Team 16 PDR
Trash·*E*

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Meet The Team

Stephen Townsend
Computer Engineer

Jasmine Hickey
Electrical Engineer

Smit Patel
Computer Engineer

John Diep
Computer Engineer

Team 16 Advisor
Professor Do-Hoon Kwon

University of Massachusetts Amherst

PROBLEM STATEMENT

Bringing garbage to the curb can be a difficult task for some, whether they are physically disabled or elderly. Aid lent by caring companions can be unreliable as everyone has their own schedule and may not be available at the necessary time. Those in need of refuse removal can be assisted using *Trash·E*. *Trash·E* will take the strenuous part of taking the barrel to the curb out of the process; it is a Wi-Fi enabled robotic system to move garbage from its near-home collection site to the curb on a path and at a time specified by the user.

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EXISTING SOLUTIONS

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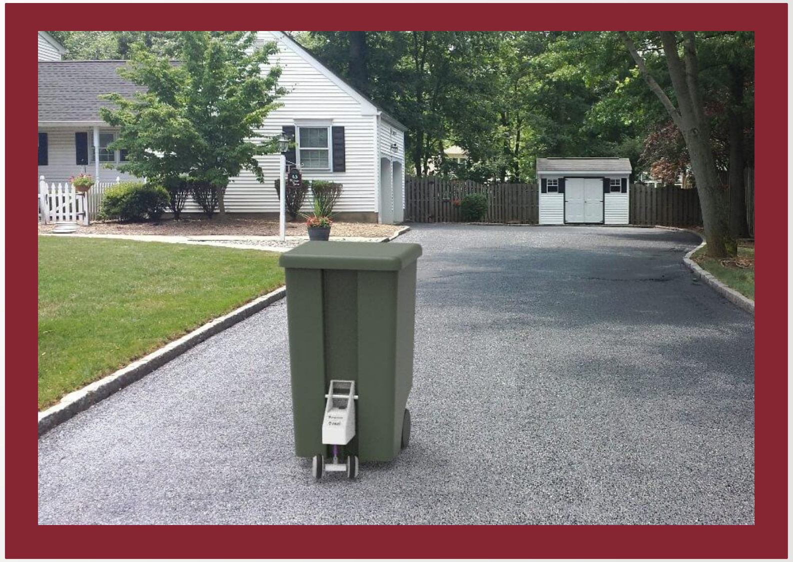
SmartCan

- In development at Rezzi
- Controlled with app
- Drives itself to curb for trash pickup on garbage pickup days
- Docking station at starting point and at pickup location
    - Zoning issues



A. Liszewski, “This self-driving garbage can remembers to take the trash to the curb for you,” *Gizmodo*, 01-Oct-2019. [Online]. Available: https://gizmodo.com/this-self-driving-garbage-can-remembers-to-take-the-tra-1838621440. [Accessed: 29-Sep-2021].

Autonomous refuse robot

- Autonomously drives to curbside for pickup
- Controlled with app
    - real time status check
    - navigation help
- Self driving car technology
- Comprehensive navigation system
- Monitor internal contents with sensors
- Hasn't been created yet

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A. I. Incorporated, "Self driving car technology on a trash can!," *Self Driving Car Technology on a Trash Can!*, 27-Jun-2018. [Online]. Available: https://www.prnewswire.com/news-releases/self-driving-car-technology-on-a-trash-can-300621889.html. [Accessed: 29-Sep-2021].

ROAR Project

- Robot-Based Autonomous Refuse handling
- Volvo Group & Renova (waste recycling company)
- Autonomously collects and empties refuse bins
- Drone finds location of bins and communicates position to robot
- Sensors will keep robot positioned
- Waste collection driver will follow and empty robot
- Predict future with more automation
- Not for home use

V. Group, "Drone to help refuse-collecting robot find refuse bins," *Drone to help refuse-collecting robot | Volvo Group*, 25-Feb-2016. [Online]. Available: https://www.volvogroup.com/en/news-and-media/news/2016/feb/drone-to-help-refuse-collecting-robot-find-refuse-bins.html. [Accessed: 29-Sep-2021].

