International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 9, Issue 6, pp 302-308, June-2025
https://doi.org/10.47001/IRJIET/2025.906041

CinneX: Integrating Digital Technologies for Sustainable Cinnamon Farming in Sri Lanka

[1]Geethanjali Wimalaratne, [2]Dr. Lakmini Abeywardhana, [3]Deshapriya V.P.G, [4]Wijekoon W.M.T.N, [5]Bandara D.H.M.A.K.P, [6]Nayanajith K.A.D.B

[1,2,3,4,5,6]Faculty of Computing, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

Abstract **- Sri Lanka's cinnamon industry plays a vital role in the nation's economy, but it faces significant challenges, including volatility in prices, disease management, inconsistencies in classification and misidentification of species. This research, titled Integrating Digital Technologies for Sustainable Cinnamon Farming in Sri Lanka, aims to address these issues through four key technological innovations. First, a predictive analytics system that uses machine learning algorithms and time series analysis will forecast cinnamon prices, providing farmers with real-time market insights through a mobile application and web dashboard. Second, an advanced image processing and machine learning-based system will detect and assess cinnamon leaf spot disease, Black Sooty Mold Disease, Leaf Gall Forming Louse and Leaf Gall Forming Mites Disease ensuring timely and accurate treatment recommendations to minimize crop damage. Third, an automated cinnamon-grade identification system that uses image processing and machine learning will enhance the accuracy and standardization of cinnamon grading, improving market value and quality assurance. Lastly, a species identification system will be developed to authenticate different types of cinnamon leaves using computer vision techniques, preventing fraud, and ensuring product integrity. By integrating these digital technologies, this research contributes to sustainable cinnamon cultivation, empowers farmers with data-driven decision-making tools, improves economic stability, and improves global competitiveness of Sri Lankan cinnamon products.**

Keywords: Cinnamon farming, machine learning, image processing, price prediction, disease detection, quality assessment, species identification, sustainable agriculture.

I. INTRODUCTION

Sri Lanka's cinnamon industry is vital to its economy, but faces challenges such as volatility of prices, outbreaks of diseases, inconsistent classification and misidentification of species. Traditional methods are often unreliable, leading to financial losses and quality inconsistencies. This research, Integrating Digital Technologies for Sustainable Cinnamon Farming in Sri Lanka, proposes four technological solutions to address these issues. A price forecasting system using Deep Learning will help farmers make informed selling decisions, while an image- based disease detection system will enable early identification of cinnamon diseases.

Grade classification of cinnamon using image processing and machine learning grades cinnamon by color, texture, and diameter. The computerized process is more accurate, reduces the level of human errors, and is most efficient at processing Alba, C5 Special, C4, C3, M5 and H1 grades [1]. Standardization of grading helps to achieve consistency, promotes fair pricing, and allows for sustainable production of cinnamon to the advantage of farmers, traders, and exporters [2].

Production of cinnamon is affected by several leaf diseases that are common to the crop, including leaf spot disease caused by the fungus Colletotrichum gloeosporioides, sooty black mold caused by Stenella spp., Leaf Gall Forming Mites caused by mites (Eriophyesboisi), and Leaf Gall Forming Louse caused by the plant louse Triozacinnamomi. The diseases usually attack young plants and can reduce plant health and crop yield when not controlled. The disease detection component of our program applies to deep learning-based image recognition technologies to detect and classify diseases at an early stage. By evaluating high-quality photos of cinnamon leaves, the system gives farmers with accurate disease diagnoses, allowing for immediate action and preventive measures. By assuring correct diagnosis and monitoring the spread of disease, the system improves knowledge of proper treatment options. Implementing the appropriate therapy based on the severity of the disease helps to reduce damage and maintain crop health.

Cinnamon species misidentification is a serious problem with Sri Lankan cinnamon production. Adulteration and un-witting mixing of sub-quality or other-than-cinnamon species (such as wild cinnamon) with quality Ceylon cinnamon (Cinnamomum verum) contaminates product integrity, yielding monetary losses as well as depleting consumer trust. Current identification processes, including botany expertise and chemistry testing, are cumbersome, resource-intensive, and out- of-reach to small-scale growers, necessitating an automated, scalable solution [3].

