capturing pictures.

Solution Generation

- Design Idea 1:
  - Two ultrasonic sensors (one in the front, one in the back
  - Two cameras (one in the front, one in the back)
  - Laptop used to communicate with robot

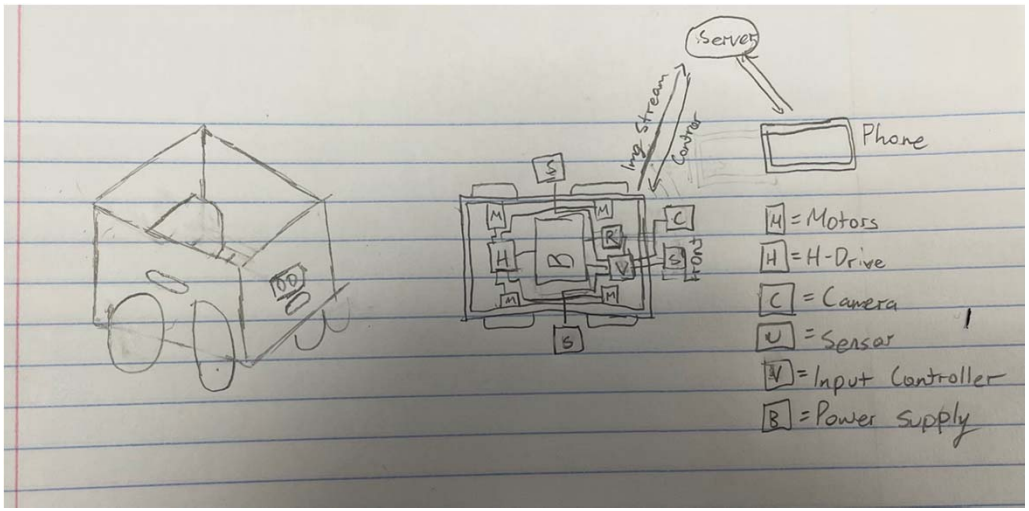
- Design Idea 2:
  - Three ultrasonic sensors (one in the front, one on the right, one on the left)
  - One camera (in the front)
  - Phone app used to communicate with robot

Solution Generation



Design Idea 1

Solution Generation



Idea 2

Design

Solution Generation

Sub	Pros	Cons
Sub - 1	• A camera in the front and back would help the robot detect objects in front of it and behind it • The two sensors would alert the robot of these objects to help it steer away from them	• Additional cameras may be needed on the sides to detect objects on the side of the robot as well.
Sub - 2	• This design only requires one camera, lowering cost. • The sensors would allow it to gather as much data as possible	• There is virtually no vision for the back of the robot • Wiring up 3 sensors could require implementing an input controller