	SmartCan	Autonomous refuse robot	ROAR Project	Trash·E
Detect and alert user of obstacles				
Automatically drives to pick up location and back				
For home use				
User specifies dates and time for bin to drive out				
No zoning issues				
Exists				

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PRELIMINARY GOALS, SPECIFICATIONS, AND TESTING PLAN

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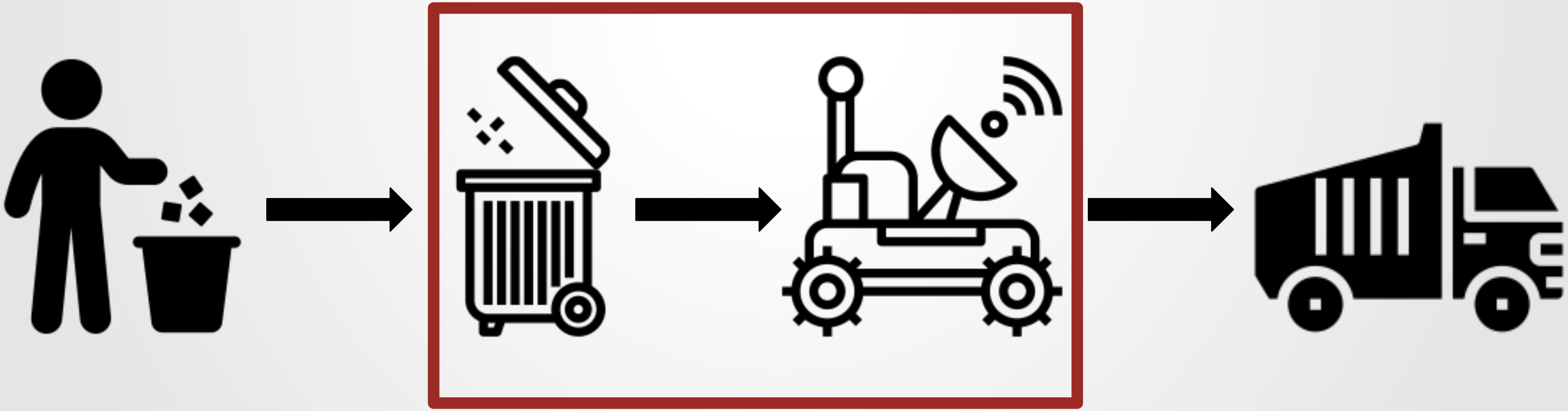
GOAL

The goal of the *Trash·E* is to provide an automated and convenient way to move trash from its place of collection to the location needed for removal by a trash service with minimal user intervention.



Preliminary System Specifications: Design-agnostic

- The System shall
    - specify what days and times *Trash·E* will run
    - wait for a preset amount of time at the pickup location before returning to its starting location
    - move at a constant speed
    - detect when trash is picked up
- Navigation
    - pre-designated route to navigate to and from starting/pick-up location
- Obstacle Detection
    - detect and stop before obstacles in front of the system
    - alert the user of an obstacle
- Environmental Restrictions
    - should work on a dry weather conditions
    - fully functional on paved smooth level surfaces

Preliminary System Specifications: Quantitative

- The System shall
  - arrive at least 10 minutes before the desired pick-up time
  - handle a payload of at least 5 lbs
  - complete 2 round trips from 1 full charge
  - wait at pick-up location for 20 minutes
- Obstacle Detection
  - detect obstacle within 2 meters

