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GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

CHIP TO CROP

24 HOURS AGRITECH HACKATHON

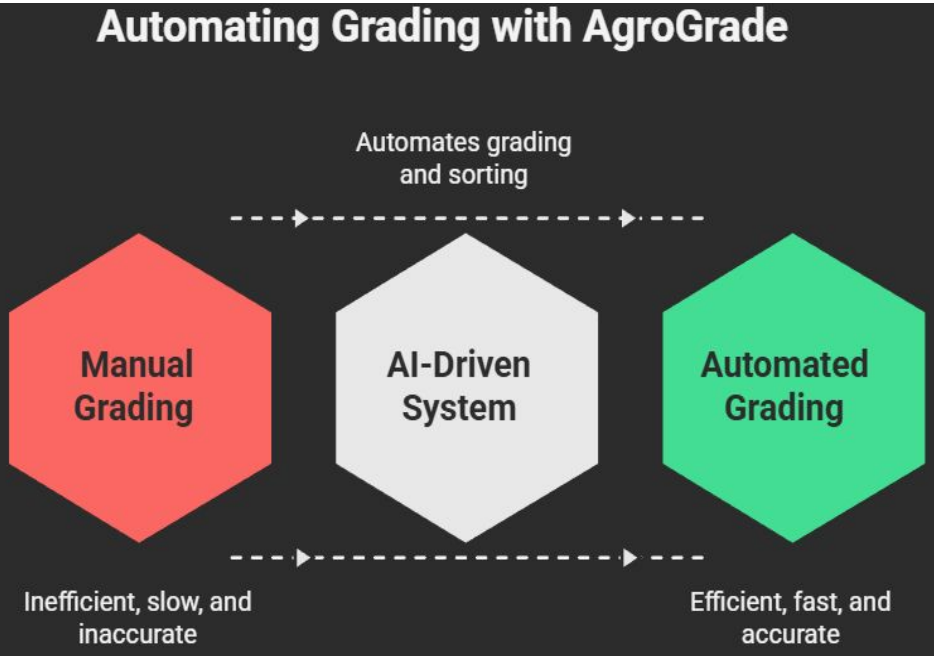
Problem Statement Title - AgroGrade: AI-Powered Fruit Sorting

Team Name - TECH MAVERICKS

FAIZAN AHMED - 20221CSE0021
PAVAN K - 20221CSE0294
HARSHA VARDHANA T - 20221CSE0224
SAYAN DAS - 20221CSG0042
PRASHANTH A - 20221CDV0028
POONACHA TC - 20231ECE0090

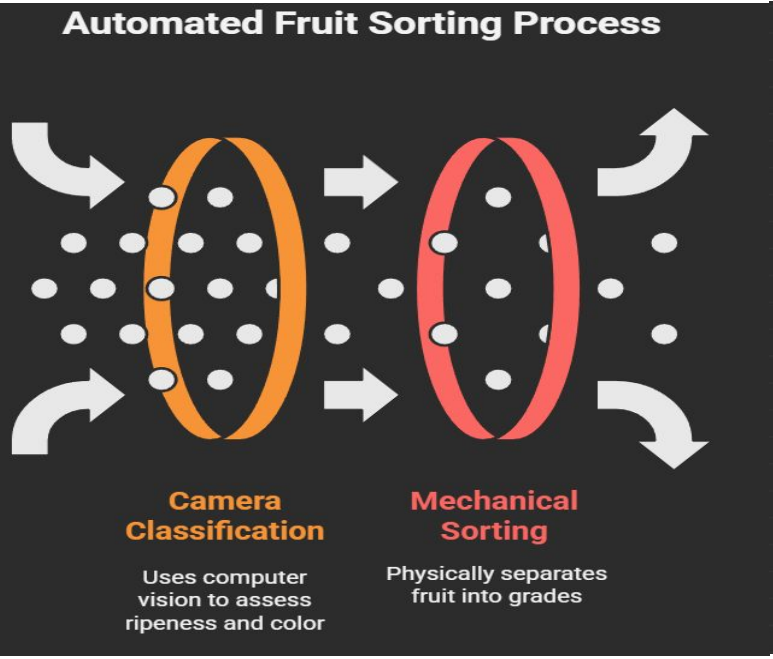
PROPOSED SOLUTION

Our Solution: Project AgroGrade



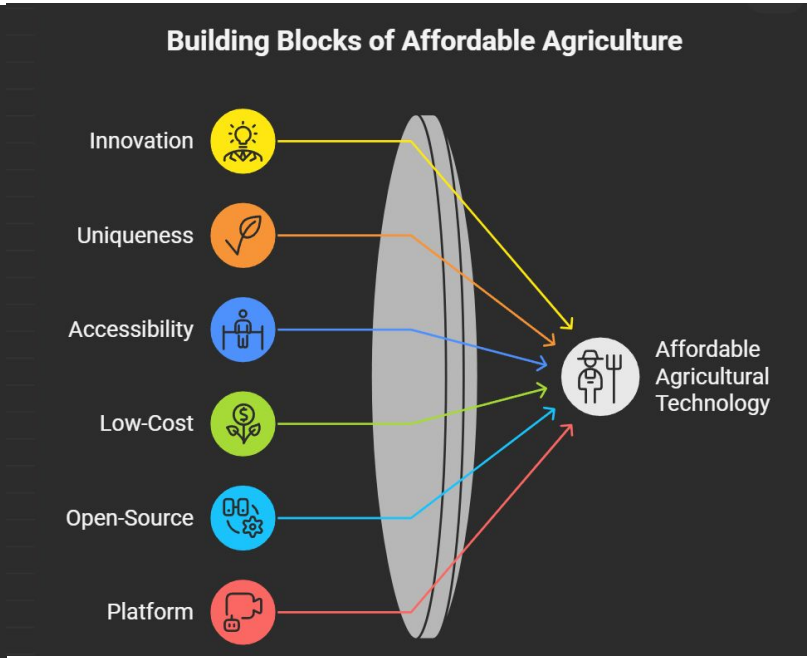
- **AgroGrade is an AI-driven system that fully automates the grading and sorting process, designed specifically for small-scale farms.**

How it Addresses the Problem:



- **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.**

Innovation and Uniqueness:



- **Our system is built on an accessible, low-cost, open-source platform (Raspberry Pi and OpenCV)**

Making advanced agricultural technology affordable for all farmers.

