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Review Article

# Automatic Arecanut Grade Analysis and Classification using Computer Vision and Machine Learning

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## Abstract

This research focuses on automating the classification of supari, or areca nut, through computer vision and AI techniques. Traditional manual methods for supari classification are time-consuming and prone to human error. Our approach involves capturing high resolution images of arecanut, processing them to extract relevant visual features, and training a deep learning model, particularly a convolutional neural network (CNN), to classify supari into distinct categories, such as "good" "bad," or "low-quality." The automated system, once trained, rapidly processes supari samples, providing real-time classification results. Benefits include improved accuracy, cost-efficiency, reduced labor, and potential for expanded applications in quality control and defect detection in the arecanut industry, offering a promising solution for enhancing supari processing and quality assurance.

**Keywords:** Machine learning, Grade analysis, Convolution neural network, Feature Extraction, Agriculture automation, Neural network Training.

## I. INTRODUCTION

The arecanut (betel nut) industry plays a crucial role in various economies, serving both cultural and economic purposes. However, traditional methods of classifying arecanut into different grades, such as "fresh," "dried," or "low-quality," have proven to be time-consuming, labour-intensive, and susceptible to human error. In response to these challenges, this research endeavours to revolutionize the classification process through the integration of cutting-edge technologies Computer Vision and Machine Learning. The proposed project aims to automate the analysis and classification of arecanut grades, leveraging the power of high-resolution images, advanced image processing techniques, and state-of-the-art machine learning algorithms. By doing so, the system is designed to overcome the limitations of manual methods, offering a more efficient, accurate, and real-time solution for grade assessment.

## II. Literature Survey

### *A. Machine Learning Techniques in Plant Disease Detection and Classification-A State of Art [1]*

The manuscript examines the deficiencies of conventional approaches like manual inspection and chemical fertilizer use, highlighting the evolution of automated systems for detecting plant diseases since the 1970s, driven by the demand for more effective solutions. This review seeks to delve into the array of existing research within this domain, encompassing diverse techniques, materials, and strategies. It's noted that a significant number of farmers remain unaware of the multitude of plant diseases. The review primarily sheds light on the integration of machine learning models, image processing methods, and advanced deep learning techniques aimed at augmenting the efficiency of plant disease detection frameworks. It further undertakes a comparative study of various methodologies, pointing out their respective advantages and limitations. Furthermore, the paper identifies existing research gaps and obstacles, setting the stage for the investigation of innovative methodologies. The primary purpose of this literature review is to foster progress in the field of plant disease diagnosis by introducing cutting-edge methods capable of accurately identifying and managing a range of plant diseases. Moreover, this document evaluates and recommends new strategies for the identification and categorization of plant diseases, with the ultimate goal of delivering more effective and scalable disease detection and classification solutions, which are especially critical for the agricultural industry in emerging economies.

***B. Deep Residual Learning Image Recognition Model for Skin Cancer Disease Detection and Classification [2]***

This study enhances existing research by implementing three cutting-edge, pre-trained deep learning models DenseNet121, VGG19, and a modified ResNet152 for the task of categorizing a detailed dataset of 3297 skin images into benign and malignant groups. Utilizing the advantages of transfer learning, these models were subjected to extensive testing and evaluation, focusing on various metrics such as accuracy, loss, precision, recall, F1 score, and the Receiver Operating Characteristic (ROC). Among these, the optimized ResNet152 model distinguished itself by securing a notable accuracy rate of 92% and an ROC score of 79%, surpassing the others with ROC scores of 88% and 75% respectively. Building on these insights, the study proposes a novel skin cancer identification system, named ResNetScr, derived from the ResNet152 architecture, which shows potential in supporting dermatologists in the precise and rapid diagnosis of skin cancer. The review of related literature highlights the critical role of deep learning techniques in the detection and classification of skin cancer, while acknowledging existing challenges and advocating for the enhanced performance of the ResNet152 model. This investigation provides a valuable contribution towards refining algorithms for more effective and dependable early skin cancer detection and diagnostic tools.

***C. Deep Image Compression with Residential Learning [3]***

The research paper discusses a novel image compression framework that leverages deep residual learning in an end-to-end model. This model is designed with a three-tiered approach to residual learning to boost the quality of image compression. These tiers include: (1) utilizing the architecture of ResNet, (2) applying deep channel residual learning for the quantization process, and (3) employing global residual learning at full resolution. The objective behind integrating these multiple levels of residual learning is to tackle various challenges within the compression workflow, leading to enhanced overall performance. A key feature of this framework is its reliance on a single Gaussian distribution for the distribution of residuals, a strategy that neural networks can easily adapt to and learn from. This simplifies the learning process and contributes significantly to the framework's efficiency. Furthermore, the framework incorporates an attention mechanism, enabling it to compress different areas of an image adaptively by varying the bit allocation. This adaptive mechanism adds a layer of flexibility to the compression technique. The framework's effectiveness is validated through tests on the Kodak Photo CD dataset, where it demonstrates clear advantages over conventional compression methods like JPEG and JPEG2000. The evaluation, based on metrics such as Peak Signal-to-Noise Ratio (PSNR) and Multi-Scale Structural Similarity Index (MSSSIM) at reduced Bit Per Pixel (BPP) rates, confirms the enhanced performance and superior visual quality of this novel approach compared to traditional standards.

