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Review on Anthelmintic Tablet from Arecanut

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Abstract: *Background/Purpose: These days, the involvement of computer science in agriculture and food science is expanding. Classification and fault identification of diverse products employ a variety of Artificial Intelligence (AI), soft computing approaches, and methodologies, which contribute to higher-quality products for consumers. The position of Arecanuts in the international and Indian markets, as well as the application of computer vision and image processing to a system for categorizing and grading Arecanuts, are the main topics of this article. Objective: The development of a system for the automated categorization of Arecanut using images is limited by difficulties. To assess the value of computer vision application for Arecanut, it is critical to taken as account the traditional and economic significance of Arecanut. Design/Methodology/Approach: Several types of Arecanut are prone to great variation in color, texture, and form depending on the category and the area in which they are cultivated. Arecanuts are processed utilizing a variety of techniques, with an emphasis on the finished product's exterior. Here, the color, size, and texture of Arecanut are used to construct a classification or grading system. Findings/Result: With reference to the cited significant work that has been done on other fruits as well as Arecanuts from the standpoint of computer vision. This article provided a thorough introduction to Arecanuts, computer vision, and the uses and benefits of visionaided technologies in the grading of Arecanuts and categorization. Result Limitations/Implications: This review is based on the detection and classification of the Arecanuts done using computer vision and AI techniques. Originality Value: Several inline resources including review papers on Arecanut, research articles, technical books, and website resources. Paper Type: Literature Review paper on smart auto Arecanut Sorting and Grading of Arecanut using Computer Vision and Image Processing.*

Keywords: Computer Vision, Arecanuts, Artificial Intelligence, Sorting, Grading, Classification, Image Processing, ABCD analysis

I. INTRODUCTION

In the economic growth of the nation, agriculture is important. It provides 18.5% of the GDP and is the backbone of the Indian economy. Besides, 10% of the nation's overall exports come from it. India is the 2nd largest country concerning overall arable land since more than sixty percent of its total land is arable. In India, agriculture is a major source of income for almost 50% of theworkforce. Being the principal source of income for humanity, it is a cultural profession that the vast majority of people Internet undertake. A strong agricultural industry ensures that a country will have enough food, money, and jobs [1]. The overall cultivation areas and agricultural produce yields have expanded quickly as the nation has developed in recent years, which has led to higher market value. Despite the fact that these methods possess a major opportunity to become a significant exporter of agricultural goods, the share of the global market is very small due to factors such as post-harvest losses in managing as well as processing different items, unscientific practices use in the trades and procurement systems, poor understanding in product protection and quality assessment procedures, and others. With a constantly growing population, there exists a constant need for high-quality items with more promising futures. Arecanut (Areca catechu L.) is a major commercial crop in India. India leads the world in both area (57%) and production (53%) of Arecanut. When compared to other states in India, Karnataka and Kerala State rank first in both area and production of Arecanut. Four southern states account for nearly 92% of total Arecanut production in the country. According to the Food and Agriculture Organization of the United Nations, India contributed 54.07% of global Arecanut production in 2017. Myanmar, Indonesia, Bangladesh, China, Sri Lanka, and Thailand are the other major contributors, in decreasing order of contribution. Arecanut comes in two varieties: white Supari and red Supari. Supari of the red variety is made by harvesting the tender (green) Arecanut and peeling the husk. The nut

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obtained by peeling the tender nut is processed as needed (i.e., whole nut, two pieces, eight pieces, etc.), boiled in water, and then sun dried. The red variety of Arecanut is primarily grown in the Karnataka districts of Shimoda, Chickmangalur, North Kanara, Chitra Durga, and Tumkur. Kerala districts include Trivandrum, Quilon, Alleppy, Kottayam, Ernakulam, Trichur, and Wayanad. White supari (Chali) is made by harvesting fully ripe Arecanut and sun drying them for 40 to 50 days. After drying, the nut's shell must be removed by hand or machine. The white variety of Areca, known as the Chali variety, is primarily grown in Karnataka's South Kanara, North Kanara, and northern parts of Kerala. Every agricultural product including Arecanut needs a focused quality determination since it is more rapid, dependable, and accurate. [2]. Generally, high-end data from the actual world is translated to numerical or symbolic data in the course of Computer Vision, which involves many phases such as picture capture, pre-processing, augmentation, and interpreting images. These days, totally computer vision technologies try to emulate the human visual system. Applications for machine vision are crucial in the realm of agriculture. Through computer vision applications, that aid in identifying the shape, size, colour, as well as texture of numerous things, numerical and symbolic data about the Arecanut and the image being taken is collected as well. The visible colour spectrum is where the researchers often perceive items [3]. Infrared, near infrared, and ultraviolet items are difficult for humans to access. However, it is possible with the aid of different Machine Vision systems. Pre-harvest plant maturity, diseases, or stress situations may all be determined using the information collected from products in low-light areas. The age, variety, quality, and freshness of fruits and vegetables may all be determined with the use of machine vision. Additionally, it is helpful in acquiring product safety information and quality characteristics, like composition, illnesses, flaws, and contamination of grains, nuts, fruits, and vegetables [4]. With the evolution of AI and Machine Learning (ML) in Computer-Aided Design (CAD), image processing has faced plenty of advancements. Numerous research and findings have been made with image classification and detection using ML algorithms [5][6]. Particularly, in Arecanut grading and sorting, several types of research have been implemented so far and some of the works are reviewed in this paper to find the recent implementations and developments.

