IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Classification and Grading of Areca Nuts using Machine Learning and Image Processing Techniques

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Abstract:*The Areca nut, often known as betel nut, is a tropical crop. India is the world's second-largest producer and consumer of areca nut. A multitude of illnesses afflict it throughout its life cycle, from root to fruit. The current method of disease detection is simple observation with the naked eye, and farmers must thoroughly study each crop on a regular basis to detect diseases. We proposed a method that uses Convolution Neural Network (CNN) and Support Vector Machine (SVM) algorithm to detect whether the given areca nut is of bad quality or good quality. We created our own dataset comprising of 208 photos of good and bad quality areca nuts to train and test the model. By using CNN we have obtained the accuracy of 97.12% and by using SVM we obtained the accuracy of 93.68%.*

Keywords: Areca nut, Convolution Neural Network, Support Vector Machine.

I. Introduction

Areca nut is one of the largest commercial plants in India. The current approach of areca nuts quality is simply observed with naked eye and farmers have to carefully analyse each crop which is a very time consuming process. Hence, There is a need for automatic disease classification. So we are using Machine learning algorithms to find the quality of areca nuts Machine Learning is an underground AI platform, which can be used to automate this process. CNN and SVM are the two algorithms we are going to use our project to detect the diseases CNN is an In-Deep Learning system that can capture an image, assign value to the various elements in the image (readable weight and bias), and distinguish one from the other. When compared to other partition techniques, CNN requires substantially less processing time. Although the filters are still constructed by hand in the old ways, CNN can read these filters / symbols with appropriate training. The SVM algorithm is a fantastic classification algorithm. It is a supervised learning method that is mostly used to categorise data. SVM is trained using a set of label data. The advantage of SVM is that it can solve both classification and regression problems. To divide or classify two classes, SVM draws a decision boundary, which is a hyperplane between them.

II. Literature Review

Siddesha S. et al., [1]This interacts with the KNN separators' split of the green areca nut based on histogram colour and colour timings. The KNN method was used to create an 800-photographic database of four classes utilising two-color features and four-grade scales. A separate image is utilised in the second stage to extract elements. Color histogram and colour timing approaches were used to extract this colour information. The areca nut is divided into four classes in the third stage. KNN, ANN, and SVM are three well-known category designers that we employ to divide.

Dhanuja K.C. et al., [2]The author used areca nut stitching grading to propose a method for diagnosing areca nut disease employing image processing technology. The viewing application on the system was designed to recognise and distinguish areca branches as different, dignified, and poor levels. The data is classified using a Deep Learning algorithm and imaging techniques. The KNN algorithm was used to train and evaluate the model using 144 areca nut samples (49 Good, 46 Poor, and 49 Incorrect samples) to detect illnesses in the areca nut.

Anilkumar MG et al., [3]In this paper, we use convolutional neural networks to detect illnesses in Areca nuts early. CNN is a deep learning system that takes a picture as input, offers legible weights and variations for the items in the picture, and then learns from the results to differentiate one from the other.

Dinesh R et al., [4] areca nut separated and altered utilising image processing and computer vision. To distinguish the areca nut category, the author uses colour, size, and texture. The main goal of this article is to give a comprehensive description of the areca nut, Computer Vision, and technological needs and applications based on areca nut categorization and grading.

Bharadwaj N K et al., [5]It is recommended to use photos of the areca nut to calculate the distance between them. The local binary pattern method is used in the proposed future extraction method. Supports a vector classification machine for determining the range of areca nuts. The confusion matrix's accuracy, memory, and F-measure are all used to test and grade the system's performance.

AjitDanti et al., [6] Raw areca nut separation procedures and methods have been proposed. The author has devised a new method for classifying areca nuts into two groups based on colour. Segmentation, Masking, and Classification are all steps in the classification process. The classification is based on two different colours: red and green areca nut phases in the region. Test performance success rates ranged from 97 to 98 percent depending on the category.

Mallikarjuna S. B. et al., [7] suggested a CNN-based method for categorising images of areca nut illnesses. Distinguish between diseases like rot, split, and rot. The proposed technique outperforms the competition in terms of classification, memory, accuracy, and F steps, according to results from a four-phase data set.

Hubert Cecotti.et al., [8]The neural convolution network was used to find grape bunches. At the same time, independent classification techniques were utilised to separate two grape varietals of white and red grapes. To get 99 percent accuracy, use the CNN algorithm.

AshishNage V.R. Raut [9]This research focuses on a plant disease detection approach based on image processing. Here is the study in which the author created a useful Android app for plant disease diagnosis by uploading a leaf image to a programme that uses the CNN leaf-cutting algorithm..

