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DEVELOPING A QUALITY CLASSIFICATION SYSTEM FOR ARECA NUTS USING MACHINE LEARNING

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Abstract—**Areca nuts, sometimes referred to as betel nuts, are a major crop in India and are grown extensively in regions like Kerala, Assam, and Karnataka. modern image processing and methods for machine learning are applied by the Areca Nut Grading System project to raise the effectiveness and market value of areca nut grading. Accurate and reliable grading is a basic need that this method meets to be able to guarantee fair pricing and quality control in the agriculture sector. The study employs a comprehensive technique that begins with preprocessing and the collection of unique images of areca nuts from several classes, including Bazar Ulli, Bazar Chali, Bazar Fator, and Bazar Karikoka.**

Index Terms—**Areca nuts, Machine learning, Image processing, Grading system, Quality control**

I. INTRODUCTION

Growing widely in areas like Kerala, Assam, and Karnataka, areca nuts also called as betel nuts are one of India's important crops. This employs state of the art machine learning and image processing techniques to improve the market value and efficiency of betel nut grading. To maintain fair pricing and quality control in the agricultural industry, this method satisfies the basic requirement for accurate and trustworthy grading. Preprocessing and gathering unique photos of betel nuts from several classes Bazar Ulli, Bazar Chali, Bazar Fator, and Bazar Karikoka are major components of the study's all encompassing methodology. The project's goal is to enhance the grading process using this cutting-edge technology, which will help both producers and customers.

A. Objectives

The four primary goals are to improve the nut grading procedure. First and foremost, it concentrates on creating an easy to use interface that permits users to quickly upload pictures of areca for grading. Second, in order to guarantee that the model is trained on an assortment of examples, it entails thorough data collecting, compiling a solid dataset of areca photos for every quality level. Thirdly, the project preprocesses these photos utilizing advanced methods of image processing to make sure they are in the best format possible for training machine learning models. To get high precision in betel nut classification and, consequently, dependable grading and equitable pricing in the agricultural market, the accuracy improvement goal is lastly pursued by iteratively training and optimizing the ML model.

II. RELATED WORKS

Several important studies that address the problems in the areca nut sector, such as quality grading and market price, are examined within the domain of linked works.

It is an novel approach to employ computer vision to accelerate grading in the market for areca nuts. The color and texture of boiled areca nuts are extracted, and then an SVM classifier with radial basis function is employed to categorize them. The technique improves grading accuracy and economy by effectively classifying Areca into multiple groups by merging info on color and texture [1].

In this study, geometric and color information such as axis length and gray levels, were taken out of in order to identify areca nuts based on quality factors. A BPNN is developed to classify nuts as excellent, good, or bad, and segmentation techniques are used to identify damaged bits. Machine vision processing of areca nuts can be automated effectively, as demonstrated by assessment utilizing training and testing datasets [2].

The research study examines a number of techniques for grading areca nuts, such as Rule-Based Classifiers (RIPPER and PART), Decision Trees , k Nearest Neighbors (kNN) Classifier, Multinomial Logistic Regression (MLR), and Linear Discriminant Analysis (LDA).These methods are applied to precisely classify the cocoanuts relating to attributes of the retrieved image, utilizing the grading standards established by the producers and distributors. With excellent classification precision for both grade levels, MLR prevails. The need of precise grading for lower costs is emphasized in the report [3].

It presents the study's methodology for automatically categorizing areca nut maturity levels using HSV images and KNNs. The hue, saturation, and value of areca nut photos are extracted following their collection and preprocessed. A number of K numbers between 1 and 9 are tested when doing a classification using the KNN method. This method offers a more precise and efficient replacement for human classification techniques by using 80 percent of the dataset for training and 20 percent for testing [4].

To grade areca nuts by hand, the RGB image is transformed into a specific color space in this study. This allows the red and blue components to be examined separately. The chroma component intensities are accustomed to empirically derive upper and lower color borders, although threshold values must be adjusted to accurately classify data into the BN and NBN classes. Experimental validation with 629 photos shows that nut categorization is successful, how- ever misclassifications with dirty or damaged nuts do happen [5].

