AI APPLICATION FOR CROP MONITORING AND PREDICT CROP DISEASES & SOIL QUALITIES

Nitin Kothari[1], Chandra Jain[2], Aashita Jain[3], Anshika Solanki[4], Darshana Sen[5], Priya Kumawat[6]

E-Mail Id: cpjain1983@gmail.com

[1]College of Technology and Engineering, MPUAT, Udaipur, Rajasthan, India

[2,3,4,5,6]Geetanjali Institute of Technical Studies, Udaipur, Rajasthan, India

Abstract-Crop disease and soil health are critical factors influencing agricultural productivity and food security worldwide. Traditional methods for disease detection and soil analysis often involve time-consuming and labour-intensive processes, leading to delays in response and management. Given the current trajectory of population growth, it is anticipated that by 2050, global crop productivity will need to double from its current levels. Pests and diseases are a major obstacle to achieving this productivity outcome. Hence, it's imperative to devise efficient methodologies for automatically detecting, identifying, and predicting pests and diseases in agricultural crops. Employing Machine Learning (ML) techniques can facilitate extracting insights and correlations from the data under analysis. This paper conducts an extensive review of the literature on machine learning techniques utilized in agricultural contexts, particularly emphasizing their application in tasks related to the classification, detection, and prediction of diseases and pests. The survey endeavours to advance smart farming and precision agriculture by advocating for the creation of methodologies that enable farmers to reduce reliance on pesticides and chemicals while simultaneously enhancing crop quality and productivity. AI models can accurately detect symptoms of diseases such as leaf discoloration, damaged area, and other visual different. the integration of IoT (Internet of Things) devices and wireless sensor networks facilitates real-time monitoring of environmental variables such as temperature, humidity, and soil moisture, providing valuable data for disease prediction and prevention.

1. INTRODUCTION

Agriculture, the backbone of human civilization, faces unprecedented challenges in the 21st century. Among these challenges, the prevalence of crop diseases and the degradation of soil quality stand out as significant threats to global food security. According to the Food and Agriculture Organization (FAO), crop diseases alone are estimated to cause losses of up to 40% of global crop yields annually. The conventional approach to detecting and identifying plant diseases relies on visual inspection by trained experts. This takes time and talent and is not a practical solution for monitoring large farms. Hence, to address the constraints of manual detection, there's a pressing need for automated approaches in crop monitoring and forecasting. Such a system holds significant potential in curbing the over-reliance on pesticides and chemicals, thereby mitigating environmental harm and cutting down production expenses linked with their usage. The growing availability of big data analysis methods has the potential to stimulate even more research and development in smart farming. In addition to advancing the cultivation of high-yield crops in a sustainable manner, the initiative also seeks to enhance capabilities in event forecasting, disease detection, and the efficient management of water and soil resources.Big data is coming to the agriculture domain by collecting data from meteorological stations, remote sensors, historical data, and publicly available datasets. Here in this paper, we present an AI-based technique for disease infection is the main drawback of Agriculture. Due to this drawback, the Quality and Quantity of agriculture products are degraded. To identify and detect the disease on agriculture product, the AI technique is introduced. We are presenting a survey for application of artificial intelligence in detection of diseases in agriculture and detection of soil quality.

2. ARTIFICIAL INTELLIGENCE IN AGRICULTURE

AI denotes the emulation of human intelligence processes by machines, particularly computer systems. Artificial Intelligence in Agriculture not only empowers farmers to leverage their expertise but also facilitates a transition to precision farming, resulting in increased yields and improved quality while optimizing resource usage. AI-based technology enhances efficiency across all sectors and addresses challenges encountered in various industries, including multiple facets of agriculture like crop harvesting, irrigation, soil analysis, and crop surveillance.AI technologies, including machine learning and computer vision, help farmers optimize resource utilization by providing insights into soil health, crop growth, and environmental conditions. Drones equipped with cameras and sensors gather data, which is then analysed to make informed decisions about irrigation, fertilization, and pest control.

2.1 Crop Monitoring and Soil Monitoring

Advanced AI algorithms can drive automatic systems to monitor soil and crop conditions, enhancing crop yield through precise analysis and management. The steps involved in training such automatic systems and elaborates on their potential merits and demerits. Artificial Intelligence is employed for tasks ranging from disease identification and detection to precision farming and beyond. Utilizing sensors and machine learning algorithms,

AI proves invaluable in monitoring crops and soil. Placed within fields, these sensors gather data on crucial parameters like temperature, moisture levels, soil nutrient content, and sunlight intensity. This data can then be fed into machine learning algorithms, which can analyse the data and provide insights on the optimal conditions for crop growth and soil health. The algorithm can determine the optimal amount of water and nutrients required for the crops and provide recommendations on when and how to apply these inputs. It can also detect potential issues such as pests or diseases and provide early warning to farmers. Moreover, AI can be employed to oversee the soil's health, offering insights into its composition and identifying potential concerns like erosion or compaction.

