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NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA)

EARLY DETECTION AND CLASSIFICATION OF ARECA NUT (BETEL NUT) DISEASES AND REMEDIAL SUGGESTIONS TO PROTECT CROP YIELDS.

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- Arecanut Disease
- Machine learning
- Convolutional Neural Network

Introduction

A widely known commercial palm arecanut grows in large portions of the Tropical Pacific, Asia, and East Africa. Large, evergreen leaves on plants are spirally arranged at the apex of the stem and are either palmately or pinnately compound. The various factors, including climatic conditions, soil conditions, diseases and more, have an impact on growth of the crops. Fruit Rot, Stem Bleeding, Yellow Leaf Spot, and Nut Split Disease are the common diseases that affect arecanut trees. The identification and categorization of diseases in arecanut is a challenging task, as the symptoms can vary greatly depending on the type of disease and the stage of infection. Moreover, the lack of expert knowledge in this area makes it difficult for farmers to accurately identify and treat diseases. Timely and accurate diagnosis is crucial for effective disease management, but this is often hindered by the lack of appropriate technology and resources. The various arecanut diseases can be prevented by using machine learning models that identifies diseases, various techniques have been employed such as Deep learning, CNN, Image processing, K-means, SVM, LAMP and real time identification of diseases.

Objectives

- To gather and process the image dataset needed for training Al based model.
- To devise an automated Areca nut discase detection and classification system exploiting deep learning Models (Convolutional Neural Network).
- Tuning the model and the model parameters for optimal performance and accuracy measures while maintaining usability.
- To provide remedial instructions for the disease for further action by the farmer.
- To develop a Web Interface for arecanut farmers across the globe.

Methodology

Figure 1 shows the workflow diagram of the System. The datasets are collected and stored in a database which is further processed to a standard format. The pre-processing includes reshaping, resizing and array conversion These pre-processed images are used for training the Convolution Neural Network (CNN) model. After training the model, the pre-processed test image is given as input to the CNN model. These input images are uploaded through the web interface. Computers are unable to recognize or evaluate images in the same way that humans do. Therefore, these images need to be converted into numbers. Using NumPy package of Python language these images are converted to the array. The array contains RGB values of each pixel of an image ranging from 0 to 256. The trained model detects diseases in areca nut and gives the probability of the detected disease. The probability decides whether Areca nut is healthy or not. If found diseased remedial instructions are provided to the user on the web interface.

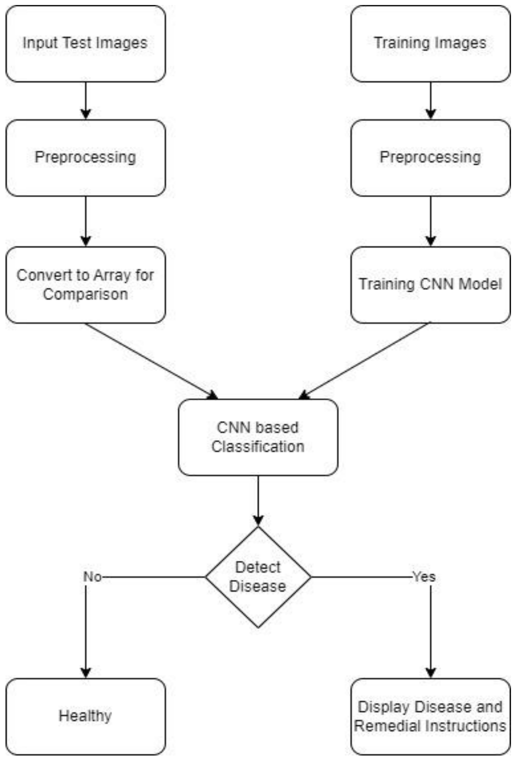

Figure 1. Workflow Diagram of the System

Figure 2 shows that the proposed CNN model consists of several layers, beginning with a 2D convolutional layer with 32 filters of size 3*3, stride 1 with 'same' padding working on 256*256 pre-processed image. Then comes a max pooling layer with a pool size of 3*3 and stride of 1, which is followed by an activation layer that employs ReLU, a batch normalization layer, and a layer of max pooling. Having a dropout rate of 0.25, the following layer is a dropout layer.

