



CHIP TO CROP

24 HOURS AGRITECH HACKATHON



Problem Statement Title - AgroGrade: AI-Powered Fruit Sorting

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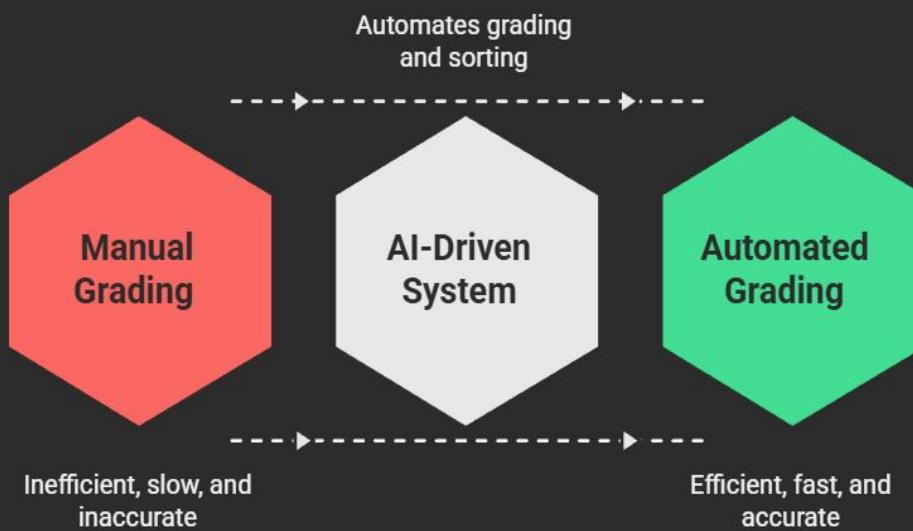


PROPOSED SOLUTION



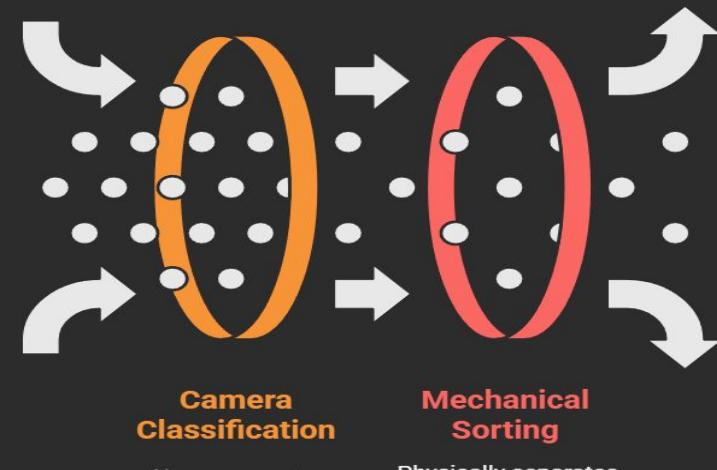
Our Solution: Project AgroGrade

Automating Grading with AgroGrade



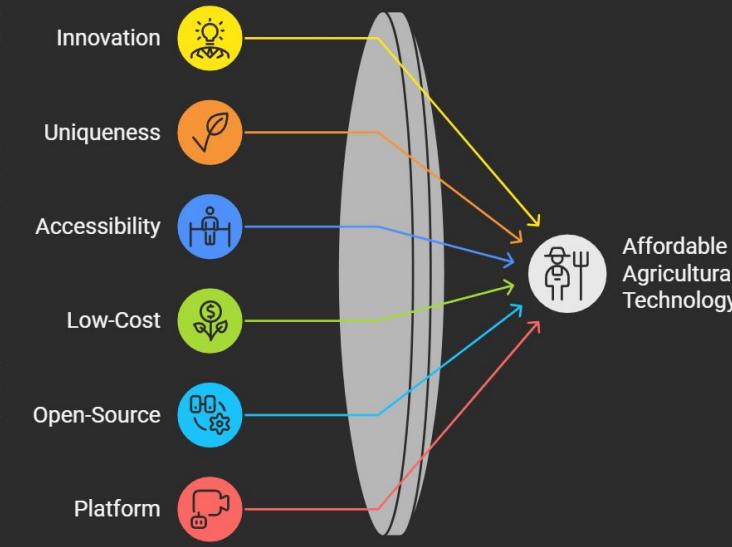
How it Addresses the Problem:

