BERR-E: Berry Examination and leaf Removal Robot

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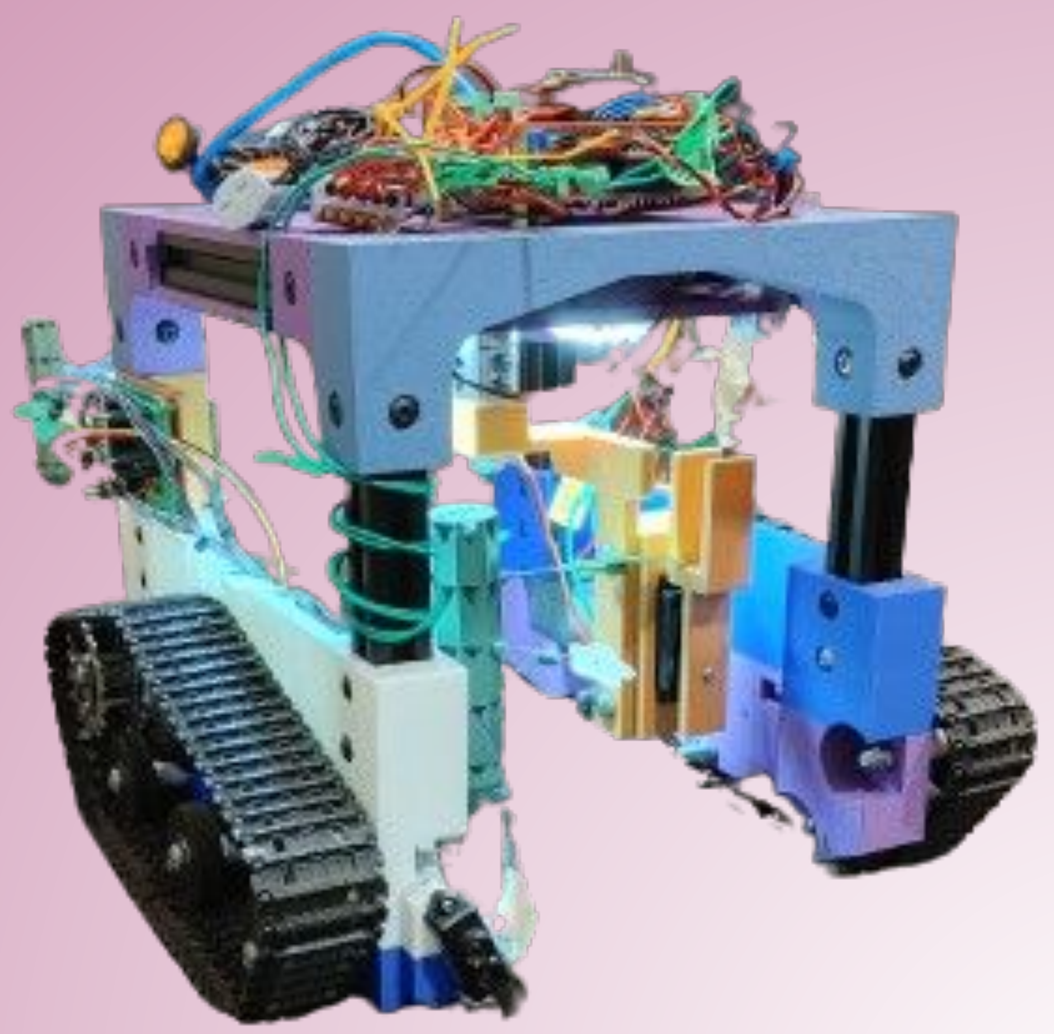
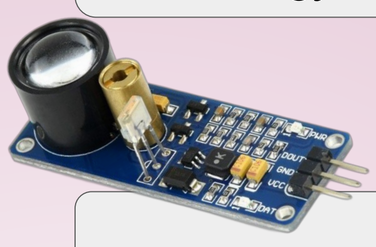


Overview

Berry Examination and leaf Removal Robot (BERR-E) is an autonomous robotic system specifically designed for the leaf characterization and trimming of strawberry plants. BERR-E integrates several subsystems, including a navigation system, sensing system, and trimming system. BERR-E demonstrates the application of robotics in the context of agriculture, contributing to advancements in automated precision agriculture technology.

