IT4010 – Research Project - 2024

Topic Assessment Form

Project ID: 24-25J-337

1. Topic (12 words max)

Revolutionizing Tomato Production and quality assessment using AI

2. Research group the project belongs to

Autonomous Intelligent Machines and Systems (AIMS)

3. Research area the project belongs to

Image Processing (IP)

4. If a continuation of a previous project:

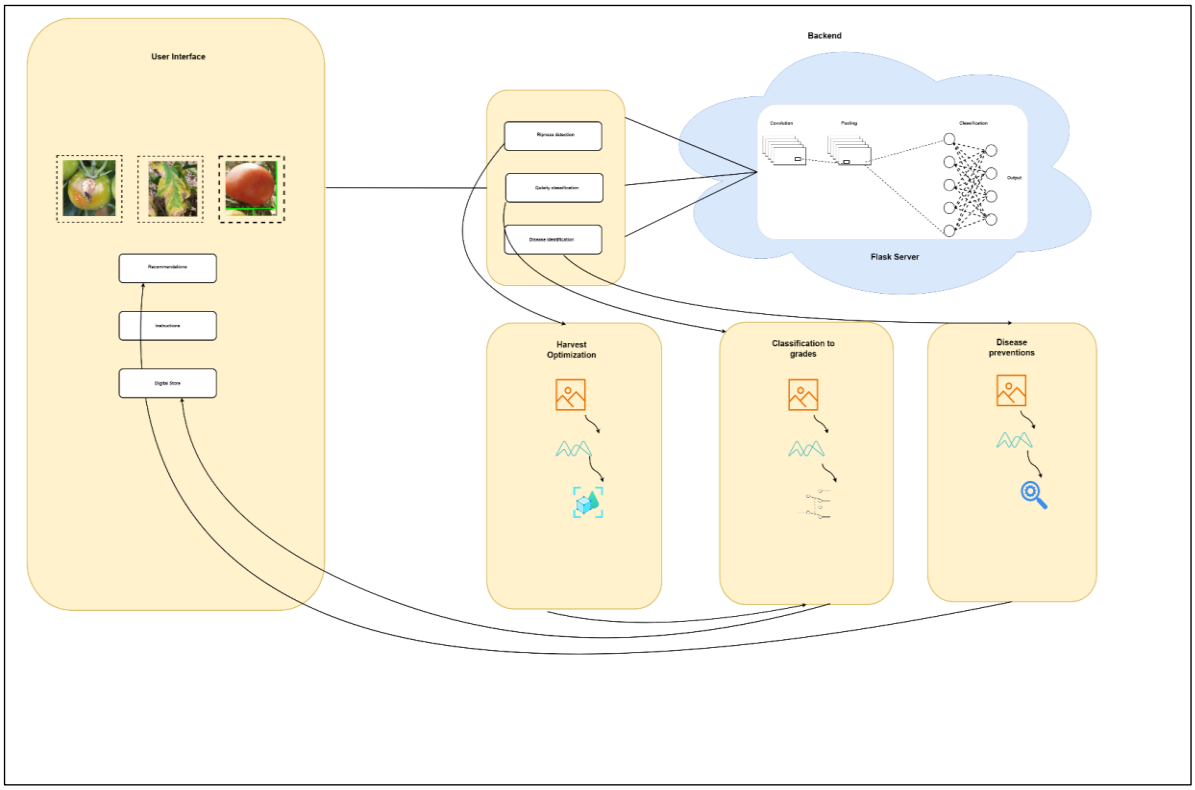
Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

Tomatoes are a crucial crop that have a substantial economic impact, specifically in places like Sri Lanka where they support both local markets and export earnings. However, farmers often lack knowledge about effective disease management, which can result in significant crop losses and reduced quality, which affects yield and profitability. This knowledge gap further exacerbates the issue of wastage, as damaged tomatoes frequently fall short of market standards, costing farmers money. By addressing these issues through advanced disease detection and management techniques, farmers can reduce wastage and improve the overall quality and marketability of tomatoes, improving economic benefits for small-scale farmers and increasing export potential from tomatoes.

