

BALL IS LIFE: The Autonomous Trash Can Project

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The Inspiration behind The Project

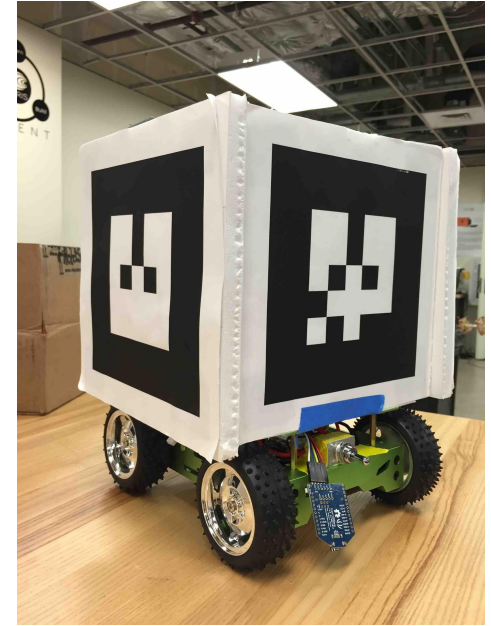
- Japanese trash can concept
- Originally planned to catch basketballs
- Reverted to trash can due to time and realistic constraints
- Project aims to catch trash projectiles real time



Overview of the System



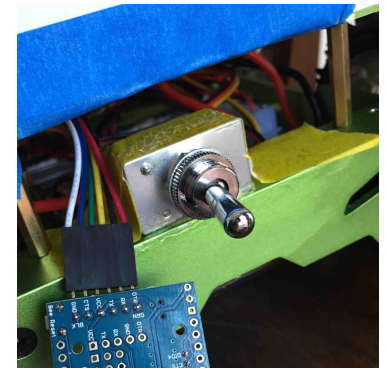
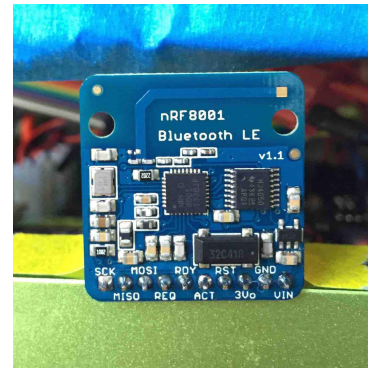
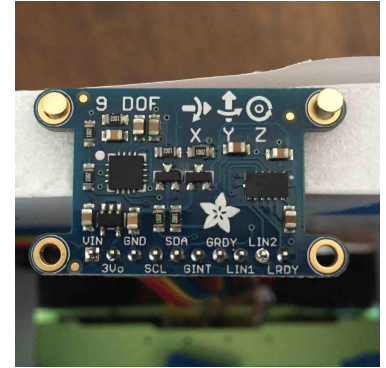
1. Depth image from Kinect
2. OpenCV finds object, robot uses AR tags
3. Robot receives relative coordinates through BLE
4. Robot calculates angle and norm of coordinates
5. Robot spins and drives forward to catch trash





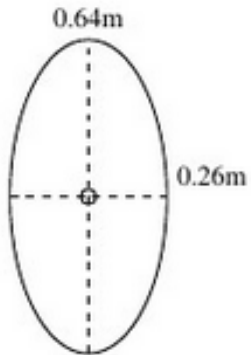
Implementation of Hardware

- Used the 4WD Hercules Robot Kit
- Atmega 168 Microprocessor
- Full H-Bridges
- Additional Components:
 - 9-DOF Accelerometer, Gyro, Magnetometer
 - nRF8001 BLE Chip
 - Power Switch



Hardware Performance Math

- Best Case Scenario: Forward/Backward
- Worst Case Scenario: Turn 90 degrees and then move
- Wheel Radius = 40 cm
- Max Rotation Time = 0.3s



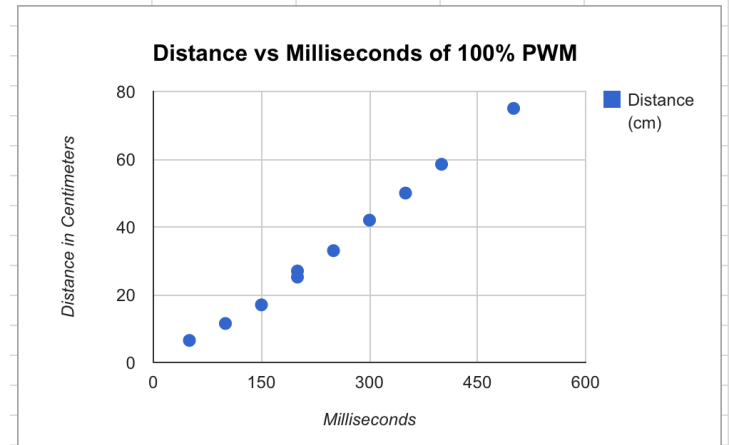
$$\text{width} = \frac{2 \times 0.04\text{m} \times \pi \times 310\text{rpm}}{60\text{s}} \times 0.2\text{s} = 0.26\text{m}$$

