IT4010 – Research Project - 2024

Topic Assessment Form

Project ID : R24-010

1. Topic (12 words max)

Synergetic Innovation in Gherkin Cultivation

2. Research group the project belongs to

Machine Learning and Soft Computing

3. Research area the project belongs toD

Machine Learning (ML)

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.

The gherkin cultivation and export industry in Sri Lanka is a significant contributor to the country's economy. However, the industry faces challenges related to maintaining consistent quality, adapting to dynamic environmental conditions, predicting market prices, and efficiently planning gherkin farms. This research aims to address these challenges through the implementation of advanced technological solutions.

- Despite the economic importance of the gherkin industry in Sri Lanka, ensuring consistent quality remains a challenge. Current methods for quality control may be subjective and prone to human error.
- The pest identification function enables farmers to swiftly identify pests through image uploads, providing prompt and accurate identification. The user-friendly system offers tailored pest management solutions, offering immediate guidance for effective crop protection, enhancing overall efficiency in pest control measures.
- Fluctuations in global demand and climatic conditions make it challenging for farmers to anticipate market prices accurately. Traditional methods lack predictive accuracy.
- The integration of fertilizer prediction and stock maintenance facilitates real-time monitoring of fertilizer levels for a specific farm. This enables farmers to predict and manage the costs associated with fertilizers during the initial phase of cultivation, providing a cost-effective approach to resource allocation and overall farm management.

- Current farm planning lacks the integration of immersive technologies and detailed planting instructions. This hinders the adoption of optimal cultivation practices.
  This research will contribute to the gherkin industry by proposing and implementing technical solutions for quality control, environmental monitoring, market price prediction, and farm planning. The interdisciplinary approach involving machine learning, artificial intelligence and virtual reality technologies aims to enhance the efficiency and sustainability of gherkin cultivation practices in Sri Lanka.

  References

[1]K. Monika, B. Ramprakash, S. Muthuramalingam, and K. Mirdula, "Crop Fertilizer Prediction using Regression analysis and Machine Learning algorithms," IEEE Xplore, Dec. 01, 2022. https://ieeexplore.ieee.org/document/10072846 (accessed Jun. 09, 2023).

[2]Jeevaganesh R, Harish D, and Priya B, "A Machine Learning-based Approach for Crop Yield Prediction and Fertilizer Recommendation," 2022 6th International Conference on Trends in Electronics and Informatics (ICOEI), Apr. 2022, doi: https://doi.org/10.1109/icoei53556.2022.9777230.

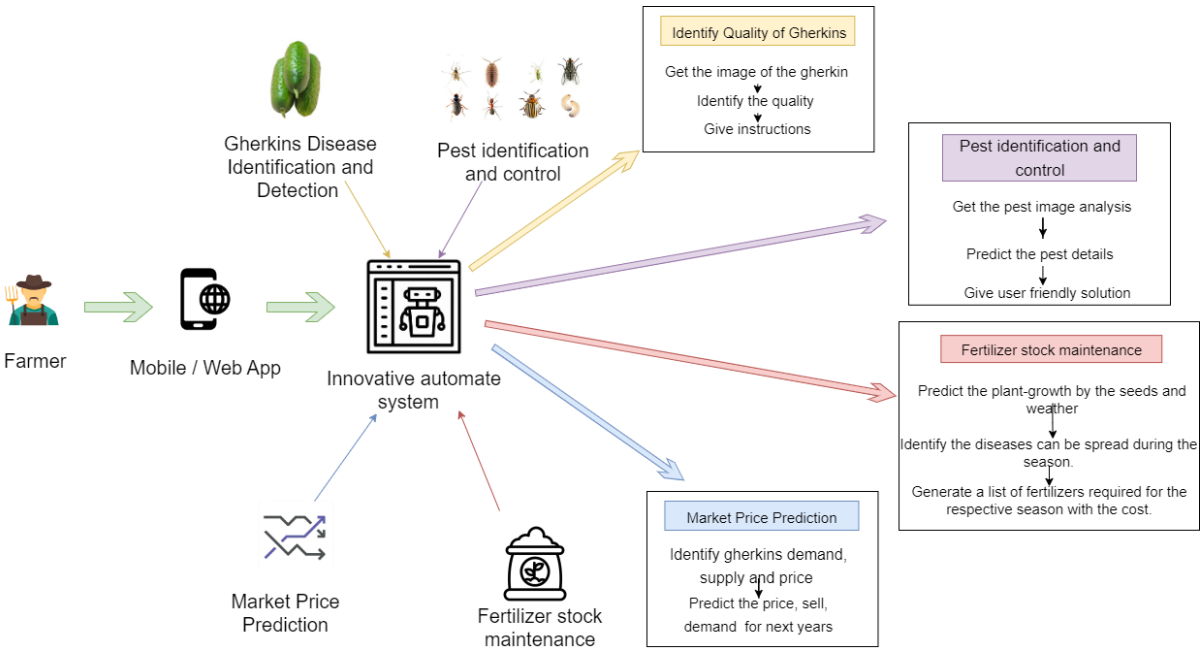
[3]"Sri Lanka's Cucumber and Gherkin Market Report 2023 - Prices, Size, Forecast, and Companies," www.indexbox.io. https://www.indexbox.io/store/sri-lanka-cucumbers-and-gherkins-market-report-analysis-and-forecast-to-2025/