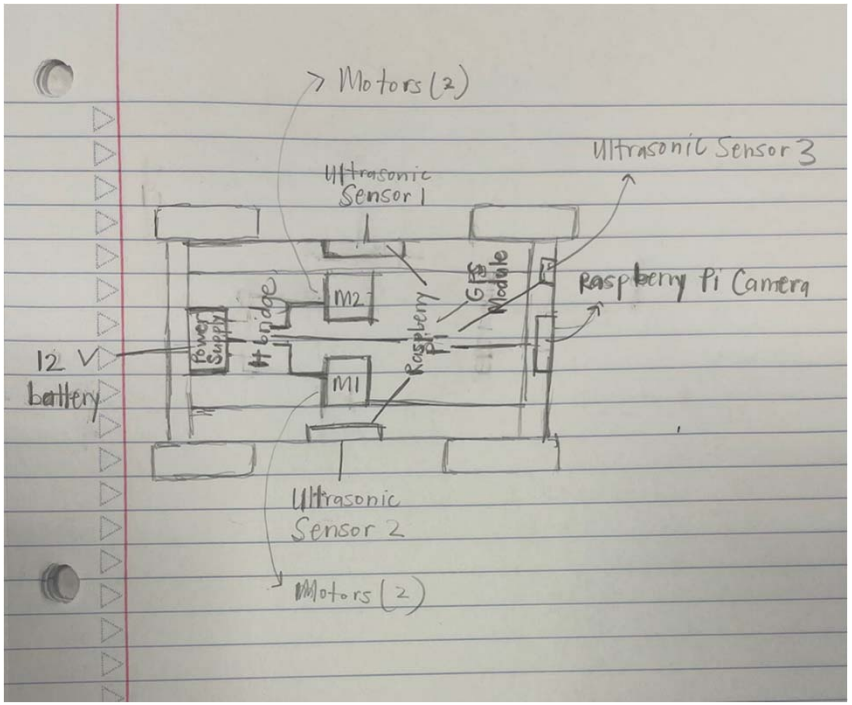
Pros & Cons

Solution Generation

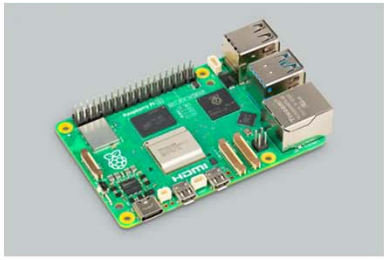
- Top solution design selection: Design Idea 2
  - Modification: Laptop will be used for communication via web application (from idea 1)

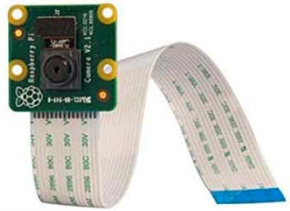
	Wt	Sub 1 Score	Agg Score	Sub 2 Score	Agg Score
Functionality	4	3	12	4	16
Connectivity	4	4	16	3	12
Mobility	4	5	20	5	20
Visibility	5	3	15	4	20
Total			63		68

Final Solution

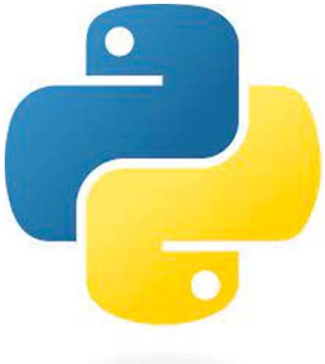


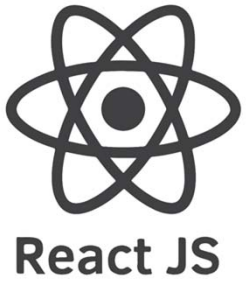
Hardware Components





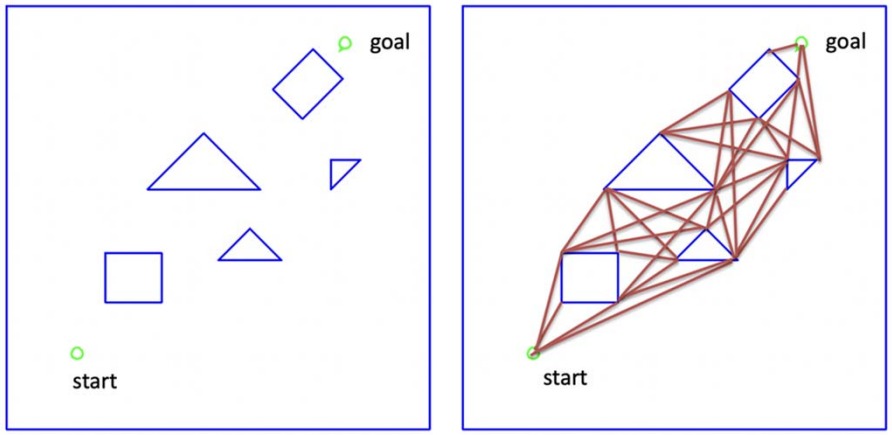
Software Components





Pathfinding Algorithm

Visibility Graph - VGRAPH



- Start, goal, vertices of obstacles are graph nodes
- Edges are “visible” connections between nodes, including obstacle edges

Source: http://www.cs.columbia.edu/~allen/F17/NOTES/lozanogrown.pdf

Realtime Optimization? Efficiently Recursive?

Conclusion

- The robot will be enhanced with cameras and sensors
- This will provide obstacle avoidance and autonomous delivery
- Two design ideas were proposed
- Design idea 2 was chosen

Conclusion

- Design idea 2:
  - One camera in the front
  - One sensor on the left, right, front of deliveroid
  - Laptop used to communicate with deliveroid
  - GPS module / coordinates will be used to direct robot
  - P3AT frame ; 9V power supply
  - Raspberry Pi used to connect cameras and sensors

Questions?