Survey Paper on Smart Agriculture Assistant

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***Abstract*—A quickly emerging field, precision agriculture aims to address contemporary issues of agricultural sustainability. Precision agriculture relies on machine learning, a state-of-the-art technology that makes it possible to create sophisticated disease detection and categorization techniques. A review of the use of deep learning and machine learning methods in precision agriculture—more especially, their detection and classification of plant diseases—is presented in this study. All pertinent works are categorized in the related classes using our innovative classification scheme. Depending on whether the research employ classification or object detection as their methodology, we divide them into two major groups.**

***Index Terms*— Precision agriculture, disease detection and categorization techniques, etc**

I. INTRODUCTION

Agriculture has a major role in the economic development of any country. The increasing population, frequent weather variations, and scarcity of resources have made it challenging to meet the population's present food needs. Crop diseases have been growing more severe and widespread in addition to the previously listed difficulties. Crop diseases result in production losses that can be reduced with ongoing observation. According to research from the United Nations Food and Agriculture Organization, plant diseases alone cost the world economy $220 billion a year. The potential yield can be greatly increased by creating new techniques for early disease detection on plants or leaves. These works approach the topic as a classification problem, either using a multi-class classification (targeting different diseases) or a binary classification (healthy or diseased plant/leaf). For this, traditional machine learning techniques such as Random Forest (RF) and Deep Learning (DL) have been used. However, there are fewer studies that tackle the topic as an object detection problem, attempting to identify both the illness kind and the affected areas of the input image. When there are multiple plant diseases present in the input image or when we wish to identify the precise location of the diseased plants in an image that encompasses a significant portion of the crop (such images are taken by Unmanned Aerial Vehicles (UAVs)), the latter problem is more significant than the classification problem. Furthermore, object detection is a more challenging problem than classification, and DL techniques for object recognition perform poorly in uncontrolled environments, such as photos with noisy objects.

II. LITERATURE REVIEW

Piyush Chaudhary, Anand K. Chaudhari, Dr. A. N. Cheeran and Sharda Godara, “Color Transform Based Approch For Disease Spot Detection on Plant Leaf” [1], An algorithm for segmenting disease spots in plant leaves using image processing techniques is put into practice. This is the initial and crucial stage of automatically identifying and categorizing plant diseases. Compared to the color of plant leaves, disease spots differ in color but not intensity. In order to improve the segmentation of illness spots, we can apply color transformation to RGB images. The impact of CIELAB, HSI, and YCbCr color spaces on illness spot identification is compared in this paper. Images are smoothed using the median filter. In order to identify the illness spot, the Otsu method can be used to the color component to determine the threshold. Experiments were conducted on several "Monocot" and "Dicot" family plant leaves with both noise-free (white) and noisy backgrounds in order to build an algorithm that is independent of background noise, plant type, and disease spot color.

Ms. Rupali S. Zambre, “Classification of Cotton Leaf Spot Disease Using Support Vector Machine” [2], Product quality control is basically necessary to get more value-added items. Numerous studies demonstrate that a variety of factors can lower the quality of agricultural products. One of the key causes of these high-quality plant illnesses. Therefore, reducing plant diseases enables a significant improvement in product quality. Accurate crop disease identification in the field is essential for higher output. The primary fungal disease of cotton, foliar, affects all cotton-growing regions in India. In order to classify the diseases using support vector machines, this paper employs technological strategies that leverage mobile devices to capture symptoms of Cotton Leaf Spot photos. The classifier is being trained to accomplish intelligent farming, which includes selective fungicide administration, early disease detection in the groves, etc. The segmentation approaches used in this proposed study first analyze the acquired images for enrichment. Next, color and texture In order to identify diseases, properties including border, form, color, and texture are extracted using feature extraction techniques.

C Rajasekaran, S Arul, S Devi, G Gowtham, S Jeyaram, “Turmeric Plant Diseases Detection and Classification using Artificial Intelligence” [3], Bacteria and viruses are the main microorganisms that cause disease, and they are invisible when they first touch a plant. Only at a later stage is it apparent to the human naked eye, and it affects entire plant sections. In order to automate tasks and increase productivity, artificial intelligence is a rapidly developing field in all industries. By identifying disease affection early and classifying the type of disease afflicted, it also helps the agricultural industry increase crop yield by adopting preventative measures to stop the disease from spreading to other plants in the field. Computer vision image processing makes this feasible, and the VGG-16 architecture—which uses Convolutional Neural Network algorithms—is used to train the model.

