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TITLE: SMART RECOMMENDATION SYSTEM TO IDENTIFY LATE LEAF SPOT AND RUST DISEASE OF GROUNDNUT USING DEEP CONVOLUTIONAL NEURAL NETWORKS

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INTRODUCTION:

This abstract presents a novel approach for identifying late leaf spot and rust diseases in groundnut plants using deep neural networks (DNNs). A comprehensive dataset of groundnut leaf images, encompassing healthy leaves, late leaf spot, and rust-infected leaves, was collected and labeled for training the DNN model. Through extensive training and validation, the model achieved high accuracy in classifying and detecting these diseases.

To make this technology accessible to a wider audience, a user-friendly web application was developed, enabling farmers and researchers to upload groundnut leaf images for disease identification. The web app employs the trained DNN model as its core engine, providing instant and accurate diagnoses. The interface is intuitive and easy to use, allowing users to obtain quick results and make informed decisions regarding disease management and treatment strategies.

This integrated approach of leveraging deep neural networks for disease identification and implementing it through a user-friendly web app has the potential to revolutionize groundnut disease management. By enabling rapid and reliable diagnosis, this system empowers farmers with actionable insights, facilitating early intervention and reducing crop losses. Furthermore, the scalability and accessibility of the web app make it a valuable tool for researchers and extension agents, promoting sustainable and effective agricultural practices in groundnut cultivation. This project is carried out in collaboration with UAS Dharwad.

OBJECTIVES:

To analyze disease in different stages (early, mid and late).

- **To verify the score from model.**
- **To analyze disease in different stages (early, mid and late) using Area Under Disease Progress Curve (AUDPC).**
- **To develop custom CNN model for identifying and classifying late leaf spot and rust disease.**
- **To calculate the percentage of infection in the leaf based on area affected.**
- **To develop a Smart Recommendation system for suggesting fungicide based on severity.**
- **To predict the spread of disease for future from obtained results using weather analysis.**
- **To develop a web-based application for accomplish our objectives.**

• **To build a dataset for late leaf spot and rust disease in groundnut.**

METHODLOGY:

The workflow of our system is illustrated in the diagram Fig 1. Users provide an input image, which is then processed by a deep learning model. In the backend, we have implemented the Faster-RCNN and TensorFlow (TF) Model for this purpose. The TF Model performs image classification, categorizing the image as either late leaf spot, rust, or healthy. The Faster-RCNN algorithm is utilized to quantify the number of late leaf spots present on the leaf. Based on the spot count, the severity of the disease is determined, and appropriate fungicide recommendations with the required quantity are provided.

