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Robotics Research with Turtlebot 2016

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Robotics Research with Turtlebot 2016

Abstract

A Turtlebot robot platform is being used for robotics and computer vision research at Boise State. Turtlebot is an opensource robotics platform controlled by the ROS (Robot Operating System) framework. This semester we are developing capabilities for the robot to participate in the Boise State Easter Egg Hunt, an event for children on the blue turf. The broad steps include: a) retrofit Turtlebot with a small motorcontrolled egg scooper, b) use Turtlebot's vision hardware to identify and locate eggs and c) navigate to and pick up located egg(s). The team used 3D modelling and printing techniques to retrofit Turtlebot with a motorized scooper controlled by an Arduino UNO and equipped with sensors. Computer vision capabilities were integrated with ROS through OpenCV Python to analyze the Kinect's video data. Frames from the Kinect video stream were modified to minimize noise while preserving features. Frames are searched to find circular clusters of white pixels (the eggs). After a target egg is chosen, Turtlebot moves towards the egg and captures it with the scoop. Through SLAM (Simultaneous Localization and Mapping), Turtlebot navigates back to its predetermined "Home" location. We utilize slow speeds and object avoidance to ensure Turtlebot was also kidfriendly

Bunny Bot – The Easter Egg Hunter

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TurtleBot

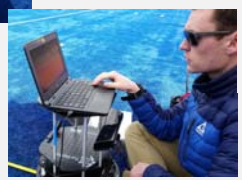
I. Introduction

Robotics is an area of engineering that is driven by extensive research and development. Robots are very effective at accomplishing specific tasks they are programmed to execute.

Turtlebot, is an Open Source, entry-level development kit integrated to a iClebo Kobuki™, which is a low-cost mobile base designed for research into cutting edge robotics. A Kinect™ sensor is used for vision.

The Turtlebot robot platform was customized to identify and retrieve an Easter egg on the famous blue turf, at Boise State University.

Boise State's Turtlebot team



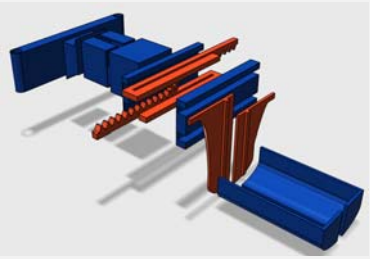
II. Methods

Project Components

- Add a small motor- controlled egg scooper to the Turtlebot.
- Use Turtlebot's vision hardware to identify and locate eggs on the blue turf.
- Navigate to and pick up the egg. Then return to a home location.

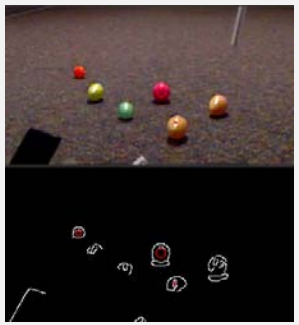
Motorized Scoop Design

To create a motorized egg scoop, the team used 3D printing to design the scoops. The motor controls for the scoops were developed using an Arduino UNO and equipped with simple sensors to detect when an egg was close enough to retrieve. The picture below shows the design of the motorized scoops.



Egg Detection and Retrieval

For the Turtlebot to identify what an egg is and what an egg is not, the vision capabilities of the Kinect senor were integrated with OpenCV. Simple Blob Detection, image thresholding and filtering were all used by the Turtlebot to identify the egg. The picture below shows a frame of the RGB video with the eggs and the output of the computer vision with egg positions indicated by circles. The image is shown on a filtered background



Robotic Navigation

The final aspect was navigation. In order for the Turtlebot to return to its original location, it needed to know where it started and where it currently was at any given time. The SLAM (Simultaneous Localization and Mapping) provided the Turtlebot with a bird's eye view of its location at all times. This meant the robot could locate an egg and return it to the predetermined "Home" location.

III. Results

Once all the elements of the robot were assembled, and the code was properly configured, the Turtlebot was able to detect eggs in the signal processing lab where most of the robot was designed and assembled. It participated in the 4th annual Easter Egg Hunt on the Blue.

Turtlebot on The Blue Turf with some future Broncos, after the team participated in the Easter egg hunt.

IV. Conclusions

This project introduced the team's students to design aspects, as well as real life design constraints, that are present in robotic applications. By brainstorming ideas and prototype testing, the team discovered the power humans have in programming robots to do specific tasks.

Mixing individual as well as team development, showed the benefits and challenges of a group effort.

The project provided insight into what was possible with robotics, and the development this term should provide a solid foundation for those who tackle the challenge in future courses.