***D. A Dilated CNN Model for Image Classification [4]***

The study presents an advanced CNN model that incorporates dilated convolution kernels instead of traditional ones, utilizing the dilated convolution algorithm often applied in image segmentation tasks. This new dilated CNN model is assessed using the Monist dataset for handwritten digit recognition, showing a 12.99% decrease in training duration and a 2.86% increase in average training accuracy when compared to standard CNN models. To overcome the issue of losing detailed features, which is a common drawback of dilated CNN models, the research introduces a Hybrid Dilated CNN (HDC) model. This model combines dilated convolution kernels with different rates of dilation and is evaluated using high-resolution remote sensing images of Earth's surface. The findings demonstrate that the HDC model, under identical experimental setups, reduces the training period by 2.02% while improving both training and testing accuracy by 14.15% and 15.35%, respectively, in comparison to the original dilated CNN approach. This literature review emphasizes the importance of the newly proposed dilated CNN and HDC models in enhancing the performance of image classification tasks. By solving issues related to computational efficiency and detail preservation, these models offer improved accuracy and training speed. This work contributes to the development of CNN-based image classification techniques, shedding light on the advancements possible with dilated convolution methods.

***E. Deep Learning for Image-Based Cassava Disease Detection [5]***

Cassava ranks as the world's third most important source of carbohydrates for human consumption but faces significant threats from viral diseases, jeopardizing food security in sub- Saharan Africa. To avert this potential crisis, innovative detection techniques for cassava diseases are crucial for enhancing disease management strategies. Image recognition technologies, noted for their affordability and scalability, present a promising solution. Recent advancements in deep learning have facilitated the adaptation of this technology for use on mobile devices. In our study, we utilized a collection of field images from Tanzania, applying transfer learning techniques to educate a deep convolutional neural network in recognizing three specific diseases and two forms of pest damage (or their absence). The highest performing model demonstrated accuracies of 98% in detecting brown leaf spot (BLS), 96% for identifying red mite damage (RMD), 95% for green mite damage (GMD), 98% for cassava brown streak disease (CBSD), and 96% for cassava mosaic disease (CMD), with an overall accuracy of 93% on images not included in the training set. These findings underscore the efficiency of using transfer learning for the image-based recognition of cassava diseases in field images, offering a rapid, cost-effective, and easily implementable method for digital detection of plant diseases.

***F. Deep Residual Learning for Image Recognition: A Survey [6]***

The article "Utilizing Deep Learning for Detecting Diseases in Cassava Plants Through Image Recognition" addresses the critical issue of cassava being susceptible to various viral diseases, which poses a significant risk to food security in sub-Saharan Africa. As a vital source of carbohydrates worldwide, it's crucial to find innovative detection methods to implement effective disease control strategies. The study advocates for the use of image recognition technology as a scalable and cost-efficient solution. It introduces new advancements in deep learning, particularly through the application of transfer learning, to create a sophisticated deep convolutional neural network (CNN) aimed at identifying three specific diseases and two kinds of pest damage in cassava crops. The research is based on a dataset of images collected from cassava fields in Tanzania, showing the technology's high accuracy in identifying diseases and pest damage. The most successful model reached detection accuracies of 98% for brown leaf spot (BLS), 96% for red mite damage (RMD), 95% for green mite damage (GMD), 98% for cassava brown streak disease (CBSD), and 96% for cassava mosaic disease (CMD). A significant focus of the study is its practical application, highlighting the technology's compatibility with mobile devices, which facilitates its use in the field. The adoption of a transfer learning methodology is crucial, offering a quick, affordable, and effective means of deploying image recognition for detecting plant diseases. The paper's findings highlight the effectiveness of using transfer learning to develop a rapid, cost-effective, and easily implemented solution for digital detection of plant diseases, particularly for cassava. This research offers important insights into leveraging deep learning technologies to tackle agricultural challenges, emphasizing the role of technological innovations in ensuring food security in at-risk areas.

***G. A Novel Mango Gradient System Based on Image Processing and Machine Learning Methods [7]***

The manuscript presents an innovative approach to mango grading, leveraging image processing and machine learning to automate quality inspection in the realm of smart agriculture. It delves into the critical review of existing computer vision techniques for fruit grading and classification, underscoring the crucial role of precise and efficient post-harvest handling in the mango sector. Through the exploration of various methods and algorithms, the paper showcases the significant promise that image processing holds for fruit sorting. The objective is to forge a system that streamlines the grading process, enhancing both its efficiency and accuracy. This research makes a pivotal contribution by amassing a novel dataset of local mango images and applying cutting-edge image processing methods for classification purposes. In its conclusion, the document highlights the encountered obstacles and the imperative for a universally accepted grading standard for mangoes, underscoring the paper's relevance and potential impact on the industry.

# REFERENCES


1. John, S., & Rose, A. L. (2021). Machine learning techniques in plant disease detection and classification-a state of the art. INMATEH-Agricultural Engineering, 65(3).
2. Jamal MustafaAI-Tuwaijari Department of Computer Science, College of Sciences University of Diyala, Diyala, Iraq, Naeem Th.Yousir,College of Information Engineering AI-Nahrain University, Baghdad, Iraq, Nafea Ali Majeed Alhammad, Department of Computer Science,Shatt AI-Arab University College, Basrah, Iraq, Faculty of Computer Science and Information Technology,University Tun Hussein Onn Malaysia, Johor, Malaysia.
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