RESEARCH OBJECTIVES

Generally, processing the Arecanut through images faces a lot of challenges. The objective of this study is to examine some of the features and challenges in processing Arecanut images with the aid of computer vision. The following objectives are focused on in this study.

• To figure out the recent studies carried out in Arecanut processing

. • To design Hardware System to sort and grade Arecanut using Conveyor System.

• To explore the various ML and Deep Learning (DL) algorithms implemented in Arecanut processing i.e., sorting and grading.

• To point out the features and challenges in sorting and grading techniques applied in Arecanut.

METHODOLOGY

The necessary material is gathered from a variety of sources, including books, published research articles, journals, and conference articles. Farmers and the CAMPCO-Mangalore, Central Areca Nut and Cocoa Marketing and Co-operative Society (CAMPCO), a largest Arecanut marketing board provided early knowledge on Arecanut grading and sorting.

II. LITERATURE REVIEW

This literature study addressed some of the grading, segmentation, and classification techniques involved in. Arecanut According to Danti. A, et al. [7], Arecanut should be graded effectively. The Arecanut's RGB picture was converted to YCbCr color space. For effective segmentation of Arecanut, three sigma control limits on color traits were found. The Support Vector Machine (SVM) technique and color characteristics were used to grade Arecanut. The experimental outcomes exposed the recommended technique was successful when employing the k-fold cross-validation method and boiling and non-boiling nuts were effectively graded. In the proposed study of Dhanesha R. et al., [8] Arecanut bunches were segmented using the YUV, YCbCr, YCbCr, YPbPr, and HSV color models. The experiment was conducted using a dataset including 1017 photos of an Arecanut bunch, and the segmentation results for every color model were

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assessed via several segmentation performance measures. According to the experiment's findings, the YCgCr as well as HSV color models were effective in segmenting Arecanut bunches. Danti. A, et al.

[9] suggested Arecanut raw segmentation and classification approaches. In this research, a unique system for dividing Arecanuts into 2 sets according to color was created. Segmentation, masking, and classification were the first three. Besides, the segmented portion of the Arecanut was classified based on several two-color components, such as red and green. The experimental efficiency had a classification success rate of between 97 and 98 percent. Siddesha. S et al.

[10] focused on examining various color segmentation approaches, including Thresholding, K-means clustering, FCM, Fast FCM clustering (FFCM), Watershed, and Maximum Similarity based Region Merging (MSRM). Utilizing a 200-image Arecanut dataset, the segmentation algorithms' efficacy was assessed. Dynamic contouring segmentation, which separates Arecanut bunches in images, was offered by Dhanesha et al.

[11]. Twenty images of Arecanut bunches in varying stages of maturity were obtained. There were no published benchmark findings to which the effectiveness of the suggested strategy was evaluated. The suggested method might not segment effectively for poor-quality images. With the aid of an active contouring-based computer vision system for segmentation, the maturity of Arecanut bunches was assessed. Dhanesha et al.

[12] determined the Arecanut bunches' maturity level. The Arecanut bunch was automatically segmented using the YCgCr color model from a given image, and the Arecanut maturity level was calculated using this segment image. Moreover, a mobile camera was used to take pictures for a database of 1000 photographs. This method's experimental results for associating the input image accomplished considerable accuracy. Mallaiah. S et al

[13] employed the Local Binary Pattern (LBP) operator, a potent tool for microtexture description, to analyze the texture of Arecanut. The Gray Level Co-occurrence Matrix (GLCM) and Gabor filters both collect data at various scales and angles. The categorization of Arecanut data has been done using the Gabor and GLCM-based LBP. Harisha, N. T et al.

