RV College of Engineering®

(Autonomous Institution Affiliated to VTU, Belagavi)

BENGALURU – 560 059

Real Time Cashew Kernel Classification Using Deep Learning

INTERDISCIPLINARY PROJECT DIARY

Team Number: 190

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Under the guidance of
Dr. Veena Devi S V
Associate Professor
Department of Electronics and Communication Engineering

VI SEMESTER - B.E.

2024-25

Interdisciplinary Project Synopsis

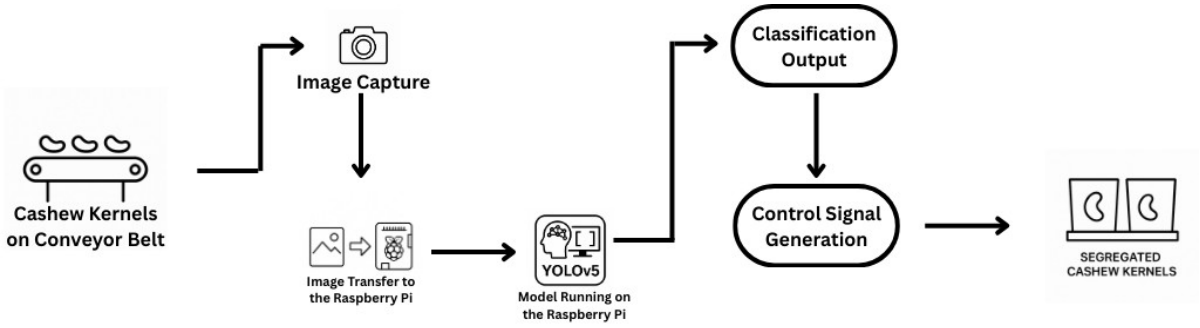
INTRODUCTION:

Cashew kernels are a valuable product in the global food market, and their quality affects both price and consumer choice. Traditionally, kernels are graded by hand based on size, shape, color, and surface condition. Skilled workers visually inspect and sort them into categories like whole, split, or scorched. However, manual grading is slow, tiring, and prone to mistakes, leading to inconsistencies in quality and profit loss. To solve this, the industry is moving toward automation using artificial intelligence and computer vision. Deep learning is especially useful because it can learn to recognize complex visual patterns from large sets of images. This project focuses on developing a real-time system that automatically classifies cashew kernels using deep learning. It aims to replace manual inspection with a faster, more reliable, and scalable method, helping improve product quality, reduce labor needs, and boost overall efficiency in cashew processing.

OBJECTIVES:

- Design an Image processing unit for capture the raw cashew kernel images and data preprocessing.
- Implement an Algorithm for data analysis, feature extraction and classification to determine the variations in the raw cashew kernels.
- Employ AI algorithms to classify and grade cashew defects.
- Integrate robust hardware and software for efficient testing and grading.

METHODOLOGY:



1. **Image Acquisition & Preprocessing**: Capture diverse cashew kernel images and apply preprocessing (resizing, normalization, augmentation) to build a consistent dataset.
2. **Labeling & Model Training**: Manually label kernels by grade (whole, split, scorched, etc.) and train a deep learning model (e.g., YOLO) for classification.

3. **Real-Time Classification**: Deploy the model on edge devices for real-time detection and grading of kernels on a moving conveyor.
4. **Hardware Integration**: Connect the classifier to microcontrollers (e.g., Arduino) and sensors to control actuators for sorting.
5. **Automated Sorting**: Sort kernels into graded bins using actuators, enabling efficient and consistent automated grading.

SOFTWARE REQUIREMENTS:

- Python (with PyTorch/TensorFlow, OpenCV, NumPy, Pandas)
- Labeling Tools (e.g., CVAT, LabelMe)
- Libraries for feature extraction VGG16, ResNet50, ResNet101, InceptionV3.
- GUI framework (Tkinter / PyQT / Streamlit)
- MATLAB (for comparison or validation analysis)

HARDWARE REQUIREMENTS:

- High-resolution Camera
- Raspberry Pi
- Lighting Setup for consistent image capture
- Conveyer System, Stepper Motor
- GPU-enabled laptop or workstation

INTERDISCIPLINARY RELEVANCE:

1. Electronics and Communication Engineering:
    a. Responsible for the hardware setup, including the selection and integration of the camera, and other sensors.
    b. Design and implementation of communication protocols for interfacing with the embedded system.
    c. Control and automation of the Cashew classification system through electronics and embedded programming.

