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Bunny Bot V3.0

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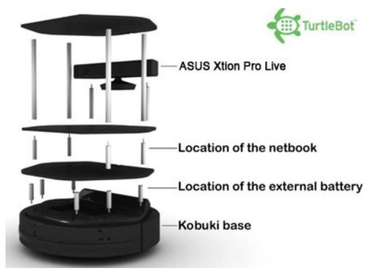
INTRODUCTION

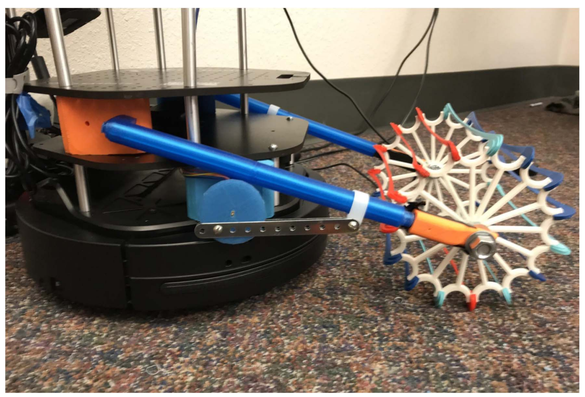
Robotics is an area of engineering driven by extensive research and development. Robots are intended to substitute for humans by replicating human actions.



A Turtlebot platform is being used for computer vision and robotics research at Boise State University. Turtlebot (above) is an open-source robotics platform controlled by the Robotics Operating System (ROS) framework. BunnyBot V3.0 is a community outreach initiative that will participate in the annual Boise State Easter Egg Hunt. on the Blue.

OBJECTIVES

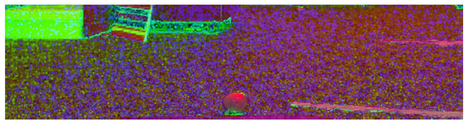
- Develop a fluid turning mechanism analogous to human navigation
- Improve and **develop** a more effective method for detection of eggs
- Assist the turning processes by enabling BunnyBot to lift the egg-collecting apparatus and reduce friction while turning
- Enable BunnyBot to return back to its starting location after the Easter egg hunt
- Programmatically develop obstacle avoidance



METHODS

Computer Vision in Egg Detection:

A multi-language open-source library, OpenCV, was used for image thresholding and analysis. In BunnyBot V2.0, eggs were detected using existing OpenCV blob detection software, which detected “blobs” by examining clustered pixel characteristics. BunnyBot V3.0 takes advantage of Easter eggs’ bright colors to increase egg detection efficiency. Hue Saturation Value (HSV) pixel bounds are created for egg colors (see below), and OpenCV is used to create corresponding masked images. Through the iterative analysis of mask contours, eggs can be detected and respective positions can be determined.

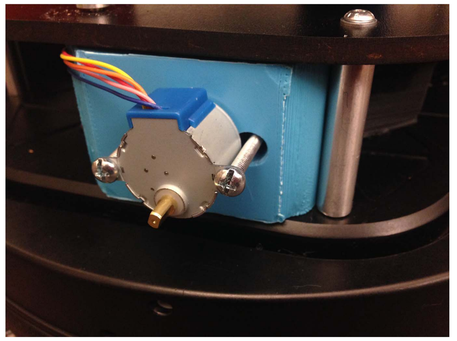


HSV Image

Corresponding Mask

Lift Mechanism:

BunnyBot V3.0 introduces a mechanism that lifts the egg-collecting apparatus slightly during turns. When the apparatus avoids contact with the ground, friction is reduced and the turning process is made easier. Without such an apparatus, the robot would have to move in small circles in order to make a turn. The apparatus is lifted using two stepper motors, connected to an Arduino Uno. BunnyBot communicates with its motors using pySerial, a Python interface that allows serial communication. The Arduino processes this serial information, allowing the motors to be controlled from within a Python program.



Stepper Motor

Fluid Turning mechanism:

When an egg was detected, BunnyBot V2.0 turned using defined increments. BunnyBot V3.0 uses a revised version of this system that appears more natural. In the new method, BunnyBot simultaneously verifies the egg’s pixel position and turns from within the context of a loop. Once the egg is in the center of the Kinect’s frame, turning is complete. Normally, the Python programming language and the ROS framework do not allow for simultaneous processes. However, with the use of the Python multiprocessing module, multiple processes can be spawned and run asynchronously. Although there were initial concerns about runtime speed, Big-O analysis shows that for small time intervals, runtime speed remains unaffected.

RESULTS

BunnyBot V3.0 can:

- Detect eggs reliably based on color features
- Turn in a fluid manner in order to center an egg
- Run several intensive processes simultaneously
- Avoid frictional resistance by lifting the egg-collecting apparatus while turning
- Return back to the starting location using computer vision based navigation