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DETECT DISEASES IN PLANTS USING ARTIFICIAL INTELLIGENCE

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ABSTRACT:
The agriculture sector can be considered as the backbone for any developing economy. To obtain the maximum yield from the crops, it is required that farmers should be provided with the best technologies and methodologies. Artificial intelligence is having its vast applications in various sectors. Due to its ability to perceive the problems, developing the appropriate reasons for that and to establish optimal solutions for it, artificial intelligence can act as a great aid in addressing the diseases of crops. The paper presents a brief overview of the application of artificial intelligence in agriculture, its available techniques for agriculture and highlights the various methods available for the detection of diseases in crops

Keywords: Agriculture; diseases in crops; AI; application; mathematics; deep convolutional neural networks; deep learning; object detection.

Introduction

It is challenging to recognize plant diseases by optically analyzing their signs on plant leaves. Skilled agronomists and plant pathologists frequently require help to accurately diagnose certain diseases due to the diverse array of cultivated plants and phyto-pathological issues, resulting in incorrect diagnoses and treatments. Entomologists who are requested to make these diagnoses by visual examination of diseased plant leaves would greatly benefit from the development of an ASO (automated systems operation) to identify and diagnose plant diseases [1]. Humans eat food that comes from plants. Furthermore, because plants create oxygen, they aid in maintaining the oxygen in the air.

Without agriculture, the life we live would not be possible. All the goods we use daily, such as oil, firewood, fiber, pesticides, medicine, and rubber, are extracted from plants. Plants, crops (fruits, vegetables, etc.), and the natural world are significant to humans. Engaging with nature is crucial for improving an individual's quality of life and delivering various measurable advantages to human beings, including psychological/cognitive advantages [2]. A plant comprises several parts, such as leaves, flowers, stems, and roots. A farmer may cultivate many plants, but diseases can impede their growth. Disease attack is one of the primary reasons that lead to plant loss. Each year 10–16% of plant production is reduced due to disease [3]. In past decades, the health consequences of exposure to nature have been described in detail. However, the role of plants, such as money plants, has received enormously little interest, as compared to the range of crop studies. Urban people spend 80–90% of their lives in houses, offices, schools, etc. Good environments are very important for their health. Indoor plants play an essential role in a good and healthy environment, but their impact on the surroundings and human beings has not yet been quantified [2]. Plants are crucial for removing harmful

emissions from the atmosphere and enhancing the ecosystem as well as providing a positive psychological effect, increased health, and a comfortable indoor environment. The above studies have shown that plants benefit humans, so caring for plants is also essential. However, there needs to be more research conducted regarding the money plant.

Currently, several strategies for minimizing plant disease include the removal of damaged plant leaves, mechanical cultivation, and the use of various pesticides. Using the services of an agricultural professional is a simple way to detect plant disease. However, manual disease detection takes a long time and is arduous work. The typical strategy is to use pesticides [4,5]; however, excessive pesticide use may enhance plant growth while harming plant quality. However, spraying more pesticides on plants before even assessing the amount of pesticide required for a specific crop could negatively affect the environment and human health [6]. However, plant disease recognition is more accessible through machine learning. The use of this technique has been identified as a vital advancement and management success for plant disease. The agriculture sector's productivity has grown as a result as well. Additionally, image processing methods have been added to this technology, which has advanced during the last three years to its present state [7,8]. The nation's problems, such as lurgies affecting plants and humans, could be mitigated. Once the unhealthy plants were recognized, they covered a large region. Machine learning (ML) has been widely employed in the world today. AI, known as ML, enables machines to interact with people and understand their needs. Additionally, it enables machines to perform actions usually performed by people. Several issues impact the reliability and performance of this technology, making it challenging for ML methods to identify specific disorders. Figure 1 shows the traditional method of image processing.

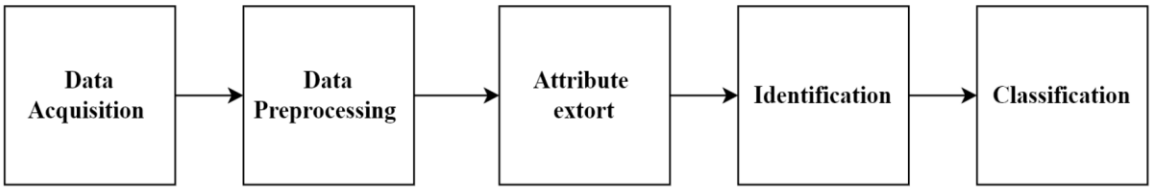

Figure 1. Traditional image pre-processing techniques: The basic method of identifying plant diseases using conventional image recognition processing technologies.