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The goal of tomato research is to apply advanced technologies to improve tomato cultivation and processing in a number of ways. For example, ripeness detection uses machine learning and computer vision techniques to accurately determine the best time to harvest tomatoes, resulting in higher-quality tomatoes and less waste. Another important area is disease identification, which uses algorithms to identify and classify diseases in tomato plants early on, reducing crop losses and increasing yields.



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

This proposed system is based on image processing and machine learning to address the problems related to our topic. Final outcome of the proposed system is a creating a mobile application that have functionalities to address the identified problems. Users required to upload images for selected functionality to get the solution. When user upload images of tomato the system will identify the ripeness and give information for optimum harvesting period. Also the system can classify the tomato according to quality grades and this will provide a classified digital store for the buyers and also buyers can ensure they can get the required stock for the required date using predicative analytics.

To achieve these functions, our technology stack includes Flutter , Flask, MongoDB, TensorFlow, and Keras. These tools will help us create a mobile application alongside a web application that is both user-friendly and powerful in its capabilities.

In summary, our team combines specialized domain expertise in tomato cultivation, machine learning, and app development. We leverage machine learning technologies and data-driven approaches to deliver an integrated platform that addresses the specific needs of tomato farmers in Sri Lanka. This solution not only enhances disease detection and management but also supports sustainable farming practices, ultimately contributing to increased productivity and agricultural resilience.

8. Objectives and Novelty

Main Objective

Improve crop output, encourage sustainable farming methods, and create a technology-driven approach to disease diagnosis and control to maximize tomato agriculture in Sri Lanka.

Member Name	Sub Objective	Tasks	Novelty
Samarasinghe G.D.M.J	• Create a system that can precisely determine the color and maturity of tomatoes by utilizing machine learning and image processing techniques. This involves taking pictures of tomatoes at different maturity levels. • Develop a machine learning model to Identify the ripeness stages accurately. • Create a predictive system that recommends the best	• Collect higher amount of images of tomatoes at various ripeness stages • Train a Convolutional Neural Networks (CNNs) which are a highly successful tool for classifying tomatoes into stages such as unripe, half ripe, and fully ripe, allowing for the prediction of tomato ripening from photographs. An LSTM can forecast future ripeness based on	• dynamic system that adjusts to environmental changes to determine the appropriate stages of ripeness. Accurate identification of the present tomato maturity stages is ensured by its constant updating to account for changing ripening patterns. The algorithm also offers practical suggestions for the best time to harvest, taking current environmental factors and ripening patterns into account. • We can classify tomatoes into several ripeness stages prior to

	time to harvest tomatoes by analyzing ripeness detection data and environmental conditions. This system will ensure maximum quality and yield by providing timely and accurate harvest recommendations.	patterns, whereas YOLO can identify and categorize several tomatoes in a single image. • Create a decision support system that utilizes model predictions to deliver suggestions in real time regarding the optimal harvesting period. Farmers will be able to take use of the insights this technology produces through data analysis. • Provide a user-friendly interface for farmers to view warnings and recommendations, like a smartphone app. Harvest suggestions will be easily accessible through the interface, enabling farmers to make well-informed decisions.	their arrival at the market, offering a thorough evaluation of their maturity. By precisely classifying tomatoes according to their level of ripeness, this last review enables improved market placement and alignment with consumer preferences. • disease detection has been use in many researches. other than just disease detection, I need to add something to make this unique from other researches. give suggestions.. • Employing an adaptive method allows farmers to receive precise and timely harvest recommendations, significantly enhancing accuracy, reliability, and flexibility. This approach not only optimizes produce quality but also maximizes yields, ensuring that agricultural practices are both efficient and effective.

