E1.07: IEEE Robotics Challenge – WALL-E

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TEXAS STATE UNIVERSITY
The rising STAR *of Texas*

Robotics Competition

This competition robot is designed to autonomously pick up items of litter on a 12ft X 12ft standard VEX robotics field. Rounds will last two minutes. The litter on the field will include four of each of the following items:

- Aluminum cans
- Plastic water bottles
- Snack size chip bags
- Paper food trays

The playing field will be bounded on all sides by a 1ft high, clear wall, with the trash bins orchestrated as shown.
An adversarial robot will be depositing trash on the field throughout the round.

Project Goal

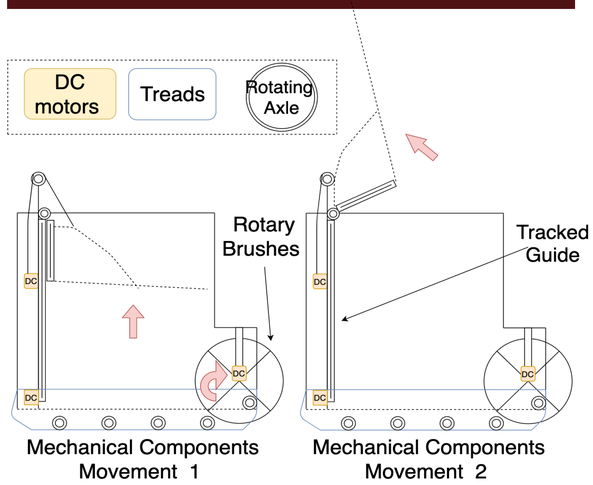
Our goal was to build a mobile trash collector for the IEEE R5 robotics competition. The robot was designed to use a combination of ultrasonic sensors and camera system to identify objects in its environment and avoid obstacles. The playing field was to be swept for 30 seconds at a time, beginning with areas of probably trash density. After the area sweep, the robot visually locates the trash bins and navigates into position to dump the trash. The sweeping process then repeats.

Hardware Components

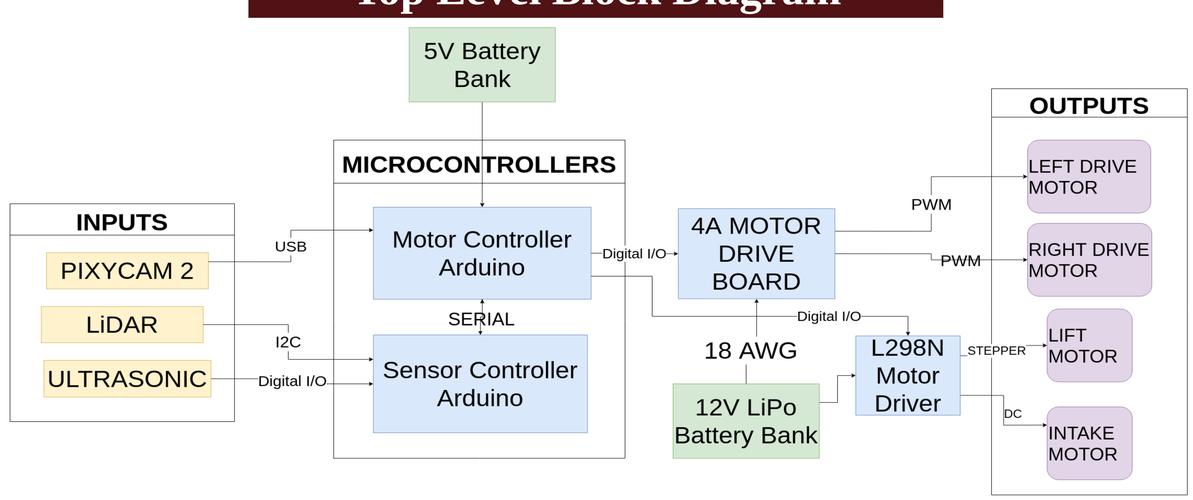
- Three 12V DC motors
- Two Arduino Uno Boards
- Raspberry Pi
- DROKL298 & L298 Motor Drivers
- Rotary trash intake mechanism
- 12 V Battery, 5V Battery
- Dual Rear Wheeled Drive System
- Stepper motor to lift trash system.
- PixvCam2 & PiCam


WALL-E

Mechanical Interfaces



Top Level Block Diagram



Test Data

Sustained Speed Test

Distance	1.	2.	3.	4.	5.	6.	Average Time Elapsed (s)	Average ft/s
2ft	1.57	1.51	1.48	1.62	1.53	1.49	1.53	1.30
4ft	3.02	2.96	2.98	3.13	3.18	2.98	3.04	1.31

Object Detection & Field of View Test

Trial	Detected Item Distance Closest(ft)	Detected item Distance Farthest (ft)	Number of Objects on Field	Angle of Farthest Left Object Detected from Center	Angle of Farthest Right Object Detected from Center
1.	0.53”	12’1”	10	61 deg	71 deg
2.	0.47”	11’8”	5	62 deg	72 deg
3.	0.59”	11’9”	15	73 deg	56 deg
4.	1.00”	12’4”	8	70 deg	66 deg
5.	0.89”	11’7”	10	65 deg	65 deg
6.	0.76”	11’9”	20	73 deg	70 deg

Area Sweep Test

	Time Elapsed 36 ft² (s)	144 ft² Extrapolation
1.	27.4	109.6
2.	26.6	106.4
3.	28.5	114
4.	28.4	113.6
5.	28.1	112.4
6.	27.9	111.6
AVG	27.9	111.3

Current Functionality

- Object recognition and approximate classification from 12 ft. (trash)
  - Classifies objects as can/bottles or not.
- Object tracking and following from up to 12 ft.
  - Can navigate itself to target colored objects (bins) from anywhere in field of view.
- Power supply - Lasts near 30 minutes
  - 5V and 12V subsystems
  - Easily recharagable setup.
- Trash dump mechanism capable of collecting 9 items with an estimated weight of 4lbs. Raises litter 16 in. and drops in the recycle bin under 10 seconds.
- Trash intake system functional at robot top speed.
- Bot Speed : ~ 1.3 ft/s
- Fully assembled bot weighs ~18lbs with batteries. Measures 23"x22.5"x20"

Future Features

- Improved object classification, from
  - bottle/can or not to
  - metal, plastic, and trash.
- Avoid obstacles while navigating to target objects autonomously.
- Integrate sensor and driver micro-controllers

Team Members

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