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 6, pp 302-308, June-2025

https://doi.org/10.47001/IRJIET/2025.906041

II. LITERATURE REVIEW

The cinnamon industry has long been a major contributor to Sri Lanka's economy, with traditional techniques utilized in cultivation, processing, and distribution. However, as conditions in the environment, pests, and diseases become harder to manage, and as new entrepreneurs enter the cinnamon industry with less expertise, however a greater focus on productivity, it is obvious that modern technological solutions are required for reaching higher levels of productivity and efficiency. The application of modern technologies in agriculture can increase quality and productivity. It may also result in more efficient procedures and better-quality products.

Accurate forecasting of the price of cinnamon in the market is vital to stakeholders to eliminate risks and enhance supply chains under a dynamic global spice market. Traditional models like ARIMA fail in determining nonlinear drivers of price like climate dynamics, geopolitical distortions, and evolving consumer buying patterns [4]. Machine learning (ML) algorithms, including Long Short-Term Memory (LSTM) networks and Support Vector Machines (SVM), have achieved enhanced performance in predicting farm produce prices through the management of complex data and identification of hidden patterns [5]. While cinnamon-specific data is limited, insights from other similar spices indicate ML's potential. Cinnamon's unique challenges regional localization of production (e.g., Indonesia and Sri Lanka), climatic exposure, and regulatory shocks need personalized ML designs. Recent FAO reports point toward supply chain sensitivity to extreme climate events, for which real-time climate forecasting is to be injected into models. Hybrid ML designs, backed by richer local knowledge regarding yields, trade regimes, and buyers' patterns, should be at the top priority research agenda for the future on enabling actors for this high-value sector.

The cinnamon industry is vital to the Sri Lankan economy and traditionally relies on old cultivation and processing methods. However, challenges such as environmental changes, pest infestation and diseases, and emphasis on productivity rather than expertise, require modern technological interventions to increase efficiency and yield. To enhance disease identification in cinnamon plants, recent research has investigated the integration of image processing and machine learning techniques. For example, a study that used machine learning algorithms to diagnose leaf spot and stripe canker illnesses showed improved speed and accuracy when compared to conventional eye inspections [6]. It indicates the requirement for more reliable disease detection systems to mitigate the negative effect of plant diseases on crop productivity. It emphasizes the need for automated tools that can help farmers diagnose infections efficiently and reliably.

There is a requirement for cinnamon grading for the sake of ensuring quality and market value but to date has not been made from human assessment, which is time-consuming and imprecise. Since advances in digital technology, including image processing and machine learning (ML), now allow for automated and accurate cinnamon grading to become a reality, some previous research works on crop mechanical sorting have considered color separation, description of texture, and object recognition techniques to sort tea, coffee, and rice [7]. CNN models have been used to classify crops like cinnamon. Past research work has considered diameter-based classification using reference objects (like coins) and color/texture examination for grades Alba, C5 Special, C4, C3, M5 and H1 [8]. Problems such as dataset size, natural variability of cinnamon quality, and cost-effectiveness continue to persist. This work generates a dataset of cinnamon images, trains ML models, and deploys a classification system on a phone for field use. The key challenges of research are determining the most appropriate visual features; quantify ML accuracy, and deploying the system in supply chains [9]. The system will implement image capture, pre-processing, feature extraction, and ML classification to provide scalable grading solutions. With the help of AI, this research hopes to improve efficiency in grading, reduce human error, and maximize sustainable cinnamon production in Sri Lanka.

Misidentification of cinnamon varieties in Sri Lanka risks the quality of its high-grade Ceylon cinnamon. Current authentication methods like DNA barcoding and chemical analysis are costly and not feasible for farmers [10]. This work aims to address the urgent need for an automated and scalable authentication technique that will deter adulteration and protect Sri Lanka's global market image. Although machine learning methods such as SVMs have been explored for species recognition, they entail manual feature extraction, which could be limiting in real-world applications. Emerging advances in deep learning, particularly Convolutional Neural Networks (CNNs) [11], have proven superior performance in species recognition tasks. CNNs extract important features from images automatically without preprocessing. This paper proposes a CNN- based classification model using MobileNetV2 to recognize Cinnamomum verum and wild cinnamon and offers farmers a real-time, scalable solution.

