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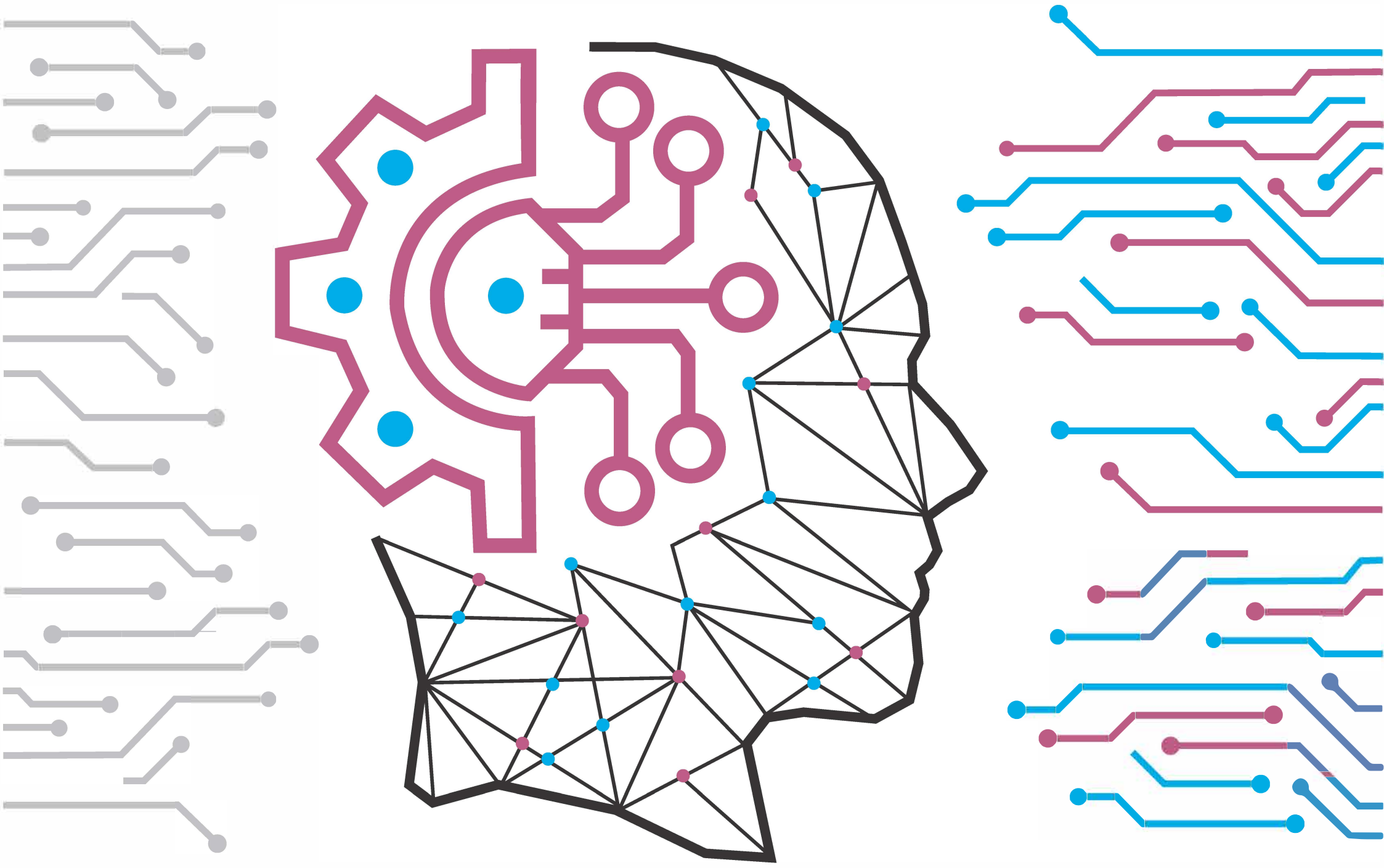

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THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

EXTENDED ABSTRACTS

e-BOOK

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THE 13th INTERNATIONAL
INNOVATION, INVENTION &
DESIGN COMPETITION 2024

Organized by:
Office Of Research, Industry,
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UiTM Perak Branch

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Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-31-4

Cover Design: Dr. Mohd Khairulnizam Ramlie
Typesetting : Zarinatun Ilyani Abdul Rahman

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AUTOMATED ROCKMELON GRADING TECHNOLOGY

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ABSTRACT

The Automated Rock melon Grading Technology presents a pioneering solution set to transform the agricultural landscape, particularly in the grading of rock melon. The system integrates state-of-the-art technologies such as weight sensors and high-resolution cameras to revolutionise the grading process by addressing the inherent challenges of manual grading methods prevalent in the industry. The system ensures rapid, precise, and consistent grading outcomes through a meticulously designed multi-stage approach, starting from weight measurement for quantitative assessment and culminating in visual inspection for quality attributes. This comprehensive methodology enhances accuracy and efficiency and minimises manual intervention, significantly improving productivity throughout the grading process. Moreover, the system's scalability and adaptability, facilitated by customisable options, cater to stakeholders' diverse scales and requirements across the agricultural supply chain, from farms to distributors. The technology provides real-time data insights and adaptive learning capabilities by leveraging sensors and machine learning (ML) algorithms, enabling continuous refinement and optimisation of grading processes. This technological innovation holds immense promise for advancing operational efficiency, quality control, and sustainability in rock melon production, thereby meeting the evolving demands of consumers and stakeholders while contributing to the overall advancement of the agricultural industry.