Automated Fruit Sorting Process



Innovation and Uniqueness:

Building Blocks of Affordable Agriculture



- **AgroGrade is an AI-driven system that fully automates the grading and sorting process, designed specifically for small-scale farms.**

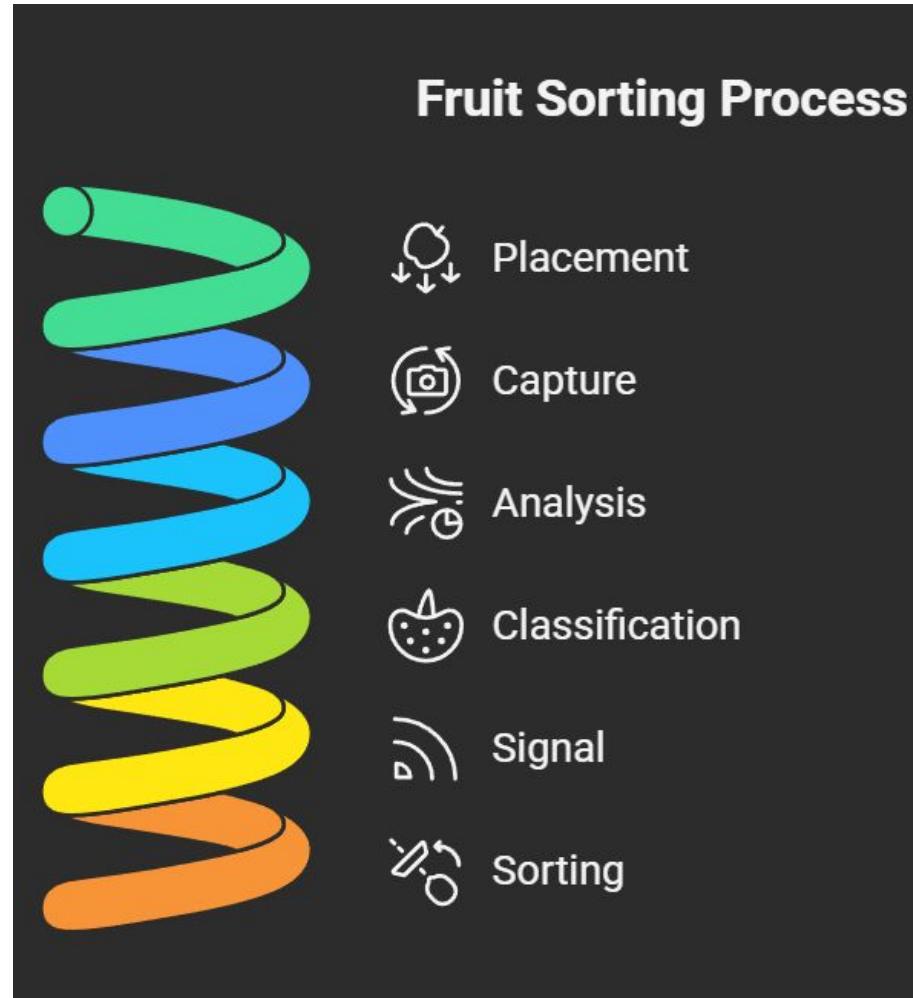
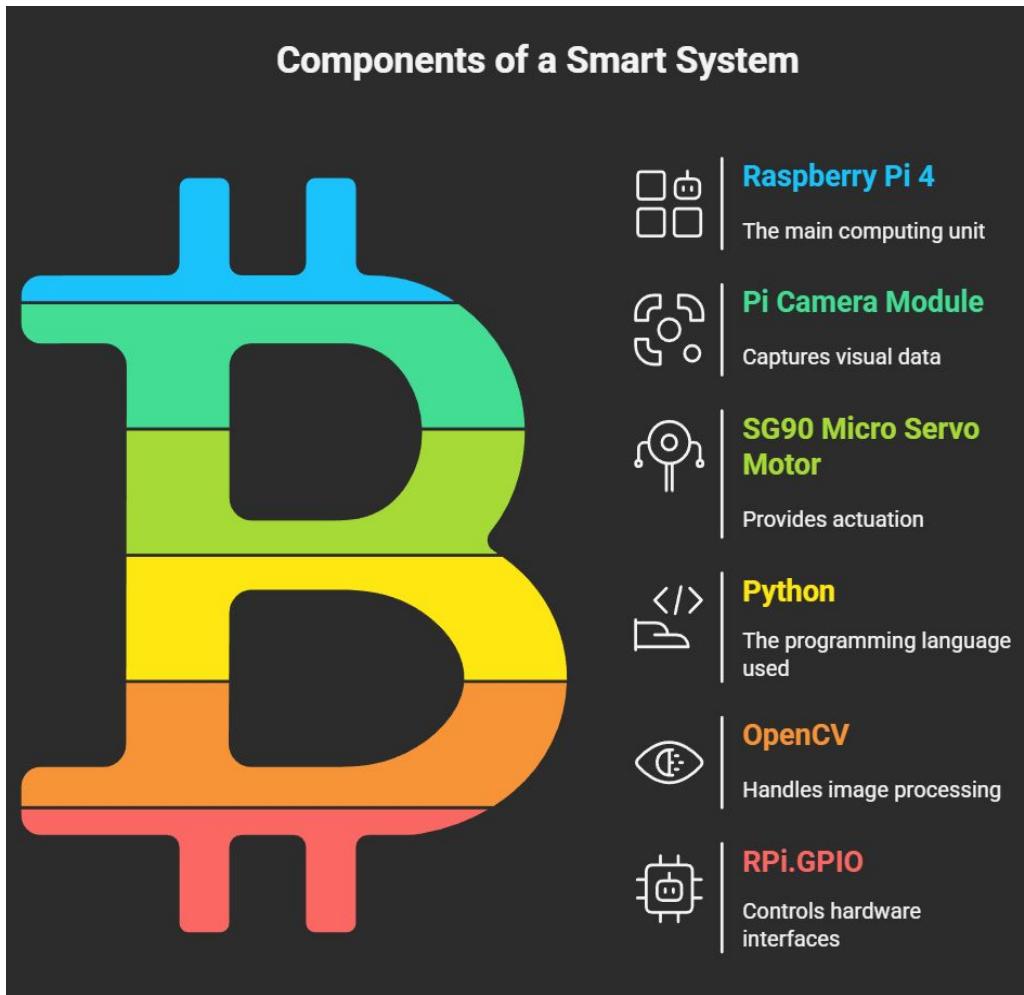
- It uses a camera with computer vision to instantly classify fruit based on its ripeness and color.
- A software-controlled mechanical gate then physically sorts the fruit into different grades.
- This process ensures uniform quality, significantly cuts down on sorting time, and removes the need for intensive manual labor.