Fig. 2.1 Drone used for crop and soil monitoring with the help of AI enabled camera

This can help farmers take appropriate measures to improve soil health and maintain productivity. The AI system can also alert farmers when soil conditions are not optimal for plant growth and suggest potential solutions. Additionally, AI can be used to monitor crop health and predict potential pest infestations or disease outbreaks, allowing farmers to take preventative measures. The machine learning algorithms, including random forests and support vector machines, to predict soil moisture levels from remotely sensed data. The algorithms underwent training using a combination of soil moisture measurements and satellite imagery data. They demonstrated high accuracy in predicting soil moisture levels, with an average error rate of less than 5%. In yet another study, researchers trained a deep learning neural network to classify different soil textures in images. The network was trained using a dataset of over 2,000 images of soil textures, and it achieved an accuracy of over 95% on a validation dataset. The model was subsequently employed to automatically detect and delineate soil textures within a designated study region. Overall, these studies demonstrate the potential of machine learning and deep learning algorithms for automating crop and soil monitoring tasks.

Overall, developing an automated monitoring system for fast and accurate prediction of soil texture using an image-based deep learning network and machine vision system is a complex and challenging task that requires expertise in machine learning, computer vision, and soil science. However, the resulting system can provide valuable information for agricultural applications.

3. PREDICTION CROP DISEASES USING AI TOOLS

AI is becoming a valuable tool for farmers looking to improve crop yields and reduce losses. One way AI is being utilized is in predicting and detecting crop disease.

3.1 AI-powered Crop Disease Prediction

3.1.1 Image Recognition

AI algorithms, specifically convolutional neural networks (CNNs), are trained on vast datasets of images showing crops with and without disease. These algorithms can then identify subtle variations in plant health, often before visual symptoms appear to the naked eye.

3.1.2 Environmental Data Analysis

AI can also analyse environmental data, such as temperature, humidity, and rainfall, to predict the likelihood of specific diseases developing. This allows for preventative measures to be taken before an outbreak occurs.

3.2 Benefits of AI-Based Prediction

3.2.1 Early Detection

Early identification of disease allows for prompt intervention, minimizing yield loss and the spread of infection.

3.2.2 Targeted Treatment

AI can help pinpoint the specific disease, enabling farmers to apply targeted treatments, reducing reliance on broad-spectrum pesticides.

3.2.3 Improved Decision Making

Data collected by AI systems can inform decisions about crop rotation, planting times, and resource allocation.

3.3 Examples of AI Tools for Crop Disease Prediction

3.3.1 Plantix

A mobile app that utilizes image recognition to identify plant diseases and offers advice on treatment.

3.3.2 Gamaya

Provides smart farming solutions that leverage AI and satellite imagery to assess crop health and predict disease outbreaks.
AI is a powerful tool with the potential to revolutionize agriculture. By predicting and detecting crop disease early, AI can help farmers improve crop yields, reduce waste, and ensure a more sustainable food supply.

3.4 Prediction of Health Crops

AI is becoming a powerful tool for farmers to predict crop health. AI is making waves in the world of agriculture, and one of its key applications is in predicting crop health. AI is indeed utilized for predicting crop health. This application falls under the umbrella of precision agriculture, where advanced technologies like AI, machine learning, and data analytics are leveraged to optimize farming practices. Here's how AI is being used for this purpose.

3.4.1 Image processing

AI algorithms can analyse images of crops captured by drones or satellites to detect patterns indicative of crop health. For example, machine learning models can identify areas of stress, disease, or nutrient deficiency based on visual cues. The process is divided into several fundamental phases.

3.4.1.1 Image Acquisition

Images of the inflamed leaves are obtained. This database has specific varieties of plant sicknesses, and the pics are saved in JPEG format. The images are subsequently analysed in MATLAB using the "study" command.

3.4.1.2 Image Pre-processing

Image pre-processing is used to erase noise from the photo or different item exclusion, specific pre-processing techniques. Image scaling is used to transform the authentic photo into thumbnails due to the fact the pixel length of the authentic photo is huge, and it calls for greater time for the general system for this reason after changing the photo into thumbnails the pixel length gets lower and it's going to require much less time.

3.4.1.3 Image Segmentation

Image segmentation is one of the maximums broadly used techniques to differentiate pixels of pics properly in a focused app. It divides an image into distinct segments where pixels within each segment share remarkable similarities while exhibiting substantial dissimilarity between segments.

