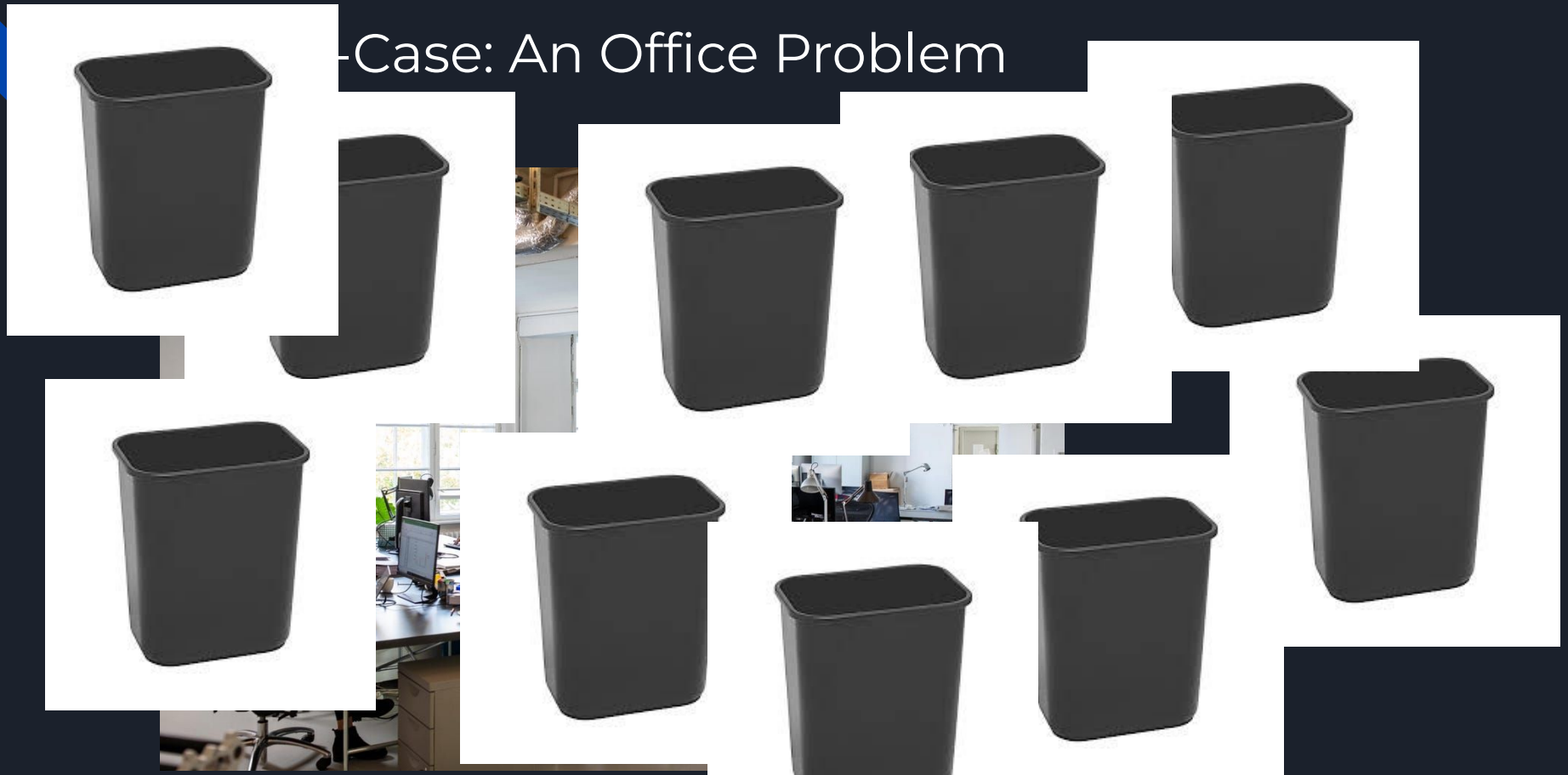
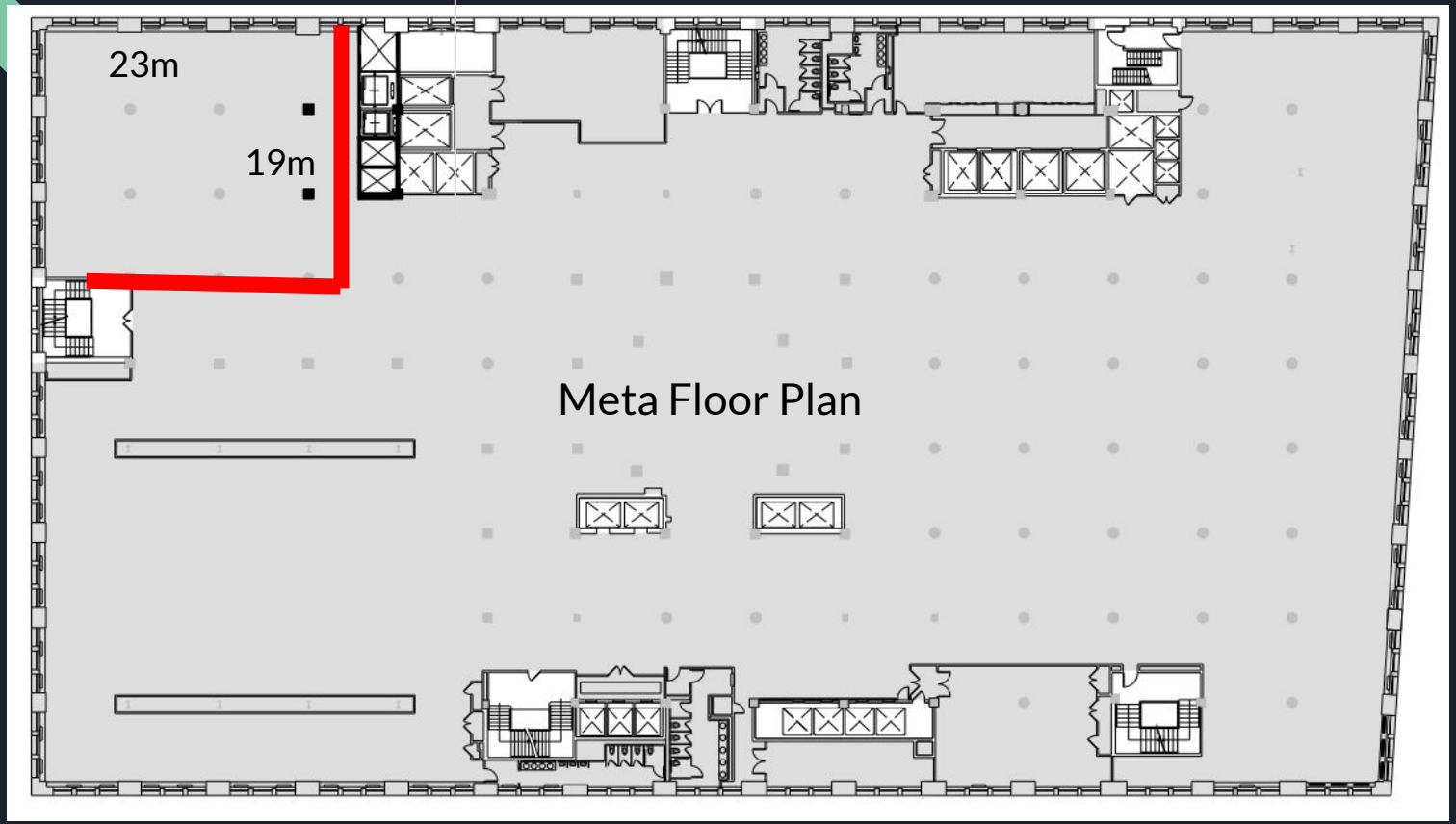
Robotic Trash Concierge

