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DETECTION OF DISEASES IN ARECANUT LEAVES USING YOLOv8

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Abstract: Monitoring plant health and finding plant diseases are essential for sustainable agriculture. Disease identification and preventative strategies are a significant challenge because of the rapid rise in a variety of diseases and the low level of knowledge of these ailments. Early discovery gives more time to implement the proper preventative measures. Since arecanut plants are very vulnerable to a variety of pests and diseases, the suggested method is used to identify arecanut leaf diseases and divide them into four groups: healthy, diseased leaves with yellow spots, leaf blight, and yellow leaves. The project main goal is to create a YOLO model that analyses leaf images and can be used to find plant diseases.

Keywords: YOLO, Dataset, Epochs, Pixels.

I. INTRODUCTION

Agriculture is the main occupation of India and is the backbone of the economy. India is the largest producer of agricultural products. A wide range of crops are grown in India. The yield of crops depends on several factors such as humidity, soil quality, organic content in the soil, climatic conditions, pests, pathogens, diseases, and so on.

Manually monitoring a plant's health and diseases is particularly challenging because it needs a tremendous amount of work, knowledge of plant diseases, and a lot of time. Consequently, a method for automatically detecting diseases is required. With a production of over 3.3 lakh tonnes and a total area under cultivation of 2.64 lakh hectares, India is the world's largest producer of arecanuts, with Karnataka and Kerala accounting for nearly 72% of the entire production.

Due to unpredicted climatic conditions and pathogens, arecanut trees are affected with yellow spots, leaf blight, and yellow diseases. They can be spread easily and fast resulting in loss to farmers. To avoid this YOLO-based a machine learning model is introduced which will detect a disease present in leaves.

In this project, a model is trained to detect yellow spots, leaf blight, and yellow diseases.

Yellow Spot Disease: The disease manifests as a result of the fungus *Curvularia sp*. Several symptoms can be seen on the leaves, including yellowish spots on the leaf blade, yellow and green spots, shorter and broom-shaped leaves, and occasionally pale, yellow, and drooping leaves. brown or yellowing of the leaf tips.

Leaf Blight Disease: *Pestalotia palmarum* Cooke is the fungus that is responsible for this disease. The disease signs include streaks of yellowish color on the leaf blades, and paleening.

Yellow Leaf Disease: This disease was identified as a result of an attack by a Micoplasm-like Organism (MLO). Yellowing of the leaf tips and up to two or three strands of branching are symptoms. Necrosis symptoms include brown parallel lines on the leaves, yellowing that continues along the leaf blade, and dried-out leaf tips. The leaves eventually turn yellow and drop off the stem. The functional leaf cross-sectional area for photosynthesis is reduced in mature leaves due to this infection.

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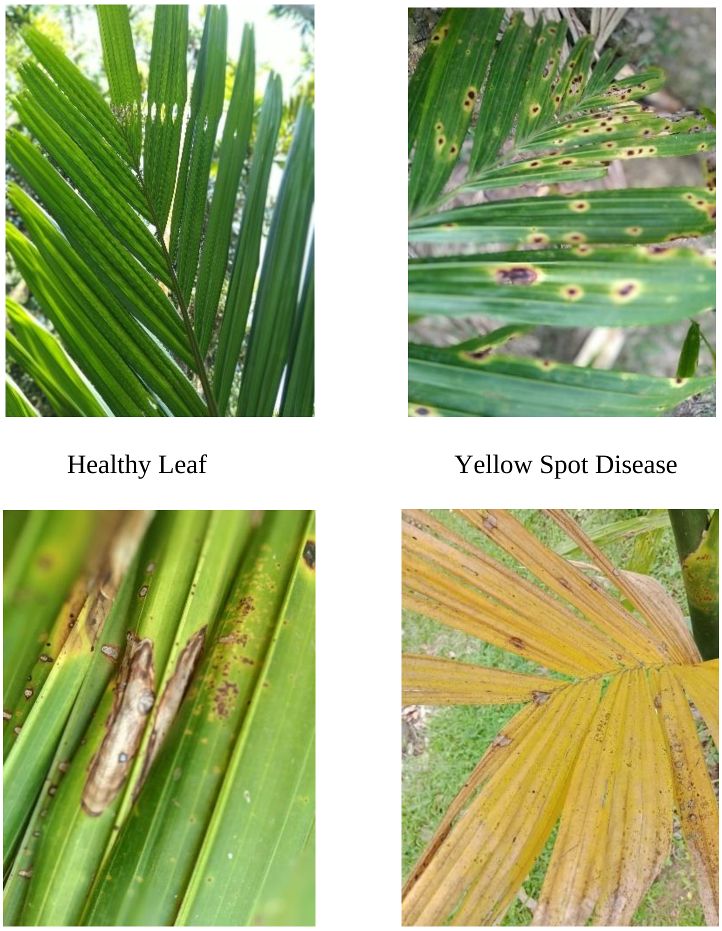

Healthy Leaf Yellow Spot Disease

Leaf Blight Disease Yellow Leaf Disease

Fig. 1 Images of healthy and diseased leaves of arecanut

II. LITERATURE SURVEY

The paper [1] offers an alternative way to identify plant diseases. Traditional methods for identifying plant leaf diseases frequently involve visual inspection and laboratory testing, both of which can be labour- and time-intensive. Modern methods based on image processing and machine learning techniques have the potential to be more efficient and precise, even though they require a lot of training data. Many image processing and machine learning techniques, including picture segmentation, feature extraction, and classification, have been used to identify plant leaf diseases. The availability of training data and the variety of plant diseases are two challenges that need to be overcome in order to develop more effective plant leaf disease detection systems.