- Our system is built on an accessible, low-cost, open-source platform (Raspberry Pi and OpenCV) **Making advanced agricultural technology affordable for all farmers.**

TECHNICAL APPROACH

Technologies Used:

- **Hardware:** Raspberry Pi 4 (Compute), Pi Camera Module (Vision), SG90 Micro Servo Motor (Actuation).
- **Software:** Python (Programming Language), OpenCV (Image Processing), RPi.GPIO (Hardware Control).



Implementation Methodology (Process Flow):

1. **Placement:** Fruit is placed on the inspection ramp.
2. **Capture:** The camera takes an image of the fruit.
3. **Analysis:** An OpenCV script analyzes the image for color thresholds.
4. **Classification:** The system classifies the fruit as "Ripe" or "Unripe".
5. **Signal:** The Raspberry Pi signals the servo motor.
6. **Sorting:** The servo gate directs the fruit into the correct bin.



3D MODEL & PROTOTYPE



AgroGrade Team Maverick

- Dashboard
- Analytics
- AI Advisor
- Settings

Dashboard Overview

Total Sorted: 10,250 from current session

Ripe: 9,840 from current session

Unripe: 410 from current session

Ripe vs. Unripe Distribution
Daily summary for the last week.

Fruits Sorted Per Hour
Throughput for the current sorting session.

Live Feed
Real-time stream of classified produce from the sorter.

Classification Produce Time

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Image Analysis Advisor

AI Advisor
Get insights on sorting errors from our AI analysis tool.

Single Image Analysis Live Feed Analysis Comparison Tool Image Generation Data Collection

Comparison Tool
Upload two Images of the same produce type to compare their quality and grading.

