

Detection and Prediction of Diseases in Arecanut Plants

Tejaswi R¹, Rajesh M Mysoremath², Pradhan D Prabhu³, Honey Jain⁴, Prof. Mahitha G⁵

^{1,2,3,4}Student Department of Computer Science and Engineering PES University Bangalore, India

⁵Professor, Department of Computer Science and Engineering PES University Bangalore, India

Abstract - Arecanut is one of the major crops in India. Because of its higher market value, it is grown more in India and other subtropical regions. This plant is susceptible to a number of diseases that cause great losses to farmers. These diseases occur due to sudden changes in temperature and other climatic conditions; Early detection of the disease is very important. This work involves a focus on early and accurate disease detection to reduce losses for farmers. The proposed work uses RGB images as input and a Res-Net model. It then assigns learnable weights and biases to different objects in the image, then based on the results, it learns to distinguish between them. Global average pooling is used for image detection.

Key Words: Arecanut, Res-Net (Residual Network), Global average pooling, RGB images.

1. INTRODUCTION

Arecanut is a crop that is widely cultivated in India. Karnataka, Kerala, and Assam are the major states that produce Arecanut in India. Karnataka produces the largest quantity of Arecanut in India, with a total cultivation area of 218,010 hectares and a production of 457.560 tones.

Arecanut is mainly grown in the southern and coastal districts of India under assured irrigation. The crop thrives well in areas with a temperature range of 20-34°C and an annual rainfall of 2000-5000 mm. The crop is grown as a garden crop and is usually intercropped with coconut, cocoa, pepper, and other crops.

The crop is used in various forms, such as raw, boiled, or roasted, and is consumed as a mouth freshener. It is also used in Ayurvedic medicine for its medicinal properties.

Since it has several importance in India and it is also a major commercial crop there are some challenges to cultivate this crop. In that challenge occurrence of Disease is a major challenge due to changes in temperature and climatic conditions.

1.1 Diseases

1. Koleroga/Mahali/Fruit Rot: This is a major disease of arecanut that causes serious losses. The characteristic symptoms are rot and significant loss of immature fruits, scattered near the base of the tree. Infected seeds lose their luster and

natural green quality and therefore have a low market value. Disease is spread by strong winds and torrential rain. The severity, persistence and spread of fruit rot disease are related to rainfall patterns. The disease usually appears 15 to 20 days after the onset of regular monsoon rains and may last until the end of the rainy season. The pathogen is a fungus called *Phytophthora palmivora*.

2. Anabe Roga/Foot Rot: This disease is characterized by the rotting of the roots and the lower part of the stem. Affected trees exhibit stunted growth, yellowing of leaves, and premature fruit drop. Disease caused by the fungus *Fusarium solani*
3. Bud Rot: This disease is characterized by the rotting of the apical bud and the surrounding leaves. Affected trees exhibit stunted growth, yellowing of leaves, and premature fruit drop. The disease is caused by the fungus *Phytophthora palmivora*
4. Yellow Leaf Disease: This disease is characterized by leaf tips of 2 or 3 outermost whorl leaves turn yellow. Brown necrotic streaks run parallel to the spreading leaf veins. The yellow color extends to the middle of the leaf blade. The tips of the leaves turn yellow and dry. At the advanced stage, all leaves turn yellow. The yellow color of the leaves is visible from October to December. Finally, the foliage falls, leaving the tree trunk bare. The ends of the roots turn black and gradually rot

2. LITERATURE SURVEY

Dhanuja K C et.al [1] Proposed detection and identification of cau nodes at exceptional, fair and poor levels. The defective regions are segmented using DL algorithm and BPNN classifier based on image technique. A random sample of 48 excellent, 46 poor, and 49 poor images was used to test the device. The classification rates for Excellent, Good, and Poor ratings were 91.7%, 89.1%, and 91.8%, respectively. And an average accuracy level of 90.9 was achieved. With the CD camera, the algorithm can accurately and successfully locate locations and determine the consistency of areca nuts, but he could not examine the covered slides.

Akshay S et.al [2] Suggested identification of healthy and unhealthy areca nuts (with shell or without shell). Using the GLCM trait model, we classify areca nuts into healthy and unhealthy types. In the proposed system, 60 images are collected, including 30 healthy images and 30 unhealthy images, captured for training and testing purposes. Classification of these images into healthy and unhealthy classes is performed with 95° accuracy in the training phase and 90° accuracy in the testing phase. This means that only good quality areca nuts are selected; Arecanut prices will therefore increase and farmers' income will also increase. The main objective of this model is to classify raw materials (shelled) into healthy and unhealthy, which is achieved by applying a decision tree algorithm. This achieves 90% accuracy.