[4]"Gherkins - Vegetables Exporters in Sri Lanka," www.srilankabusiness.com. https://www.srilankabusiness.com/exporters-directory/fruits-nuts-vegetables-exporters-in-sri-lanka/vegetables-exporters/gherkin-suppliers/ (accessed Jan. 10, 2024).

[5]"Gherkins export helps farmer incomes in NWP," Daily News. https://archives1.dailynews.lk/2017/03/06/business/109432/gherkins-export-helps-farmer-incomes-nwp (accessed Jan. 10, 2024).

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

Our synergetic innovation in gherkin cultivation employs cutting-edge machine learning across four key functions. Firstly, in gherkin quality identification, our system utilizes computer vision to analyze size, color, plant health, and texture, adapting to evolving standards through continuous learning. Second, identify and classify pests affecting gherkin plants using advanced image processing. The system also incorporates user-friendly insights into the pest's life cycle and defense strategies. Third, market price prediction integrates machine learning for accurate forecasts based on global demand, pricing trends, and meteorological data. Lastly, Predict the Weather for the season and generate a list of fertilizers required for the respective season. This holistic approach enhances gherkin quality, maximizes yield, and empowers farmers with innovative tools. This comprehensive system transforms gherkin cultivation, making it sustainable, informed, and collaborative.



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

Synergetic Innovation in Gherkin Cultivation requires a comprehensive understanding of specialized domains, leveraging knowledge and data to optimize various aspects of Gherkin cultivation.

First Function of "Identify Quality of Gherkins" expertise in computer vision, image processing, and machine learning is crucial. The system must be capable of extracting features like size, color, and texture from images of gherkins, using algorithms to ensure quality control. As Data Requirements, we need to diverse dataset of gherkin images with labeled quality parameters, Historical data on quality issues and resolutions for model training, Information on evolving quality standards for continuous learning.

The individual, with a strong coding foundation and pest-related expertise, plans to improve their agricultural knowledge by collaborating with agricultural specialists and using advanced technologies like YOLO and Xception/InceptionV3. They will also ensure accessibility and strengthen the collection process, sourcing pest images from Hayleys and collaborating with pest management and agriculture experts.

The third function of market price prediction requires data science expertise, including historical pricing data, global demand trends, and meteorological information. Machine learning algorithms, regression models, and a dynamic forecasting system are needed to accurately predict market prices. Data requirements include historical pricing data, global demand statistics, meteorological data, economic indicators, and trade policies affecting the market.

The Fertilizer Stock Management system aims to improve efficiency in fertilizer stock management for gherkin cultivation by utilizing advanced regression algorithms to predict seed-to-yield outcomes and collaborating with agricultural experts to define growing stages. The system will estimate fertilizer quantities based on predicted yields and provide farmers with specific recommendations for optimal gherkin growth, driven by continuous collaboration.

8. Objectives and Novelty

Main Objective

This research initiative aims to revolutionize gherkin cultivation by integrating innovative technologies to enhance quality, efficiency, and decision-making for farmers. Leveraging machine learning, computer vision, and virtual reality, our objective is to create a synergetic solution addressing key challenges in gherkin farming. Our primary focus is on gherkin quality identification using computer vision for size, color, plant health, and texture analysis. The system adapts continuously, aligning with evolving quality standards. Additionally, Identifying and classifying pests affecting gherkin plants using advanced image processing techniques and algorithms. This comprehensive tool helps farmers assess gherkin quality, manage pests, and enhance yield and sustainability. Simultaneously, the research aims to optimize market-oriented decisions through accurate price predictions using machine learning models analyzing global demand, pricing trends, and meteorological data.

