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Real Time Emblica Fruit Disease Monitoring System

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Abstract: ***Phyllanthus Emblica (Amla) fruit is vulnerable to fungal diseases mainly soft-rot and rust causing 25-30% loss in production of fruit in India, the largest producer of Phyllanthus Emblica. So, effective automated detection of Phyllanthus Emblica fruit disease at early stage will not only monitor health status but also help farmers to correctly identify and treat Phyllanthus Emblica disease.***

This project proposes novel technique of real time detection and categorization of soft-rot (Phomopsis Phyllanthi) and rust (Ravenelia Emblicae) using CNN and YOLO-V2 and providing eco-friendly treatment of detected disease using Apple Cider Vinegar (ACV) and bio-fertilizer as fungal controller. For early detection of disease, input image is taken directly from the field using ESP32 camera and YOLO-V2 detects whether input contains Phyllanthus Emblica fruit or not. The output image is trained using CNN to classify fruit disease. CNN and YOLO-V2 is used together for the increased accuracy and better IOU as it is faster algorithm than its counterparts, running at 45 FPS in detection of Phyllanthus Emblica fruit disease over SVM methods and result showed 99.99% accuracy in early detection of soft-rot and rust.

Ravenelia Emblicae and Phomopsis Phyllanthi were isolated and identified using PDA and assessed for fungitoxity of homemade ACV and Bio-fertilizer using microbes culturing method. ACV effectively inhibited fungi on 5th day .Thus disease can be controlled after 3-5 attempts of ACV. This technique is easily accessible to farmers and finds a great future for timely detection, prevention and control using eco-friendly treatment of fruit disease which is crucial to promote healthy growth and maintain nutritive value of Phyllanthus Emblica fruit.

Keywords: Phyllanthus Emblica fruit, Diseases for Phyllanthus Emblica fruit, CNN (Convolutional Neural Networks), YOLO (You Only Look Once) V2 object detection.

I. INTRODUCTION

Amla is commonly known as Phyllanthus emblica or Indian gooseberry. Phyllanthus emblica is of great importance as it is beneficial for our health due to its medicinal and nutritious properties. Phyllanthus emblica is rich in antibacterial and antioxidant properties, iron content, vitamin C and dietary fiber which makes it useful for improvement of immunity, hair care, stress reduction, eye care, treatment of anemia, blood purification, weight management and skin care. Phyllanthus emblica also occupies a prominent place in Ayurveda.

The Effective automated detection of Phyllanthus emblica disease during production not only monitors the health status of Phyllanthus emblica fruit but help farmers to correctly identify Phyllanthus emblica disease. Then the timely prevention and control to avoid large scale disease can be implemented by farmers which is crucial to promote healthy growth of Phyllanthus emblica and increasing its economic benefits and

production. The manual detection of Phyllanthus emblica fruit disease is a naked eye observation which consumes more time, is more expensive and sometimes produces an error in identifying the disease. Fruit diseases are described under several different symptoms types but differences are not always

clear cut resulting in imprecise detection of disease by farmers. Also due to wrong diagnosis farmers uses a lot of wrong and unnecessary fungicide on fruits which further causes depletion in nutritive value of fruit as well as soil. By the use of image processing techniques in identifying agricultural plant disease, the farmers will be less dependent on the protection of plants. Based on different features extraction of Phyllanthus emblica, a new target detection model of Phyllanthus emblica diseases mainly the Soft rot (figure 1) caused due to fungus *Phomopsis Phyllanthi* and Rust ([1]) (figure 2) caused due to fungus *Ravenelia Emblicae*, YOLO-V2 and CNN, based on Deep Learning ([2],[3]) is proposed to realize more effective and faster automatic detection.

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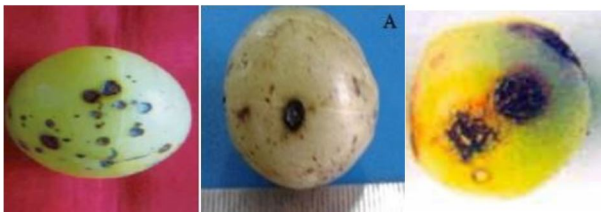

Figure 1- Soft Rot diseased Phyllanthus emblica fruits

Figure 2- Rust diseased Phyllanthus emblica fruits

II. AIM AND OBJECTIVE

Our projects aims in real time detection and categorization of two Phyllanthus emblica fruit diseases, i.e. Phyllanthus emblica rust caused due to fungus *Ravenelia Emblicae* and Soft rot caused due to fungus *Phomopsis Phyllanthi* using CNN and YOLO-V2 and automatically suggestive eco-friendly treatment of the disease by using the ESP32 camera module to take images directly from the crop field and then interfacing the images with help of MATLAB code. For the image acquisition the Phyllanthus emblica fruits diseases are collected directly from diseases fruits. This is an economical, eco-friendly and easily accessible solution for the farmers.