Multiple techniques for sorting and grading cacao using ma chine vision and neural networks technologies are investigated. There is discussion of techniques as texture analysis and image processing techniques. Combining these methods improves agricultural operations with state-of-the-art technology and produces sorting systems with more precision [6].

This study looks into the best ways to correctly grade and classify Areca nuts according to their texture, color, and other attributes. Methods including neural networks, processing of images, and Deep Neural networks are used for segmentation and classification. The benefits of computerized systems in agriculture are emphasized, especially in the detection and management of crop diseases, in an attempt to increase output and reduce farmer losses [7].

This research proposes to classify areca nuts using a de cisiontree and a Gabor wavelet-related approach. It involves segmenting areca nut pictures, extracting features with Gabor wavelets, creating a matrix based on these features, and ex tracting specific attributes like contrast and energy. Classifying unknown data using decision trees and kNN algorithms is the next stage. Upon evaluating these classifiers, the research discovers that decision trees outperform kNN in the texture grouping of areca nuts, particularly when paired with the en tropy rule. This illustrates how effectively the method performs for texture-based categorization [8].

Methodology for classifying raw betel nuts into four categories is presented in this paper. It comprises segmentation using K-means clustering and feature extraction with the help of a color histogram. Following testing, the K-NN, ANN, and SVM classifications produced the best accuracy, at 98.13 percent. The 800 digitally photographed images that make up the dataset are divided into four groups using K-Means. Highlighted are SVM's challenges in building hyper planes and ANN's challenges in network training, with a particular emphasis on K-NN's effectiveness in accurately categorizing raw areca nut pictures [9].

This paper demonstrates how computers science has a significant part in modern agricultural and food science. A variety soft computing methods and artificial intelligence are employed to ensure that flaws in various goods are classified and identified, ultimately leading to improved products for end users. Understanding the part that computer vision technology plays in processing areca nut requires an appreciation of the fruit's cultural and economic value. Depending on the classification and the region in which they are grown, several areca nut types exhibit noticeable differences in color, texture, and shape. Various methods mostly focus on processing Areca nut based on its external appearance. One measure that can be used to classify or rank areca nuts is color and texture [10].

III. METHODOLOGY

A. Data Collection

To properly train our model, we concentrated on assembling a large dataset for this project. We gathered between 400 and 500 high-quality photos for every category of areca nuts. The aforementioned photographs were carefully selected to guarantee that they faithfully depict the diverse classes of areca nuts, thereby furnishing a sturdy basis for educating the machine training model. For the model to develop and accurately identify between the various quality classes, a large dataset was essential.

B. Data preprocessing

To ensure guarantee high-quality input for the machine learning model's training, this project's data preprocessing included multiple crucial procedures. To preserve image consistency and lower noise, we gathered between 400 and 500 high-quality photos for every class of areca nuts, utilizing a white background and removing shadows. Every image was scaled to a standard size, usually 224 by 224 pixels, to be able to comply with the CNN input specifications. Additionally, in order to increase the model's performance and training efficiency, we standardized the pixel values to an interval of [-1, 1]. These preprocessing procedures were necessary for creating clear, uniform, and standardized images, which led to classification results that were more trustworthy and accurate.

C. Model Training

After the photos had been preprocessed, a CNN model was trained to recognize patterns and characteristics unique to each class of areca nut. Throughout the training process, the model underwent several iterations in which it modified its weights in response to prediction errors. Through the use of methods like gradient descent and back propagation, the model was able to minimize these errors and eventually increase its accuracy. in order to ensure effective and quick inference, TensorFlow Lite was utilized to transform the training model into a format appropriate for implementation on edge devices. Due to the extensive training procedure that was meticulous data collecting and preprocessing, the model was able to categorize areca nuts into their appropriate quality categories with a high degree of accuracy.

D. Classification Prediction

Classification prediction in the Areca Nut Grading System entails evaluating an input image of an areca nut and allocating it to a predetermined quality grade. The submitted image is first preprocessed to comply with the model's specifications, including resizing and normalizing it. A built CNN is then fed the image in order to extract hierarchical features. Every quality grade has a probability calculated by the network, and the level with the greatest probability is chosen as the projected class. The system uses TensorFlow Lite to enable fast deployment on multiple devices and produces the projected grade, a score of trust, and an explanation context for the grade. This facilitates equitable pricing and control of quality in agriculture by enabling accurate and dependable areca nut grading.