PrasannaMohanty et al., [10] has proposed using CNN training to diagnose plant diseases. The CNN model has been taught to distinguish between 14 healthy and sick plants. In the test set, the model was 99.35 percent accurate. While 31.4 percent accuracy is greater than a basic random selection model when using photographs acquired from trusted internet sources, a very diverse collection of training data can help to boost accuracy. And, depending on the model or neural network used, great accuracy could be achieved, making plant disease detection more accessible to the general public.

Siddesh et al. [11]A disease detection model was reported that used K-Means and the Otsu technique to detect and identify diseased raw arecanut. To reduce shadow effects, the arecanut image is separated from the backdrop using colour K-means clustering in preprocessing. In disease detection, the RGB image is converted to monochrome via Otsu thresholding. The damaged arecanut regions are then identified using the related components method. The collection comprised 50 raw arecanut photographs that had been affected by the disease. The model's performance is measured by counting the number of spots in the RGB image and then in the tagged photographs.

AshfaqurRahman et al. [12]To find healthy grape bunches, a series of image processing and intelligence processes were used. The technique is separated into two phases: in the first, the grape bunches images are extracted from the backdrop image, and in the second, the grape bunches are identified based on the mature group, with an accuracy rate of 96 percent.

Scarlett Liu et al., [13], From the image, a grape bunch detecting technique was presented. The grape bunches are counted from photos using an image processing and support-vector machine technique, with an overall success rate of 88 percent for red grape.

III. Proposed Methods

Segmentation: The process of segmenting an image into subparts in order to extract the required area for further processing is known as segmentation. It is determined by the discontinuity and similarity of intensity values. Here, segmentation is utilised to remove the image's undesired background and feature extraction is performed on the segmented foreground. CNN and SVM are employed in our project.

SVM: A two-class problem is classified using SVM by dividing the classes using a hyperplane. It makes similar arguments in order to put arecanuts into a specific category. After a hyperplane has been built for training samples, we must check whether the testing samples are in the same boundary.

Feature Extraction: This is mostly used for detection, classification, and recognition. A feature is a piece of visual data in numerical form that is used to match other images based on their similarity or dissimilarity. It is classified into two categories: global and local. Local features are used to characterise the essential points of a given image, whereas global features are used to describe the image as a whole. We used the global feature in our project to classify raw areca nuts.

Color feature extraction: Color is one of the most fundamental and often used elements in computer vision and machine learning applications. Red, green, and blue are the three primary hues of any colour image. The RGB colour model is the most extensively used. We employed an RGB model with colour histograms and colour moments in our project.

Classification: Classification is the process of grouping together classes that share specific characteristics. It assigns unidentified samples of the areca nut picture to finite classes that are defined physically. The CNN and SVM classifiers are used to classify the different types of Areca nuts. This categorised patterns that are close to each other in the feature space as belonging to the same pattern class. The neighbours are chosen from a set of samples with correct class knowledge. Different distance formulas were employed to measure the similarities between the pattern classes. We used four different distance metrics to examine the effect on classification accuracy in our project: Euclidean, Manhattan, Cosine, and Chebyshev.

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IV. METHODOLOGY

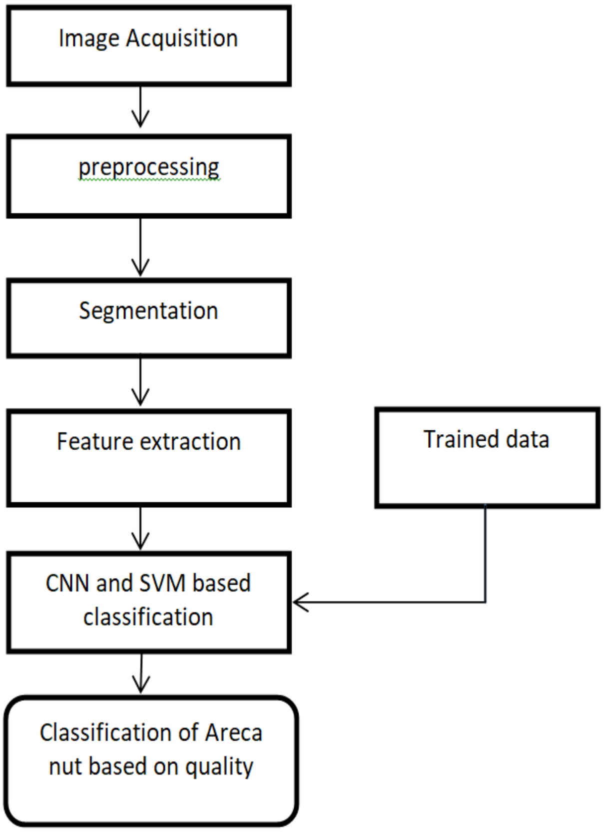

Fig.1: Block Diagram of the Proposed System

Image Acquisition: Smartphones are used to take healthy and unhealthy areca nut photos, which are then saved in the dataset. The acquired photographs were uploaded to the system as a first stage in the image processing technique.