III. INNOVATION

Our project innovates the use of CNN and YOLO-V2 together for the first time for increased accuracy in predictions and a better Intersection over Union. Also CNN is more computationally efficient and YOLO-V2 is a much faster algorithm than its counterparts, running at as high as 45 FPS in detection and categorization of diseased Phyllanthus emblica fruits and suggest eco-friendly treatment of disease, over the SVM (Support Vector Machines) methods which has higher Computational time and is difficult to understand and interpret the final model, variable weights and individual impact. It finds a great future for real time early control of fruit disease and crop yield management in Agriculture fields. Our project gives a real time and low cost solution for farmers as there is no need to go in lab for the detection of Emblica fruit diseases. The camera installed on the field site will directly capture the images and these images can be directly given as an input to MATLAB code which will process the images using deep learning algorithms and image processing techniques ([4]). The output will directly get on the command window and can be analyzed with in a very less time.

Thus, our project is an improved design using CNN and YOLO-V2 for Phyllanthus emblica fruit disease detection system.

IV. PROPOSED METHOD

Here we have proposed a novel technique of using CNN and YOLO-V2 with image processing techniques for the detection and classification of Phyllanthus emblica fruit diseases. Firstly the image of the Phyllanthus emblica fruit is taken directly from crop field using ESP32 cam module. Then the captured images are given directly as an input to MATLAB code. Using image processing and YOLO V2 technique the input images are detected that whether the input image contains Phyllanthus Emblica fruit or not. The output detected images are then trained using CNN which classifies the diseases of Phyllanthus Emblica fruit in input image. Then the name of disease and the causing fungus along with the favorable conditions for the disease to spread and the eco-friendly treatment using Apple Cider Vinegar ([5]) and Bio-fertilizer as fungus controller is also printed on the command window. Whereas, if no fruit is detected in input image then there ends the process and displays that no fruit is detected input image. For getting better and accurate output we have built a CNN consisting of Layers, Data Set and Training options.

CNN or convNet eliminates the need for manual feature extraction and is a network architecture for deep learning, which learns directly from data and YOLO v2 object detector uses a single stage object detection network and is more faster than other object detectors based on two stage deep learning, such as faster R-CNN.

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The model YOLO v2 executes the deep learning CNN on the input image to produce network predictions. Then the object detector sorts out the predictions and generates bounding boxes. Objects in the images are predicted by YOLO v2. Anchor Boxes are used by YOLO v2 to detect classes of objects in an image. The three attributes predicted by YOLO v2 for each anchor box are -

1) *IoU:* In this objectness score of each anchor box are predicted .
2) *Anchor Box Offsets:* Refine the position of anchor box
3) *Class Probability:* Predicts the class label to which each anchor box has been assigned