Produce Type: Banana

Image A:  shutterstock.com - 1734683099

Image B: 

Compare Images

Comparison Result

Classification: Image A is classified as Unripe. Image B is classified as Ripe.
Color: Image A displays a uniform light green color across all bananas, indicating immaturity. Image B shows a vibrant, uniform bright yellow color, characteristic of ripeness.
Size & Shape: Both images show bananas of comparable standard size and shape, exhibiting the typical curved form without noticeable deformities.
Blemishes & Defects: Neither image shows any significant blemishes, bruises, spots, or other defects. Both bunches appear to be in good condition.
Ripeness Indicators: The primary ripeness indicator in Image A is its distinct green hue, signifying that the bananas are not yet ready for consumption. In contrast, the bright yellow color of the bananas in Image B clearly indicates that they have reached optimal ripeness and are ready to eat.

AgroGrade Team Maverick

- Dashboard
- Analytics
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Historical Analytics

Historical Data
Review and filter past sorting sessions.

Filters

Date Range: Aug 15, 2025 - Sep 14, 2025 Machine ID: All Machines Min Error Rate (%): 0

Sort Sessions
Displaying 5 of 5 sessions.

Session ID	Machine ID	Date	Total Sorted	Ripe	Unripe	Error Rate
SESSION-001	AG-001	Sep 13, 2025	10,250	9,840	410	4.00%
SESSION-002	AG-002	Sep 12, 2025	15,300	14,535	765	5.00%
SESSION-003	AG-001	Sep 11, 2025	8,900	8,010	890	10.00%
SESSION-004	AG-002	Sep 10, 2025	11,200	10,976	224	2.00%
SESSION-005	AG-001	Sep 9, 2025	13,450	12,000	1,450	10.70%

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Single Image Analysis Live Feed Analysis Comparison

AI Image Generation
Describe the produce you want to see, and the AI will generate an image. For example, "a Grade B tomato with blossom end rot" or "an overripe banana with brown spots".

Image Description
e.g., A ripe tomato with a small crack near the stem

Generate Image

Image Analysis Advisor

AI Advisor
Get insights on sorting errors from our AI analysis tool.

Single Image Analysis Live Feed Analysis Comparison Tool Image Generation Data Collection

Data Collection & Labeling
Upload an image to get an AI-suggested label. Review, correct if needed, and save it to build your training dataset.

Produce Image:  shutterstock.com - 1734683099

Get AI Suggestion

Verify & Save Label
Correct the AI's suggestion if needed, then save the data point.