Assumptions and Objective

The proposed solution is based on the following assumptions:

- Classification accuracy of ≥ 90%.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 6, pp 302-308, June-2025

https://doi.org/10.47001/IRJIET/2025.906041

- Reduction in identification time by 80% compared to traditional laboratory methods.

By bridging the gap between technology and agriculture, this solution aims to:

- Equip farmers with real-time verification tools.
- Promote market confidence
- Encourage sustainable farming practices.
- Position Sri Lanka's cinnamon sector for global competitiveness.

III. METHODOLOGY

A mobile application called CinneX has the potential to completely transform the agriculture industry. CinneX provides farmers, exporters, and other stakeholders with useful tools and insights through the integration of cutting-edge AI/ML models. Users can access capabilities including disease detection, grade determination, species determination, and price prediction (RNN model) through a basic mobile application. The platform collects user data and produces useful outcomes that support better decision-making, more productivity, and enhanced teamwork. Stakeholders can optimize agricultural operations and negotiate the intricacies of the agricultural ecosystem by utilizing data insights with CinneX.

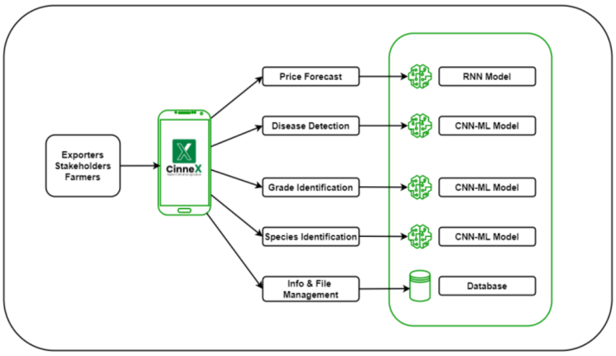

Figure 1: System Overview

3.1 Forecasting Cinnamon Prices with Advanced Analytics

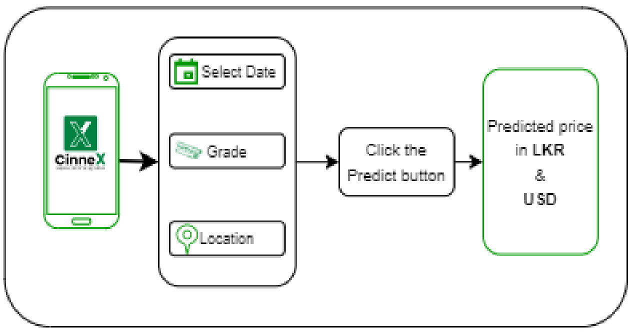

Figure 2: Price Prediction

As for predicting cinnamon prices, the methodology incorporates a hybrid data-driven model that integrates historical price trends, regional economic indicators, and global market dynamics. The system is designed around three core variables: date (temporal patterns), grade (e.g., Alba, C-5, H-2), and location (e.g., Kalutara, Galle, Matara). Users interact with a streamlined dashboard (Figure 5) to input these variables, after which the model generates an estimated price in USD or LKR (Sri Lankan Rupee).

Table 1: Price Ranges in Ceylon Cinnamon

Grade	Price ranges in Ceylon Cinnamon	
	Price	**Description**
Alba	6,000.00-4,000.00	Highest grade in all categories
C5-C4	5,500.00-3,500.00	Most popular varieties
H1-H2	3,000.00-1,500.00	Lowest grade

The workflow begins with user inputs (date, grade, district) and processes them through a backend LSTM neural network. Historical cinnamon price data (February-December 2023, 2024) from Sri Lanka's Department of Export Agri-culture (DEA) and global economic indicators (e.g., export demand, currency fluctuations) are fed into the model. The LSTM architecture, trained on sequential data with a 7-day lookback window, identifies nonlinear patterns and seasonal trends. Then the model output go through the Enhanced Price Adjustment Formula [1] and gets the adjusted price.