Keyword: Automated, Machine Learning, Dataset, Grading, Fruit, Vegetable, Rock melon, AgTech

1. INTRODUCTION

In the dynamic landscape of agriculture, there is a pressing need for grading systems that are efficient, precise, and scalable. Conventional manual methods, while foundational, often suffer from labour intensiveness, time constraints, and susceptibility to human error, leading to inconsistencies in the quality assessment. Addressing these challenges, the Automated Rock melon Grading Technology emerges as a groundbreaking solution to redefine the grading paradigm specifically for rock melons.

This innovative system represents the pinnacle of technological integration, meticulously crafted to streamline the grading process for rock melons. This solution delivers instant, precise, and comprehensive grading outcomes by leveraging advanced weight sensors and high-resolution cameras. Through a structured workflow comprising multiple assessment stages, the system begins with weight measurement for quantitative evaluation before seamlessly transitioning to visual inspection for quality attributes. This methodical approach ensures that intricate details such as colour, ripeness, surface defects, and sweetness are discerned precisely, bolstering grading accuracy while minimising manual intervention and enhancing operational efficiency and throughput.

Furthermore, the Automated Rock melon Grading Technology is designed with scalability and adaptability at its core, offering customisable options to meet the diverse needs of stakeholders across the rockmelon supply chain, from small-scale producers to large-scale distributors. This solution provides real-time data insights and adaptive learning capabilities by harnessing the power of sensors and ML algorithms, facilitating continuous refinement and optimisation of grading processes.

2. METHODOLOGY

2.1 Requirement Analysis

The development process commenced with a comprehensive analysis of the requirements and challenges associated with traditional manual rockmelon grading methods. This phase involved stakeholder consultations, market research, and domain expertise to ascertain critical features and functionalities needed in the automated grading system.

2.2 Technology Selection

Following requirement analysis, an extensive evaluation of suitable technologies for rockmelon grading was conducted. This encompassed research into high-resolution cameras, sensors, and machine-learning algorithms. Selection criteria included accuracy, speed, scalability, cost-effectiveness, and compatibility with the grading process.

2.3 Software Development

The software infrastructure of the grading system was developed to create a user-friendly interface for real-time monitoring and control. Image processing and analysis algorithms were implemented, and a backend system for data storage, retrieval, and analytics was designed.

2.4 Machine Learning Model Development

The acquisition of data from rock melon farms formed the foundation for developing the machine learning model. A dataset of approximately 1200 rock melon images representing various qualities was collected. Data preprocessing techniques were applied to enhance data quality, followed by data augmentation to increase dataset diversity. Convolutional Neural Networks (CNNs) were employed for their efficacy in image classification tasks. Three primary CNN-based machine learning models were trained: defect identification, netting presence and ripeness classification.

2.5 Integration and Testing

Once the machine learning models were developed, they were integrated into the software infrastructure for seamless interaction. Extensive testing was conducted to ensure accuracy in grading results and robustness in various operating conditions.

2.6 Iterative Improvement

The final stage involved iterative refinement and improvement based on user feedback. Continuous updates and enhancements were made to optimise performance, address identified issues, and adapt to evolving user needs and market dynamics. This iterative approach ensured the development of a reliable, scalable, and future-proof automated rock melon grading technology.

3. FINDINGS

The Automated Rock Melon Grading Technology was rigorously evaluated through the performance of three CNN models focused on appearance, netting, and ripeness classification. Each model was trained with a comprehensive and augmented dataset to ensure robust performance.

Table 1 Accuracy Percentage of CNN Models

Model	Test Accuracy Percentage
Appearance	93.81%
Netting	88.82%
Ripeness	85.43%

Based on Table 1, the appearance model achieved a test accuracy of 93.81%, indicating its high reliability in assessing rock melon appearance. The netting model, trained with augmented data and using a robust CNN architecture with regularisation and dropout, achieved an accuracy of 88.82%. The ripeness model showed a test accuracy of 85.43%, demonstrating its ability to determine the ripeness of rock melons accurately.

These models were trained using data augmentation techniques to enhance robustness, including rotation, shifts, shear, zoom, and flips. The evaluation involved extracting test loss and accuracy from a separate test dataset, ensuring an unbiased assessment of the model's predictive capabilities. The test loss measured prediction accuracy, while test accuracy reflected the proportion of correct predictions.

Overall, the high accuracy percentages across all models confirm the system's potential to revolutionise the grading process, offering a scalable and reliable solution for the agricultural industry. This technology promises to enhance operational efficiency, quality control, and sustainability in rock melon production, paving the way for broader applications in agricultural grading practices.

4. CONCLUSION

In conclusion, the Automated Rock melon Grading Technology represents a significant advancement in agricultural grading systems, particularly tailored for rock melons. This innovative solution offers precise, efficient, and scalable grading capabilities by integrating cutting-edge technologies and machine learning algorithms. The system's multi-stage assessment process, encompassing weight measurement and visual inspection, ensures comprehensive quality evaluation while minimising manual intervention. Its adaptability and scalability cater to the diverse needs of agricultural stakeholders, from small-scale farms to large-scale distributors. Moreover, the machine learning models, trained on a robust dataset acquired directly from farms, demonstrate the system's capacity for accurate grading across various quality attributes. Overall, this technology holds immense promise for enhancing operational efficiency, quality control, and sustainability in rock melon production, paving the way for broader advancements in agricultural grading practices.

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