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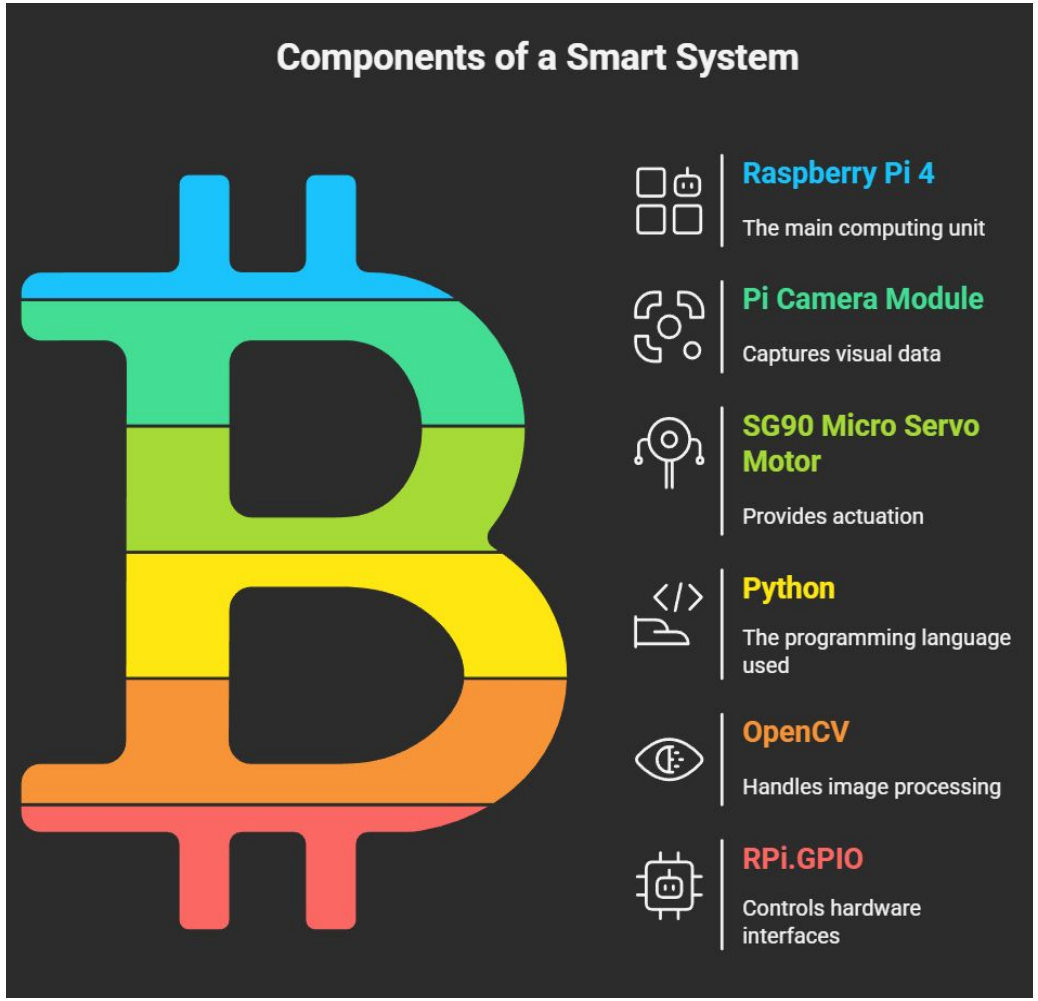
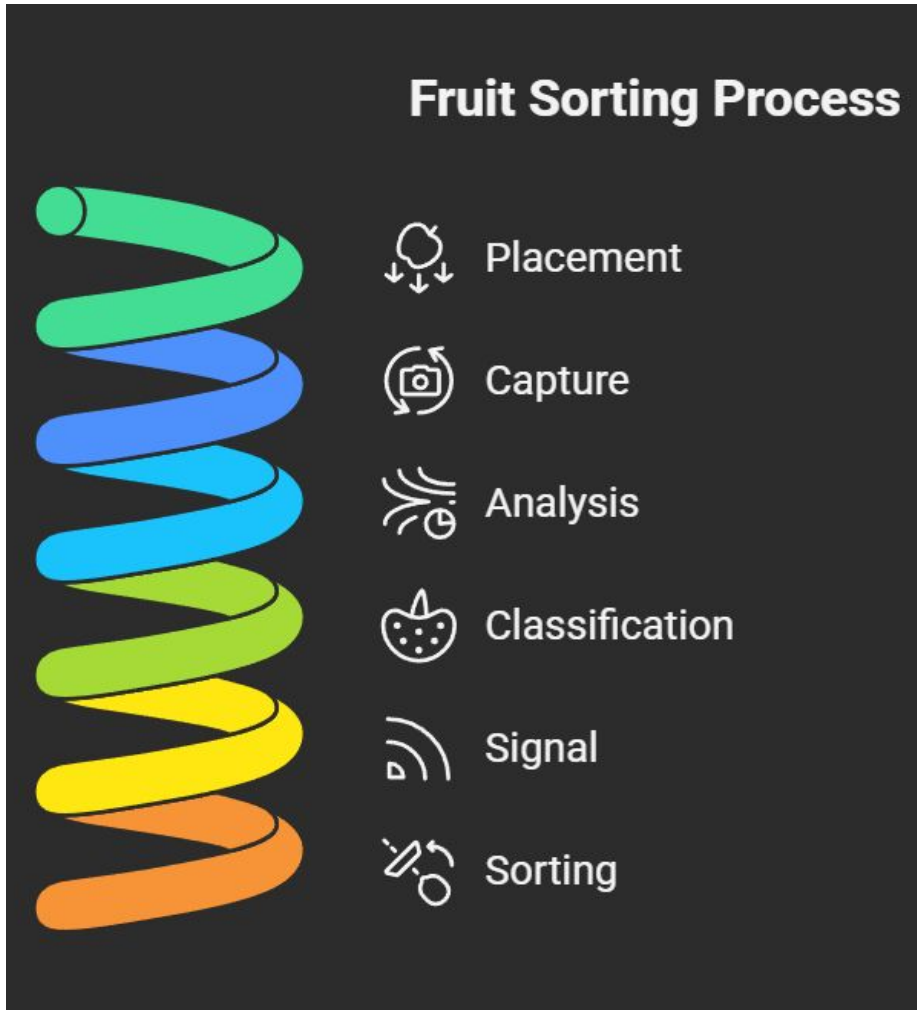
TECHNICAL APPROACH