Member Name	Sub Objective	Tasks	Novelty
Jinasena H.D.S.S	Develop an innovative system to "identify and classify pests affecting gherkin plants", providing accurate results accessible to all users. The system employs	• Efficient Pest Identification Choose an image processing approach to identify pests in images,	The present research addresses a notable gap in the current literature, as prior studies lack an integrated solution for gherkin pest identification.

	advanced image processing to pinpoint pests in images, refining the classification for precision. Integrate an engaging Augmented Reality view to showcase the identified pest's life cycle, making information accessible and interactive. Additionally, implement Natural Language Processing for user-friendly insights into the pest's life cycle and effective defense strategies. The system is designed to continuously meet evolving quality standards, ensuring reliable pest classification and offering practical solutions for safeguarding gherkin plants.	without specifying technical details. Utilize an Object Detection algorithm, like YOLO (You Only Look Once), for initial pest identification. • Precision Classification Refine pest classification accuracy using a classification algorithm, such as Xception or InceptionV3. Ensure the system can accurately categorize pests based on their characteristics. • Augmented Reality (AR) Integration Implement AR capabilities to visualize the identified pest's life cycle, making the information interactive and engaging.	Unlike previous works that focus on singular aspects of pest management, this study introduces a pioneering method utilizing YOLO and Xception/InceptionV3 algorithms for precise pest identification, a novel application not explored in prior research. Additionally, the integration of AR technology to visualize pest life cycles and potential inclusion of Natural Language Processing for user-friendly insights marks a distinctive advancement in the field. This comprehensive system promises accurate identification, refined classification, and interactive solutions, presenting a significant contribution to gherkin cultivation research.

		• Natural Language Processing (NLP) Implementation: Develop an NLP component to process and present user-friendly insights related to the identified pests. • Improvement and Testing Conduct comprehensive testing, considering performance, usability, and user feedback, to ensure a reliable and user-friendly system.	
Perera H.M.A.G	The sub-objectives of the function "Identify diseases of gherkin and leaves" involve implementing a machine learning and deep learning-based system for gherkin and plant disease identification through image processing, focusing on symptoms, surface, color, and texture	• Problem Definition: Clearly define the problem: "Develop a system to identify diseases in gherkin plants based on visual symptoms." • Data Collection: Gather a labeled dataset containing images of healthy and diseased gherkin plants.	Our innovative disease identification function utilizes Convolutional Neural Networks (CNNs) to accurately discern diseases affecting gherkins and gherkin leaves, offering a distinctive feature by not only identifying issues but also

	analysis. This includes continuous adaptation to evolving quality standards and the development of a disease control system to detect anomalies. System provides solutions for getting rid of diseases. Additionally, the system aims to calculate the area of disease propagation throughout the plant and gherkin. Also give solutions for how to get rid of these diseases and what kind of chemicals or fertilizers have to use.	Include a variety of diseases to ensure model robustness. • Data Preprocessing: Clean and preprocess the images: Resize images to a consistent resolution. Normalize pixel values. Augment data to increase diversity and improve model generalization. • Model Selection: Choose an appropriate ML/DL model architecture: For a start, consider a pre-trained Convolutional Neural Network (CNN) for image classification. • Model Training: Split the dataset into training and validation sets. Train the chosen model on the training set, fine-tuning if necessary. Utilize transfer learning to leverage pre-trained models. • Model Evaluation: Evaluate the model on the validation set: Measure accuracy, precision, recall, and F1 score.	measuring disease propagation. This goes beyond traditional detection, providing farmers with valuable insights and solutions. This approach pioneers disease identification through image processing, presenting a comprehensive solution for efficient problem resolution in gherkin cultivation. The novelty extends further as this not only identify problems but also offer actionable recommendations, such as suggesting the optimal amount of fertilizer to mitigate disease spread. This integrated and holistic approach sets our function apart, making it a groundbreaking and valuable tool in gherkin cultivation.