Produce Type: Banana
Quality / Ripeness: Unripe

Confirm and Save

3D MODEL & PROTOTYPE

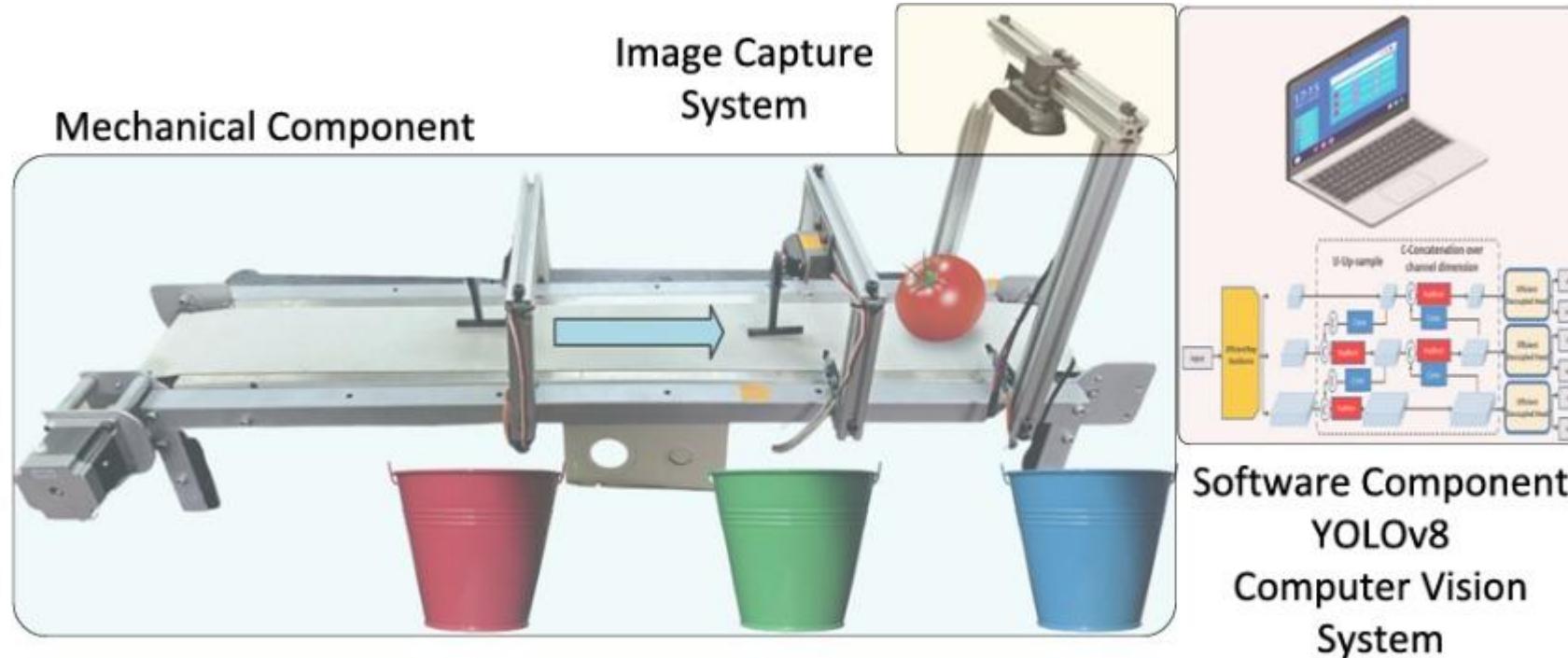


Fig. 1. Prototype for tomato sorting. The machine includes a conveyor belt, camera, proximity sensors, and servo-controlled gates for automated classification based on colour and size.