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.

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3D MODEL & PROTOTYPE

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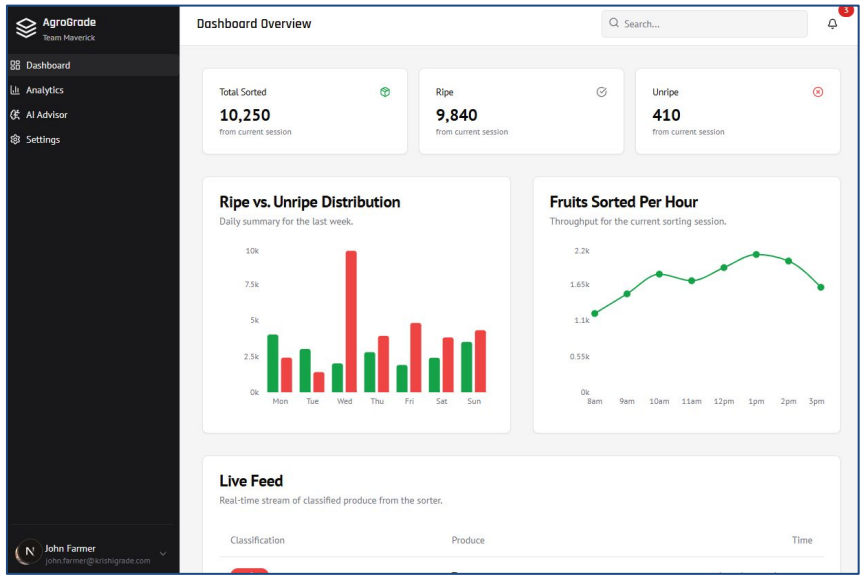