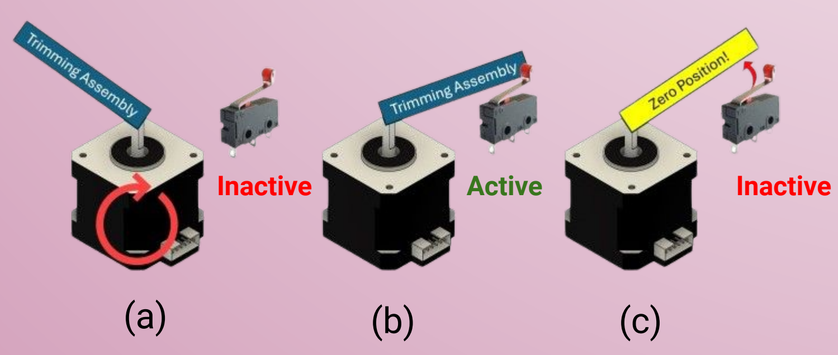


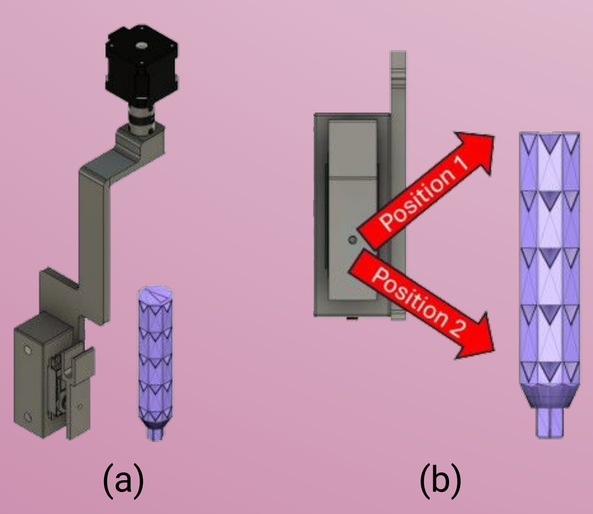
Navigation & Locomotion

Navigation of BERR-E is coupled with locomotion via the centralized sensor system. The robot is equipped with a laser sensor and three LiDAR sensors to determine its position from the boundaries of the playing field and its own orientation. Locomotion of BERR-E is driven by two high torque DC motors with gearboxes, allowing the robot to reliably traverse the peat moss course.

Trimming

The trimming subsystem has been designed to remove any unhealthy leaves that were identified by the onboard camera, and operates via a combination of a stepper and servo motor. The position of both motors are known via a homing function using limit switches, allowing for the trimming assembly to be precisely positioned about the stalk. Once the stepper motor is in position, then the trimming arm connected to the servo then actuates an arm to remove the unhealthy leaves and undesired flowers.





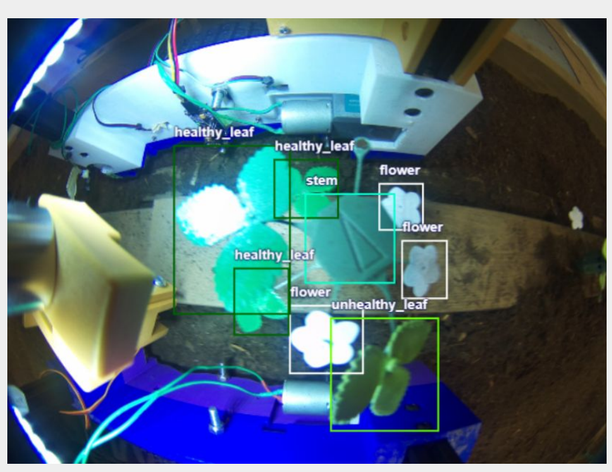
Follow the path

1. From the initial position, align with the strawberry row
2. Travel down the course and stop when a stalk is detected to image and harvest the plant
3. Two 90 turns from the first to the second strawberry row
4. Travel down the second row and continue harvesting
5. Return to the final position

Robot Vision

Image Processing → YOLO Object Detection → Mapping

To achieve accurate and efficient plant organ detection, we trained a YOLOv5 model specifically for the task of identifying healthy and unhealthy leaves of strawberry plants. A lightweight variant of the YOLO model, optimized for low-power devices is implemented.



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