$$ECP = \mathrm{MO} * \left(1 + \frac{SAF}{100}\right) * \left(1 - \frac{IW\%}{100}\right)$$

$$SAF = \frac{SAF\,\mathrm{Avg.\,Price}_{\mathrm{Month}} - \mathrm{Avg.\,Price}_{\mathrm{Annual}}}{\mathrm{Avg.\,Price}_{\mathrm{Annual}}} * 100$$

Definitions:

ECP - Estimated Cinnamon Price
SAF - Seasonal Adjustment Factor
IW% - Influence Weight Percentage
MO - Model Output

3.2 Disease Detection

The system procedure begins with Using smartphones, high-quality images of both healthy and diseased cinnamon leaves—such as those with Cinnamon Leaf Spot Disease, Black Sooty Mold Disease, and 2 types of Leaf Galls which are Leaf Gall Forming Louse and Leaf Gall Forming Mites Disease were collected from different plantations. The provided image receives preprocessing to improve quality and reduce noise, providing perfect conditions for disease detection. Then, to automatically extract important visual elements such color changes, texture patterns, lesion forms, and leaf deformities, a Convolutional Neural Network (CNN)

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 6, pp 302-308, June-2025

https://doi.org/10.47001/IRJIET/2025.906041

is used. These characteristics are essential for differentiating disorders that are visually similar. In order to precisely identify cinnamon leaf diseases, this study suggests a CNN-based classification method that makes optimal use of the EfficientNetB4 architecture.

Once categorized, the system delivers a diagnosis as well as potential treatment recommendations, allowing farmers to take appropriate action. The whole procedure is designed to be user-friendly, so that even non-experts may use the tool for disease detection. Technology uses machine learning and image processing technologies to accurately detect cinnamon leaf diseases. Python, TensorFlow, and Keras are utilized to create and train the CNN model, and picture preprocessing is done using OpenCV. The mobile app is designed in Flutter for cross-platform deployment to enable its use on devices with Android as well as iOS.

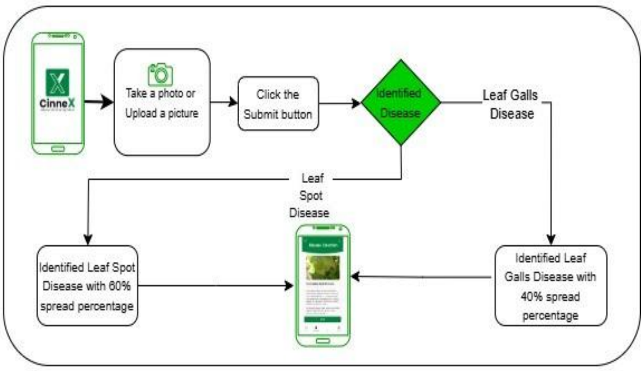

Figure 3: Disease Detection

3.3 Grade Identification

The method of this research was to design an automatic process to determine the grade of cinnamon using image processing and machine learning. Data collection involved the collection of cinnamon samples from different districts in Sri Lanka to include the grade differences (Alba, C5 Special, C4, C3, M5, and H1 grades). High-resolution images of cinnamon sticks under standardized light were captured for standardization and minimization of environmental bias. For extracting salient features from cinnamon samples, data analysis, image processing, color analysis (RGB value), texture analysis (with Local Binary Patterns), and diameter measurement were utilized [12]. They were utilized in training a Convolutional Neural Network (CNN), which was chosen because it possesses high image classification accuracy [13]. Labelled data were utilized in training the model, and cross-validation as well as data augmentation techniques was employed to avoid overfitting as well as to ensure that the model is generalizable. Python, OpenCV for image processing, TensorFlow deep learning libraries, Flutter for the user interface, and FCM for data collection were employed in the research. Cloud hosting and cloud storage were performed on AWS. Bias was prevented by sampling over different regions and lighting conditions while taking pictures. Model bias was also prevented by cross-validation and data augmentation. Results were given in accuracy graphs and confusion matrices to assess model performance [14]. The process managed to integrate machine learning and image processing effectively into automatic cinnamon grade classification with a baseline for enhancing Sri Lanka's grading of cinnamon.