[14] used the color characteristics of the components of the Arecanut's RGB, HSV, and YCbCr color spaces, a categorization of Arecanuts with husk has been presented in this study. Here, the SVM and k-Nearest Neighbour (kNN) algorithms were employed to classify the Arecanuts. Huang, K. Y.

[15] developed and determined a class of Arecanuts. To categorize the Arecanut diseases, a Detection Line (DL) approach was employed. Furthermore, 6 geometrical characteristics, 3-color features, and the fault area were employed in the categorization approach. To classify the quality of Arecanuts, a Back-Propagation Neural Network (BPNN) algorithm was used. Suresha M. et al. [16] distinguished Arecanut diseases through LBP, Haar Wavelets, GLCM, and Gabor filter. There were two phases to these operations including LBP which was applied to every color component of the HSI and YCbCr color model and the creation of an LBP histogram. Since the 1st phase's findings were poor, the 2nd phase utilized texture features from Haar wavelets, GLCM, and Gabor and accomplished better accuracy. Suresha, M., et al.

[17] employed LBP, Haar Wavelets, GLCM, and Gabor wavelets to classify the affected and unaffected Arecanuts. Three models were presented for the categorization. LPB has been modified and used in the initial model. The second model uses empirical feature combinations to choose the most discriminative subsets of features from the HSI and YCbCr color model components. The third model suggests a symbolic way of classifying infected and unaffected Arecanuts. Meghana, D. R., et al.

[18] addressed Convolutional Neural Network (CNN) technology to identify disorders and suggests treatments. Herein, 241 healthy and diseased photos were included in the dataset for training and evaluating the CNN algorithm. Categorical cross entropy was employed as a loss function in this instance, Adam was used as an optimizer function, and accuracy was used as measure for model construction and attained considerable accuracy.

SR. No.	Author	Methods	Process	Feature	Challenges	Achievements
1	Siddesha, S., et al in 2015 [19]	Nearest Neighbour (NN) classifier	Classification on w.r.t Grading	Various varieties of grades were classified	Too many processing steps using LBP, Gray Level Difference Matrix (GLDM), GLCM, and NN	Accomplished d accuracy of 91.43%

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					classifier.	
2	Danti, A., et al in 2012 [20]	Decision Trees Classifier	Classification on w.r.t Grading	6 various grades were classified	The large dataset is used to avoid overfitting and exposed high computational time	Achieved 99.05% of accuracy
3	Balanagouda, P. et al in 2019 [21]	Fungicide Loaded Urea Briquettes (FAUB)	Fungicide to resist FRD	Attained stronger fungicide activity and minimized 70 percentage of severity	However, the economic analysis yields low performance	Attained better yield response and efficiency concerning severity
4	Patil, S., et al in 2021 [25]	K-means Segmentate on approach	Segregation w.r.t Quality	Processing and edge detection steps were involved	8 various preprocessing approaches have been implemented and only 3 of them attained considerable performance	Obtained reasonable accuracy
5	Bharadwaj, N. K. in 2021 [28]	SVM	Classification on w.r.t Grading	Four various grades of Arecanuts were classified	Estimating values for texture extraction was complex	Experiments were conducted in terms of precision, score, and accuracy
6	Anilkumar M G., et al in 2021 [29]	CNN	Disease Detection	Helps to detect diseases in Arecanut, leaves, and bunches	A total of 620 images were employed for experimentation on and resulting in overfitting	88.46% of accuracy was accomplished d
7	Siddesha, S., et al in 2018 [30]	k-NN	Classification on w.r.t Grading	Color histogram and color features of Arecanuts were used for classifying the grades	Various k values were used for implementation on which increased the computation time	98.13% of accuracy was obtained

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Normal and Infected Arecanuts

