Abhishek R. Angelo P. and Sithindu S. | December 8, 2025

Autonomous Crop Harvesting

Robotic system for autonomous blackberry harvesting, integrating object detection, kinematics, and manipulation to improve efficiency and support sustainable farming"

Content overview

Berry harvesting is labor-intensive and time-consuming

Up to 40% of food wasted in U.S. due to ripening issues

Vision + robotics enables selective harvesting can reduce labor cost and improve quality

Project Overview

Harvest your food without lifting a finger!

Complete perception-to-action pipeline

Detect ripe berries → Compute position → Pick and place

Application-oriented prototype for real-world agriculture

Doesn’t this already exist?

We wish! But no.

01
Scope often too narrow

Prior work focuses on detection or ripeness classification only

02
No full-stack integration

Few integrate full robotic picking pipeline

03
Overcomplicated

Blackberries rarely addressed using simple RGB setups

04
So expensive!!!

Cost-prohibitive systems block out small-scale farmers

Method & Architecture

Our pipeline uses battle-tested, openly available technology.

Camera-based berry recognition

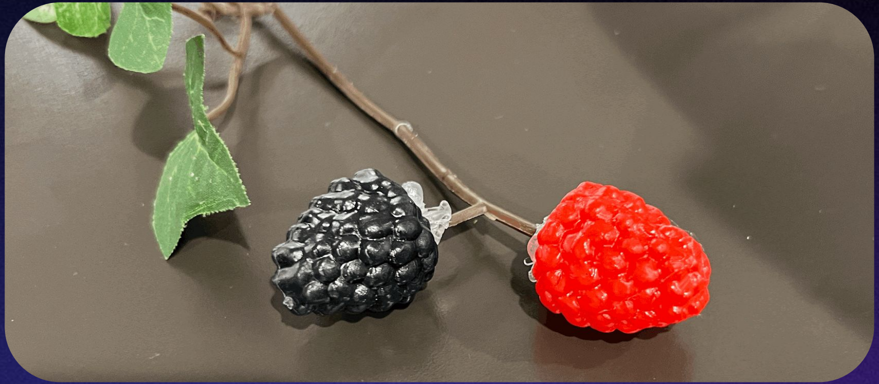
We use YOLO v8, an open source object recognition model, to locate berries and gauge ripeness.

2D → 3D Mapping

A single camera is used to estimate a berry's spatial position, avoiding complexity and processing power requirements.

Open-source robot and software

Our system relies on the communities that power the SO-101 robot and the ROS2 software, allowing us to bring this system to the end user without subscriptions or expensive hardware..



Yummy plastic

Rubber blackberries are loosely attached to artificial plant matter to simulate real-world conditions. As blackberries ripen, they turn from red to black, meaning our system must differentiate ready-to-pick from unripe berries.

Perception

Yolo V8 - RGB Camera

Trained a custom model on annotated berry dataset

Images with Labels : 545

Total Bounding Boxes: 17774

Classes	Labels Count
0.Ripe	2682
1.Ripening	3977
2.Unripe	7196
3.Sepal	3919

Detection Results

Key Challenges:

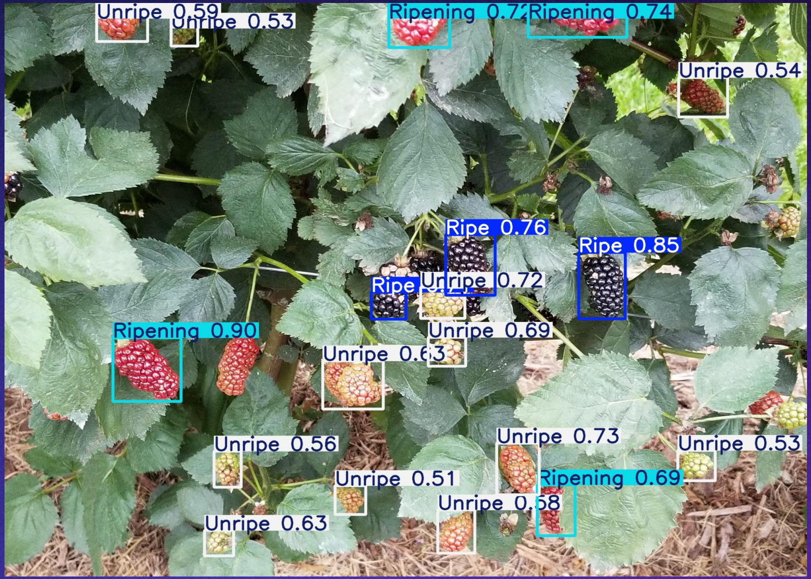
Presence of many small berries → harder detection

Smaller boxes → more sensitive to blur & lighting → Performed data augmentation

Before

After

conf > 0.50



Next Steps

We have lots of room to develop our system into a more capable and valuable product. Here are some of the potential avenues for growth.

01

Further and more varied full-stack testing

Although we have test data for each of the components of the system, in the future we can put together a comprehensive and varied set of scenarios to benchmark the performance of our system as a whole.

02

Larger and more mobile robots

We can explore adding wheels and/or making the arm longer so that the robot can act on berries that are out of its current reach.

03

More types of fruits and vegetables

Our product currently focuses on blueberries, but there are many kinds of garden crops that would benefit from this technology, like other berries, greens, or even fruit trees.

Thank you!