With Turning

$$\text{height} = \frac{2 \times 0.04\text{m} \times \pi \times 310\text{rpm}}{60\text{s}} \times 0.5\text{s} = 0.64\text{m}$$

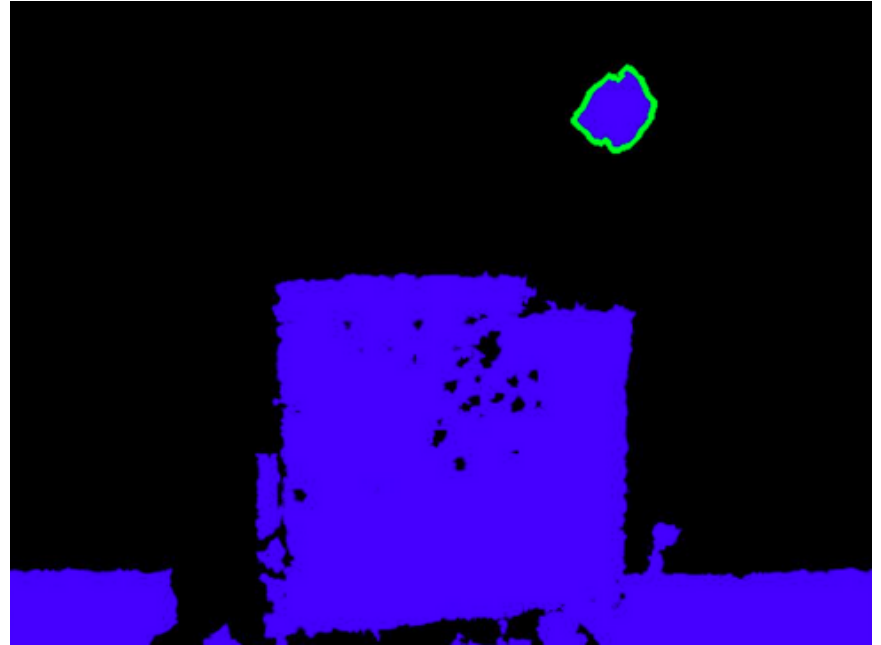
Without Turning

Battery Voltage	Milliseconds	Distance (cm)	Slope of the line
304	50	6.5	0.1559428571
304	100	11.5	
304	150	17	
304	200	27	
304	250	33	
303.5	200	25.2	
304	300	42	
304	350	50	
304	400	58.5	
304	500	75	



Implementation of Software

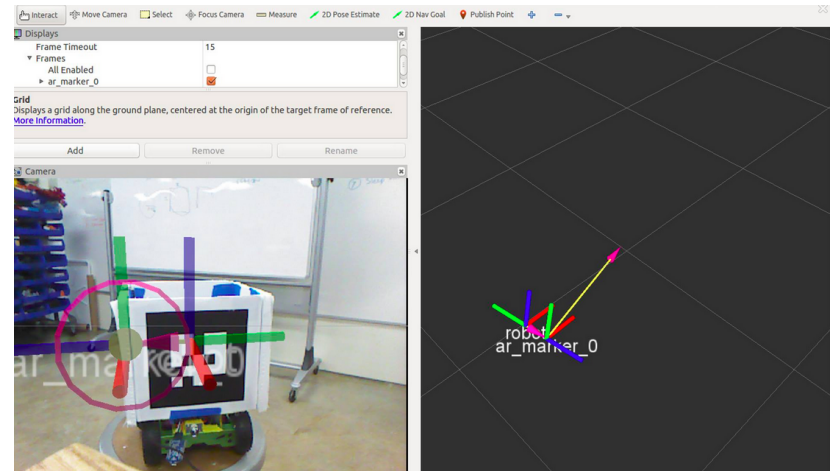
- Built on ROS
 - Supplies network and transformation tool
- Alvar AR tag tracking
- OpenCV image processing
- NumPy trajectory prediction
- gatttool bluetooth tool