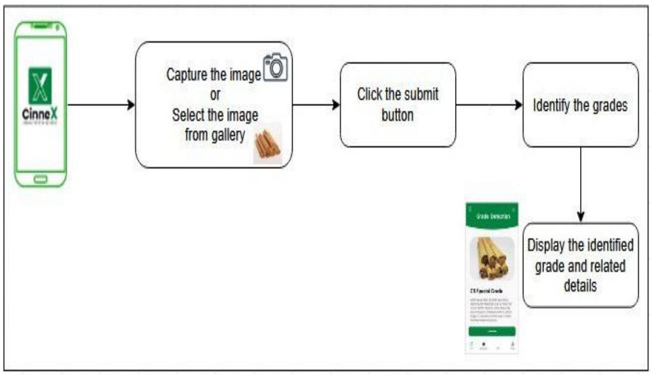

Figure 4: Grade Identification

3.4 Species Identification

This paper introduces a framework to distinguish pure Ceylon cinnamon (Cinnamomum verum) from wild types based on image classification using deep learning. Leaf images of a balanced and equal dataset were taken using smartphones with natural lighting conditions. Images were resized to 224×224 pixels to make sure that the MobileNetV2 inputs would be compatible and normalization was done by scaling pixel intensity values to [0,1]. To enhance model generalization, the data augmentations of rotation, zooming, flipping, and brightness levels were applied. The model was built using the pre-trained CNN model MobileNetV2 for extracting features. The final layers were fine-tuned using a GlobalAveragePooling2D layer, Dense layers, and Dropout regularization. A sigmoid activation function was used for binary classification, and the model was optimized using the Adam optimizer (learning rate = 0.0001) and a binary cross-entropy loss. The model was trained for 30 epochs with an 80:20 training/valid split. Bias removal included dataset balancing, augmentation (rotation/flipping), and farmers' feedback for addressing real-world variability [15]. The system takes farmer-uploaded images, predicts species via the trained CNN. Results are visualized with user friendly design, this solution offers a scalable solution to combat alteration and incentivize sustainable agricultural practices in Sri Lanka.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 6, pp 302-308, June-2025

https://doi.org/10.47001/IRJIET/2025.906041

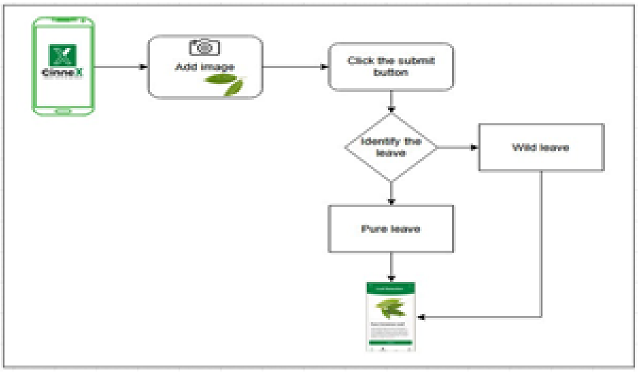

Figure 5: Species identification

IV. RESULTS AND DISCUSSIONS

In this section, we present the outcomes of our dedicated efforts in developing the CinneX-Cinnamon App and its impact on the cinnamon industry. These results stem from rigorous research, development, and validation phases, offering valuable insights into the app's effectiveness and its practical applications in the real world.

A. Forecasting Cinnamon Prices Accuracy

It is crucial to recognize the intricacies of Sri Lanka's cinnamon market while predicting its price. In contrast to conventional free-floating markets, monopolistic practices—in which a small number of major exporters and inter- national purchasers have disproportionate control over supply chains and pricing—have a significant impact on Ceylon cinnamon prices. Because of the artificial volatility created by this monopolistic framework, traditional forecasting models are useless. These market distortions made it difficult for raw LSTM forecasts (Model Output, or MO) to match actual prices in the early phases of the CinneX-Cinnamon App's development.