2. Computer Science and Engineering:

    a. Responsible for the software development, including image processing, machine learning model implementation, and system integration.

    b. Applying algorithms for defect detection, classification, and feature extraction.

    c. Developing a GUI for real-time monitoring and control, as well as database management.

3. Biotechnology:

    a. Defines quality parameters of cashew kernels based on biological and nutritional standards to guide accurate classification.

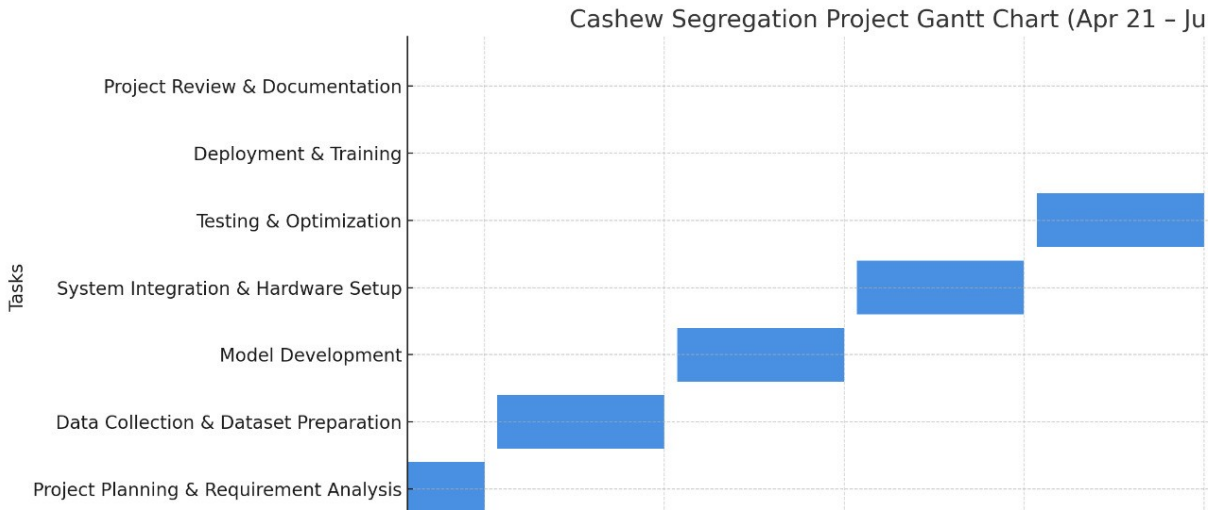
    b. Supports dataset labeling and validation using domain knowledge to identify visual and biochemical defects.

    c. Ensures the system aligns with industry standards by providing insights into biological variations affecting kernel quality.

INNOVATION / CONTRIBUTION TO THE FIELD:

- Develops a real-time deep learning-based system for accurate and automated classification of cashew kernels.
- Replaces traditional manual grading methods, reducing human error, labor dependency, and subjectivity.
- Incorporates image acquisition, pre-processing, and classification in a seamless pipeline suitable for industrial deployment.
- Enables consistent, scalable, and objective quality grading based on visual attributes such as shape, size, and surface defects.
- Enhances processing efficiency and product uniformity, contributing to improved profitability and quality assurance in the cashew industry.