Pre-processing: The Areca nut image has been pre-processed and modified. In order for the noises in the photo of areca nut has been reduced. Pre-processing is a generic term for activities involving pictures. Intensity images are the lowest level of abstraction for both input and output. Pre-processing is used to improve image data by removing undesired distortions or noise and boosts certain essential image attributes for further processing.

Segmentation: Segmentation Image segmentation, enhancement, and colour space conversion are all part of the pre-processing process. To begin, a filter is applied to the digital image of the image. After that, make an array out of each image. Each image name is transformed to a binary field using Binarize Diseases' scientific name

Feature Extraction: The image will be forwarded to the feature extraction module after it has been segmented. The process of transforming the input data into a set of features is called extracting the important information from the input image. Color, texture, forms, and edges are only a few examples of conceivable attributes. To improve accuracy, we deal with the colour and shape of the leaf in our proposed approach. As a result, the skewness asymmetry degree of the pixel distribution in the provided window around its mean is considered a feature.

Classification: The features will be forwarded to the classifier when they have been extracted. Both the training and testing phases are included in classification techniques. Features are examined in the training process, and their generalization is validated in the test step. The most used binary classification method for Areca nut categorization is SVM. It's built around a hyper plane. This hyper plane splits the space into two sections, one for healthy leaves and the other for unhealthy leaves. We next use a deep learning system to further classify the data. The image was classified using CNN. Convolution operation, ReLU layer, pooling layer, flattening, and fully connected layer are the five basic processes in building a CNN model. CNN has an autonomous feature extraction system in place. As a result, the feature is extracted from the input image using the convolution process, which also employs a kernel to learn the relationship between features. The ReLU is used to conduct the non-linear operation. By lowering the number of parameters, the pooling layer is used to obtain crucial information for retraining. The output is classified using the SoftMax activation function. Using the classifier, the obtained data is compared to trained data. In order to get improved accuracy in classifying the quality of arecanuts, both CNN and SVM classification are applied. We will use machine learning and digital image processing to categorise areca nuts based on their colour and quality in this project. We will put the data of areca nuts in our device memory at the very beginning of the operation. Our technology then processes the collected samples. The sample data obtained throughout the operation is compared to data previously stored in the device.

V. RESULTS AND DISCUSSION

After Training the model the trained accuracy and test accuracy to be found was 97% in CNN and 87 % in SVM as shown in Figure 2 and Figure 3 .The trained model detects diseases in areca nut and prints the probability of the areca nut which is of good and bad quality.

```
acc = model.evaluate_generator(train_generator)[1]

print(f"The accuracy of your model is = {acc*100} %")
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1:
  """Entry point for launching an IPython kernel.
The accuracy of your model is = 97.12643623352051 %
```

Fig.2 : Model Accuracy of train data

```
acc = model.evaluate_generator(test_generator)[1]

print(f"The accuracy of your model is = {acc*100} %")
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1:
  """Entry point for launching an IPython kernel.
The accuracy of your model is = 87.5 %
```

Fig.3 : Model Accuracy of test data

```
path = '/content/drive/MyDrive/test/bad/IMG_20220110_101501_147.jpg'
img = load_img(path, target_size=(256,256))

i = img_to_array(img)

i = preprocess_input(i)
input_arr = np.array([i])
input_arr.shape

pred = np.argmax(model.predict(input_arr))

if pred == 0:
  print(" the arecanut  is of  bad quality ")
else:
   print("the arecanut  is of good quality")


plt.imshow(img)
plt.title("input image")
plt.show()
```

```
the arecanut  is of  bad quality
```

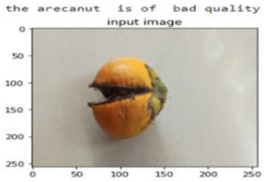

Fig.4 :Prediction result in CNN

```
import numpy as np
from tensorflow.keras.preprocessing import image
test_image = image.load_img('/content/drive/MyDrive/test/bad/IMG_20220110_101501_147.jpg', target_size = (64,64))
test_image = image.img_to_array(test_image)
test_image=test_image/255
test_image = np.expand_dims(test_image, axis = 0)
result = cnn.predict(test_image)
if result[0]<0:
    print("The Arecanut is of bad quality")
else:
    print("The Arecanut is of good quality")
```

```
The Arecanut is of bad quality
```

Fig. 5 : Prediction result in SVM

VI. CONCLUSION

The paper focuses on applying Convolution Neural Network and Support Vector Machine algorithms to classify and grade areca nuts. Experimentation is done out using a 208-image dataset of high and bad quality arecanuts. The overall accuracy of the Convolution Neural Network is 97 percent, and the Support Vector Machine is 93 percent. As a result, this technology assists farmers in practising smart farming and making better production decisions by allowing them to take critical preventive and corrective actions on their arecanut crop.

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