Mishra, A., Chaurasia, P., Arya, V., & Jos´e Garc´ıa Pe˜nalvo, F “Plant Disease Detection using Image Processing” [4], Early detection is essential because plant diseases affect the growth of their specific species. Plant diseases have been identified and classified using a variety of Machine Learning (ML) models; this area of research now seems to have a great deal of promise for increased accuracy. Many developed/modified machine learning architectures are used in combination with various visualization techniques to detect and classify the symptoms of plant diseases. These structures and procedures are also evaluated using a variety of performance metrics.

C. Senthilkumar, M. Kamarasan, “A Survey On Leaf Disease Detection Using Image Processing Techniques” [5], While monitoring vast swaths of crop fields can be aided by leaf disease detection research, it is crucial to identify the illness as soon as feasible. Our survey paper primarily focuses on research-oriented methods that identify leaf illnesses early on. The authors have also presented image processing techniques that increase crop output by preventing numerous bacterial, viral, fungal, and nematode diseases. Numerous studies have been summarized, which helps us understand how to enhance other factors, which in turn aids in the prevention of diseases. Since agriculture plays a significant role in both the economy and social life, plant disease detection is a new field in India. There were earlier, non-scientific approaches. As science and technology progress, more dependable techniques with the quickest turnaround times are created and put out for the early identification of plant diseases. These methods are popular and have shown to be helpful to farmers since they allow for the quick identification of plant diseases and the timely implementation of corrective measures. In order to gain a comprehensive understanding of the methods and approaches used, we examined and assessed current plant disease detection techniques in this research.

Adesh V. Panchal, Subhash Chandra Patel, K. Bagyalakshmi, Pankaj Kumar, Ihtiram Raza Khan, Mukesh Soni, “Image-based Plant Diseases Detection using Deep Learning” [6], In developing nations like India, agriculture is important, but food security is still a serious concern. Plant diseases, transportation issues, and a lack of storage facilities cause the majority of harvests to be squandered. In India, illnesses cause almost 15% of crops to be wasted, making it a big issue that needs to be addressed. An automated system that can recognize these illnesses and assist farmers in taking the necessary actions to eliminate crop loss is required. Farmers have been using the traditional method of using their own eyes to identify plant illnesses, and not all farmers are able to do it in the same way. With the development of artificial intelligence, computer vision capabilities must be used to the agricultural sector. Deep Learning is the best approach to begin solving this problem because of its vast libraries and conducive working environment for both developers and users. Because deep learning has several benefits when working with photos, particularly in image classification, we applied it in this paper to reach improvised findings. Taking leaves from diseased crops and labeling them according to the disease pattern is part of the process. Pixel-based processing techniques are used to enhance the information contained in the photos of sick leaves. The following phase is feature extraction, which is followed by image segmentation and, finally, crop disease classification using the patterns found in the damaged leaves. Convolutional Neural Networks (CNNs) are utilized to classify diseases; for the demonstration, a public dataset comprising around 87 K RGB-type photos of both healthy and diseased leaves is employed.

III. CHALLENGES IN PLANT DISEASE DETECTION

1. Models that deal with non-image data are scarce. The majority of classification and object detection algorithms now in use only use picture data, ignoring additional pertinent variables like humidity and temperature. For forecasts to be more accurate, methods for incorporating non-image data must be developed.
2. The number of fully annotated open datasets is quite small. A lot of research uses the Plant Village dataset, which was collected in a lab environment. Creating bigger datasets in practical settings is essential. Working together is necessary to produce representative datasets.
3. The majority of publications approach the challenge of disease detection as a classification problem, using either binary or multi-class classification. More focus should be put on object recognition to identify the illness kind and affected regions in the image, even if many works regard disease detection as a classification problem.
4. The model is trained and tested on a single dataset in the majority of publications. It is common for models that were trained on one dataset to perform poorly on other datasets. To increase model resilience, a variety of datasets must be taken into account.
5. Overuse of CNN architectures: Although CNNs produce good results, investigating alternative neural network architectures, such as recurrent neural networks, can improve disease detection techniques.
6. Early-stage disease detection and small leaf: The majority of the photos in the current datasets have huge leaves. Datasets must be annotated for small leaf recognition and early disease diagnosis.
7. Issues with illumination and occlusion: Pictures with different lighting and occlusion provide difficulties for current algorithms. Stronger approaches are required to deal with these problems.
8. Computational efficiency: Real-time applications are hampered by the computational complexity of many models. Researchers ought to concentrate on making their models more computationally efficient.

IV. CONCLUSION

This study's objective is to review previous research on precision agriculture using ML and DL approaches, with an emphasis on plant disease detection and classification techniques. A new classification system that groups all pertinent works into their appropriate classes is also presented. Depending on the approach each study used (classification and object detection), we divide them into two major groups. The accessible datasets for plant disease detection and classification are also shown, together with information about the classes and data they contain and if a given dataset is appropriate for object detection or classification.

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