GANTT CHART:



Signature
Internal Guide

Signature
Dean Academics

Name: Dr. Veena Devi S V
Designation: Associate Professor
Department: ECE

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
1.	From Date: 21/04/2025 To Date: 26/04/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
2.	From Date: 28/04/2025 To Date: 03/05/2025	
Guide Remarks:		
Guide Signature with Date:		

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
3	From Date: 05/05/2025 To Date: 10/05/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
4	From Date: 12/05/2025 To Date: 17/05/2025	
Guide Remarks:		
Guide Signature with Date:		

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
5	From Date: 19/05/2025 To Date: 24/05/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
6	From Date: 26/05/2025 To Date: 31/05/2025	
Guide Remarks:		
Guide Signature with Date:		

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
7	**From Date:** 02/06/2025 **To Date:** 07/06/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
8	**From Date:** 09/06/2025 **To Date:** 14/06/2025	
Guide Remarks:		
Guide Signature with Date:		

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
9	From Date: 16/06/2025 To Date: 21/06/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
10	From Date: 23/06/2025 To Date: 28/06/2025	
Guide Remarks:		
Guide Signature with Date:		

REPORT OF ACTIVITY CARRIED OUT

Sl. No.	Week wise plan	Activities carried out
11	From Date: 30/06/2025 To Date: 05/07/2025	
Guide Remarks:		
Guide Signature with Date:		

Sl. No.	Week wise plan	Activities carried out
12	From Date: 07/07/2025 To Date: 11/07/2025	
Guide Remarks:		
Guide Signature with Date:		

Phase I Date of Presentation: _____

Committee Remarks: Guide Signature

Phase II Date of Presentation: _____

Committee Remarks: Guide Signature

Phase III Date of Presentation: _____

Committee Remarks: Guide Signature

Project Presentation

Outcome of the Project

  Guide Signature

RUBRICS FOR EVALUATION (THREE PHASES)

INTERDISCIPLINARY PROJECT

Course Code	CS367P	Course Title	Interdisciplinary Project
Credits	0:0:3	CIE	100 Marks
		SEE	100 Marks

PHASE I					PHASE II				PHASE III(Exhibition Mode)					
Problem Definition+ Synosis Submission	Literature Survey	Objectives	Methodology	Total	Partial Project Execution	Tools and Techniques Used	Partial Results	Total	Complete Prototype Demonstration	Results & Discussions	Draft Paper & Report	Poster & PPT demonstration	Total	Total
10	5	5	10	30	15	10	10	35	05	5	15	10	35	100

Phase-I: Problem Definition

Criteria	Excellent (10-8)	Very Good (7-6)	Good (5-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Clarity	Clearly and concisely defines the interdisciplinary problem with specific focus and feasibility.	Clearly defines the problem but could improve conciseness.	Defines the problem but lacks specificity or focus.	Problem is vaguely defined or lacks feasibility.	Problem is unclear or not well-defined.
Relevance	Highly relevant to all three disciplines, addressing significant challenges.	Relevant and significant to two disciplines.	Somewhat relevant to one or two disciplines.	Relevance to the interdisciplinary context is unclear.	Not relevant to the domains of study.
Context	Provides a thorough background with technical, economic, and societal impact.	Provides adequate background with limited impact discussion.	Provides some background but lacks depth.	Provides minimal background.	No background or context provided.
Synopsis	Submitted synopsis in the given format	Submitted synopsis in the given format	Submitted synopsis in the given format	Submitted synopsis not in the given format	Not submitted synopsis

Phase-I: Literature Survey

Criteria	Excellent (5)	Very Good (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Coverage & Relevance	Comprehensive review of key, credible sources; strong interdisciplinary focus.	Adequate coverage but misses some relevant works or lacks depth in places.	Limited or irrelevant sources; no clear connection to the research problem.	Comprehensive review of key, credible sources; strong interdisciplinary focus.	Adequate coverage but misses some relevant works or lacks depth in places.
Critical Analysis	In-depth comparison of methods/results; highlights strengths and weaknesses.	Summarizes sources but lacks synthesis or critique.	Only paraphrases sources; no analysis or evaluation.	In-depth comparison of methods/results; highlights strengths and weaknesses.	Summarizes sources but lacks synthesis or critique.
Research Gap Identification	Clearly articulates unresolved questions or limitations in existing literature.	Mentions gaps briefly but lacks clarity or justification.	No identification of gaps; only repeats existing findings.	Clearly articulates unresolved questions or limitations in existing literature.	Mentions gaps briefly but lacks clarity or justification.