3D MODEL & PROTOTYPE

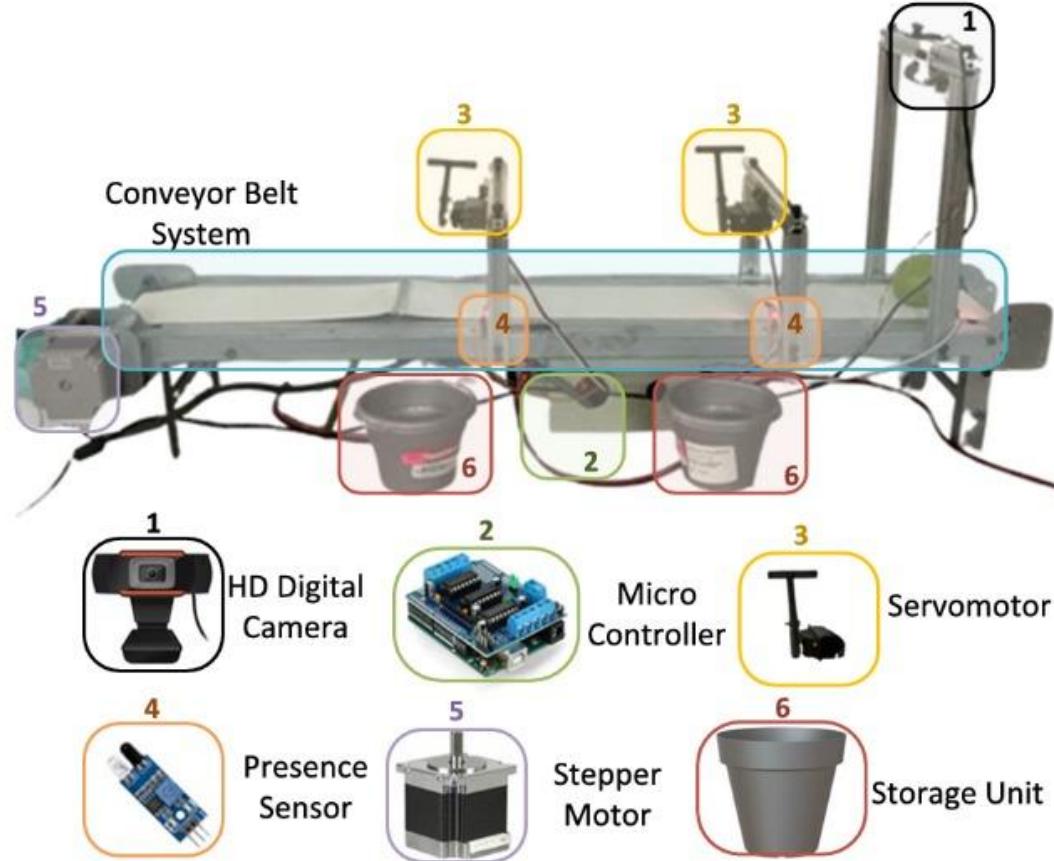


Fig. 2. Hardware components of the tomato sorting system. The image highlights the main physical elements, including the stepper motor, high-resolution camera, sensors, and sorting gates.