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BLOCK DIAGRAMS & PCB DESIGN

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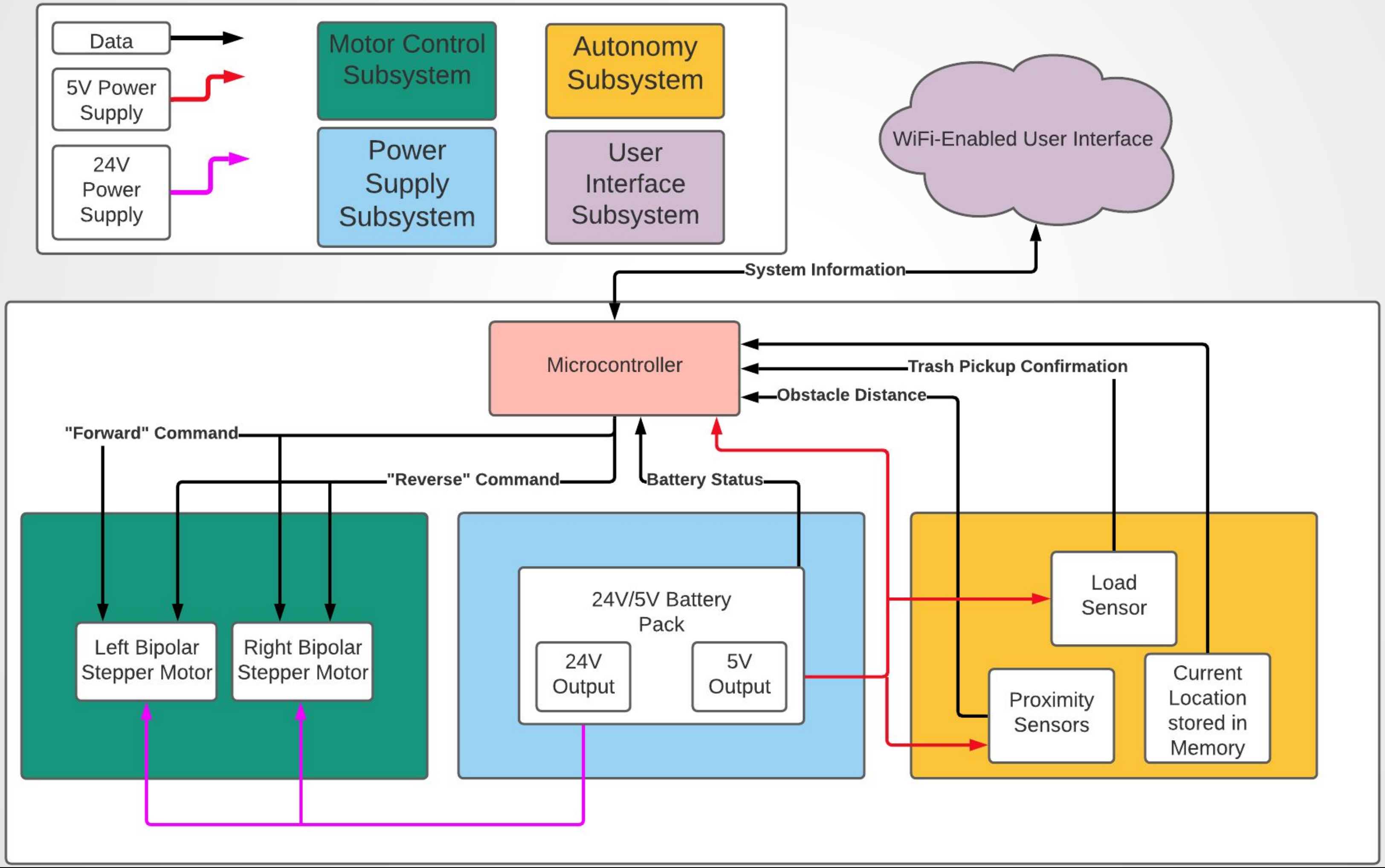
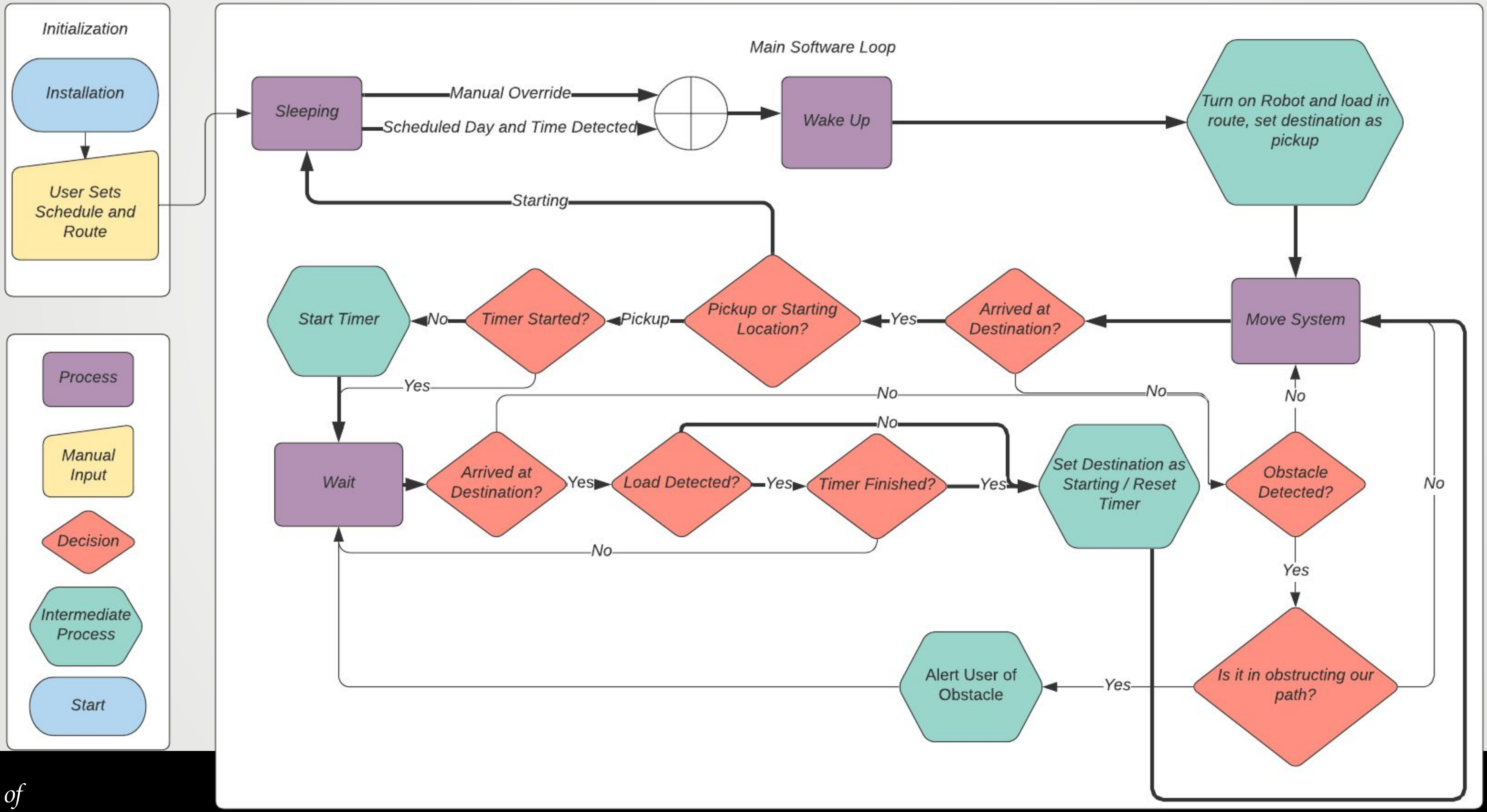
SYSTEM BLOCK DIAGRAM