Meghana D R et.al [3] This article proposes a system to detect diseases on Arecanut trees using Convolutional NeuralNetwork (CNN) and suggests remedies for the same. CNN isa deep learning algorithm that takes images as input and learns to distinguish different objects in the image. The authors created a separate dataset of 620 images of areca nuts, healthy and diseased, and divided it into a training set and a testing set. They used categorical cross-entropy as the loss function, Adam as the optimization function, and accuracy as the metric to compile their model. They trained the model for 50 epochs to achieve high validation and testing accuracy with minimal loss. The proposed method is found to be 88.46° curative in identifying Arecanut diseases, especially Mahali (Koleroga) disease, stem bleeding and yellow spot disease.

Anilkumar M G et.al [4] proposed early detection of diseases on areca trees, leaves and stems using convolutional neural networks. The experiment was performed using a healthy and diseased areca nut image dataset of 620 images. First, the images are preprocessed, followed by feature extraction, training, and classification. This project helps detect diseases on areca trees such as Mahali, stem bleeding, yellow leaf spots and provide solutions to overcome this problem. The accuracy of the working model is 88.66%. Enable them to make better yield decisions by allowing them to take all the necessary preventative and corrective measures on their areca trees.

Mamatha Balipa et.al [5] gives the classification and accuracy differences between SVM and CNN model. Here the authors have used a self-created dataset for the project with 200 original images and they are taken in Shivamogga. Then they augmented the images for training and testing the model. They considered the diseases like Koleroga, bud rot, yellow leaf disease, stem bleeding etc. they converted the image to GLCM and GLDM matrices for input data to CNN and SVM models. The SVM model gave the accuracy of 0.75 eq(1) and CNN gave 0.9 eq(1) when the training and testing data was sent. Here this paper states that CNN has better Accuracy than SVM model in image processing models.

Mallikarjuna et.al [6] In the paper, multi gradient images are used here to detect the disease in Arecanut fruit. Multi gradient images are augmented and taken, they are then converted to array and sent to the ResNet model for training and testing. This model gave the accuracy of 80.02% for normal images and 82% for MGD images. ResNet is the most efficient and popular model for image processing which contains up to 152 layers. ResNet can also handle vanishing gradient problems.

Mohammed Khalid Kaleem, et.al [7] In the paper focuses on developing a prediction model for the occurrence of Mahali/Koleroga/Fruit Rot disease in areca crops using machine learning algorithms such as Support Vector Machine Regression (SVMR) and Random Forest Classifier (RFC). The study was conducted in the areca fields of the Vittal region in Dakshina Kannada, Karnataka, India, from January 2018 to April 2019, along with historic weather data. The environmental conditions that are suitable for the disease occurrence were identified as frequent splashes of rain, humidity higher than 90%, low temperatures in the range of 20 °C to 23 °C, and intermittent sunshine and rain hours, usually 15-20 days after the onset of monsoon. Environmental data such as temperature, rainfall, humidity, soil, and wind speed were collected using sensors such as DHT-11 and soil humidity sensor. The collected data was processed and converted into a tabular format to develop the input dataset for the model. The proposed algorithm involved calculating the difference between two consecutive data values, identifying patterns in the data, and predicting the occurrence of the disease. The results of the study could be used to provide suitable countermeasures to prevent or control the disease and improve crop productivity.

L. Vinod Kanan et.al [8] proposed a disease prediction system to address the challenges faced by the agricultural industry, such as the growth of diseases in essential crops, which has resulted in a scarcity of food supplies. The proposed system takes into consideration various environmental factors, such as temperature, humidity, rainfall, wind flow, and soil moisture, to predict the occurrence of disease. The system analyzes different relationships among these factors and provides information prior to the occurrence of disease. The study also presents a system to predict the susceptibility of Arecanut plants to disease infection by comparing data values obtained from IoT sensors, such as DHT11 and soil humidity, with data values that have caused diseases in plants, based on historical research. A regression algorithm is used to identify similarities in the pattern of conditions, and a range is determined for scoring the results. The output obtained is manually confirmed with experience, helping to evaluate the model effectively. The farmers are warned about the possibility of disease so that they can take necessary precautions.