Phase-I: Objectives

Criteria	Excellent (5)	Very Good (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Specificity	Objectives are well-defined, measurable, and aligned with all three disciplines.	Objectives are clear but not fully specific to all disciplines.	Objectives are somewhat clear but lack measurable aspects.	Objectives are vague or lack clarity.	No clear objectives.
Alignment	Strong alignment with the problem definition and interdisciplinary approach.	Mostly aligned with the problem definition.	Partial alignment with interdisciplinary relevance.	Weak alignment with problem definition.	No alignment with problem definition.
Feasibility	Objectives are achievable given the technical constraints and scope.	Objectives are challenging but feasible.	Objectives are somewhat realistic but could be improved.	Objectives are unrealistic or difficult to achieve.	Objectives are not achievable.

Phase-I: Methodology

Criteria	Excellent (10-8)	Very Good (7-6)	Good (5-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Appropriateness	Methodology is well-suited for objectives and integrates all three disciplines perspectives.	Methodology is appropriate but has minor gaps in interdisciplinary integration.	Methodology addresses only one or two disciplines adequately.	Methodology is somewhat inappropriate for interdisciplinary scope.	Methodology is inappropriate or missing.
Detail	Detailed methodology with clear workflow and implementation plan.	Mostly detailed with minor gaps.	Lacks some documentation or clarity.	Poorly detailed with minimal documentation.	No methodology or poorly documented.
Flowchart	Well-structured flowchart with clear representation of all steps.	Accurate flowchart but missing some details.	Flowchart lacks clarity in key steps.	Incomplete flowchart with missing information.	No or incorrect flowchart.

Phase-II: Partial Project Execution

Criteria	Excellent (15-12)	Very Good (11-8)	Good (7-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Adherence	Follows methodology strictly with well-documented progress.	Follows methodology with minor deviations.	Some deviations from methodology but still relevant.	Major deviations impacting quality.	No adherence to methodology.
Timeliness	Completed on schedule with milestones met.	Minor delays but within scope.	Noticeable delays affecting project execution.	Significant delays impacting deliverables.	Not completed on time.
Quality	High-quality results with proper validation.	Good quality with minor technical issues.	Acceptable quality with noticeable gaps.	Poor quality with significant issues.	Very poor or incomplete work.

Phase-II: Tools & Techniques Used

Criteria	Excellent (10-8)	Very Good (7-6)	Good (5-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Selection	Tools and techniques are cutting-edge and suitable for interdisciplinary work.	Appropriate tools are selected but minor improvements needed.	Somewhat relevant tools but lacking efficiency.	Tools are outdated or not well-suited.	No tools or inappropriate selection.
Application	Tools are expertly applied for optimal results.	Effectively applied but with minor issues.	Adequately applied with gaps in efficiency.	Poor application with minimal impact.	No application or incorrect use of tools.
Integration	Tools are seamlessly integrated into the project workflow.	Well-integrated with minor issues.	Some integration but lacks cohesion.	Poorly integrated.	No integration or incorrect application.

Phase-II: Partial Results

Criteria	Excellent (10-8)	Very Good (7-6)	Good (5-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Clarity	Partial results are well-documented and clearly explained.	Clear results with minor gaps.	Some clarity but lacks detail.	Unclear results with minimal documentation.	No partial results or poor documentation.
Progress	Significant progress with meaningful insights.	Good progress but needs more refinement.	Some progress but lacks depth.	Minimal progress.	No progress.
Analysis	Thorough analysis with interdisciplinary insights.	Good analysis with some depth.	Basic analysis with minor gaps.	Poor analysis with little interpretation.	No analysis or misinterpretation.

Phase-III: Complete Prototype Demonstration (Hardware/Software)

Criteria	Excellent (5)	Very Good (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Functionality	Fully functional, meeting all objectives.	Functional with minor issues.	Works but has noticeable issues.	Major issues affecting usability.	Not functional.
Innovation	Highly innovative and demonstrates creative problem-solving.	Shows good levels of innovation.	Some innovation but lacks novelty.	Minimal innovation.	No innovation.
Usability	Highly user-friendly and intuitive.	User-friendly with minor issues.	Some usability but needs improvement.	Difficult to use.	Not usable.