		Adjust hyperparameters or change the model architecture if performance is suboptimal. • Model Deployment: Deploy the trained model into a production environment: Consider using frameworks like TensorFlow Serving or Flask for deployment. • Integration with User Interface: Develop a user interface (UI) for users to interact with the system: This could be a web or mobile application. • Continuous Monitoring and Maintenance: Update the model periodically with new data to ensure it adapts to evolving disease patterns.	
Dayarathna T.W.K.D.A.	The sub-objective of the function "Fertilizer Stock Management" is to implement a machine learning-based system for optimizing seed-to-yield predictions in gherkin cultivation. This involves	• Data Collection and Preprocessing: - Collect historical data on gherkin cultivation, including the number of seeds planted, plantation	The "Fertilizer Stock Management" function introduces notable innovations. An Integrated Prediction and Recommendation System seamlessly combine seed-to-yield predictions,

	developing a robust algorithm that considers factors like plantation percentage, historical cultivation data, and relevant variables to enhance the accuracy of forecasting the number of seeds that will successfully grow during the gherkin season. Additionally, the objective extends to categorizing gherkin plant growth into distinct stages, collaborating with agricultural experts to define these stages, and tailoring fertilizer solutions accordingly. The overarching goal is to establish a comprehensive understanding of the plant's developmental phases and align them with appropriate nutritional needs. Lastly, the sub-objective aims to streamline the fertilizer procurement process by developing a method to estimate the quantity of	percentage, fertilizer usage, and actual yield. - Preprocess the data by handling missing values, formatting, and encoding variables. • Machine Learning Model Development: - Choose a regression algorithm for seed-to-yield prediction. - Split the dataset into training and testing sets. - Train and evaluate the machine learning model using relevant metrics. • Growing Stages and Fertilizer Recommendations: - Collaborate with agricultural experts to define three growing stages of gherkin plants. - Research and compile a list of fertilizers suitable	growing stage identification, and fertilizer recommendations, offering a holistic approach to optimize gherkin cultivation. The focus on Data-Driven Fertilizer Management stands out, leveraging machine learning for informed decision-making, thus maximizing resources and yield. Additionally, Collaboration with Agricultural Experts is a key feature, incorporating practical insights to align growing stages and fertilizer recommendations with real-world agricultural practices. This collaborative approach enhances the overall effectiveness of the system.

	fertilizer required for the entire gherkin farm, integrating predictions from the seed-to-yied algorithm and identified growing stages to provide precise recommendations for optimal plant growth.	for each growing stage, considering nutritional requirements. • Algorithm Implementation: - Implement the machine learning algorithm for seed-to-yield prediction. - Integrate the algorithm with the growing stages and fertilizer recommendations. • Estimation and Recommendation System: - Develop a system to estimate the overall fertilizer quantities needed for the gherkin farm based on the predicted seed yield and growing stages. - Create a recommendation system for farmers, suggesting	

		the types and amounts of fertilizers to purchase for optimal gherkin growth.	
Nissanka K.G.T.R.K	The implementation of a novel predictive model for gherkins market price Prediction, which includes the country wise forecasting of export demand, is the sub-objective of market price prediction. This entails combining historical data with information on the weather in the future, patterns in global demand, and meteorological data unique to each export destination. The solution aims to continually refine predictive models using machine learning and statistical techniques, incorporating an adaptive learning mechanism for dynamic adjustments based on real-time market conditions. Additionally, the sub-objective includes the development of user-friendly interfaces and an alert system tailored to countryspecific export demand,	Model Development: • Implement machine learning and statistical techniques to develop predictive models for gherkin prices. • Continually refine models using insights gained from the integrated data sources. Adaptive Learning Mechanism: • Integrate an adaptive learning mechanism into the model to allow dynamic adjustments based on real-time market conditions. User-Friendly Interfaces: • Design and implement intuitive user interfaces that provide stakeholders with easy access to market price predictions.	The current study's findings show that there is no research conducted on a comprehensive and adaptive approach to market price prediction in gherkins cultivation. After implementing this system, we can integrate diverse data sources, employ machine learning and statistical techniques, and utilize an adaptive learning mechanism. The emphasis on real-time data fusion and adaptive learning positions our solution at the forefront of innovation, enabling a more agile response to market trends and ensuring a competitive edge in the gherkin market.

	enhancing stakeholder engagement and providing timely insights into market dynamics, growth patterns, and demands in different regions.	Alert System: • Develop an alert system to notify operators and relevant personnel of significant changes or trends in gherkin prices	

9. Supervisor checklist

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

Yes	x	No	

b) Does the proposed topic exhibit novelty?

Yes	x	No	

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

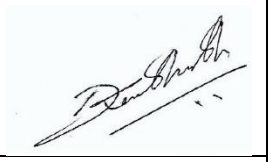
Yes	x	No	

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

Yes	x	No	

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

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Assistant Professor	Dharshana	Kasthurirathna	
Co-Supervisor	Assistant Lecturer	Poojani	Gunathilake	
External Supervisor	Manager - IT Infrastructure, Group IT	Gayan	Fernando	
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 request the RP Team for a new topic assessment.
3. The form approved by the panel must be attached to the **Project Charter Form**.