S. No	Author	Diseases
1	Chandrashekhara, H., et al in 2019 [66]	Split, Rot, Split-Rot
2	Naik, B. H. P., et al in 2019 [67]	Microbial consortia and Phytophthora meadii
3	Sastry, M.N.L., et al in 1988 [68]	Koleroga
4	Lokesh, M.S., et al in 2014 [69]	Koleroga/Mahali
5	Narayanaswamy, H., et al in 2017 [70]	Phytophthora meadii (Koleroga)
6	Pande, V. S., et al in 2016 [71]	Phytophthora meadii
7	Ramesh, R., et al in 2014 [72]	Koleroga/Mahali
8	Balanagouda, P., et al in 2021 [73]	Phytophthora meadii
9	Balanagouda, P., et al in 2021 [74]	Fruit Rot Disease (FRD)
10	Patil, S., et al in 2018 [75]	Phytophthora meadii

Arecanut disease detection, classification, and early detection are currently the subjects of a lot of studies. For better quality of Arecanuts, disease prevention is necessary. Farmers can take preventative actions if the problem is found early [76][77]. No algorithms have been created or are currently in use for the early identification of Arecanut diseases. Farmers can limit the spread of further bunches and other Arecanut trees and take preventative actions. There are a number of diseases that harm Arecanuts as shown in Table 4, but the most prevalent one emerges during the wet season and spreads quickly across the crop [78][79].

RECENT RELATED STUDIES AND IMPROVISATION REQUIRED

Many studies have focused on examining the raw Arecanut quality and categorizing the Arecanut using its quality, size, color, shape, texture, and so on. Previous studies help to diagnose Arecanut grading/sorting however ends up with inaccurate results. Besides, the grading of Arecanuts comprised various levels and in the literature, up to 6 levels of Arecanuts were processed. Even though the implementation of AI including ML and DL algorithms in Arecanuts processing enhances the grading/sorting processes, plenty of studies have been needed to achieve accurate results [80][81].

RESEARCH GAP

Automated systems must be used to decrease effort, cut down on process time, and eliminate mistakes since people get weary easily and there is a lack of Laboure. The research community has recently given computer vision a lot of attention. Extracting a particular object from an image includes edge detection as well as object detection, which are the recent technologies that evolved in the current real-time image processing system. However, the complications still restrict the performance due to dynamicity in the foreground and background scenarios. In real-time systems, feature extraction is done by eliminating unnecessary features among all the features. The detection and classification tool can be utilized with high processing capability systems intending to immediately trace the anonymous or suspicious regions in the camera view of the Arecanuts. Still, grading/sorting the Arecanuts using images requires proper dataset, image enhancement algorithms, image acquisition techniques, feature extraction, feature selection, and pre-processing techniques for the improvement computer vision applications. Thereby, these approaches result in computational complexity, time-consuming, and expensive experiments. Thus, betterment in the implementation of AI algorithms can solve the current issues and aid in the progress of Arecanuts processing.

RESEARCH AGENDAS BASED ON RESEARCH GAP

The following are some of the suggestions which can help to accomplish better solutions in Arecanuts processing with the aid of computer vision applications.

Implementation of Arecanut sorting Hardware system using conveyor, camera, sensors, and actuators.

• The image pre-processing algorithms can be used to enhance the image quality before being given as input to classifiers.
• Segmenting images using image processing techniques like Fuzzy C-Means clustering (FCM), U-Net, and other ML/DL algorithms can improve accuracy.
• Feature extraction methods using Principal Component Analysis (PCA), Fast Fourier Transform, etc., can be employed to extract the significant features and thereby reduce the computational complexity.
• Feature selection approaches such as the wrapper method, optimization techniques, and so on can be used to pick the exact features which in turn minimizes the computational time.
• Choosing the appropriate AI algorithm helps to attain better accuracy.
• Optimization of the AI algorithms like weights, activation function, kernel, etc., can help to achieve better performance.

ANALYSIS OF RESEARCH AGENDAS

Even though Arecanuts provide revenue, time-concentrated, complex, subjective, costly, and handily assessments are mandatory for the delivery of quality products, and identifying the proper environmental variables is challenging. Besides, the manual effort required to identify the quality products is weary. Thus, the efficiency of ML/DL algorithms is employed to identify and classify the quality products and can ensure protection through AI technology. Moreover, utilizing a hybrid technique by combining the aforementioned criteria because it is quite difficult to handle the categorization and grading of Arecanuts using just color, shape, and texture parameters. Researchers have already created a few systems that use color, shape, and texture data to categorize Arecanuts, and they are producing results that are believable. Using form characteristics as the primary classifier before taking color, which is important in Areca, into account as the grading parameter is an example of a hybrid strategy that produces a simple, superior classification with minimal error and high accuracy.