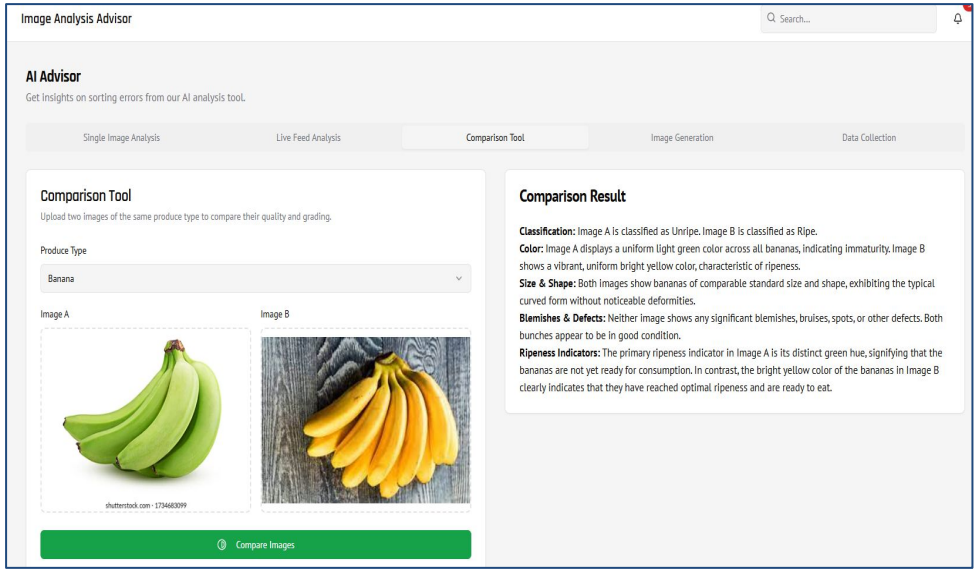

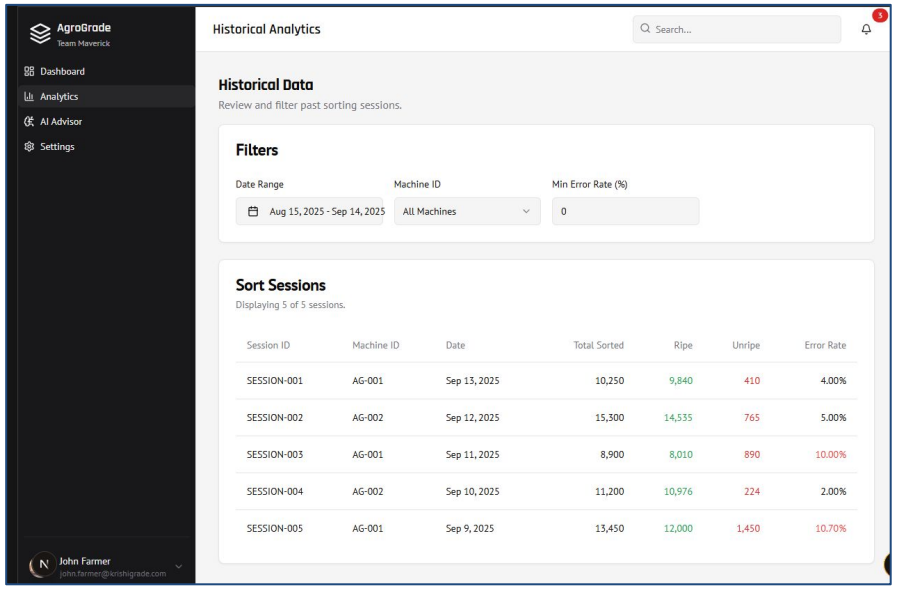

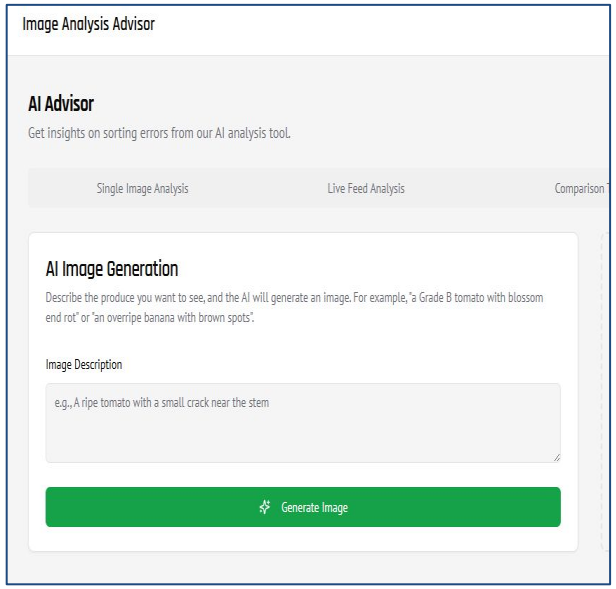

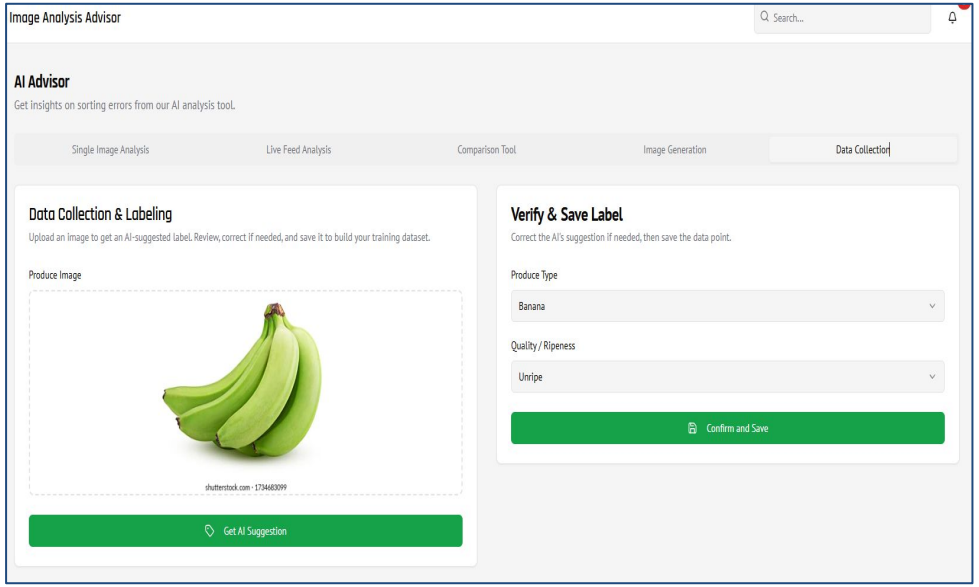

3D MODEL & PROTOTYPE

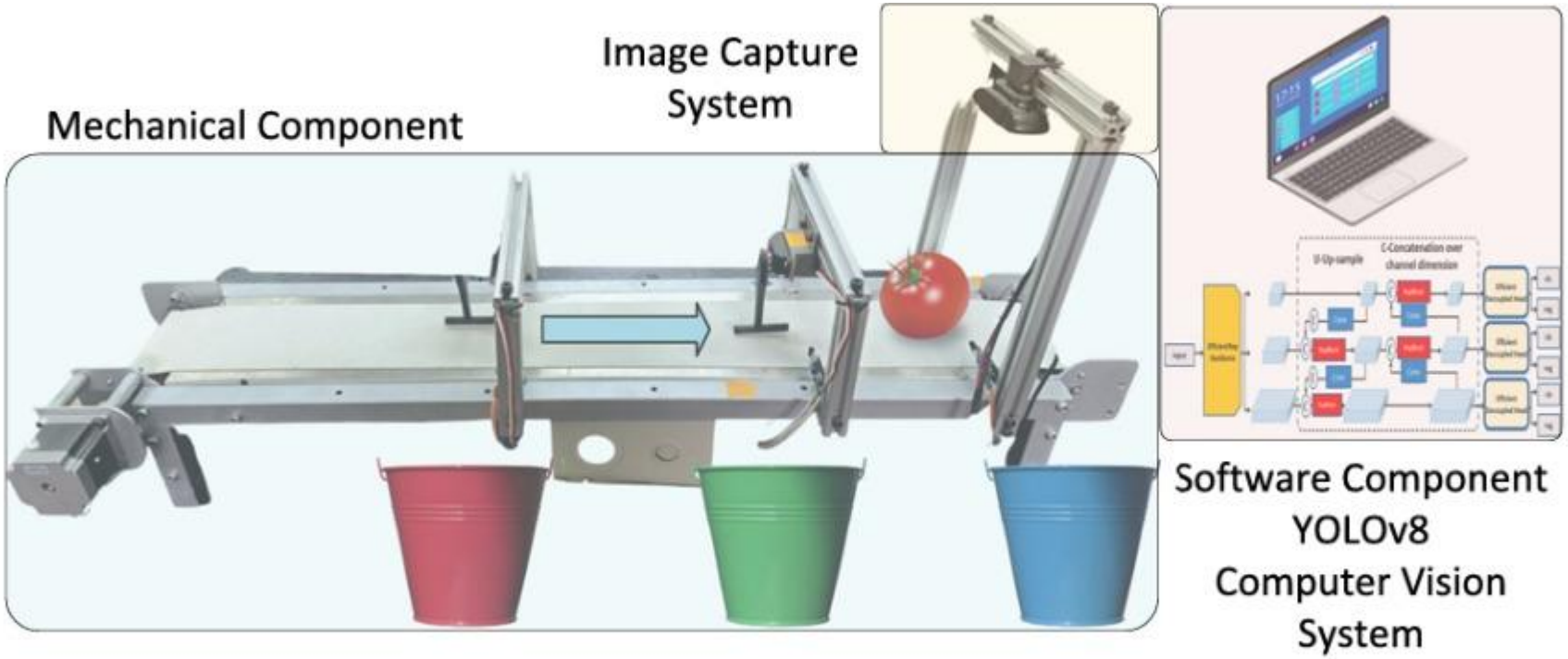

Fig. 1. Prototype for tomato sorting. The machine includes a conveyor belt, camera, proximity sensors, and