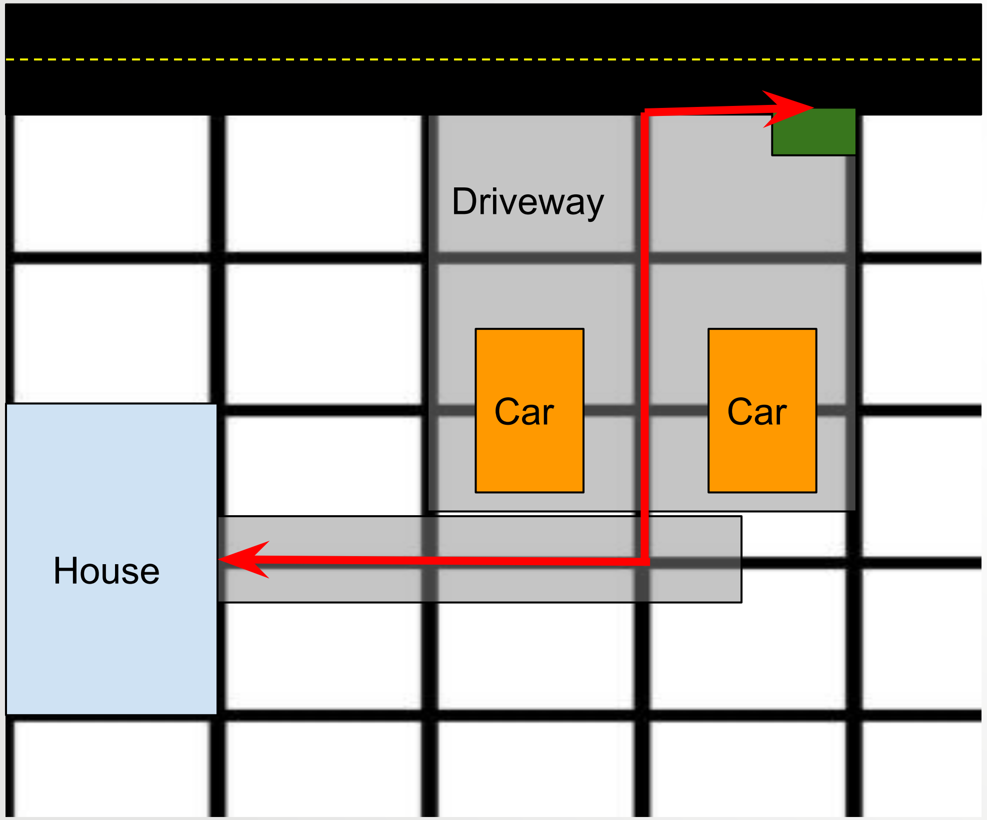
Software Block Diagram



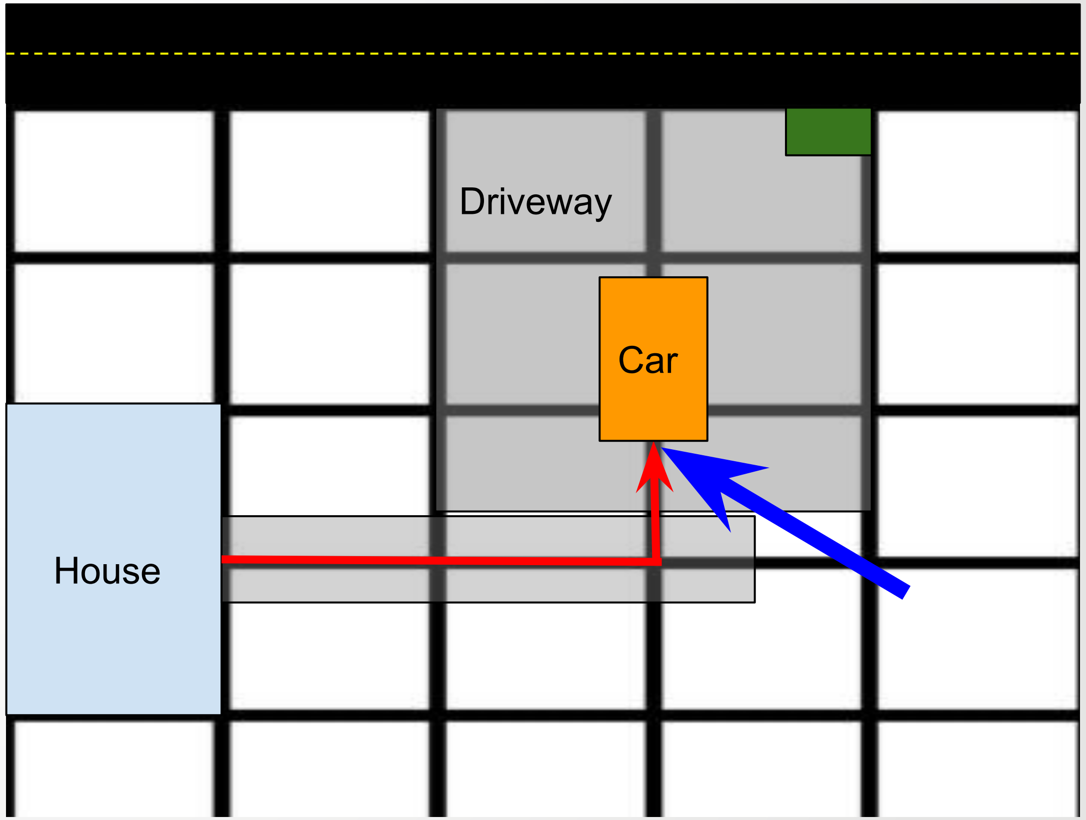
In **Bold** represents the main software path, if there were no obstacles

Comparison of Scenarios

No Obstacle in Path

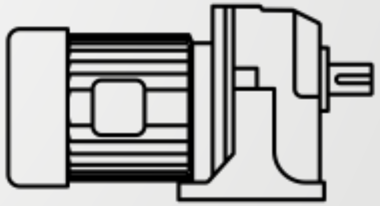


Obstacle in Path



Significant Custom Hardware Design

- Distributes power to all subsystems
- Microcontroller for communication with a phone through wifi
- Microcontroller for communication with stepper motors
- Microcontroller for communication with load sensor and proximity sensor