The research [2] provides a deep learning method for identifying and diagnosing plant diseases. The technique to extract information from images of plant leaves uses convolutional neural networks (CNNs). The features are then used to build a classifier to distinguish between healthy and unhealthy leaves. The approach was evaluated using a dataset of 87,848 images of 58 different plant-disease pairs. The results showed that the method had an accuracy percentage of 99.53%.

The research [3] suggests the YOLO object recognition approach as a technique for crop disease diagnosis. The programme divides the image into a grid of cells and calculates the bounding boxes and class probabilities for each cell. Using a dataset of 10,000 images of healthy and diseased leaves, the YOLO model was trained. The model was able to achieve an accuracy of 96.7% on the test set. The research discusses the advantages of using YOLO for agricultural disease identification, including its speed and accuracy.

The paper [4] presents an improved Yolo V3 algorithm for the detection of diseases and pests in tomatoes. The method uses multi-scale training, multi-scale feature recognition based on image pyramids, and object bounding box dimension

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clustering. The testing results show that the algorithm has a detection accuracy of 92.39% and a detection time of less than 20.39 milliseconds. The updated Yolo V3 algorithm's advantages are presented along with its accuracy, speed, and noise robustness. One of the challenges with implementing the approach—and one that is also mentioned in the paper is the requirement for a big training image collection.

The research [5] recommends using the MGA-YOLO lightweight one-stage network to detect apple leaf disease. The network, which is based on the YOLO algorithm, uses the Ghost module and CBAM to improve the performance of feature extraction and classification. The article used a dataset of 8,838 images of healthy and diseased apple leaves to evaluate the performance of the MGA-YOLO network. The results showed that the MGA-YOLO network had an accuracy of 89.3% and a mean average precision (mAP) of 94.0%. The study discusses the advantages of the MGA-YOLO network, such as its lightweight design and high accuracy.

The YOLO-JD deep learning network, which uses images to detect jute diseases, is introduced in the paper [6]. The network, which is based on the YOLO approach, uses three novel modules called the Sand Clock Feature Extraction Module (SCFEM), Deep Sand Clock Feature Extraction Module (DSCFEM), and Spatial Pyramid Pooling Module (SPPM) to effectively extract image data. A completely new, enormous image collection with ten classes for jute pests and illnesses was also produced by the study. The study evaluated the YOLO-JD network's performance on the new dataset and compared it to existing state-of-the-art methods. The results showed that YOLO-JD had the highest detection accuracy, with an average mAP of 96.63%.

The paper [7] proposes an improved YOLOv5 model called YOLO-Tea for identifying tea illnesses. The model uses a self-attention and convolution (ACmix) module and a convolutional block attention module (CBAM) to improve the recognition of the feature pictures. In order to better maintain global knowledge about tea disease and pest targets, the spatial pyramid pooling fast (SPPF) module is replaced in the model by the receptive field block (RFB) module. The GCnet structure is added to YOLOv5 in order to enhance tea leaf disease and pest identification while reducing parameter overhead. The article evaluated the performance of the YOLO-Tea model using a dataset of 1,390 images of pests and illnesses that affect tea.

The study [8] proposes a novel object identification method called YOLO (You Only Look Once). Because it is a one-stage method, the YOLO algorithm predicts bounding boxes and class probabilities in a single run. As a result, YOLO performs far more quickly than two-stage algorithms like R-CNN. The study evaluates YOLO's performance on the PASCAL VOC dataset and achieves a mean average precision (mAP) of 57.9%. Despite the fact that YOLO is much faster, this is on par with the performance of two-stage algorithms.

Ag-YOLO, a real-time, inexpensive object detector, is recommended by the research [9] for precise palm spraying. Ag-YOLO, which is based on the YOLO algorithm, was created with embedded devices in mind. Using a collection of aerial photos of palm trees, the accuracy and frame rate of Ag-YOLO were investigated in the article, and both were found to be 92.05% and 36.5 fps. The study discusses the advantages of Ag-YOLO, including its versatility, cost, and real-time performance.

The paper [10] recommends a cutting-edge mobile application called PlantifyAI for efficient crop disease identification and treatment. PlantifyAI uses convolutional neural networks (CNN) to swiftly detect crop illnesses. The CNN was trained using a set of 87,860 leaf images separated into 38 classes. On a test dataset, the accuracy rate for the paper's assessment of PlantifyAI's performance was 95.7%. The report also discusses other advantages of PlantifyAI, such as accuracy, usability, and low cost.