servo-controlled gates for automated classification based on colour and size.

3D MODEL & PROTOTYPE

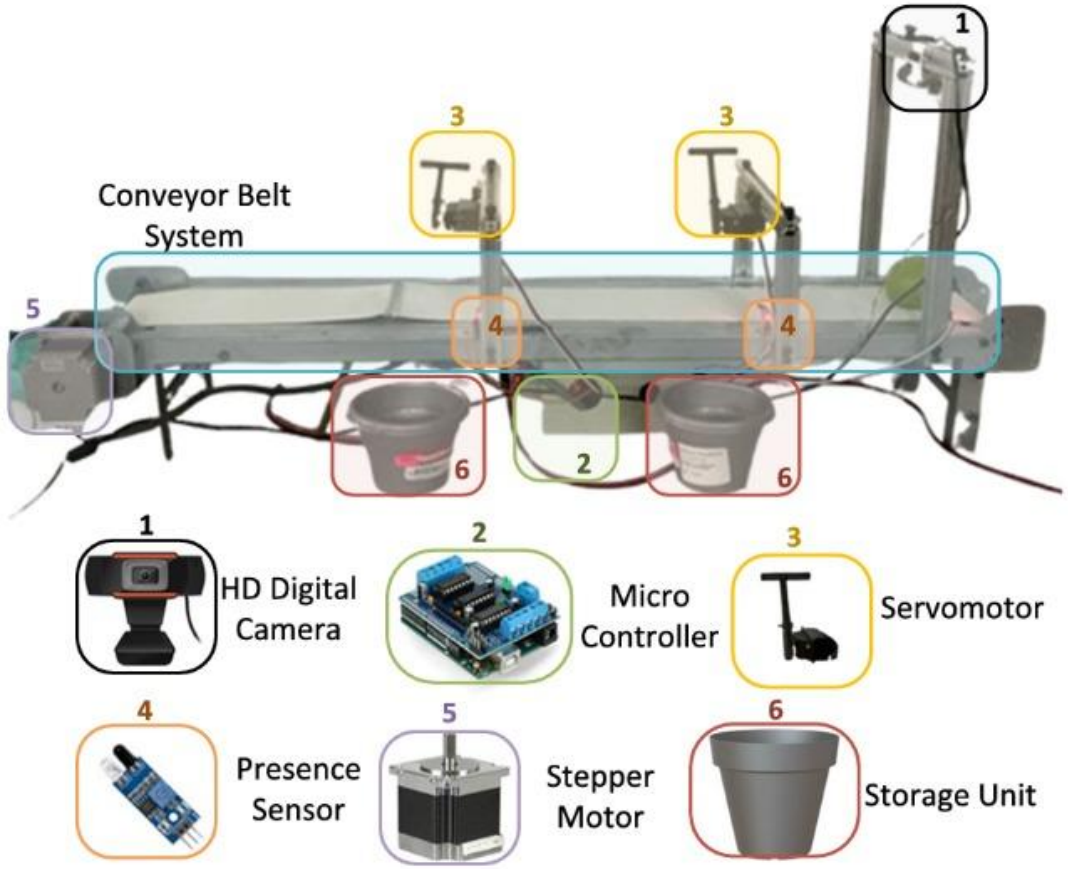

Fig. 2. Hardware components of the tomato sorting system. The image highlights the main physical elements, including the stepper motor, high-resolution camera, sensors, and sorting gates.