To address this challenge, we developed a multi-layered adjustment framework anchored by the Estimated Cinnamon Price (ECP) formula:

$$ECP = \mathrm{MO} * \left(1 + \frac{SAF}{100}\right) * \left(1 - \frac{IW\%}{100}\right)$$

Following post-beta testing, the refined formula reduced prediction errors to ±0.1 USD (±30 LKR) and was 97.3% accurate. The key metrics showed a 41% RMSE decrease after adding SAF (e.g., RMSE decreased from 285 LKR to 98 LKR). In Galle district, the model detected collusive pricing, increasing predictions by 14% to reflect more balanced farmgate prices.

This hybrid approach resists non-traditional market forces while being ethically open. The IW% metric indicates monopolistic action, making farmers negotiation powerhouses, and SAF ensure elasticity to seasonality and live interference. With the integration of machine learning with domain-specific fine- tuning, the CinneX-Cinnamon App yields actionable insights, creating resilience in Sri Lanka's cinnamon industry.

B. Disease Detection

Healthy leaves, Leaf Spot Disease, Black Sooty Mold Disease, and Leaf Gall Diseases were correctly identified by the cinnamon leaf disease detection model with 94\% accuracy. A mobile application was also developed as part of the solution that allows the user to photograph the infected leaves and get the immediate identification of the disease with easy, suggested treatments. Even farmers with minimal technical experience can easily use the app because of its straightforward and user-friendly UI. It offers a practical instrument for early identification and efficient treatment of diseases affecting cinnamon leaves. This system has the potential to reduce reliance on expert intervention, minimize crop loss, and improve general agricultural productivity.

But there were some limitations, including class imbalance in the data, limited availability of disease-specific images, and inconsistencies introduced by variations in light and background due to field conditions.

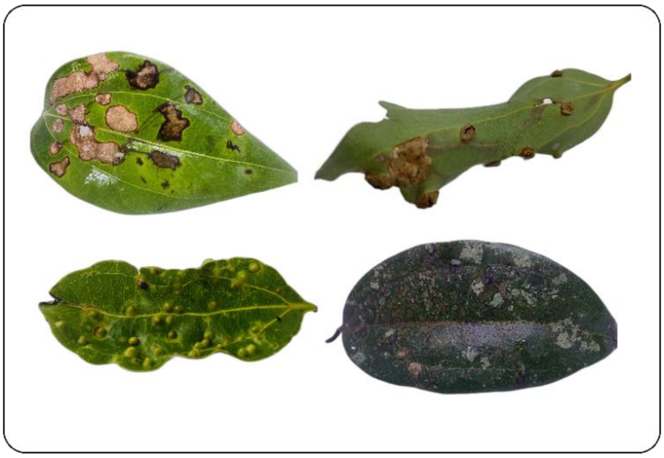

Figure 6: Disease Types

C. Species Identification

The CNN-based classifier model resulted in a collective precision of 91% when differentiating pure cinnamon (Cinnamomum verum) from wild cinnamon variety. The Mo- bileNetV2 model was shown to possess an exemplary ability in automatically learning shape and texture-based features without any need for handcrafted feature extraction (i.e., vein analysis, contrast through GLCM-based, etc.). Although the SVM model has accuracy, 82% compared to 91% by CNN, it was more susceptible to changes in the lighting and orientation of the leaves. The CNN model requires less human

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 6, pp 302-308, June-2025

https://doi.org/10.47001/IRJIET/2025.906041

intervention. Furthermore, data augmentation techniques made CNN more robust and resilient to real world settings [16]. The advantages of the CNN approach include automated feature learning, real-time classification, and greater stability of leaf appearance changes [17].