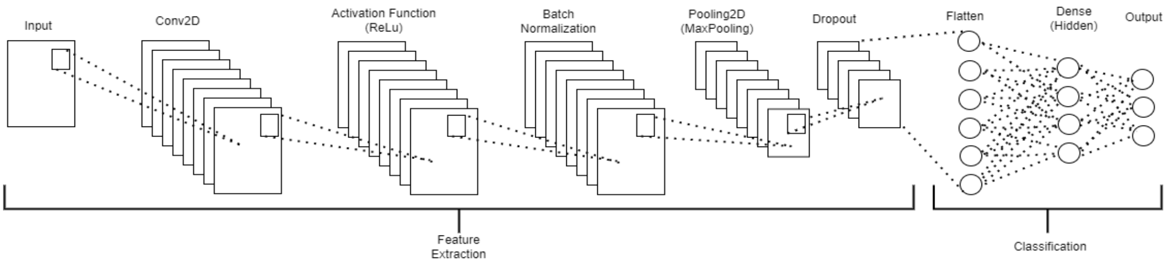

Figure 2. Sequential CNN Model

Alternating 2D convolutional layers, activation layers, batch normalization layers, max pooling layers, and dropout layers are used in the succeeding layers, which also follow this pattern. The convolutional layers have more filters than before 32, 64 and 128 altogether. The stride, padding, and kernel sizes are kept 1 and 'same,' respectively. The last layers consist of a flatten layer to reshape the output from the preceding layer, a fully linked dense layer with 1024 units, another activation layer, a batch normalization layer, and a dropout layer with a dropout rate of 0.5. Seven units with a softmax activation function make up the last dense layer. The model comprises 58,094,471 total parameters, of which 58,091,591 are trainable.

Results and Conclusions

The proposed method was evaluated on a proprietary dataset of images of arecanut distributed among 7 classes which includes healthy leaves, healthy nuts, healthy trunks, fruit rot, stem bleeding, yellow leaf spot and also nut split disease. The CNN model was trained by the training set and the accuracy of the network was evaluated on the test set. The novel work demonstrated the potential of using CNN for the identification and categorization of diseases in arecanut plants. Through the development and testing of the model, it was possible to achieve a high accuracy rate of 93%. The results of the study can have significant implications for farmers and agricultural researchers who are looking for more efficient and accurate ways to diagnose and manage diseases in arecanut plants.

With manual approach it is hard to detect the disease at early stage and avoid spreading of disease. This project aims at providing an easy approach for farmers to detect diseases related to Areca nut and also provides timely hassle-free remedial instructions to the farmers. The system shall be able to detect and classify the diseases found in Areca nut, Areca nut tree leaves, trunk and stem. If found diseased, the system provides remedial suggestions to farmers for further precautionary measures. The system encourages farmers to practice intelligent farming and empowers them to make more informed decisions about yields.

Scope for future work

Future studies could benefit from the use of larger datasets to increase the reliability of the model. Additionally, there may be other environmental and climatic factors that could affect the accuracy of model in real-world scenario. With further research and development, this technology could become a valuable tool for farmers and agricultural researchers in the management of crop diseases. Consequently, this approach helps in encouraging farmers to have good yield and giving them the tools, they need to make better educated decisions regarding yields. The future scope encompasses various potential directions for growth and development. By collecting various and large amounts of datasets and investigating cutting-edge deep learning algorithms, disease detection capacities can be further improved. Creating a real-time disease monitoring system using edge devices or embedded systems connected to the internet of things or drones would give farmers prompt notifications. Future directions for development include multi-disease categorization scope expansion, user-friendly mobile app integration, collaborative disease database creation, and investigation of interaction with precision agriculture technology.