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WORKFLOW

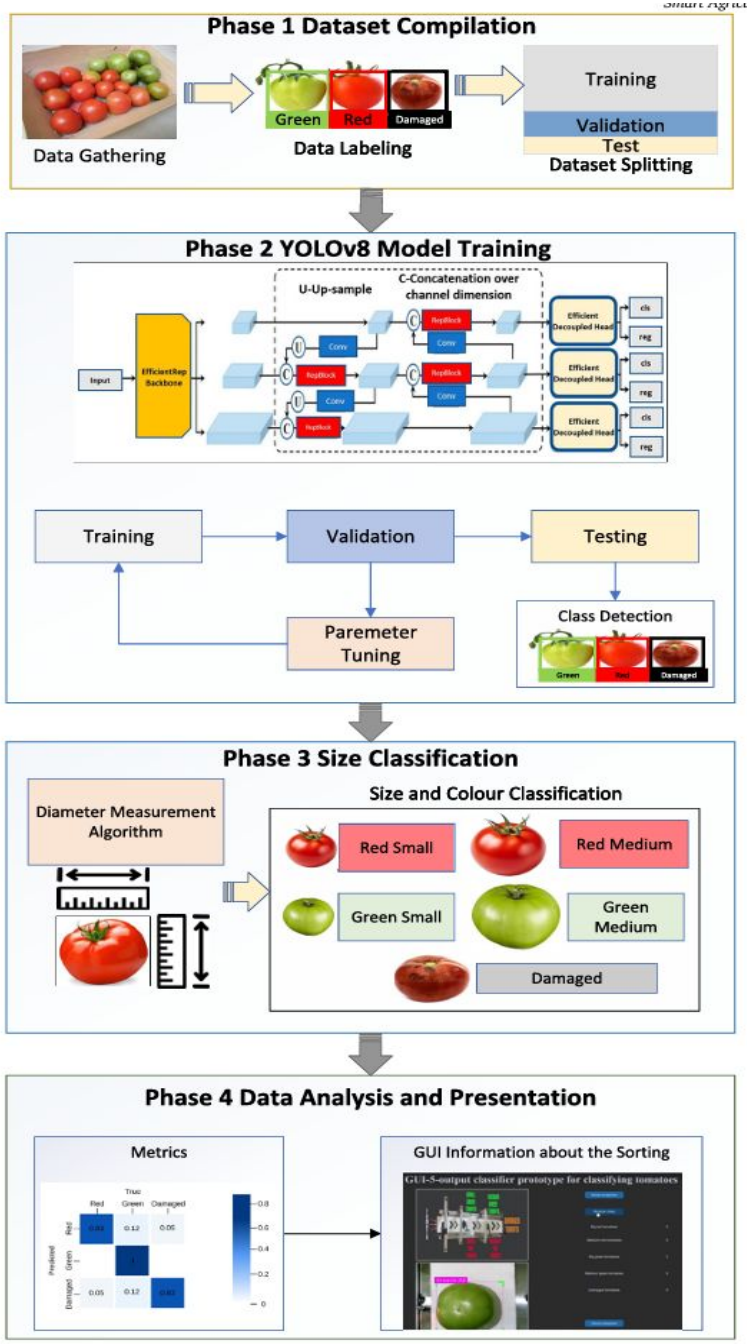
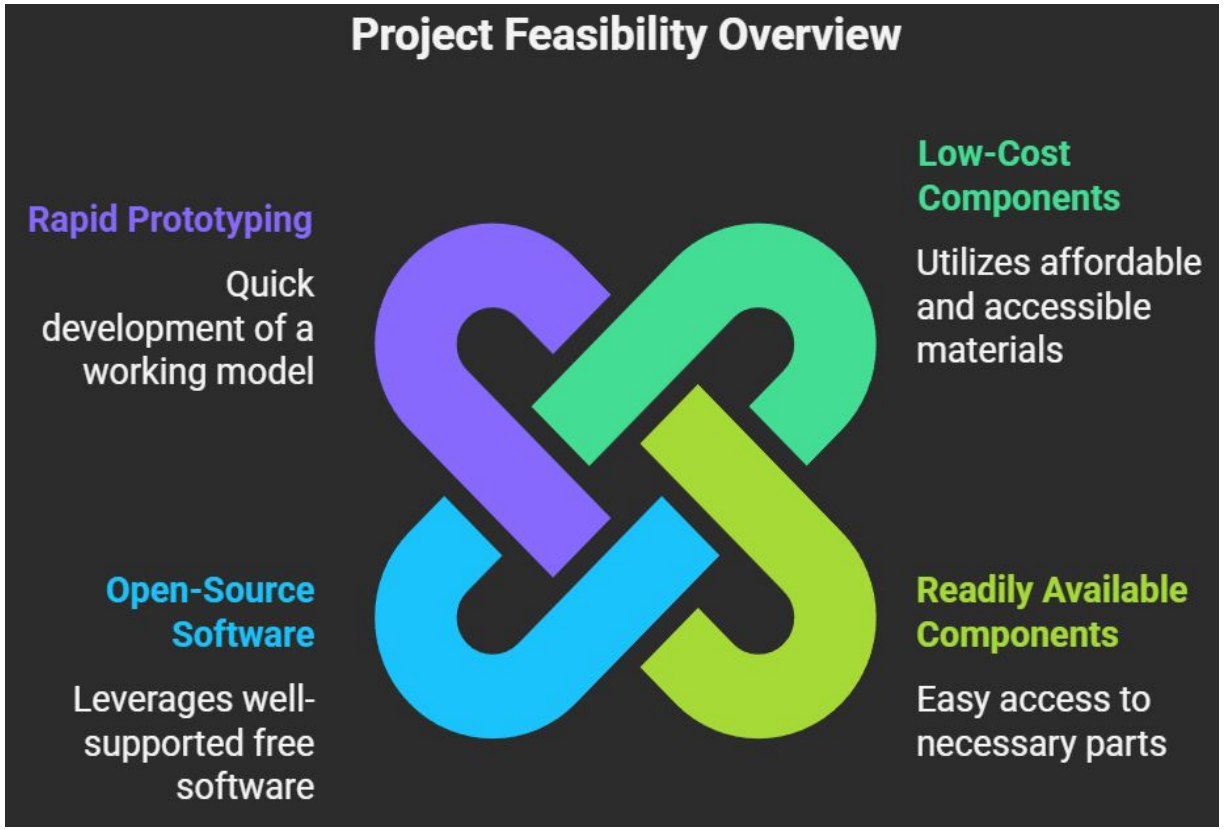