3. DATASET INFORMTION

We searched for dataset in internet and all opensource sites but we got just a reference dataset with few image data which was not enough for our project so with the help of UAS Shivamogga we visited the cultivated farm and got the information about the Arecanut plant and its diseases. We took photos with the help of mobile at standard resolution. We took about 1200 images and augmented it to 11063 images. The figure 1-6 show the sample images.



Fig.1 Healthy leaf



Fig.2 Healthy nut



Fig.3 Healthy trunk



Fig.4 Koleroga



Fig.6 Stem bleeding



Fig.4 Yellow leaf disease

4. PROPOSED METHOD

A. Dataset preparation

The collected images were divided into their respective disease category. We had the images of stem cracking, Stem bleeding, Healthy Leaf, yellow leaf disease, healthy foot, Healthy Trunk, Mahali Koleroga, bud borer, Healthy Nut.

B. Data preprocessing

The images were augmented to reduce overfitting and underfitting of data. We used rotate, flip and rotate-flip technique to augment the data. The image size was reduced to 150*150 pixel to reduce more memory usage. The images

are then converted to float32 array which ranges form 0-255. This conversion is because computers cannot read images directlylike humans so the images are converted to digits, the float32 gives higher precision and memory efficient than any other format so which helps to get minute information present in image and better accuracy during detection.

C. Res-Net model for disease detection

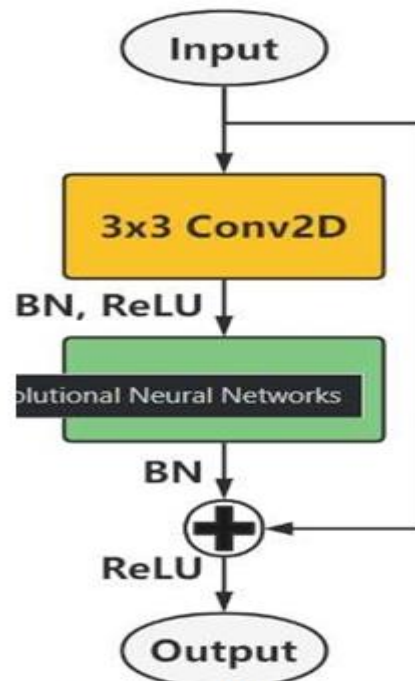


Fig.7 Res-Net V1 model

Deep convolutional neural networks have achieved great heights in image classification but when deeper networks are considered, there is a degradation problem where accuracy initially rises with increased depth but then reaches saturation and decreases with further depth increases. The error rate of training and testing set increases, this indicates that it is not caused by overfitting. The Res-Net enhances the feature extraction ability by using cross layer feature fusion this helps in gradual increase in performance when depth is increased. The deeper Res-Net models were tested in acceptable time frame and it was compared with other deep learning models. Res-Net proved it has better classification performance than other models and accuracy can be improved by increasing depth.

Res-Net (Residual Neural Network) was proposed by theKaiming He team at Microsoft Research Institute, and is also called Residual Network in Chinese. The basic motivation forthe Res-Net design was to solve the problem of neural network degradation, where the error rate increases as the network depth increases. To address this issue, the teamproposed a residual structure in which the

functionality of each network layer is reprogrammed as a residual function of the input to that layer. The concept of residual in mathematical statistics is the difference between the actual observed value and the estimated (adjusted) value.

There are many types of Res-Net residuals that you can define depending on your project requirements. Figure 7 shows the remaining configuration of his Resnet-20 used in this paper, which successfully solves the mining problem. The remaining components include his two layers: convolution and identity mapping. The convolution kernel size is 3x3. Therefore, the input and output sizes of the residual components are equal and can be added directly. If the step size is 1, the fill layer becomes the original input layer after batch normalization, ReLU activation, and Res-Net input convolution. When the step size is 2, the input of Res-Net performs the same operation again before being averaged to obtain the fill layer. Finally, the input to the output layer is the output of the filled layer plus the output of the residual component.

In this work a 20-layer Res-Net version 1 model is used which has a stack of Conv2D-BN-ReLU 2 x (3 x 3) blocks where the feature map size is halved at the beginning of each stage, and the number of filters is doubled. The stack of residual blocks for each stage creates the specified number of residual blocks containing Res-Net layers. The first layer of each stage contains 2 strides to down sample the feature map size and uses residual connections to add the input tensor without output of the residual block.