The first problem was the computational time involved with machine learning and deep learning because some methods used to diagnose such diseases must be updated as they rely on obsolete information. Another problem has been segmentation reactivity [9], which refers to the high sensitivity and precision in the relevant field that is required (ROI). A significant amount of resources are required to create and implement the bulk of machine learning and deep learning tasks. Organizations that use this technology for people and plants are frequently supported by non-government organizations, which may affect the development and use of this technology.

To identify diseased leaves, image recognition may be performed. According to background research, by scanning images of infected and healthy leaves, experts in this field have been able to compare them accordingly [10]. Several traditional image processing techniques were

used. The image processing had the following steps, e.g., the images were segmented first, then the plant disease features were retrieved, and finally, the disease was categorized. This research developed an attribute image-based method for classifying wheat plant diseases and used an SVM to diagnose the condition [11] successfully. The capability for generalizing new datasets has to be enhanced since attribute information can only be learned superficially. Deep-learning methods, however, are being used in farming research more often, as they can rapidly retrieve deep feature data and are quicker and more accurate than the standard machine learning (ML) algorithms [12,13]. Researchers have created a rider neural network based on the sine-cosine algorithm and discovered that the classifier's identification performance increased significantly [14]. As has been demonstrated, deep-learning models have proliferated over the last decade. Experts have been assisted by the numerous methods used in machine learning (ML) and deep learning (DL) to quickly identify the causes of plant diseases and evaluate their symptoms. In summary, deep learning has shown successful outcomes in the identification of plant diseases. Our research was conducted on categories of plants because both plants and crops have the same importance for the environment and humans. For the sake of world health and well-being, it is essential to identify plant diseases accurately.

Artifical Intelligence In Agriculture

Artificial Intelligence (AI) is one of the mainstreams of research in software engineering with its rapid scientific advancement and the tremendous region of Application. The fundamental idea of AI in agriculture is its adaptability, speedy performance, precision, and cost-viability [4]. Artificial Intelligence in Agriculture not only helps farmers to use their farming skills but also shifts to direct farming to get higher yields and better quality with less resources [5]. AI-based technology helps to improve efficiency in all sectors and manages the challenges facing various industries including various sectors in the agricultural sector such as crop harvesting, irrigation, soil content sensitivity, crop monitoring, weed, harvest and establishment. AI technology helps diagnose plant diseases, pests, and malnutrition on farms and AI sensors can detect and identify weeds. The mythologies utilized for disease detection, segmentation of the affected part and classification of the diseases [3]. Artificial Intelligence can offer an effective and practical solution for the problem and introduced Machine Learning (ML) and Deep learning (DL) [6]. Machine learning to train the large data sets available publicly give us a clear way to detect the disease present in plants in a colossal scale [7]. The machine learning-based approaches, which will be used for detecting and classifying the diseases on agricultural products including various plants, fruits and vegetables [8]. A robot that identifies the leaf disease utilizing image processing and Machine learning is conveyed [9]. The survey of CNN-based research efforts applied in the agricultural domain [10]. Detecting diseases and pests from rice plant images using CNN (convolutional neural networks) [11].

Field Of Artificial Intelligence In Agricultural Sector

In the field of agriculture, Artificial Intelligence is a rising revolution. Artificial Intelligence has boost crop production and better-quality real-time monitoring, harvesting, processing and marketing.[12]

The Internet of things (IoT) driven development

The Internet-of-Things (IoT) is a foundation to impact a wide array of sectors and industries, ranging from manufacturing, health, communications, and energy to the agriculture industry. The application of IoT in agriculture is about empowering farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for good efficiency, quality, and profit.

Image-based insight generation:

Drone-based images can help in crop monitoring, scanning of fields and so on. Farmers can join them with PC vision innovation and IOT to guarantee quick activities. These feeds can produce ongoing climate alarms for farmers.

Disease detection:

The image sensing and analysis make sure that the plant leaf images are segmented into surface areas like background, diseased area and non-diseased area of the leaf. The infected or diseased area is then harvested and sent to the laboratory for additional diagnosis.

Expert System:

The need for Expert systems for the transfer of technical information in agriculture can be identified by identifying problems through the traditional technology transfer system, and by demonstrating that professional systems can help to overcome the problems identified, and are likely to be improved.

FieldManagement:

Employing images of high description from the drone and copters systems, real-time estimations can be achieved during the period of cultivation by building a field map and discovering areas where the crops require water, fertilizer and pesticides.