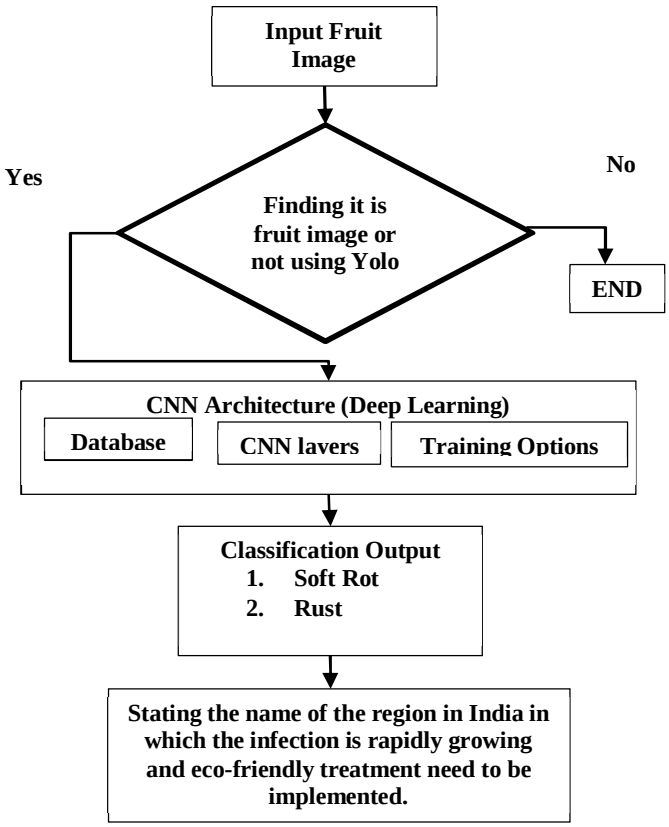

Figure 3- Block Diagram of proposed method Detector

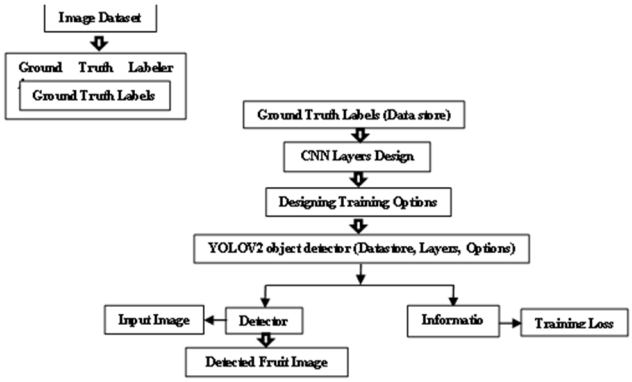

Figure 4- Block Diagram of YOLO V2 Object Detector

Isolation of *Ravenelia Emblicae* and *Phomopsis Phyllanthi* fungus were done using the PDA *(Potato Dextrose Agar)* media and the effect of home-made Apple Cider Vinegar and Bio-fertilizer as fungus controller was recorded and found that the fungal disease in Phyllanthus emblica can be treated after 3-4 attempts of vinegar.

V. RESULTS

Figure- Input Image

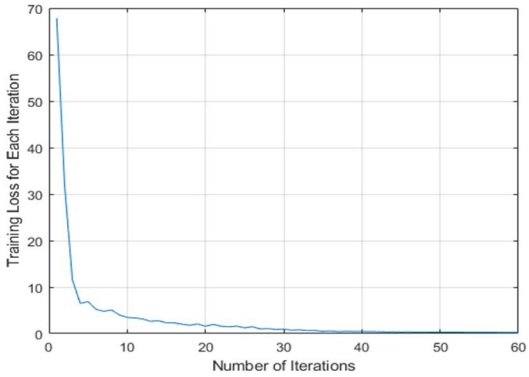

Figure- Training Loss Graph

Figure- Fruit Detected Image

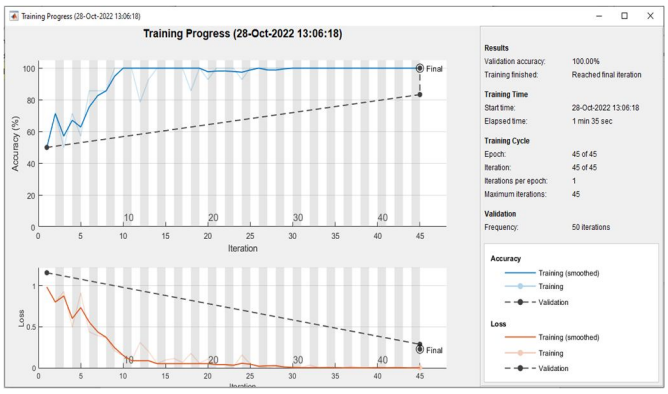

Figure- Training Progress Graph

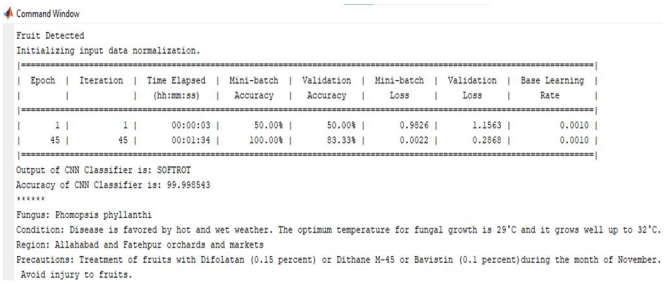

Figure- Output Of Command Window

The fruit was correctly identified by YOLO-V2 and the accuracy of our CNN classifier was 99.99% for the detection and classification of Soft rot and Phyllanthus emblica rust diseases of Phyllanthus emblica fruit. And the prompt eco-friendly treatment of disease was also printed. It was much faster and accurate method than the existing method, i.e. SVM (Support Vector Machine), which is less computationally efficient and more time taking.