PROBLEMIN THE GIVEN TOPIC

Generally, computer vision is a fast and trustworthy way for testing the quality of Arecanuts as well as classification simultaneously. To assure the Arecanuts quality, several methodologies have been used. Moreover, the Arecanuts need to be assured concerning protection, quality, and standard. The unsurpassed characteristics of AI for every classification are utilized to confirm the quality and assessment of the Arecanuts using pre-owned structures (various ML/DL architectures), and the information investigation strategies (including feature extraction, multivariate modification, choice of factors, feature selection) are further needed to be explored. In agro-business technology, modernization along with computerization assists in attaining enriched production and monetary turnover of events with local viability. Particularly, Arecanuts derived from the earth earn interest in tariffs, the customer's desires, and the market attention. Furthermore, the analyses of the broadly speaking existence of Arecanuts are necessary since they occupy a major role in the revenue of farmers.

ABCD ANALYSIS

Advantages, Benefits, Constraints, and Disadvantages (ABCD) are an ordered list of a model's advantages, benefits, limitations, and drawbacks which are produced by applying ABCD analysis. Through the analysis of the primary problems and the identification of the essential constituent parts, their approach takes into account all factors in important areas. The general structure for the four cases currently working with provides models and strategies involved. Table 5 provides the ABCD analysis performed on Arecanuts processing using computer vision.

Advantages	Benefits
• Retrieval of open-source data • Faster and simpler computation • Quality assurance • Accurate detection and classification • Improvements are possible. • Cost-effective	• Advancement in Technologies • Progressive move in Arecanuts farming • Real-time implementation is feasible. • Enhances revenue of farmers • Manual efforts are minimized
Constraints	**Disadvantages**
• Needs a proper understanding of the AI algorithms. • Complex architecture leads to computational complexity. • Too many processing steps result in a time-consuming process. • Availability of data is limited	• Proper input determines the precise results. • Pre-processing steps are needed for accurate results. • Hybridization of AI algorithms accomplishes better performance yet, it is time-consuming. • Expensive implementation in real-time

SUGGESTIONS TO IMPLEMENT RESEARCH ACTIVITIES ACCORDING TO THE PROPOSAL

Fast, affordable, and consistent computer vision-based applications have been utilized by several industrial sectors. In general, high-end data from the real-time scenario can be translated to Computer Vision-aided data, which involves many phases such as image capture, pre-processing, augmentation, and interpretation of images. These days, totally computer vision technologies try to emulate the human visual system. Applications for machine vision are crucial in the realm of agriculture. Furthermore, computer vision is particularly useful for determining the age, variety, quality, and freshness of fruits and vegetables. It is also helpful in determining the product's safety as well as its quality attributes, such as its composition, diseases, flaws, and qualities, as well as any contamination of grains, nuts, fruits, and vegetables.

LIMITATIONS OF THE PROPOSAL

Plenty of methodologies are introduced for Arecanuts processing. However, these algorithms possess performance issues such as variations in illuminations, glooms, and noises which can drastically reduce the algorithmic efficiency and thus results in inappropriate results. Even though AI algorithms provide enhanced efficiency, implementing a real-time application is still a challenging process. Existing techniques for performing such unsupervised tasks can be broadly categorized into partitioning, hierarchical, segmenting, and classifying model techniques. An unsupervised foreground-background Arecanuts processing of the image is a challenging issue, which has several applications in the field like object identification, food safety, and health. However, it is not surprising that several efforts have been devoted to implementing efficient techniques, which are incapable of effectively separating foreground from background for complex images.

III. CONCLUSION

The economic growth of the nation is greatly influenced by the agricultural sector. With 18.5 percent of the GDP, it serves as the foundation of the Indian economy. Every agricultural commodity is required. a focused quality evaluation that is more reliable and accurate. Currently, hand-performed categorization and grading procedures completely rely on people's hands for distinguishing various kinds of fruits and vegetables. An automated mechanism must be put in place to do this. Reduce the quantity of work required, the time needed to finish the process, and the number of mistakes. Specifically, the main cash crop in India is the Arecanut. Family is significant as a source of renewal, tradition, and culture. This review aimed to provide detailed information about Arecanuts processing using AI techniques (ML/DL)

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and image processing approaches to increase productivity and help farmers. Image analysis based on texture and color aspects will be helpful to farmers in evaluating and classifying items based on color and quality. With this study, automation of the categorization of Arecanuts and developments in AI methodology will reduce processing costs.

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