WORKFLOW

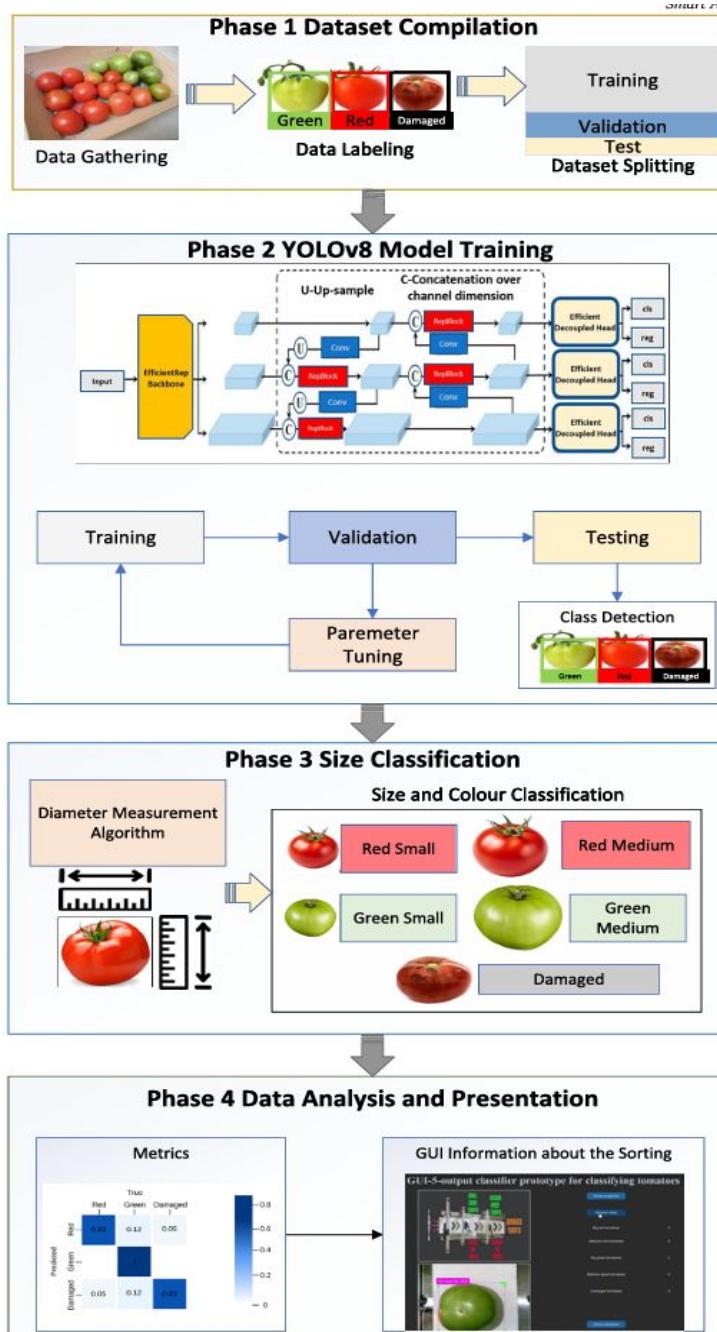


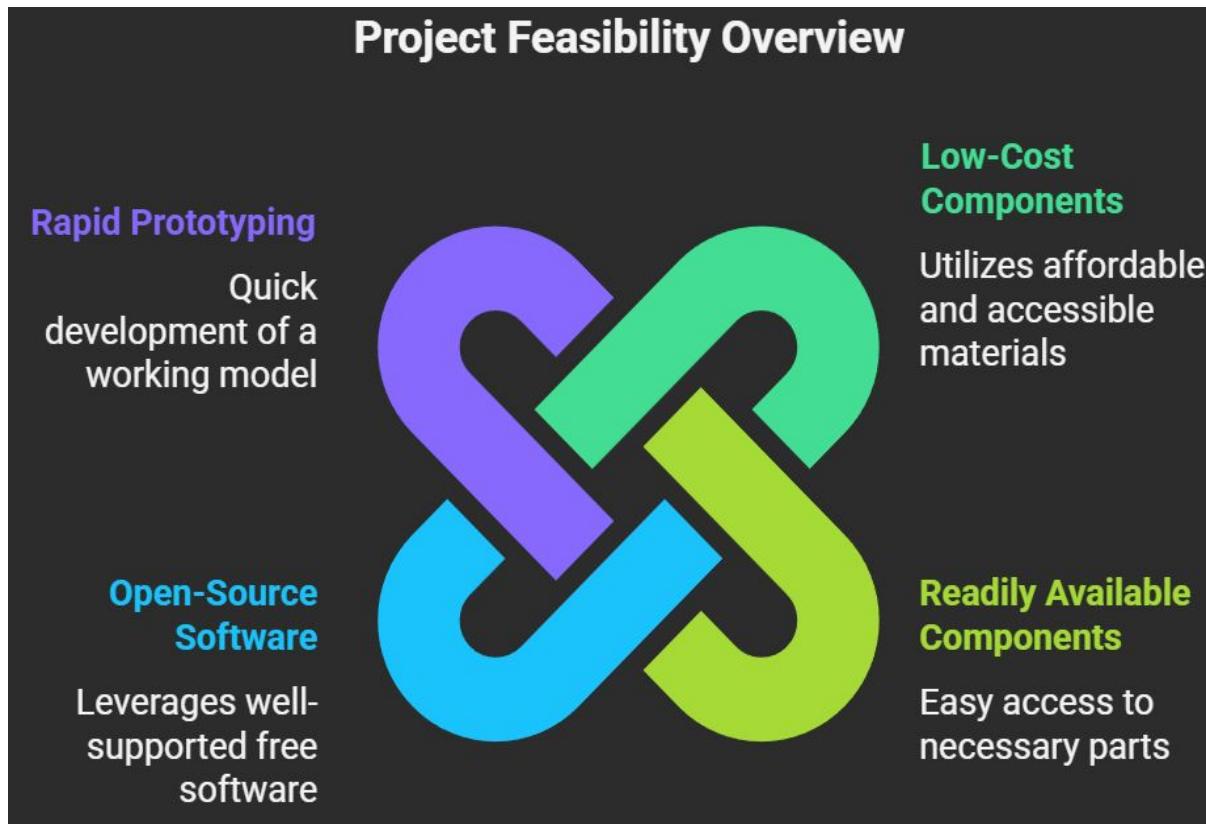
Fig. 3. Flow diagram of the intelligent tomato sorting system. The diagram shows the integration of YOLOv8-based detection and size estimation into the sorting decision logic.



Feasibility:

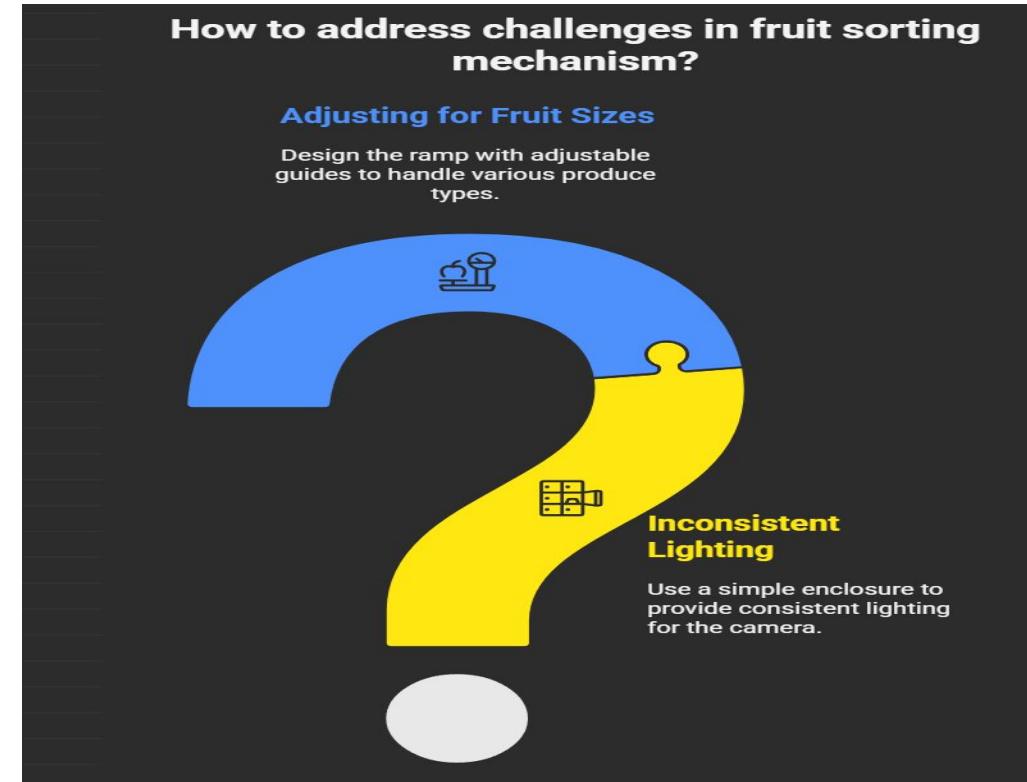
The project is highly feasible because it uses low-cost, readily available components and well-supported open-source software.

A working prototype can be built within 24 hours.



Potential Challenges & Solutions:

- Challenge:** Inconsistent lighting affecting color accuracy.
- Solution:** Use a simple enclosure to provide consistent lighting for the camera.
- Challenge:** The mechanism may need adjustments for different fruit sizes.
- Solution:** Design the ramp with adjustable guides to handle various produce types.



IMPACT AND BENEFITS



Potential Impact:

- Directly increases farmer income by reducing labor costs and ensuring better prices for consistently graded produce.

Initiative Boosts Farmer Income



Benefits of the Solution:

- **Economic:** Makes small farms more competitive and reduces post-harvest financial losses.
- **Social:** Frees up farm workers from tedious manual labor, allowing them to focus on more skilled tasks.
- **Environmental:** Reduces food waste by efficiently sorting produce for different market needs (e.g., immediate sale vs. transport).

Balancing Economic and Social Benefits in Agriculture



Relevant Academic Papers

- **For a comprehensive overview of the field:**
 - **Paper:** Bhargava, A., & Bansal, A. (2021). *Fruits and vegetables quality evaluation using computer vision: A review*. Journal of King Saud University - Computer and Information Sciences.
 - **Relevance:** This review paper provides a broad understanding of how computer vision is applied for quality evaluation in produce, validating the project's foundational approach.
- **For a specific implementation example:**
 - **Paper:** Cubero, S., Aleixos, N., Albert, F., & Blasco, J. (2011). *A new colour vision-based system for quality control of citrus fruits*. Journal of Food Engineering.
 - **Relevance:** This paper details a practical system for sorting fruit based on color, which is a core feature of the AgroGrade project.
- **For low-cost system design:**
 - **Paper:** Mohanty, A., Singh, V., & Kumar, D. (2020). *Design and development of a low-cost automated system for fruit grading and sorting using image processing*. International Journal of Engineering and Advanced Technology.
 - **Relevance:** This research focuses on creating an affordable sorting system, aligning directly with AgroGrade's goal of making technology accessible to small-scale farmers.

RESEARCH AND REFERENCES



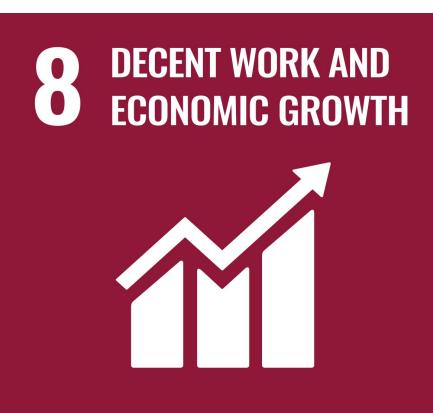
SDG 1: No Poverty



SDG 2: Zero Hunger



SDG 8: Decent Work and Economic Growth



SDG 9: Industry, Innovation, and Infrastructure



SDG 12: Responsible Consumption and Production