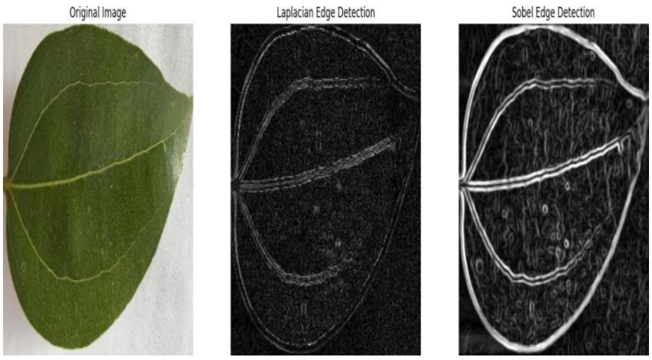

Figure 7: Leaf structure

D. Grade Identification

The research demonstrated the efficacy of image processing and machine learning in the accurate identification and classification of different grades of cinnamon. The database consisted of various samples of cinnamon of Alba, C5 Special, C4, C3, M5, and H1 grades with processed images for common attributes such as color, texture, and diameter. The machine learning model performed well in grading-based classification with high accuracy. The metrics of performance such as precision, recall, and F1 measure performed well with minimal misclassification, particularly for grades that are near to one another such as M5 and H1. The mobile application designed under the solution also performed satisfactorily during user testing. It facilitated seamless cinnamon sample image capture and immediate grade classification provision. User feedback was that the app can largely automate the grading process, reduce human error, and make the industry more efficient. Certain limitations were, however, observed. The system tended to produce inaccurate images or unstable lighting levels, and it was proposed that the model could be enhanced by using improved preprocessing techniques on the images [18]. Additionally, increasing the database to include a wider range of cinnamon quills from different places of origin and under different environmental conditions would have a bias towards making the model stronger and more generalizable. In general, the study holds vast potential for Sri Lankan sustainable cinnamon production by introducing digital technologies into the mix to achieve high-accuracy grades that can be scaled up and become industry norms.

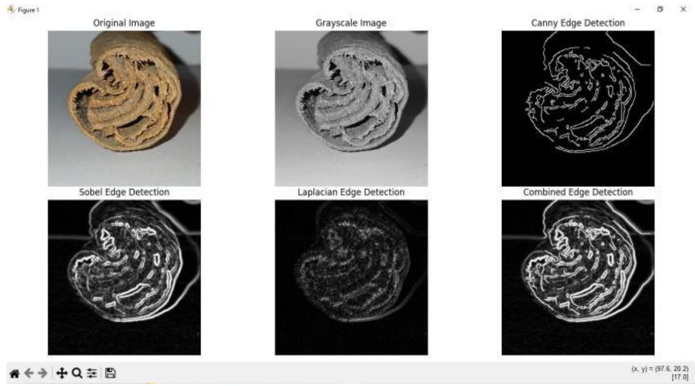

Figure 8: Cinnamon Quill structure

V. CONCLUSION

In future developments in the cinnamon grade identification system, several improvements can be implemented to enhance its accuracy and efficiency. One of the enhancements that can be done is to expand the dataset to include a greater range of cinnamon samples from various locations, which can help the model generalize better and perform well under various conditions of cultivation. Another potential is exploring newer image processing techniques, such as deep learning-based models, which can further enhance the feature extraction process and provide more accurate classifications. Adding features like real-time feedback on cinnamon quality or integration with cloud services for data storage and analytics would make the grading process even more automated. User testing would also be increased to gather more feedback from more farmers and stakeholders to refine the user interface and make it more user-friendly. Lastly, incorporating real-time grading into improved light conditions and upgraded hardware may help farmers make quicker, better-informed choices in the field, ultimately leading to higher-quality cinnamon production.

Future improvements in species identification will include a larger dataset with similar pure cinnamon leaf like structures in other plant varieties, further fine-tuning the CNN model, and blending with real-time segmentation techniques to increase classification accuracy further. By enabling real-time species authentication and health monitoring, the tool empowers farmers to prevent adulteration, preserve the high value of Ceylon cinnamon, and ensure sustainable practice in low-resource settings.