Projectile Detection via OpenCV

Software Algorithms

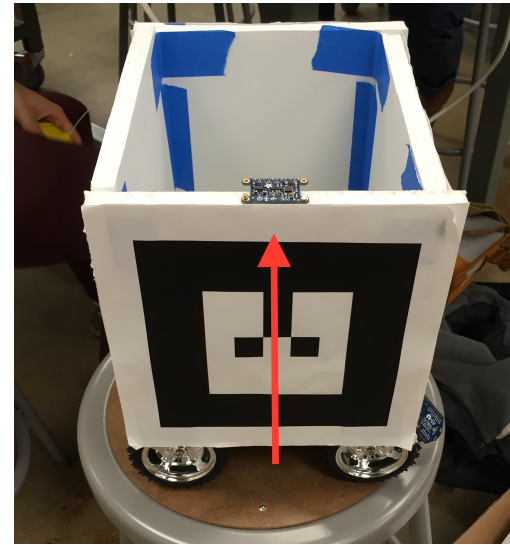
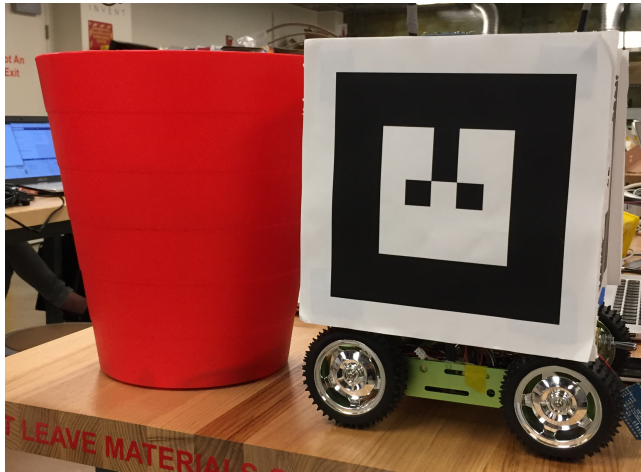
- Projectile Detection
 - Contours based on depth
 - Filtering based on shape, size, and depth
- Trajectory Prediction
 - Least squares curve fitting
- Compares position of robot to position of object
- Motor Actuation
 - Time based



3D Visualization of Robot and Projectile in RViz

Roadblocks Faced

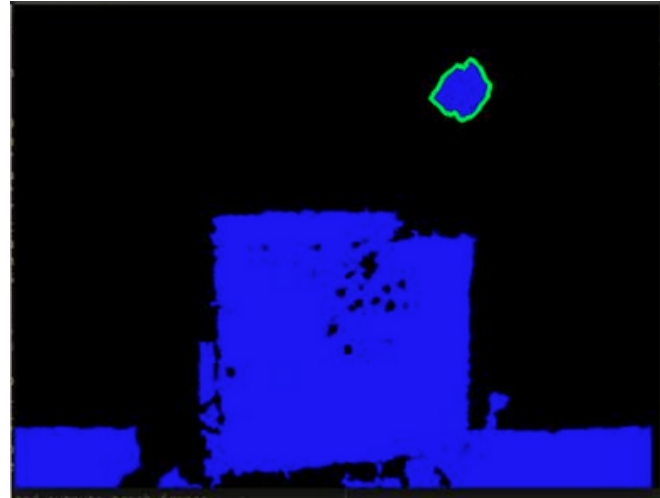
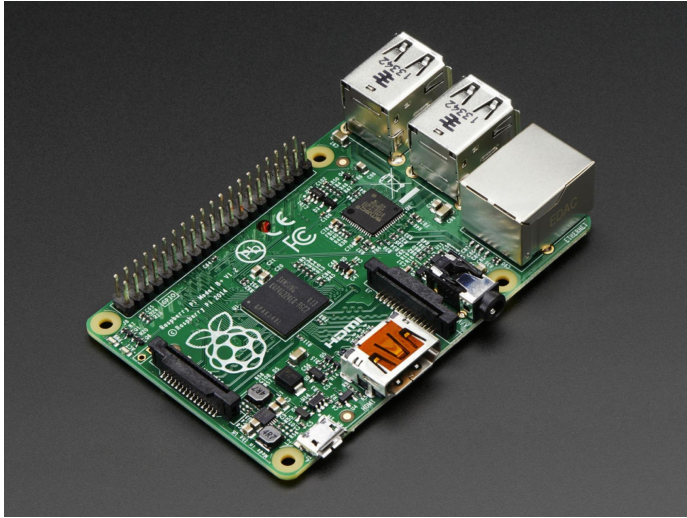
Centripetal Force



Magnetic Motor Interference

Roadblocks Faced

Processing Power



Motion Blur and Latency

Acknowledgements

- Professor Edward A. Lee
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Thank You!