B4 - George Gao, Jack Girel-Mats, Zachary Mason

-Case: An Office Problem



Expected Customer Use Case



Use-Case Requirements

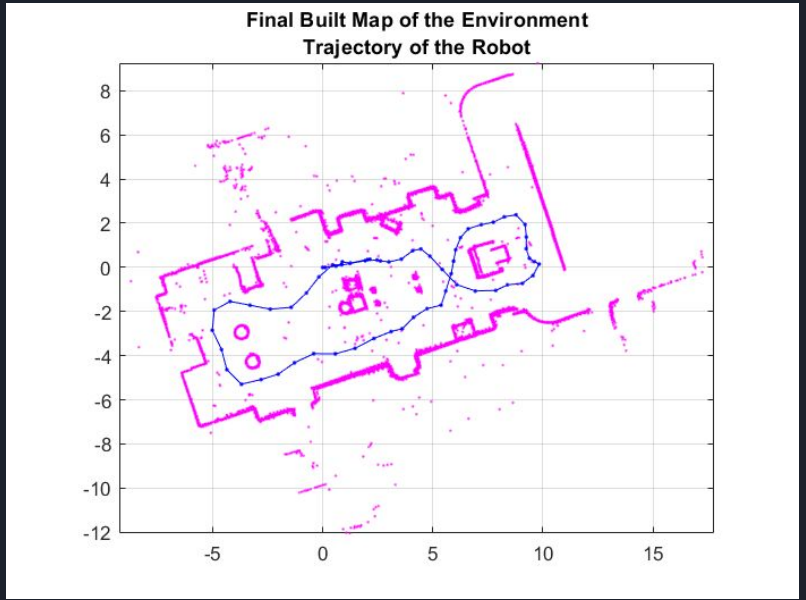
- Room size
  - 19 m x 23 m
  - 90 people
- Health and Safety
  - No human collisions
  - No trash can tip over
- Configurable trash can and drop off locations
- Movement
  - 5 hour work period
  - 42m avg round trip per trash can
  - Robot needs to be at least 0.21 m/s