Herath H.M.R.K	• Defect Identification Create an automated system to recognize and categorize tomato surface flaws such cracks, bruises, and blemishes using machine learning and computer vision. The accuracy and effectiveness of quality control procedures will be improved by this technology. • Examine the Texture in 2. Analyze tomato surface texture using advanced image processing techniques. Utilize techniques such as Gabor filters and Local Binary Patterns (LBP) to identify anomalies and evaluate the tomatoes' general quality. • Use Commercial Quality Standards to Determine Tomato Classification	• Data collection: Compile a large dataset of photos of tomatoes that show various defects such spots, cracks, and bruising. To increase model robustness, make sure the dataset include a variety of sets and lighting situations. • Preprocessing: To improve the dataset, clean up and preprocess the tomato photos by resizing, standardizing, and enhancing them. Methods like as flipping, rotating, and adjusting hue can aid in producing a training set that is more varied. • Model Choice: SVM and KNN are suitable for classifications . In this case we can classify	• Integration of Multiple Data Points: Unlike existing solutions that may focus on one or two aspects of tomato cultivation (e.g., just classification or just prediction), your system integrates multiple data points—harvest per day, classification, weight, tree counts, and more—into a single comprehensive system. • Use of Advanced ML Techniques: Employing LSTM for time-series prediction and sequential data analysis in agriculture is relatively novel. It's not just about predicting future availability but doing so by taking into account a variety of factors (e.g., daily harvest, newly planted trees, defeated trees) which are dynamically updated. • User-Focused Dashboard: The implementation of a user-friendly digital dashboard for buyers to visualize and interact with the data in real-time is innovative.

	Develop a tomato classification model that employs existing commercial quality requirements for categorization. In order to guarantee consistent and trustworthy tomato grading for market readiness, this model will take into account variables including size, color, shape, and texture.	tomato using pre extracted features. • Make sure to validate your models with historical data to ensure their accuracy before deploying them in the live environment. • -Consider implementing a user-friendly interface that clearly shows the predictions and guides buyers in placing orders. • Training: Use the preprocessed tomato dataset to train the chosen models. In order to properly assess the performance of the model, make sure the data is divided into training, validation, and test sets.	This includes real-time updates, future predictions, and integration with a booking assistant for order placement, which provides significant practical utility. • Automatic Grading and Prediction Integration: Your system's ability to automatically classify and grade tomatoes in real-time during the sorting process, and predict future availability for users, sets it apart from more manual or less integrated approaches.

Ranawaka .T.D	• Create a system that uses advanced image processing and machine learning approaches to reliably identify common tomato diseases in Sri Lanka. • Use methods to evaluate the severity of diseases found, giving a precise idea of the level of infection. • Make sure to take efficient disease control by identifying specific steps to stop the spread of diseases.	• Gather a comprehensive dataset of tomato plant images showing various disease symptoms and sort them according to diseases. • Resize images to a uniform dimension, adjust brightness and contrast, and apply techniques like rotation, flipping, and cropping to augment the dataset. • Develop a model to get optimum results by train on the preprocessed dataset. • Fine-tune the model by experimenting with different architectures and hyperparameters. • Implement transfer learning with pre-trained models to improve accuracy.	• It can be difficult to tell different tomato leaf diseases apart with the human eye since they frequently present with similar visual characteristics. The use of image processing and machine learning approaches to precisely identify and distinguish between various disorders is what makes this research distinctive. • Identify co-existing diseases in the same plant is also very critical when identifying the diseases. This could be hard to identify clearly in traditional methods. • To minimize yield loss, early detection of diseases is essential. Only the human eye may be able to identify subtle symptoms that point to the beginning of a disease. we aims to create a system that can precisely identify diseases in their early stages. • This study analyzes leaf images and uses machine learning algorithms to quantify the severity of the disease. We can

		• Provide necessary information and recommendations to mitigate the damage to the crops. • Develop user friendly user interfaces for the mobile application. • Create a system that uses advanced image processing and machine learning approaches to reliably identify common tomato diseases in Sri Lanka.	get accurate information on the severity levels of different diseases thanks to the system, which classifies the extent of leaf damage based on appearance and disease characteristics

9. Supervisor checklist

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes	✓	No	

b) Does the proposed topic exhibit novelty?

Yes	✓	No	

c) Do you believe they have the capability to successfully execute the proposed project?

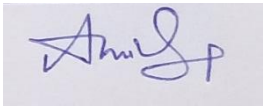
Yes	✓	No	

d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes	✓	No	

e) Supervisor's Evaluation and Recommendation for the Research topic:

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Mr.	Amila	Senarathne	
Co-Supervisor	Dr.	Lakmini	Abeywardhana	
External Supervisor				

Summary of external supervisor's (if any) experience and expertise

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Topic Assessment Form

<u>This part is to be filled by the Topic Screening Panel members.</u>

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

*__Important__:

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.