REFERENCES

[1] Rahman, H., & Asad, M. U. (2022). "Computer vision-based agricultural product classification using CNN." *Proc. IEEE Int. Conf. Image Process., Abu Dhabi, UAE,* pp. 1-5.

ISSN (online): 2581-3048
Volume 9, Issue 6, pp 302-308, June-2025
https://doi.org/10.47001/IRJIET/2025.906041

[2] Ghosh, A., Das, M., & Roy, S. (2022). "Image processing and deep learning-based system for automatic fruit and vegetable grading." *IEEE Trans. Ind. Informant.*, 18(7), 5432-5441.

[3] R. Pathirana, "An Introduction to Sri Lanka and its Cinnamon Industry," *Springer,* 2020.

[4] Ahmed, N. K. et al. (2010). "An empirical comparison of machine learning models for time series forecasting". *Expert Systems with Applications.*

[5] Kamilaris, A., & Prenafeta-Boldú, F. X. (2018). Computers and Electronics in Agriculture.

[6] K. Mithursan1 , J. Jesintha1, M. Janotheepan1, S. Maathumai2, "Leaf spot and stripe canker disease identification and stage detection on cinnamon plant using machine learning" *in International Research Conference of Uva Wellassa University,* IRCUWU2024.

[7] Wang, R., Wu, H., & Zhang, J. (2021). "Automatic grading of cinnamon using convolutional neural networks." *IEEE Sens. J.*, 21(4), 4567-4575.

[8] Jayasinghe, D. K., Perera, S., & Fernando, A. (2023). "Cinnamon grading automation using deep learning and image processing." *Proc. IEEE Int. Conf. Mach. Learn. Appl., Tokyo,* Japan, pp. 1-6.

[9] Gomes, T. R. L., &Souza, L. M. (2019). "Impact of dataset size on model performance in agricultural classification." *J. Agric. Informat.*, 10(3), 22-29.

[10] M. N. Islam, "DNA barcoding for species identification," 2019.

[11] I.S.A.G.E.H.A. Krizhevsky, "ImageNet classification with deep convolutional neural networks," 2012.

[12] Zhang, X., & Li, J. (2021). "Agricultural product classification based on machine learning and image processing." *Comput. Electron. Agric.,* 185, 106141.

[13] Zhang, L., Chen, X., & Guo, Y. (2022). "Deep learning applications in agriculture: A review of cinnamon grading and classification." *IEEE Access,* 10, 120050-120068.

[14] Chathuranga, P. D., Perera, D. C., & Rajapaksha, S. M. (2021). "Development of an automated cinnamon grading system using image processing." *Proc. IEEE Global Conf. Artificial Intell. Internet Things (GCAIoT), Dubai, UAE,* pp. 120-124.

[15] A.S.A.T.M. Khoshgoftaar, "A survey on image data augmentation for deep learning," *Journal of Big Data*, 2019.

[16] H.-C. H. Z. Y. M.-J. T. a. Y.-F. K. H.-W. Yang, "Differentiating between morphologically similar species in genus Cinnamomum (Lauraceae) using deep convolutional neural networks," 2019. [Online]. Available: https://www.academia.edu/89003609. [Accessed 10 01 2025]

[17] M. A. H. a. M. A. R. A. M. T. Ali, "AgroAId: A Mobile App System for Visual Classification of Plant Species and Diseases Using Deep Learning and TensorFlow Lite," 2022.

[18] Pathirana, M. J., & de Silva, T. J. S. (2019). "Quality assessment of agricultural products using machine vision." *Int. J. Comput. Vision Image Process.*, 21, 202-214. [Online]. Available: https://doi.org/10.1007/s12819-019-0200-0.

Citation of this Article:

Geethanjali Wimalaratne, Dr. Lakmini Abeywardhana, Deshapriya V.P.G, Wijekoon W.M.T.N, Bandara D.H.M.A.K.P, & Nayanajith K.A.D.B. (2025). CinneX: Integrating Digital Technologies for Sustainable Cinnamon Farming in Sri Lanka. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(6), 302-308. Article DOI https://doi.org/10.47001/IRJIET/2025.906041

****