Use-Case Requirements: Measuring Success

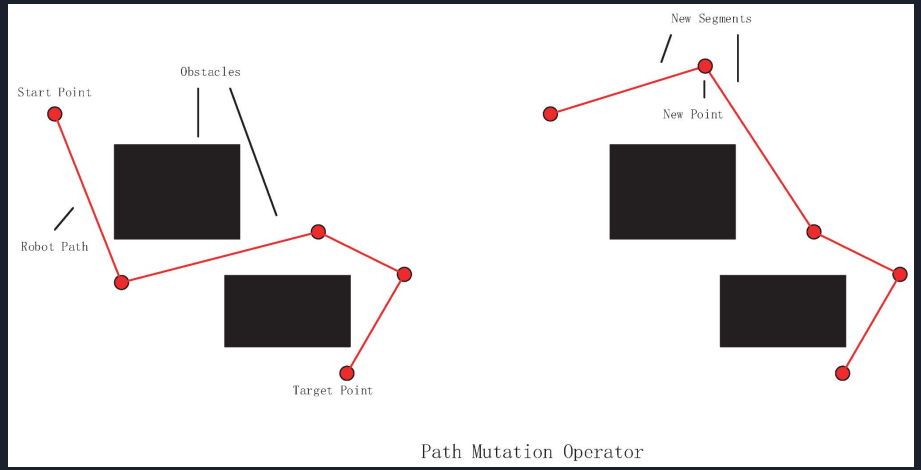
- 85% Trip success rate
  - 90% No human collisions
  - 80% Bin docking success rate
- Highest priority: 99% bins SHOULD NOT tip over during pick-up and journey
  - Privacy
  - Health
  - Safety
  - More work for janitors
- Should work with bins <10lbs

Technical Challenges

- Bin Docking
- Bin Tracking System
- Vision / Sensing System
  - 15 fps
  - 100 degree FOV
  - Global shutter
  - Obstacle detection
- Mapping
  - Path planning
  - LIDAR / SLAM pre-mapping
- Movement
  - Minimizing power use
  - Average movement speed



Solution Approach: Software



Solution Approach: Hardware

Testing / Verification Mile Stones

- Docking ability
- Roomba move speed with full 10 lb trash can
- Battery life stress test > 5 Hours
- Movement follows path
    - Reaches destination within < 0.5m radius
- SLAM mapping accuracy

Testing / Verification Goals

- Test room setup
  - 8.2 * 8.2 m^2
  - 2 bins
  - Greater than 5 trials to test 85 % trip success rate
    - Each trial will vary location of bins

Tasks and Division of Labor

Jack:

- Movement and obstacle detection software
- Mapping LIDAR/SLAM

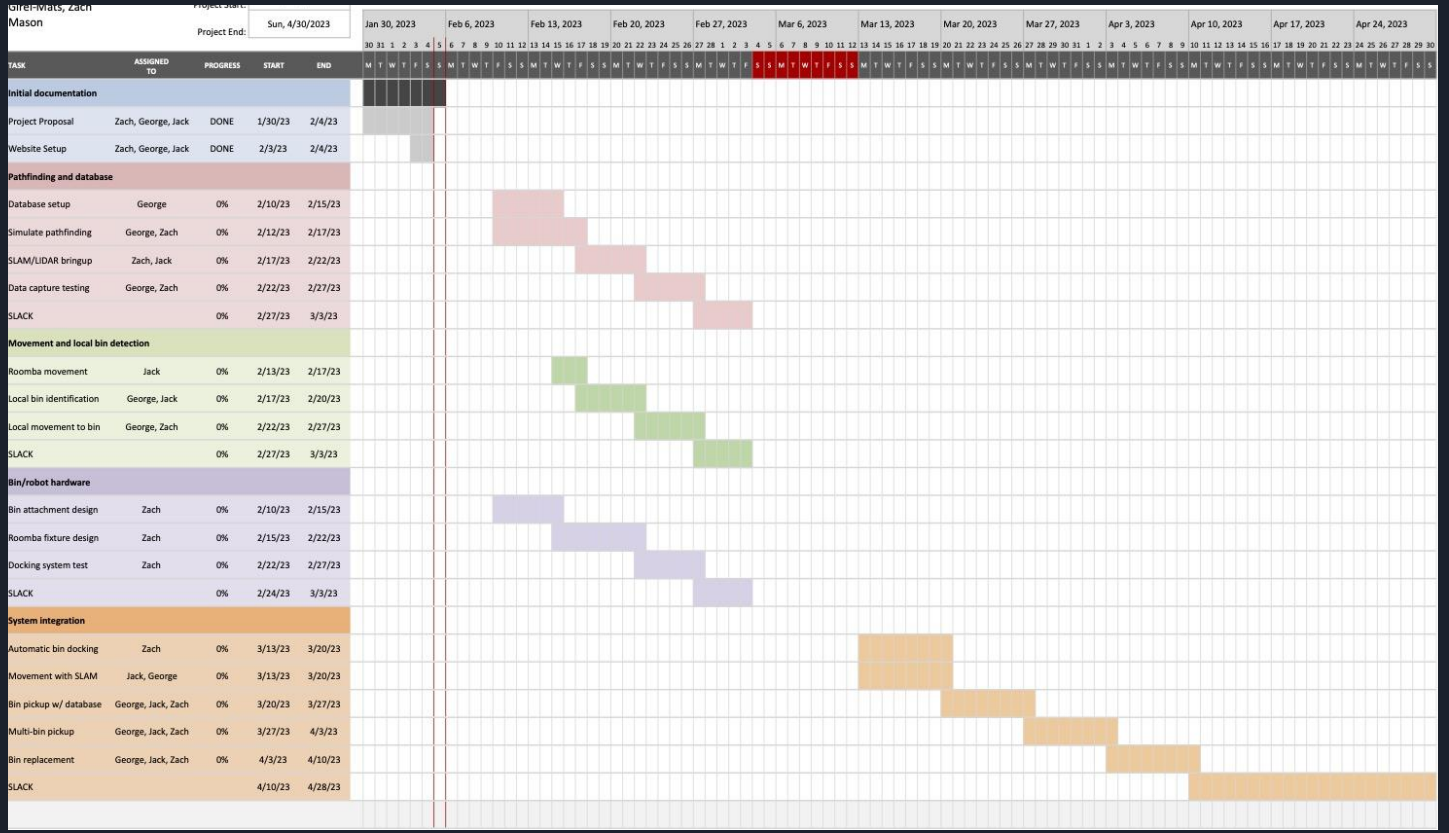
Zach:

- Bin hardware and docking mechanism
- Interface of onboard software with bin hardware and associated movement

George:

- Bin database and tracking
- Onboard CV for bin detection
- Path Planning

Preliminary Schedule



Gitel-Mats, Zach
Mason

Project Start:

Project End: Sun, 4/30/2023

TASK	ASSIGNED TO	PROGRESS	START	END
Initial documentation				
Project Proposal	Zach, George, Jack	DONE	1/30/23	2/4/23
Website Setup	Zach, George, Jack	DONE	2/3/23	2/4/23
Pathfinding and database				
Database setup	George	0%	2/10/23	2/15/23
Simulate pathfinding	George, Zach	0%	2/12/23	2/17/23
SLAM/LIDAR bringup	Zach, Jack	0%	2/17/23	2/22/23
Data capture testing	George, Zach	0%	2/22/23	2/27/23
SLACK		0%	2/27/23	3/3/23
Movement and local bin detection				
Roomba movement	Jack	0%	2/13/23	2/17/23
Local bin identification	George, Jack	0%	2/17/23	2/20/23
Local movement to bin	George, Zach	0%	2/22/23	2/27/23
SLACK		0%	2/27/23	3/3/23
Bin/robot hardware				
Bin attachment design	Zach	0%	2/10/23	2/15/23
Roomba fixture design	Zach	0%	2/15/23	2/22/23
Docking system test	Zach	0%	2/22/23	2/27/23
SLACK		0%	2/24/23	3/3/23
System integration				
Automatic bin docking	Zach	0%	3/13/23	3/20/23
Movement with SLAM	Jack, George	0%	3/13/23	3/20/23
Bin pickup w/ database	George, Jack, Zach	0%	3/20/23	3/27/23
Multi-bin pickup	George, Jack, Zach	0%	3/27/23	4/3/23
Bin replacement	George, Jack, Zach	0%	4/3/23	4/10/23
SLACK			4/10/23	4/28/23

Jan 30, 2023 | Feb 6, 2023 | Feb 13, 2023 | Feb 20, 2023 | Feb 27, 2023 | Mar 6, 2023 | Mar 13, 2023 | Mar 20, 2023 | Mar 27, 2023 | Apr 3, 2023 | Apr 10, 2023 | Apr 17, 2023 | Apr 24, 2023

Conclusion

- Reduced human workload
- Privacy and safety priorities
- Easily scalable
- Multiple rooms
- Improved interfaces