Fig. 3. Flow diagram of the intelligent tomato sorting system. The diagram shows the integration of YOLOv8-based detection and size estimation into the sorting decision logic.

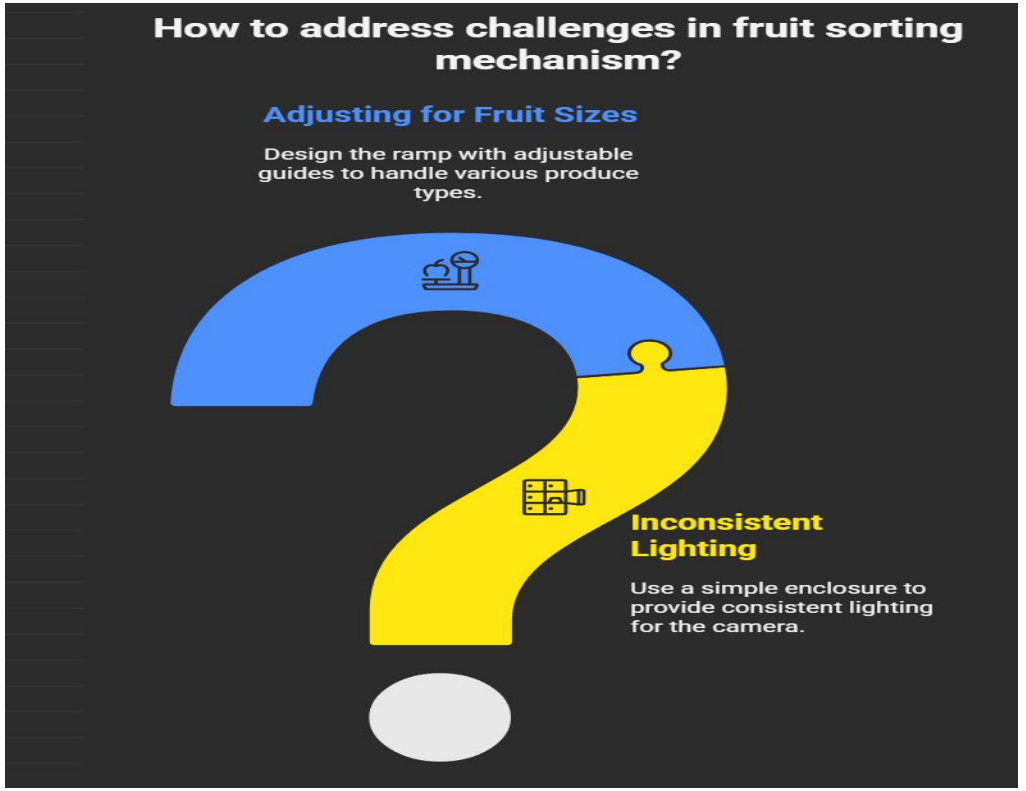
FEASIBILITY AND VIABILITY

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.