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COST ESTIMATE

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Cost Estimate

Component	Predicted Cost
Platform	$80
Stepper Motors	$107
Battery	$84
Proximity Sensor	$24
Arduino Nano IOT	$21
Load Sensor	$8
PCB	$125
Totals	**$449**

Bipolar Stepper Motor x 2

- Bi-polar for 2 directions of rotation
- Easy to fine tune movement

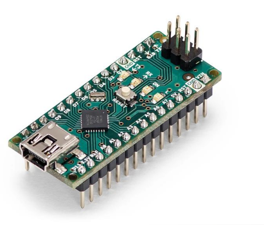
Robot Tank Chassis/Platform

- Allows for rapid prototyping
  - Less Mechanical work, more electrical/computing
- Easy to interface and install motors

Ultrasonic Sensor - HC-SR04 x 6

- Very General Purpose
- Can measure distance

Lithium ion Battery Pack



Arduino Nano 33 IOT with Headers

- 8 Analog inputs
- Many Digital Pins
- Breadboard Friendly
- WiFi Capability

Load Sensor x 2

- Cheap
- High Measurement range (up to 110kg or ~242.5 lbs)

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Responsibilities

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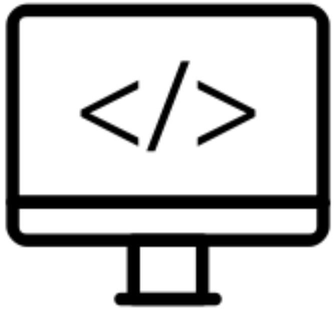
Team Member Responsibilities

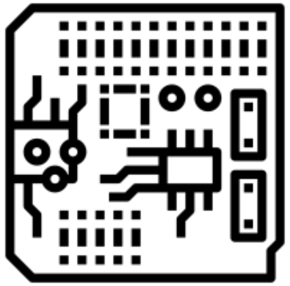
John Diep

- Software Lead
- User Interface & Verification
- Systems Integration



Jasmine Hickey

- PCB Lead
- Motor Enclosure
- Obstacle Detection
- Load Detection
- User Interface Integration & Verification
- Systems Integration



Smit Patel

- Budget Lead
- Motor Enclosure
- User Interface
- Load Detection
- Load Detection Integration with User Interface
- Systems Integration

Stephen Townsend

- Team Coordinator
- Motor Control
- Route Preset System
- Systems Integration

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MDR DELIVERABLES

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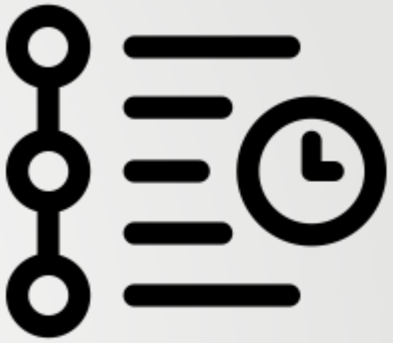
Proposed MDR Deliverables



- **Be able to preset a route for the system to navigate**
- **Tabletop demonstration of Ultrasonic obstacle detection**
  - Show 2 meter detection range specification
- **Tabletop demonstration of load detection**
  - Show ≥ 5 lbs detection specification
- **Demonstrate a mobile system**
- **Define platform for User Interface**

Schedule Moving Forward

Gantt Chart									
		Week 6 (POST PDR)	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Task To Be Done	Team Members	10/4 - 10/8	10/11 - 10/15	10/18 - 10/22	10/25 - 10/29	11/1 - 11/5	11/8 - 11/12	11/15 - 11/19	11/22 - 11/26
Motor Enclosure	Smit, Jasmine								
Motor Control System	Stephen								
Route Preset System	Stephen								
Motor Control Verification	John								
Route Preset Verification	John								
Obstacle Detection System	Jasmine								
Obstacle Detection Verification	Stephen								
Load Detection System	Jasmine								
Load Detection Verification	Smit								
User Interface	John, Smit								
User Interface Integration with Route Preset	Stephen, John								
User Interface Integration with Detection Systems	Smit, Jasmine								
User Interface Verification	Jasmine								

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QUESTIONS?

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