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Smart Agriculture Techniques for Plant Leaf Disease using AgriRobo

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Abstract: *Machine learning is a branch of artificial intelligence (AI) and computer science. The primary causes of decreased agricultural production quality and quantity are Plant diseases. As plant structures and cultivation methods evolve, new diseases continue to emerge on plant leaves. Accurately classifying and detecting plant leaf diseases in their early stages restricts infection spread and promotes the healthy growth of plant production. Detecting plant diseases manually is a time-consuming and error- prone process. It can be an unreadable method of identifying and preventing the spread of plant diseases. The review resolves around two main axes: 1. Plant Leaf Disease Detection & Clas- sification. 2. Agrirobo Suggested disinfectant and automatically spraying for that plant leaf disease. Smart Agriculture to produce good crops quality and quantity without harming the healthy plant. A deep CNN (Convolutional Neural Networks) model captures the deep features while LBP (Local Binary Pattern) effectively extracts the local texture information.YOLO algorithm divides an image into the grid system and in that each grid detects objects within itself. This review paper explores the recent advancements and methodologies employed in this area, focusing on key techniques, challenges and emerging trends. Various image processing algorithms including Deep Convolutional Neural Net- works (DCNNs) and deep learning architectures, are discussed for their efficiency in automating plant leaves disease detection and classification.*

Keywords: Machine Learning, Plant leaf disease detec- tion, Classification, AgriRobo, Disinfectant, You Only Look Once(YOLO), Convolutional Neural Networks (CNN), Local Binary Pattern (LBP), Deep Convolutional Neural Networks (DCNN), Deep Learning

I. INTRODUCTION

One of the world's leading grape-producing nations is India. Grapes are cultivated in different states throughout India, and Maharashtra, contributing to over 80% of the total grape pro- duction in the country, stands as the largest grapes-producing state. Commencing in December and extending until May, the grape season in India typically unfolds. Generally, grapes thrive in well-drained soils with good fertility and sufficient water-holding capacity. Grapes are one of the most cultivated fruits across the globe, mainly for wine production. Downy mildew, powdery mildew, grey mold, black rot and anthracnose are caused by fungi that attack the plant, reducing yield and quality [1]. Crown gall is caused by a bacterium and can kill the grapes plant. Rapid and accurate identification of diseases in the field is key to preventing serious outbreaks and losses in yield and quality. Recently, the convolutional neural networks (CNN), special of deep learning techniques, are quickly be- coming the preferred methods [7]. Various diseases varies from year to year, depending on weather conditions. This means that a disease can be devastating one year and insignificant the next. The measures to be taken to prevent losses may therefore vary from season to season. The purpose of this review is to aid in the identification of grape diseases and in pest management decision-making. Accurate identification of pests is critical to an effective management program that provides optimal control while minimizing pesticide use.

Fig. 1. Unhealthy Leaf.

Hosny et al. [1] Studied apple, grapes, tomato leaf diseases including healthy, early blight, black rot and extracted its characteristic parameter such as colour texture and shape information of above plants using CNN and LBP. The accuracy of this method reached 98.8%, 96.5% and 98.3%.

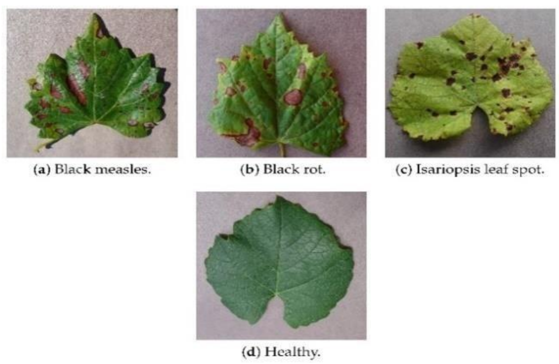

Fig. 2. Grapes plant leaf disease

Guan et al. [2] 63 parameters, encompassing morphology, color, and texture features of rice leaf disease spots, were isolated. These were subsequently subjected to classification and recognition using step-based discriminant analysis and the Bayesian discriminant method. The outcome revealed successful differentiation among three distinct rice diseases blast, stripe blight, and bacterial leaf blight with an impressive recognition accuracy reaching 97.2%.

Amaresh et al. [3] Farmers manage a pesticide sprinkling device via an IoT application, while a robot is positioned in the field to capture images of the crops. The signal is transmitted to the operating end and visualized through an Android application..

Kawasaki et al. [8] Implemented a CNN-based system for the recognition of cucumber leaf disease, achieving an accuracy rate of 94.9%.

In summary, research on plant disease recognition utilizing traditional image technology has yielded notable outcomes, demonstrating high accuracy in disease identification. How- ever, there persist deficiencies and limitations as outlined below:

Evaluating the model's performance in recognizing dis- eases poses a challenging task.

The systems are time consuming. s

Therefore, it is of great significance to realize intelligent, rapid, and accurate plant leaf disease recognition.