The v1 model will first undergo 1d convolution and then it is sent to Batch-normalization and then it is passed through activation function which is ReLU. ReLU activation function helps to learn non-linear dependencies which returns the value greater than 0, if value is less than 0 then 0 is returned so the equation goes like this $f(x) = \max(0, x)$. The Res-Net layers function creates the Res-Net layer then it is used to create a pool of Res-Net layers. Each layer has 3 kernels 16 filters and 1 stride. The filters get doubled at beginning of each stage and down sampling with stride 2 is applied when transitioning between 2 stages. For the final class prediction, the model uses global average pooling with SoftMax activation function.

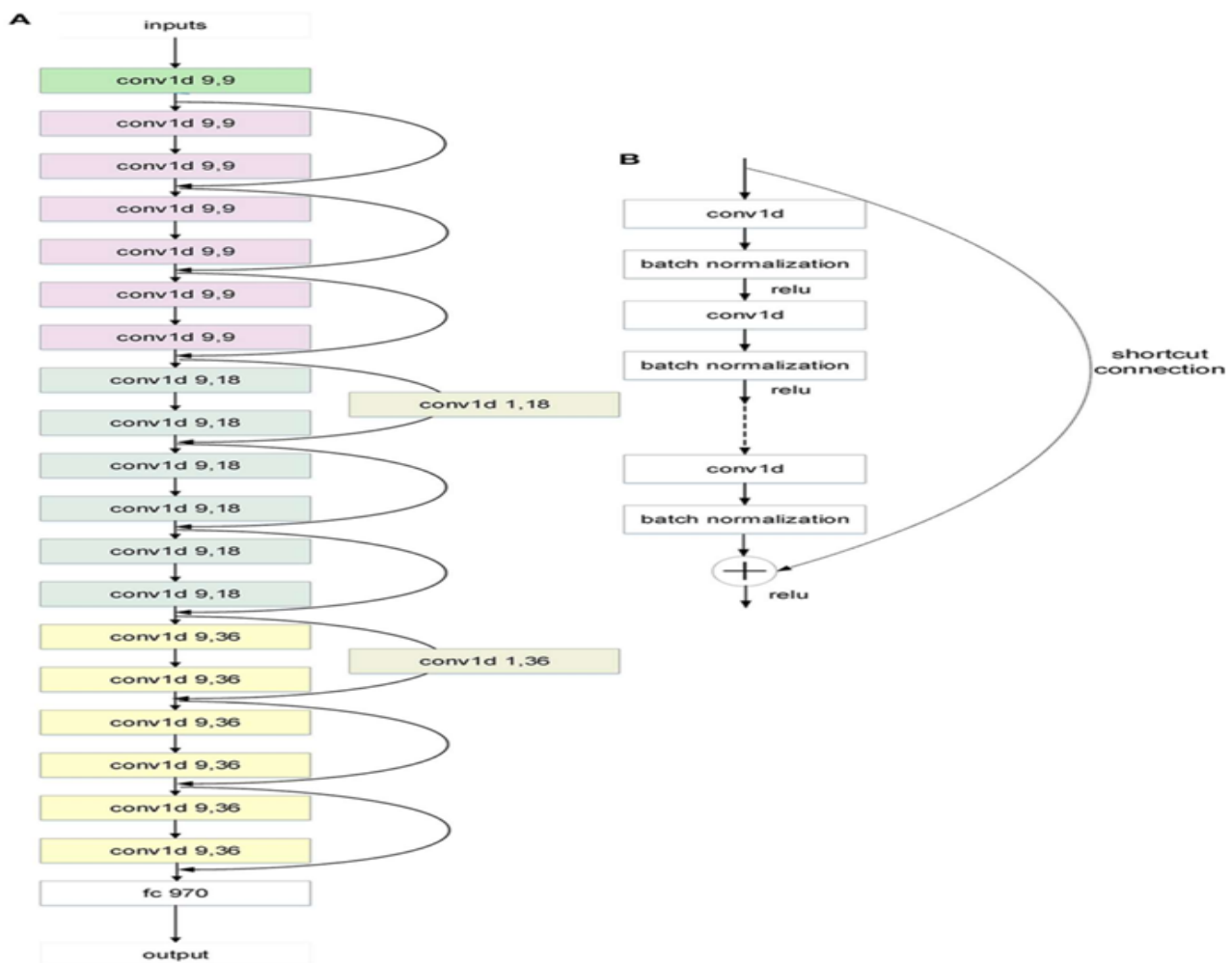


Fig.8 Res-Net V120

5. RESULTS

A thorough test is conducted on our own dataset to evaluate the system's capability. The 1200 photos that were gathered for the suggested method included several Areca nutplant diseases. Following RESNET model training, the observed accuracy was 97.5 percent. Images and location are inputs used to identify diseases and choose suitable measures. The model identifies the disease and highlights the need for action with regard to Areca nut plants. The output of the model in Kaggle is shown below Fig 8 RESNET model-Kaggle. The model will determine the disease's name and the likelihood of each possibility after receiving an image.