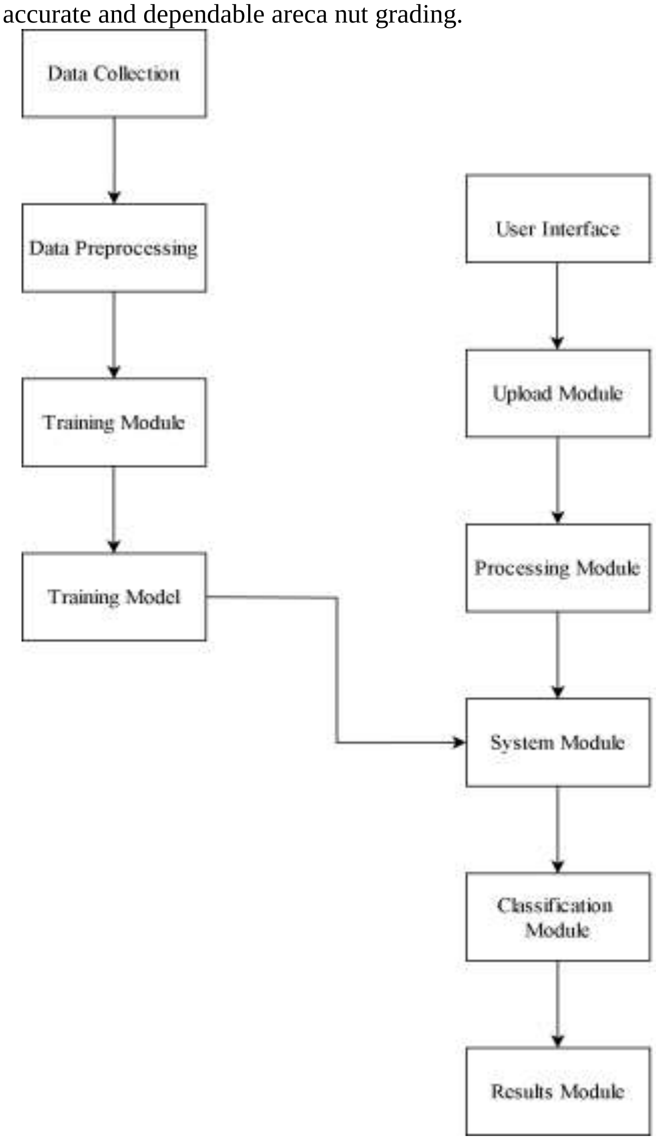

Fig. 1: System Architecture

IV. RESULTS AND CONCLUSION

The Areca Nut Grading System Project created and evaluated a machine learning algorithm that successfully divided areca nuts into four different quality categories. Based only on the nuts' outward appearance, the model was able to accurately and efficiently determine their quality. The model performed reliably thanks to meticulous data collecting and preprocessing, which included the use of excellent, shadow less photos on a white backdrop. The system's ability to differentiate between classes effectively highlights its potential to promote equitable marketing methods and better quality control within the areca nut business.

Two primary causes of misclassification in the Areca Nut Grading System are the issue of one-sided visibility and the minute visual variations across areca nut classes. It might be difficult for the model to distinguish between grades because of the sometimes-subtle visual distinctions between them. Furthermore, the model may make inaccurate choices made with a partial perspective of the nut's state if faults exist on the side of the nut that is not visible in the photos used for categorization. These difficulties show that in order to increase the grading system's accuracy, better imaging strategies and more sophisticated approaches are required.

In conclusion, In conclusion, the Areca Nut Grading System demonstrates significant potential in revolutionizing the grading process for areca nuts. By leveraging advanced image processing and machine learning techniques, the system en sures consistent and accurate classification of areca nuts into distinct quality grades. This innovation not only aids producers in achieving fair pricing and marketability but also instills consumer confidence in the quality of the product.

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