

Developing a Proof of Concept for an Autonomous Runner Cutter in Strawberry Production in Plasticulture

Daeun Choi

Summary

This project evaluated an AI-guided robotic system designed to automatically detect and cut strawberry runners to reduce labor needs in strawberry production. The prototype combined a compact robotic arm, an RGB-D depth camera, and deep-learning software trained to identify runner positions and guide precise cutting motions. Laboratory trials using greenhouse-grown strawberry plants showed that the depth-imaging system successfully cut about 50% of runners. Each cutting cycle required roughly 7 seconds, including image processing and cutting mechanism. The system consistently avoided crop damage and demonstrated strong potential for safe, repeatable, and efficient operation.

Background

Runner management is one of the most repetitive and labor-intensive tasks in strawberry production. Runners divert plant resources from fruit development, reducing yield and quality if left unmanaged. Traditionally, workers remove runners by hand, a process that can require hundreds of labor hours per acre each season. As labor availability continues to decline, there is growing interest in automation to perform delicate, plant-specific operations such as pruning and runner cutting. An AI-guided robotic prototype capable of identifying and cutting strawberry runners automatically was developed using a low-cost depth-imaging camera and a small robotic arm. This project evaluated the feasibility and performance of this prototype as a foundation for future field-deployable automation.

Methods

The prototype consisted of three modules: (1) a vision module with an RGB-D stereo camera that captures both color and depth data, (2) a cutting module, and (3) a 4-degree-of-freedom robotic arm fitted with dual utility blades. A control module powered by an edge computer, which runs the AI model and coordinates the arm's motion.

The AI model (YOLOv8x-seg) was deployed to detect strawberry runners in real time from RGB images. Depth information from the same camera was used to estimate each detected runner's 3D position relative to the planting surface, providing height and location data for robotic targeting. The control system then commanded the robotic arm to move to the identified coordinates and execute a precise cutting motion using the dual-blade end-effector.

All experiments were conducted under controlled laboratory conditions using greenhouse-grown strawberry plants that represented realistic canopy geometries and runner orientations. The setup ensured consistent lighting and background conditions while allowing evaluation of detection reliability, height estimation, and mechanical precision prior to field deployment.

Results

The AI-guided robotic system performed reliably under controlled conditions and successfully demonstrated the feasibility of automated runner cutting using depth imaging (Figure 1). Across all trials, the system achieved approximately 50% successful cuts, with each cutting cycle requiring about seven seconds from image capture to blade

movement (Figure 2). The image processing and inference steps averaged three seconds per frame, while the robotic actuation and cutting phase took approximately four seconds. The study demonstrated that depth imaging provides a practical balance between accuracy, speed, and computational efficiency for automated strawberry runner cutting.

These findings suggest that depth-based AI perception can serve as an effective sensing backbone for field-deployable strawberry management robots. Although additional improvements are necessary to enhance generalization under variable field lighting and canopy conditions, the present results establish a strong foundation for scalable and low-cost automation. Future development will focus on integrating the depth-imaging system onto a mobile unmanned ground vehicle (UGV) platform to evaluate performance under natural lighting and outdoor environmental conditions.



Figure 1. The setup of the AI-guided runner-cutting system in a controlled greenhouse environment. The upper image shows the robotic arm positioned beside strawberry rows, and the lower image displays the RGB camera's detection view with bounding boxes identifying runners and their confidence scores.



Figure 2. Laboratory demonstration of the robotic runner-cutting mechanism. The upper image shows the robotic arm aligning toward a detected runner on a potted strawberry plant, while the lower image presents a close-up of the dual-blade assembly during the cutting operation.

Takeaways

- The developed AI-guided runner-cutting system successfully demonstrated the integration of deep learning-based perception with a robotic manipulator for precision runner management in strawberries.
- Depth imaging enabled acceptable height estimation and efficient cutting, achieving precise blade alignment without plant damage.
- These results highlight the feasibility of depth-assisted robotic actuation for automating repetitive horticultural tasks, laying the groundwork for future field-scale deployment and UGV integration.
- This summary is based on ongoing research conducted at the UF/IFAS Gulf Coast Research and Education Center and will be submitted for peer-reviewed publication.

Contact

Dr. Daeun “Dana” Choi
UF/IFAS Gulf Coast Research and Education Center
P: 813-419-6591
E: dana.choi@ufl.edu