Fig.8 Predicted image

The website shown in Fig. 9 allows us to upload an image and receive results regarding the disease that the model has diagnosed.

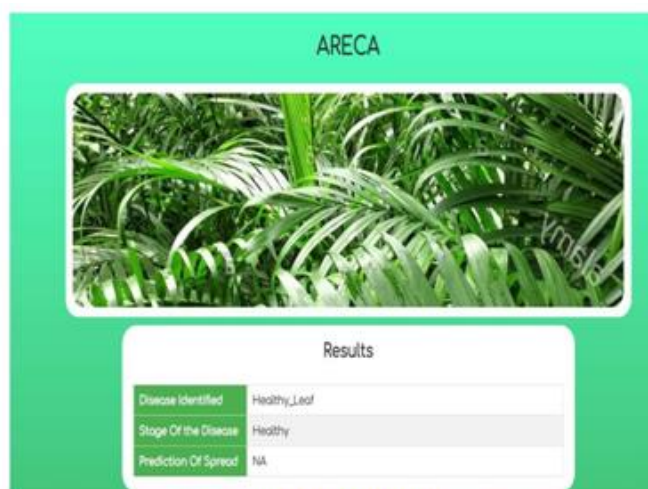


Fig.9 Simple user interface

The testing of accuracy of the model is done using confusion matrix. Using confusion matrix, the standard matrices like Precision (P), Recall (R) and F-measure (F) is used to measure the accuracy and performance of the model.

Metric	Train	Test
False Positive Rate	0	0
False Negative Rate	0	0.0285714
True Positive Rate	1	0.971429
True Negative Rate	1	1
Precision	1	1
Recall	1	0.971429
F1 Score	1	0.985507

Fig.18 Confusion matrix

6. CONCLUSIONS

As per literature survey previous research had shown that use of various deep learning models for detection of diseases but they were focusing on a particular disease. This work focuses on detecting many diseases with greater accuracy using Res-Net model. The reason for using Re-Net is that it has skipping connections so that the vanishing gradient problem is removed which increases the accuracy of the detection. This helps the Arecanut farmers in early detection of diseases so that they can be pre-prepared and this helps them to reduce their yield loss. This model has achieved the accuracy of 97.5 percent which can achieve good result. This work can be extended further for other various diseases of Arecanut and other crops also. This model can be made as software so that farmers can get access to it.

REFERENCES

M. K. H. P. Dhanuja K C, "Areca Nut Disease Detection using Image Processing Technology," ISSN, 2022.

[1] Akshay S, Ashwin Hegde, "Detection and classification of areca nut diseases", ISBN: 978-1-6654-2867-5, 2021.

[2] M. D. R. a. P. S, "Image Processing based Areca nut Diseases Detection Using CNN Model," ISSN, 2022.

[3] K. T. P. H. S. U. D. A. D. Anilkumar M G, "Detection of Diseases in Areca nut Using Convolutional Neural Networks," ISSN, 2021.

- [4] P. S. A. K. B. R. P. a. A. M. Balipa, "Areca nut Disease Detection Using CNN and SVM Algorithms," International Conference on Artificial Intelligence and Data Engineering (AIDE), no. 10.1109/AIDE57180.2022.10060130, pp. 01- 04, 2022.
- [5] P. S. V. K. M. B. U. P. B. P. B. Mallikarjuna, "Multi-gradient-direction based deep learning model for areca nut disease identification," IET, 2022.
- [6] N. P. K. A. S. A. Mohammed Khalid Kaleema, "A Modern Approach for Detection of Leaf Diseases Using Image Processing and ML Based SVM Classifier," TURCOMAT, 2021.s
- [7] M. S. K. L. Vinod Kanan, "Areca nut Yield Disease Forecast using IoT and Machine Learning," IJSREAT, 2021.