Autonomous Litter Collector

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Problem Statement

The Autonomous Litter Collector can identify objects using machine vision and navigate itself back to its wireless charging station. This is done using sensor data and a path tracking algorithm.

Background/Introduction

Litter is an enormous problem at the global level. It negatively impacts health, and it is visual unappealing. Litter also costs billions per year in clean up to both governments and private businesses. The Autonomous Litter Collector can reduce the need of cleanup crews and collect the litter before it reaches our precious waterways.

Hardware Interconnection

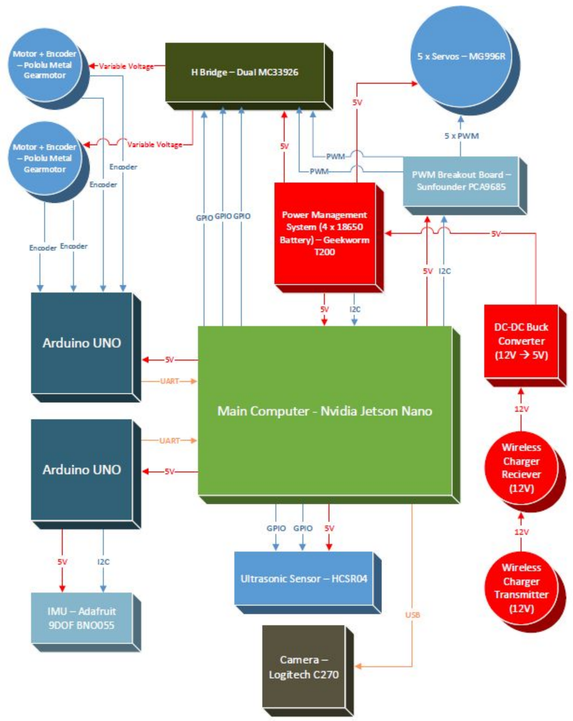

Figure 1. Hardware Diagram

Impact on Community

- Increased property value
- Decrease the one million deaths of marine animals caused by plastic waste per year
- Improved sanitation in neighborhood parks and waterways.
- Removes the need of an operator or clean up crew

Figure 2. Final Prototype

Sensor Feedback

Robot uses different sensors to gain feedback for tasks:

- Quadrature Encoders - tracks wheel travel for PID control and path tracking
- IMU - tracks robots angle over ground to assist with accurate turning and path tracking
- Camera - Identifies and aligns robot with object. Aligns robot with AprilTag at base.
- Ultrasonic sensor - Used for more accurate distance feedback when in close proximity of object.

Summary of Work

- Prototype development on a differential drive chassis using software on an Nvidia Jetson Nano Microcomputer
- Machine vision for object detection and alignment
- 4-axis 3D printed Manipulator mechanism to handle object
- Power management system capable of wireless charging
- Base localization and navigation using IMU and encoder feedback
- Path planning using Snake algorithm

Software Diagram

The software on the robot is executed on multiple devices. The Jetson Nano microcomputer executes the main program which is coded in Python. There are also two Arduino Unos used for sensor data gathering with software in C++. Data exchange between Nano and microcontrollers is done through serial communication.

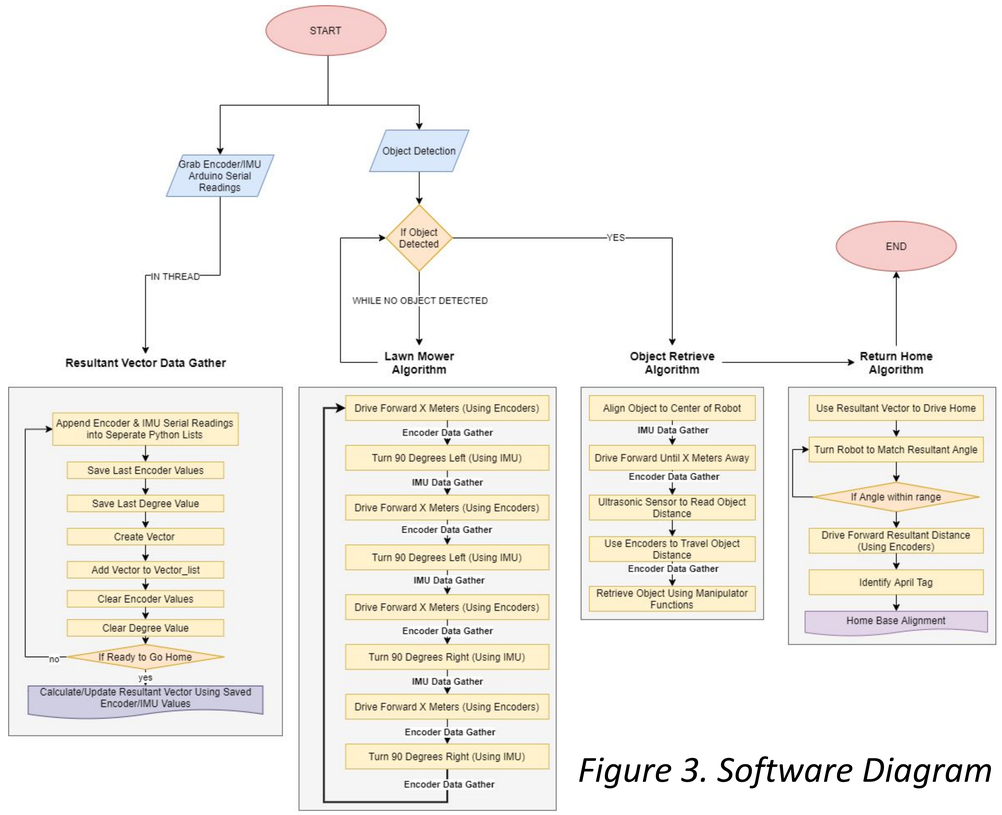

Figure 3. Software Diagram

Thank you TechnipFMC Schilling Robotics in Davis, CA for sponsoring this project!

https://github.com/alphateam-sacstate/ALC_Robot