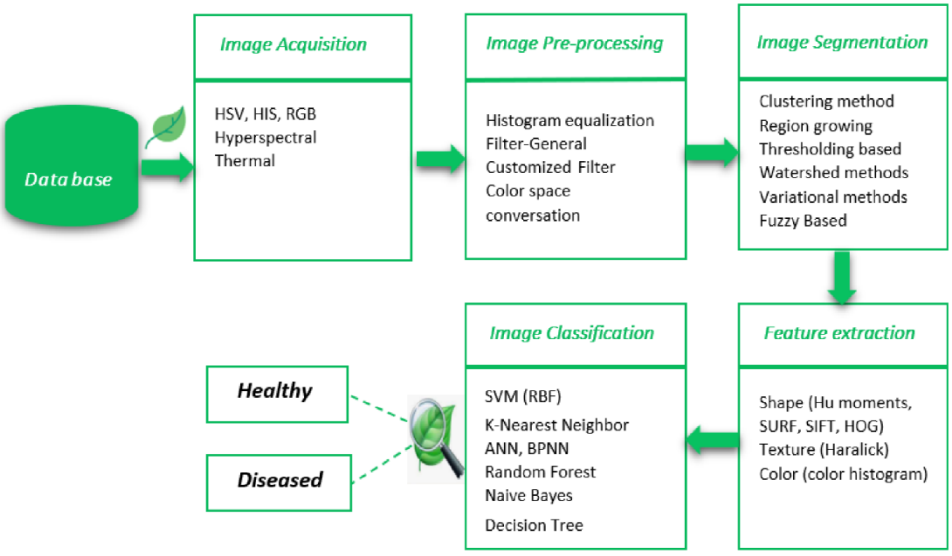

Fig. 3.1 Using image processing in AI to predict the health of crop

3.4.1.4 Feature Extraction

Feature Extraction is a critical part of illness detection. Feature extraction plays a crucial role in identifying objects, utilized across various applications in image processing. Colour, texture edges, and morphology are the features, that are applied in sickness detection.

3.4.1.5 Detection and classification of plant illnesses

The final phases are the detection of diseases and the classification of plants with disease matches in the given dataset using disease classifiers.

3.5 Convolutional Neural Networks

AI is indeed utilized for predicting crop health. This application falls under the umbrella of precision agriculture, where advanced technologies like AI, machine learning, and data analytics are leveraged to optimize farming practices. Convolutional neural networks are versatile, capable of processing various data formats such as audio, video, images, speech, and natural language. First user must 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. CNN can receive any form of data as input, such as audio, images, video, speech and natural language. CNN constitutes a class of deep, feed forward ANN that has been applied successfully to computer vision applications. CNN reached high precision in most of the problems where they have been used, scoring higher precision than other popular image-processing techniques.

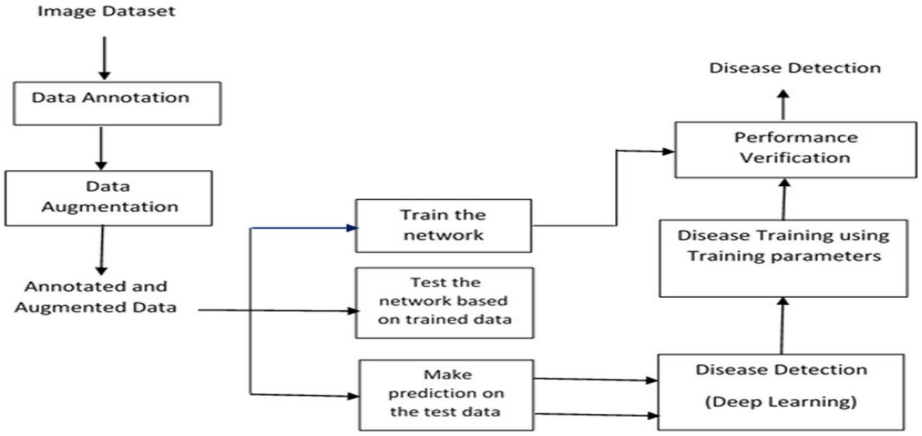

Fig. 3.2 illustrate the CNN system to monitor the crop health

CONCLUSION

Agriculture is the major occupation in our country. Now, farmers are facing a lot of problem. The integration of technology and agriculture are needed now more than the past era. The goal of this research was to provide an overview of the uses and existing techniques of artificial intelligence to help farmers achieve the desired output. Literature suggests that artificial intelligence constitutes a valuable asset for enhancing a nation's agricultural sector. Hence, future researchers should organize a proper dataset covering all area of agriculture and enhance the available technologies to increase the productivity of primary sectors.

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