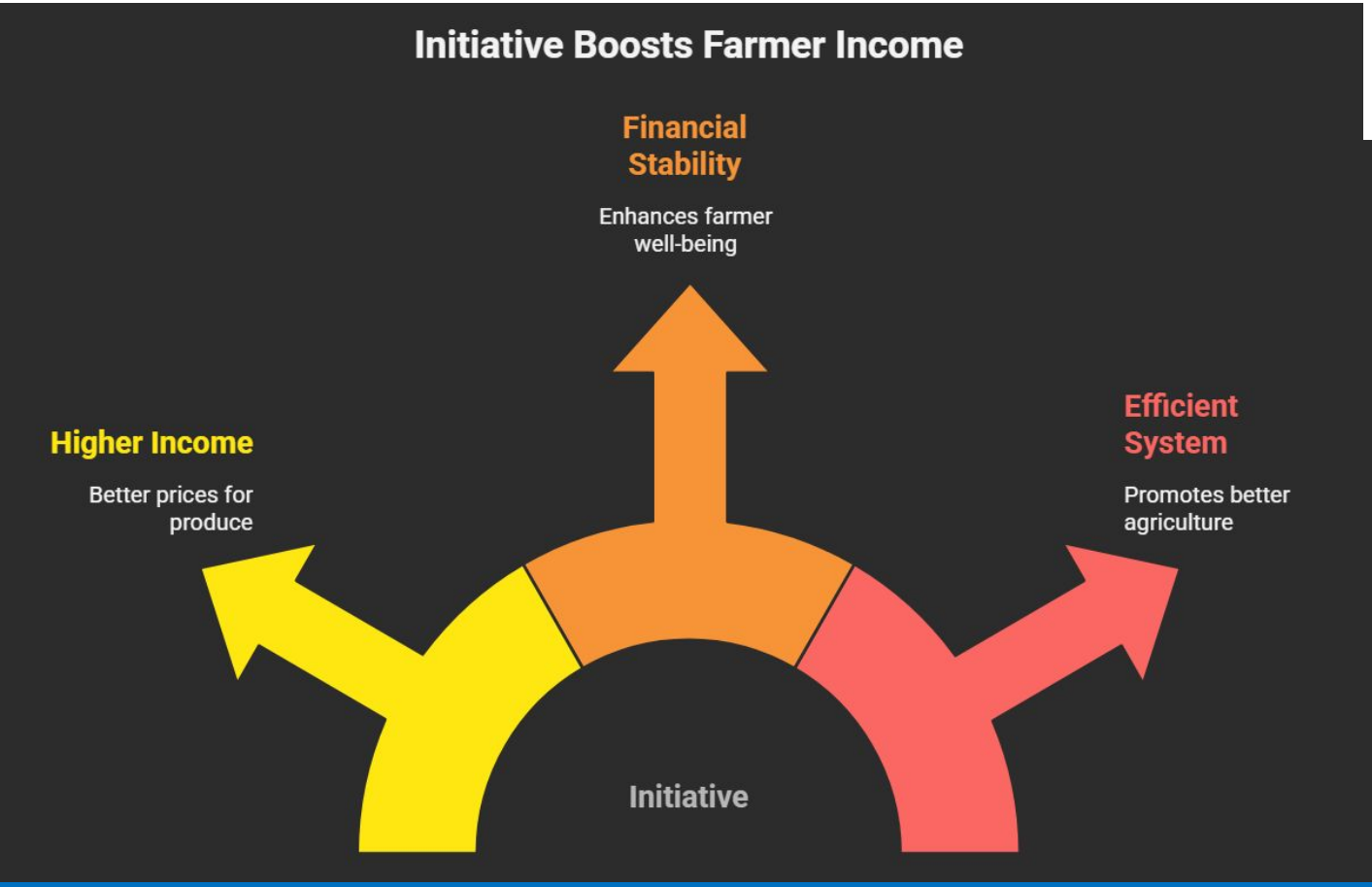
IMPACT AND BENEFITS

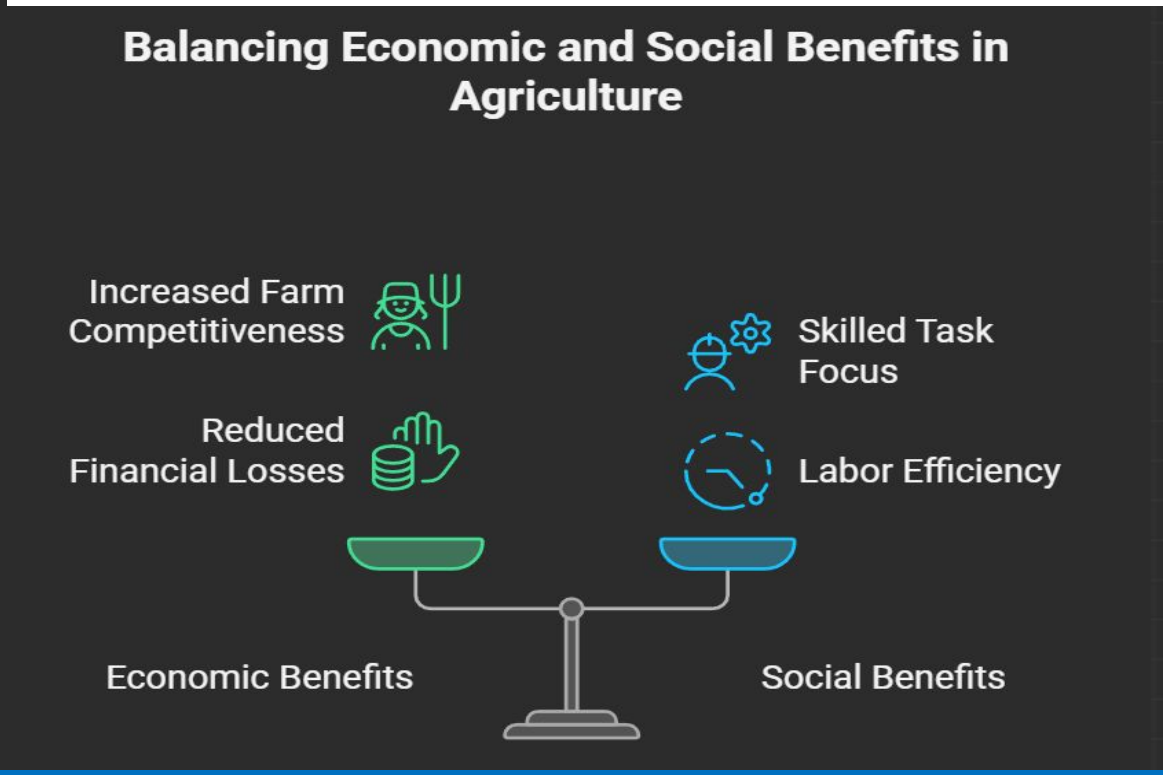
Potential Impact:

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

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).





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RESEARCH AND REFERENCES

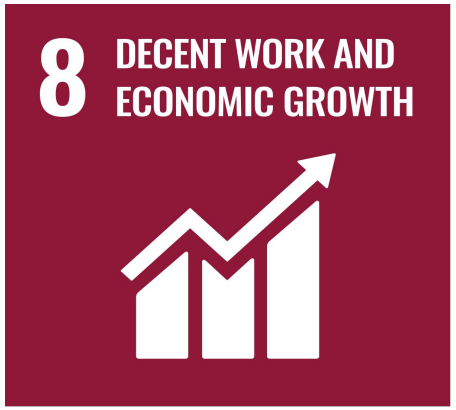
Relevant Academic Papers

- **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.

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