Figure 3. shows Continuous supervision of the agricultural field is possible with automatic performance of such AgriRobo. In propose model, AgriRobo capture the plant leaf image and then YOLO algorithm is applied for scan the leaf of plant in single step and then it detect disease. A deep CNN model captures the deep features while LBP effectively extracts the local texture information. We combine these two sets of features to obtain the final feature vector of plant disease samples.This paper is based on developing a AgriRobo which is used in agriculture for spraying pesticides.

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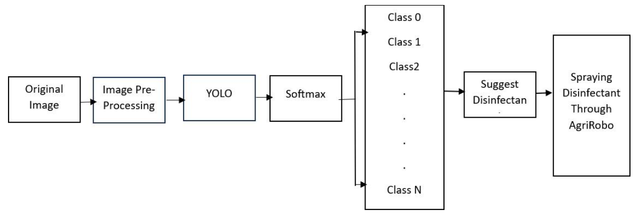

Fig. 3. Architecture of proposed system

In this research, YOLO is trained to recognize the pattern associated with the various plant disease on leaves. When AgriRobo is deploy it enables the robot to quickly identify if a plant is affected by a disease or not. Softmax is applied for classification. According to their classification like healthy, unhealthy AgriRobo suggest disinfectant for the particular disease. With the help of AgriRobo automatically spraying the disinfectant for particular plant that's why healthy plants are not affected by pesticides. The system is based on providing security to the farm in the absence of the farmer and keeps the farmer updated about the where abouts of the farm.

II. BACKGROUND

Dataset

The Plant Village dataset, accessible on Kaggle, comprises 54,305 images captured under controlled conditions, focusing on diseased instances (Plant Village Dataset). The images represent 14 crop species, such as grape, apple, blueberry, cherry, orange, peach, pepper, potato, raspberry, soy, squash, strawberry, and tomato. This dataset from Plant Village in- cludes 38 plant classes.

You Only Look Once

There are agriculture robot design to perform the task in farming. In this case the robots are being use to assist in detecting disease on plant leaves. YOLO looks at entire image once and identify objects. This make it faster and more efficient. YOLO is trained to recognize pattern associate with the various plant disease on leaves. YOLO helps AgriRobo efficiently scan leaves, quickly identifying and flagging any disease of plant leaves. This can be crucial for a farmer in taking timely action to prevent the spread of disease and ensure the helathy leaves yield.

Deep Convolutional Network

Deep Convolutional Neural Networks are mainly focused on applications like object detection, image classification, recommendation systems. The primary advantage of employ- ing deep CNNs for image classification lies in their ability to obviate the need for a feature engineering process. To capture images, various pre-processing techniques such as image filtering, sharpening, and resizing are applied. The architecture comprises three convolutional layers, three max- pooling layers, and four dense (fully connected) layers. The convolution layers function as adept feature extractors from the images. Consequently, the initial convolutional layer in the model employs 32 filters, with this number progressively increasing to 128 filters in the final convolutional layer. Research indicates that a gradual augmentation in filter sizes has a discernible impact on the model's performance.

Local Binary Pattern

LBP, renowned and extensively applied, serves various pur- poses such as face recognition, fingerprint identification, and numerous classification tasks. This feature is derived by binary encoding the contrast in pixel intensities within a defined local neighborhood. LBP stands out as a potent descriptor for capturing the local texture pattern in an image, finding widespread use in image processing applications.

III. APPLICATIONS

Detection and Classification of Plant Leaf Diseases using AgriRobo can be beneficial in several domains and scenarios, including:

- **Automated Disease Detection:** Farmers and agricultural researchers can use this technology to quickly identify plant diseases in crops, enabling timely intervention and reducing crop losses.
- **Precision agriculture:** It can help in the targeted application of pesticides and treatments, reducing the overall use of chemicals.
- **Plant Disease Research:** Scientists studying plant diseases can leverage this technol- ogy to streamline their research efforts and develop a better understanding of disease patterns and progression.
- **Disease monitoring:** Continuous monitoring of plant health in research fields or botanical gardens.
- **Learning tool (Education):** It can be used as an educational tool in agricultural and botanical studies, helping students understand plant diseases and their identification.
- **Integration with IoT:** This technology can be integrated into IoT-based agricul- tural systems to create smart farms that automatically detect and respond to plant diseases.
- **Sustainable agriculture:** By reducing the reliance on chemical treatments, it con- tributes to more sustainable agricultural practices.

IV. CONCLUSION

This paper provides fundamental insights into Aritificial Intelligence offering a thorough review of recent research endeavors in the recognition of grape plant leaf diseases through Artificial Intelligence methods. The paper presented an automated mechanism designed to classify grape leaves as either healthy or diseased. The classification involves extracting features from grape images using various pre- trained networks and subsequently employing ensemble learning methods across these networks to improve diagnostic accuracy. Moreover, the approach should undergo testing in leaf diseases affecting various crops and be assessed for its real-time application performance.

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