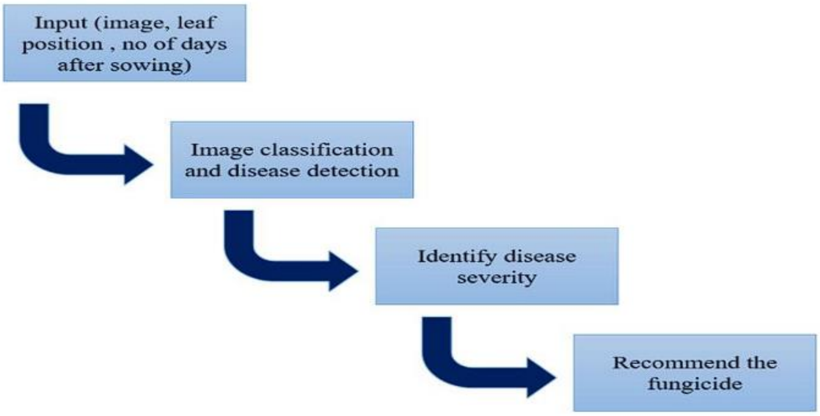

Fig 1. Block Diagram for Recommendation System

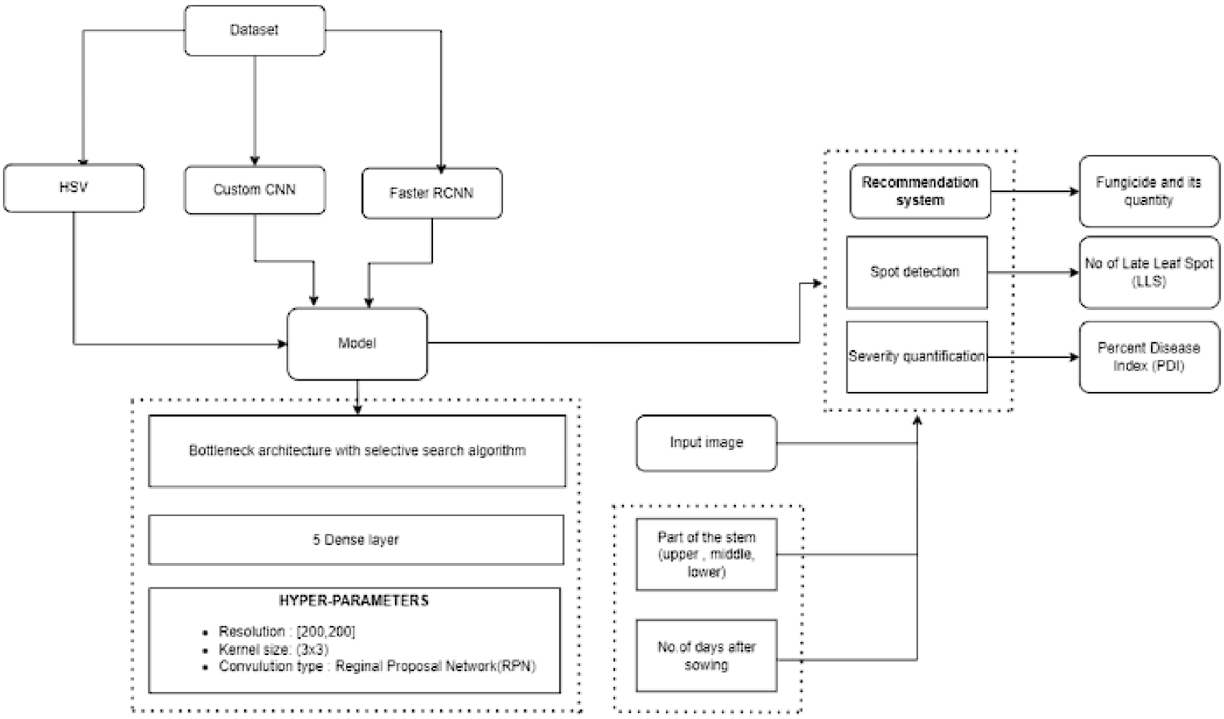

Fig 2. Detailed Workflow of our system

Our recommendation system comprises three modules that perform distinct tasks and operate in a sequential pipeline, where the output of one module serves as the input for the next. The first module is the Classification module, responsible for image classification by categorizing the image as healthy, rust, or late leaf spot. This module incorporates a handpicked CNN architecture consisting of three layers: convolution layer, pooling layer, and fully

connected layer. The output of the Classification module is a processed image that is passed on to the second module, called Count Leaf Spots it is depicted in Fig 2.

The Count Leaf Spots module focuses on quantifying the number of leaf spots on the leaves and determining the severity of the disease based on spot count. It generates localized spot images that highlight the regions of interest, i.e., the leaf spots. The second module employs the Faster R-CNN algorithm for accurate identification of leaf spots. It consists of two components: a deep fully convolutional network for proposing regions and a rapid R-CNN detector that utilizes these suggested areas.

The third module, known as the Severity Quantification module, is specifically designed for measuring the extent of leaf damage caused by the disease. Both the second and third modules serve the purpose of quantification, but the second module generally achieves higher accuracy. The Severity Quantification module employs color analysis based on the HSV color code to identify the regions of interest, i.e., the leaf spots. The severity calculation formula is as follows: the total affected area divided by the total leaf area. The total affected area is determined by the number of yellow and brown pixels, while the total leaf area is calculated by summing up the green, brown, and yellow pixels on the leaf.

RESULTS:

Figure 3. represents the graph of no of epochs and accuracy for classification. Here we can observe that as number of epochs increases accuracy increases and remains stable after certain number of epochs. We have achieved accuracy of 99.54%. Figure 4. represents the graph of no of epochs and loss for object detection. Here we can observe that as number of epochs increases loss decreases and has slight fluctuations.

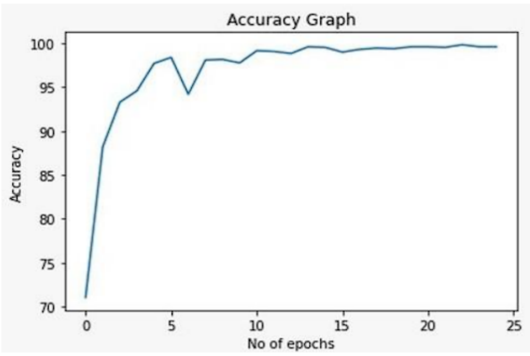

Fig 3. Accuracy Graph for TF Model

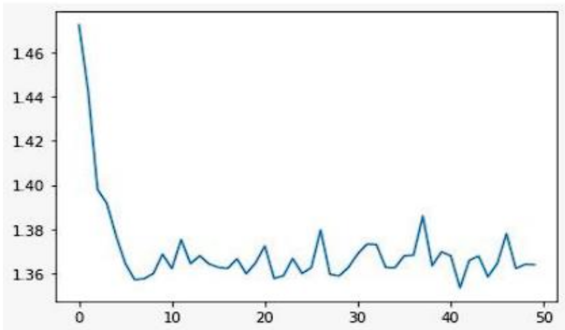

Fig 4. Loss Graph for Faster-RCNN

CONCLUSIONS & FUTURE SCOPE:

Based on the aforementioned work, it can be concluded that Deep Neural Networks have proven to be highly successful in disease identification, achieving an impressive accuracy rate of 99.54% on the Ground leaf dataset. The proposed methodology has demonstrated effectiveness in both detecting and quantifying the spread of diseases in plant leaves. Our recommendation system not only identifies the diseases but also provides recommendations on the appropriate quantity of fungicide to be used, based on the severity of the disease. The disease scoring procedure follows established standards.

In our research, we have introduced two innovative approaches for severity quantification in leaf disease identification. The approach based on the number of spots has shown promising results, while the severity quantification based on color analysis is more susceptible to background noise interference. As part of future work, we aim to improve the accuracy of severity quantification based on color analysis, even in the presence of background noise.

While our recommendation system currently focuses on the Late Leaf Spot and Rust diseases in Groundnut, there is potential for extending our work to encompass different types of diseases. By expanding the scope of our system, we can provide valuable recommendations for a broader range of plant leaf diseases.