



Robotic Trash Concierge



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

Use-Case / Application



Design Requirements

Requirement	Use-case Specification	Design Requirement
Work Area	META Open Office Work Section	Robot Height <30in, Robot Width: <3ft Flexible Mapping Technology
Health & Safety	Minimize human collisions and trash spills.	Obstacle Avoidance System, Easily Identified
Movement	Room Setup: 19m x 23m, 90 People, ~90 bins 5 Hour Work Period: 7 PM - 12 PM	Robot Battery >5 Hr, Movement Speed: >.21 m/s

Solution Approach





- 1. General Welfare: Maximize engineer happiness
- 2. Health and Safety: Eliminate leftover/overfilled trash bins
- 3. Economic Consideration: Reduce custodial workload

System Diagram



Implementation Plan Software

Lidar Slam / Path Planning

CV System

Drive System

Database

Implementation Plan Hardware

Electronics Mount	Laser-cut wood / 3D printed
Drive System	Roomba motors
Power System	1 - 2 External battery banks Stepper motor driver
Bin Docking	Stepper motor lift system Worm gear for high torque
Bin Modification	Laser-cut wood base plate

Testing / Verification

Measurement	Input	Output / Goal	Risk Factors / Mitigation
Bin Identification	ARUCO Tag On Bin	Successful Identification	Misaligned Bin, Multiple ArUco tags
Bin Docking	ARUCO Tag On Bin	Successful Localization and docking	Misplaced Bins, Notify Custodian
Bin Tow	10 lb Trash Can	< 0.2 m of destination	Make Bins Smaller/Lighter
SLAM Bin Mapping	HH1307 + Randomized Bin Locations	Map Location of All Bins	Misaligned Bins, Manual Placement of Bins

Testing / Verification

Measurement	Input	Output / Goal	Risk Factors / Mitigation				
SLAM Room Mapping	HH1307 Lab	General Accuracy	Overhead Camera				
Path Finding	Multiple Bin Locations + Obstacles	.5 m Accuracy	Room Changes, Notify Custodian, Manual path planning				
Obstacle Avoidance	Mason Walking around	< 90% collision rate	Move Around Objects, Stall, Notify				
Integration Test	HH1307 two bin rotation	Runtime, 85% Overall Success	Aftermarket Battery/Add Charing Cycle				

Project Management

Mason		Project End:	Sun, 4/	30/2023	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
TASK	ASSIGNED	PROGRESS	START	END	30 31 1 2 3 4	5 6 7 8 9 10 11 5 M T W T F 5	12 13 14 15 16 17 18	19 20 21 22 23 24 25	26 27 28 1 2 3 4	5 6 7 8 9 10 11 1 5 M T W T E S 9	2 13 14 15 16 17 18 M T W T F S	19 20 21 22 23 24 25 S M T W T F S	26 27 28 29 30 31 1 S M T W T F S	2345678 SMTWTES	9 10 11 12 13 14 15 S M T W T E S	16 17 18 19 20 21 22	23 24 25 26 27 28 29 30
Initial documentation	то									ر ایر این این این این این ای			الداقا ليا إيرانيا إيراني				
Project Proposal	Zach, George, Jack	DONE	1/30/23	2/4/23													
Website Setup	Zach, George, Jack	DONE	2/3/23	2/4/23											Georg	e	-
Pathfinding and databas	ie															-	
Database setup	George	0%	2/10/23	2/15/23											Jack		
SLAM/LIDAR bringup	Zach, Jack	0%	2/17/23	2/22/23											Zach		
Data capture testing	George, Zach	0%	2/22/23	2/27/23											Zach		
Simulate pathfinding	George, Zach	0%	2/12/23	2/17/23													
SLACK		0%	2/27/23	3/20/23													
Movement and local bir	detection																
Roomba movement	Jack	0%	2/13/23	2/17/23													
Local bin identification	George, Jack	0%	2/17/23	2/20/23													
Movement towards bin	George, Zach	0%	2/22/23	2/27/23													
SLACK		0%	2/27/23	3/20/23													
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	3/20/23													
System integration																	
Automatic bin docking	Zach	0%	3/20/23	3/27/23													
Movement with SLAM	Jack, George	0%	3/20/23	3/27/23													
Bin pickup w/ database	George, Jack, Zach	0%	3/27/23	4/3/23													
Muid-bin pickup	George, Jack, Zach	0%	4/3/23	4/10/23													
siace	George, Jack, Zach	0%	4/10/23	4/17/23													
JUNCK			4/1//23	4/20/23													