Robotics in Agriculture:

Agribot or Agbot is an Agriculture Robot. It supports the farmer to increase the crop's efficiency and also reduces the need for manual labour to the farmer. In the upcoming generations, we can expect that these agricultural robots will do the tilling, sowing, harvesting and many other farm works individually. Indeed, even the weeding, ccontrol of pests and diseases will be dealt with by these agricultural robots.

Automation techniques in irrigation and enabling farmers:

AI accomplished machines alert of historical climate outline, quality of soil and kind of crops to be grown, can automate irrigation and enhance the whole yield. Nearly 70% of the world's freshwater resource is utilized for irrigation; such automation can conserve water and benefit farmers in managing their water probs.

Crop health monitoring:
Remote sensing (RS) techniques along with hyperspectral imaging and 3D laser scanning are crucial to constructing crop metrics over thousands of acres of cultivable land.

Image Processing:
Image processing is a method, which is used to measure the affected area of disease, and to find differences in the color of the affected area.Thesurveys show detection of disease by using Image processing [3]. Aintroduction a robot in agriculture that detects the leaf disease-using image processing [9].

Machine Learning:
Machine learning AI Application and have been successfully made in the present world for the diagnosis of diseases. Machine learning algorithms are fast and accurate to detect any diseases.The paperemployed to increase the recognition rate and the accuracy of the results by using machine learning and deep learning algorithm and detect the plant disease [7].The Support Vector Machine (Machine Learning Algorithm) is a better option for detection of diseases [8].

Deep Learning:
Deep learning helps in finding out a vital relationship in the data as well as it also records the information regarding existing clients that might help patients having similarities in symptom or diseases. Plant disease identification model based on deep learning proposed in this paper can overcome the complexity of the environment and improve the accuracy of identification [13].

Convolutional neural networks:
Convolutional Neural Networks (CNNs) are considered state-of-the-art in image recognition and offer the ability to provide a prompt and definite diagnosis.

Expert System:
Expert System in the area of agriculture would take the form of Integrated Crop management, decision aids and would encompass irrigation, nutritional disorders and fertilization, weed control, cultivation and herbicidal.

AI Techniques Used For Detection Of Diseases In Agriculture

Image Processing

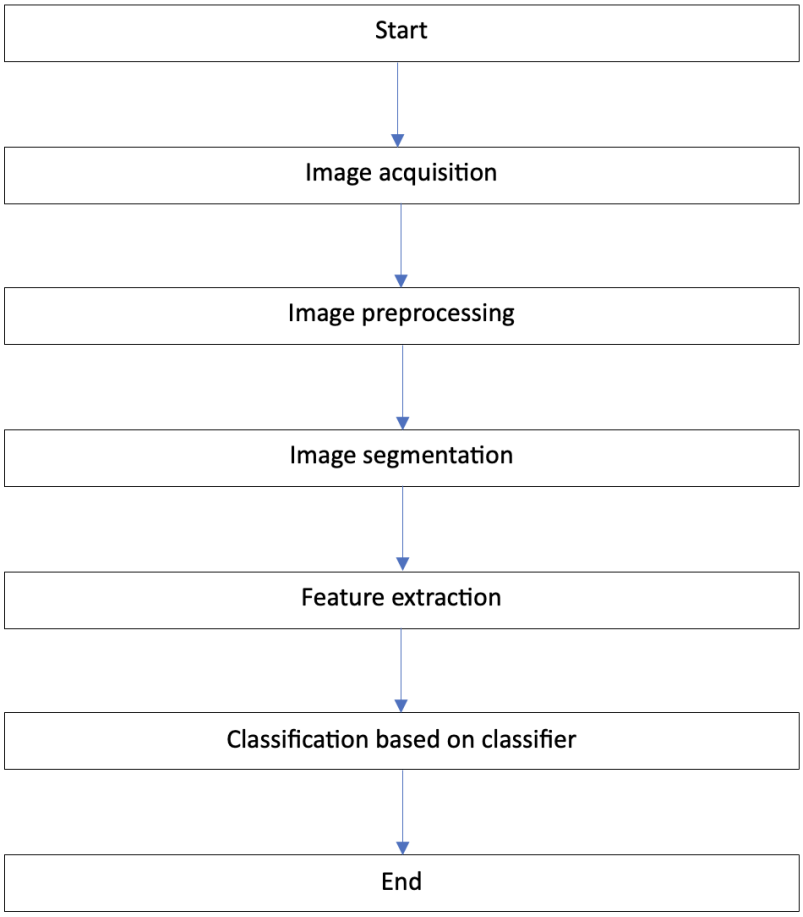

Figure 2: Basic Flowchart Of Disease Detection And Classification[15]

a) Image Acquisition:

Images of the infected leaves are obtained. This database has different types of plant diseases, and the images are stored in JPEG format. These images are then read in MATLAB using the read command.

b) Image Pre-processing:

Image pre-processing is used to erase noise from the image or other object exclusion, different pre-processing techniques. Image scaling is used to convert the original image into thumbnails because the pixel size of the original image is large and it requires more time for the overall procedure hence after converting the image into thumbnails the pixel size will get decreases and it will require less time.

c) Image segmentation:

Image segmentation is one of the most widely used methods to distinguish pixels of image well in a targeted app. It distributes an image into numerous discrete states such that the pixels have great similarity in each area and high dissimilarity between areas.

d) Feature Extraction:

Feature Extraction is an important part of disease detection. It plays an important role in the identification of an object. Feature extraction is utilized in several applications in image processing. Colour, texture edges, morphology are the features, which are utilized in disease detection.

e) Detection and classification of plant diseases

The final stages are the detection of the diseases and with the help of disease classify the plants with the disease matches with the given dataset.

A. Convolutional neural networks

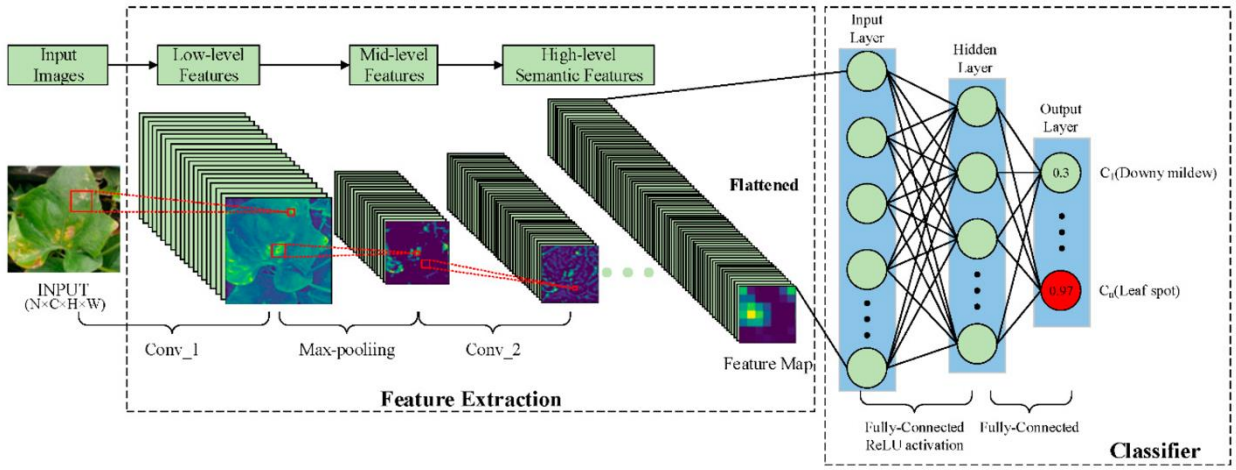

Figure 3: BLOCK DIAGRAM OF CNN [16]

To perform plant disease detection and diagnosis using simple leaves images of healthy and diseased plants Convolutional Neural Network (CNN) models were created, through deep learning methodologies. First user has to capture the plant leaf image from app. The application will send this image to our AI system. The image goes through number of processing steps like preprocessing, feature extraction, selection of feature etc.A novel method of creating a visual database that has been successfully used to train CNN which is a deep residue with 97.8% accuracy in detecting four species of insects [17].Convolutional neural networks can receive any form of data as input, such as audio, video, images, speech and natural language [18]. CNN constitutes a class of deep, feed forward ANN that has been applied successfully to computer vision applications [19].CNN reached high precision in the large majority of the problems where they have been used, scoring higher precision than other popular image-processing techniques [10].

Conclusion

Present review study summarize the different applications of artificial intelligence in agriculture sector. The main motive of this study was to brief the applications and available techniques of artificial intelligence to solve the problems of farmers in getting the required yield. The paper also highlights the different literatures, which reflects various methodologies to detect the diseases in crops. From the literature, it is concluded that artificial intelligence is

a great tool for a nation's agronomics. Hence, future researchers should organize a proper dataset covering all arena of agriculture and enhance the available technologies to increase the productivity of primary sectors.

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