VI. CONCLUSIONS

In this paper, we have investigated a novel technique using CNN and YOLO V2 together with image processing techniques and deep learning algorithms for detection of Phyllanthus emblica fruit using images and classifying the Phyllanthus emblica fruit disease. It was the most effective strategy to identify the fruit and classify the fruit disease. Early fruit disease diagnosis is crucial for taking preventive measures to prevent it and restore the plant's health and reduce the risk of heavy crop destruction. Firstly, input image is taken from field using the ESP32 cam module and identifying fruit and then classifying different fruit diseases using images of fruit. YOLO V2 is used for identifying and detecting whether the input image is containing a Phyllanthus emblica fruit or not. If the image has fruit detected then classifying the Phyllanthus emblica fruit disease type from the input image and then we will specify the fungus, condition which the disease is favorable to grow and the eco-friendly treatment need to be implemented to restore the plant's health. Our proposed technique is better than the existing methods and effective method for detecting and classifying the fruit diseases.

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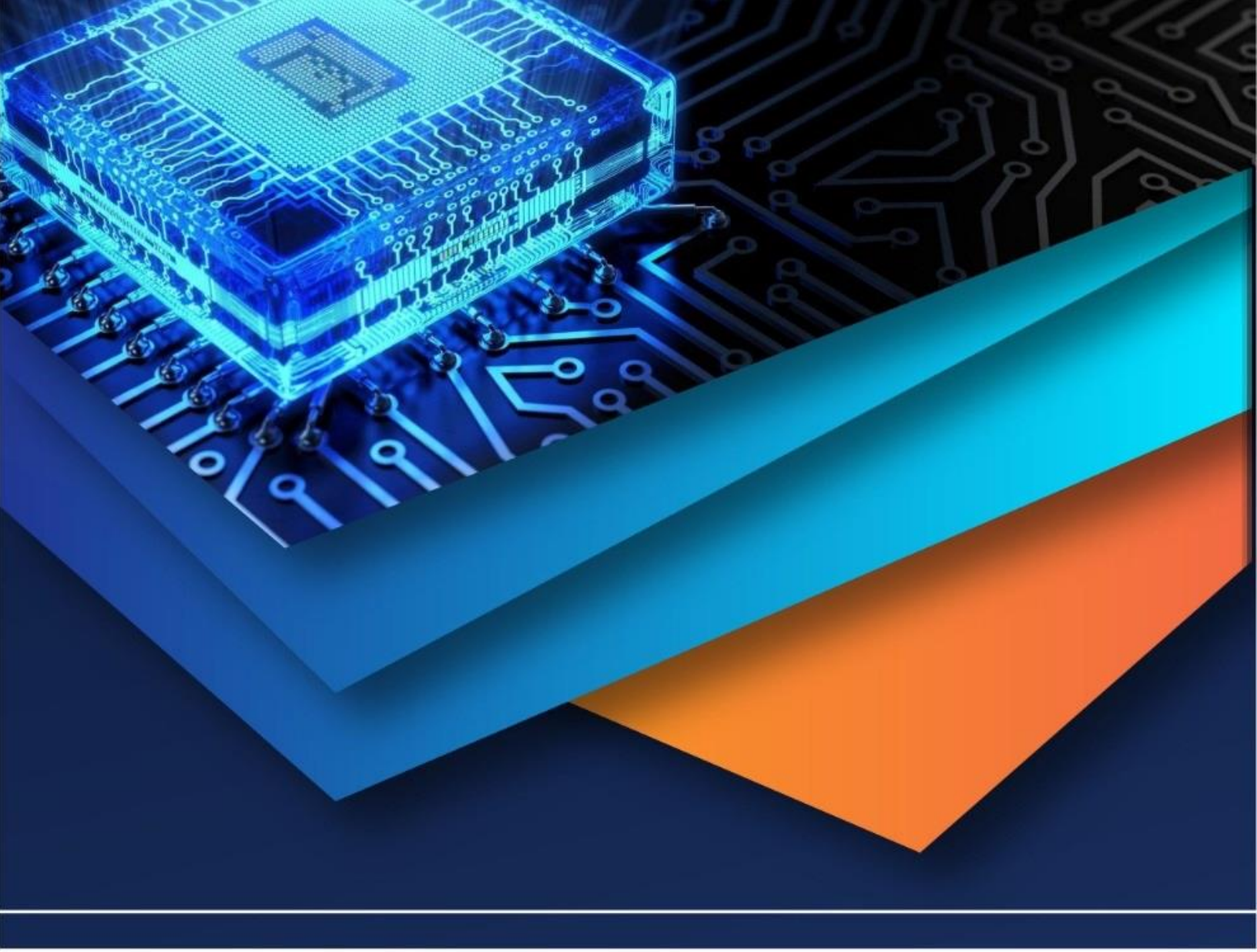

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