Phase-III: Results & Discussion

Criteria	Excellent (5)	Very Good (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Clarity	Results are well-explained and presented effectively.	Clear results with minor explanation gaps.	Somewhat clear but needs more explanation.	Unclear or poorly explained results.	No results or highly unclear.
Analysis	Insightful and in-depth analysis with strong validation.	Good analysis but minor gaps in reasoning.	Adequate analysis with basic insights.	Limited analysis with few insights.	No analysis or incorrect interpretation.
Interpretation	Logical and well-supported conclusions.	Mostly logical with minor flaws.	Some logical interpretations but weak justification.	Poorly supported conclusions.	No interpretation or illogical reasoning.

Phase-III: Report and Research Paper Writing

Criteria	Excellent (15-12)	Very Good (11-8)	Good (7-4)	Satisfactory (3-2)	Needs Improvement (1-0)
Report Organization	Well-organized, logical structure with clear headings and subheadings	Clear organization, minor lapses in flow	Basic organization, some sections could be more logically arranged	Poor organization, hard to follow	No clear organization, difficult to navigate
Plagiarism	No plagiarism, proper citations for all sources used	Few minor citation errors, no unintentional plagiarism	Some citations missing, but no evidence of deliberate plagiarism	Several sources without citation or improper citation	Clear evidence of plagiarism, missing citations or incorrect use
Paper Submitted to Conference/Journal	Submitted to a relevant and high-quality conference/journal	Submitted to an appropriate conference/journal with some relevance	Submitted to a less relevant conference/journal	Submitted to a low-impact or inappropriate conference/journal	Not submitted or submitted to an irrelevant conference/journal
Paper Accepted in Conference/Journal	Accepted in a reputable conference/journal with peer-reviewed status	Accepted in a well-regarded conference/journal	Accepted in a less prestigious conference/journal	Accepted in a minor or non-peer-reviewed journal	Not accepted in any conference/journal

Phase-III: Poster, PPT and Exhibition

Criteria	Excellent (10-8)	Very Good (7-6)	Needs Improvement (5-0)
Poster	Highly organized, visually appealing, and effectively conveys the message	Good organization and design with minor issues in clarity or visual appeal	Poor organization or cluttered design, difficult to understand
PPT	Well-structured, clear, engaging slides with excellent visual design	Good structure and design, minor issues in clarity or engagement	Disorganized or hard-to-follow slides, poor visual design or presentation
Exhibition	Highly engaging, interactive, and informative, capturing audience attention	Good interaction and information, mostly engaging with minor issues	Minimal interaction, hard to maintain audience attention, lacking clarity

Phase Evaluation:

Sl. No.	USN	PHASE EVALUATION	PHASE-1					PHASE-2				PHASE-3				
		MAX MARKS	10	5	5	10	30	15	10	10	35	5	5	15	10	35
		COs Mapped	1	2	1	1		3	4	4		4	4	3	3	
		NAME														
1	1RV23EC408	RAVIKANT														
2	1RV23EC410	SAGAR T NAYAK														
3	1RV23BT404	YOGEESH A S														
4	1RV23CS405	KIRAN H R														
5	1RV23CS407	MANOJ KUMAR B V														

CIE Marks:

Sl. No.	USN	NAME	I Phase (30)	II Phase (35)	III Phase (35)	Total (100)
1	1RV23EC408	RAVIKANT				
2	1RV23EC410	SAGAR T NAYAK				
3	1RV23BT404	YOGEESH A S				
4	1RV23CS405	KIRAN H R				
5	1RV23CS407	MANOJ KUMAR B V				

Signature of Internal Guide
Name: Dr. Veena Devi S V
Designation: Associate Professor
Department: ECE
RV College of Engineering

Signature of the HOD
Name: Dr. H V Ravish Aradya
Department: ECE
RV College of Engineering