III. METHODOLOGY

The entire project is divided into two parts:

1. Building a Dataset
2. Training a YOLO model

Dataset: The dataset is prepared by collecting photos manually from fields under the guidance of experienced farmers. There are 225 images belonging to healthy and diseased classes. Before training a model, using openCV images are resized to 640*640 pixels.

Training YOLO Model: To train and test the Model, a total of 225 photos, including both healthy and sick images, were employed.

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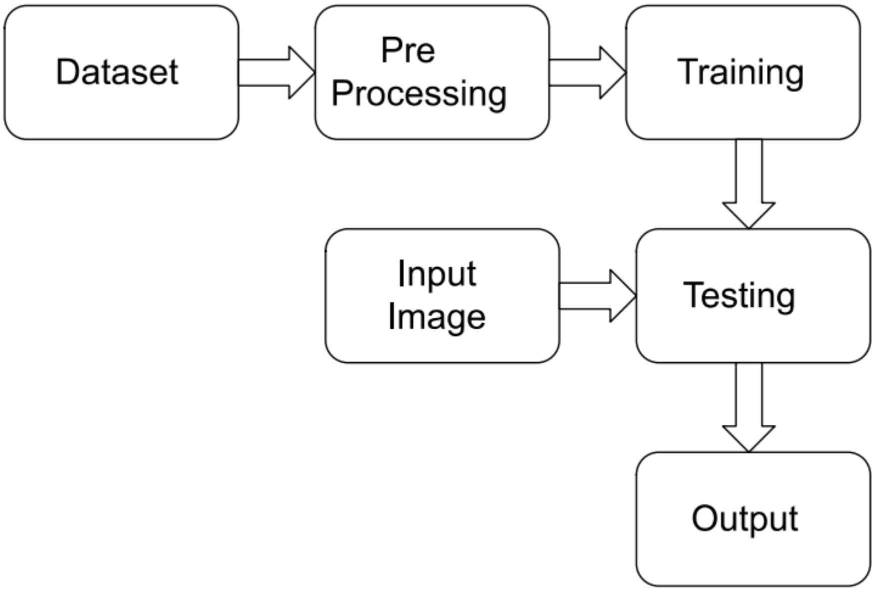

Fig. 2 Design of working model

Preprocessing of the database entails resizing, reshaping, and array conversion. Similar processing is likewise applied to the test image. Images are resized to fixed pixels 640*640 resolutions and were transformed into an array before the YOLO model was trained. Due to the limited dataset, we employed the augmentation technique, which rotates, shifts, zooms, and flips the image to produce new data for training.

Fig. 3 Sample trained dataset

The train and test data are divided into a ratio of 80:20. In order to train the model with the highest validation and test accuracy and the least amount of loss, 15 Epochs are employed.

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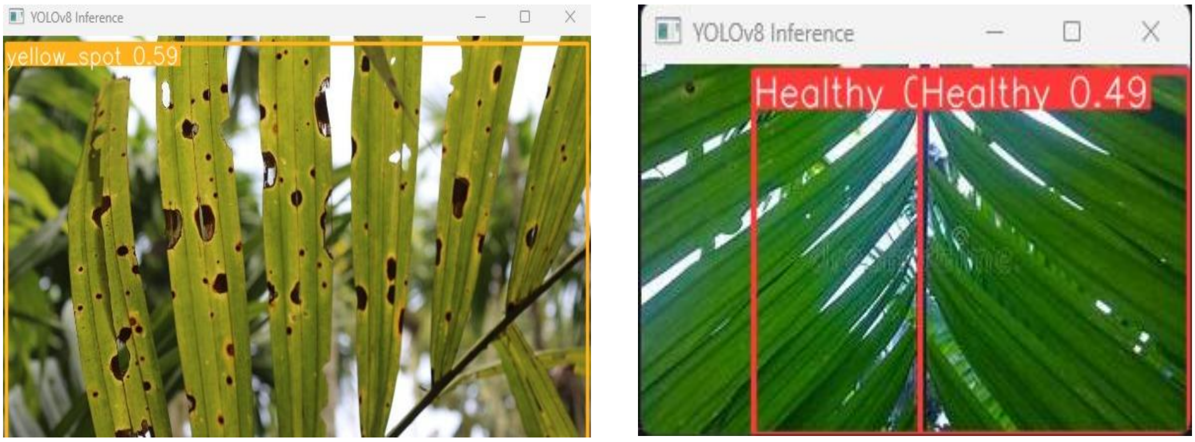

Fig. 4 Outputs of model

IV. CONCLUSION

In this paper, a YOLO model is proposed to detect diseases in arecanut leaves. The goal was to offer a reliable and effective method for early disease detection and managing disease found in arecanut plants. The main contribution of this paper is to build a new dataset containing 225 images belonging to 4 different classes. The YOLO-based model shown excellent precision and is easy to use, efficient for limited datasets, and can be improvised. In order to make the model more widely applicable, the next work will collect a large number of high-quality images of different types of diseases.

In the future, this model can be deployed to a farmer-friendly mobile application or web interface for real-time detection of the disease. This will allow farmers to capture and upload the images and helps to make decisions on disease management. A UAV (Unmanned Aerial Vehicle) like drone can be used to capture real time images.

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