Artificial Intelligence In Agriculture: Crop Disease Detection And Monitoring Plants

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Abstract - *Artificial intelligence is having a significant influence across all industries. By limiting environmental deterioration, AI was able to solve a variety of issues while also protecting a valuable resource. In terms of agricultural output, India ranks second. Each crop is susceptible to certain diseases, which have an impact on yield quantity and quality. Crop diseases account for roughly 42% of crop failure for most of the major food crops. Crop diseases tend to wipe out an entire crop's productivity. Early illness detection will allow for more efficient monitoring and good crop product.*

This article offers a thorough review of an AI-based strategy for detecting and monitoring pest-infested crops and leaves. We share our research on crop disease detection and crop health using image processing, sensors, and other techniques in this publication. When it comes to assessing crops, the suggested method saves time and yields more precise results. In addition, we mentioned the destiny of AI-Powered agriculture and the realistic and technical demanding situations ahead. This survey will provide a clean concept approximately the present AI-Powered agriculture gadget and could assist researchers to broaden a brand-new ecosystem.

Key Words: Agriculture, Artificial intelligence, Disease Detection, CNN, Image processing, Sensors

1.INTRODUCTION

At present, approximately 37.7% of the overall land floor is used for crop manufacturing, from the employment era to contribute to National Income, agriculture is crucial. With its rapid clinical growth and high-quality application location, Artificial Intelligence (AI) is one of the most popular subjects in software program engineering. The essential concept of AI in agriculture is its adaptability, rapid performance, precision, and cost-viability. Artificial Intelligence in Agriculture now no longer handiest allows farmers to apply their farming abilities however additionally shifts to direct farming to get better yields and

higher fines with much fewer assets. AI enhances performance in crop harvesting, irrigation, soil content material sensitivity, crop monitoring, weed, harvest, and establishment. AI era allows diagnosis of plant diseases, pests, and malnutrition on farms, and AI sensors can hit upon and become aware of weeds.

Here in this paper, we present an AI-based technique for detecting pest-infected crops and leaves in this paper. When it comes to assessing crops, the proposed method saves time and yields more exact results. Crop photographs are used to categorize them.
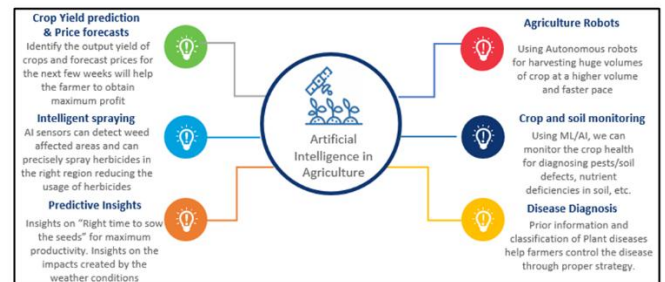

Figure 1: Artificial Intelligence uses in Agriculture, Accessed 16 April 2022.

2. AI Techniques Used for Detection of Diseases in Agriculture

2.1 Image Processing

A picture is turned into a numerical matrix that can be easily read by a computer to be processed. Picture enhancement, image restoration, image compression, and image analysis are just a few of the various forms of processing available. The latter is particularly intriguing since it allows precise information to be extracted straight from a picture. The analysis can be done by looking at the edges of images (image extraction), the colors of the images (texture analysis), and the motions identified as

they go from one image to the next. The procedure is broken down into a few fundamental phases.

(a) **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. These pics are then studied in MATLAB with the use of the study command.

(b) **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.

(c) **Image segmentation**: - Image segmentation is one of the maximum broadly used techniques to differentiate pixels of pics properly in a focused app. It distributes a photo into several discrete states such that the pixels have wonderful similarities in every region and excessive dissimilarity among areas.
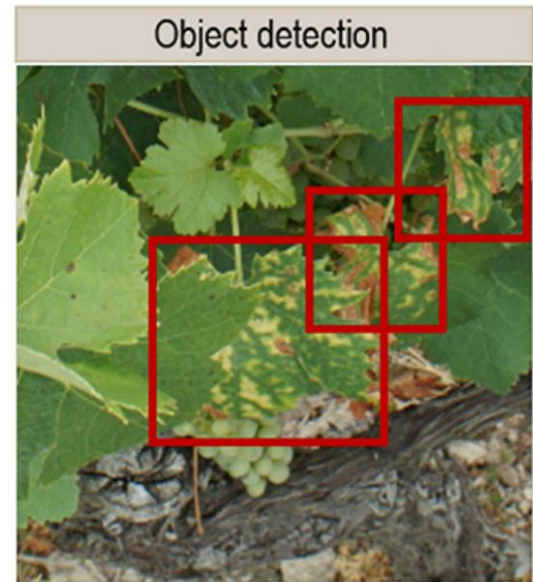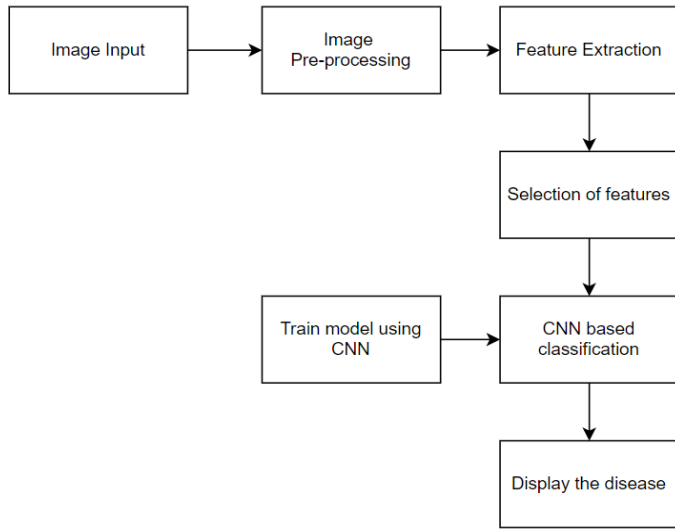
(d) **Feature Extraction:** - Feature Extraction is a critical part of illness detection. It plays a critical characteristic withinside the identification of an item. Feature extraction is applied in numerous programs in photo processing. Color, texture edges, and morphology are the features, that are applied in sickness detection.

(e) **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.
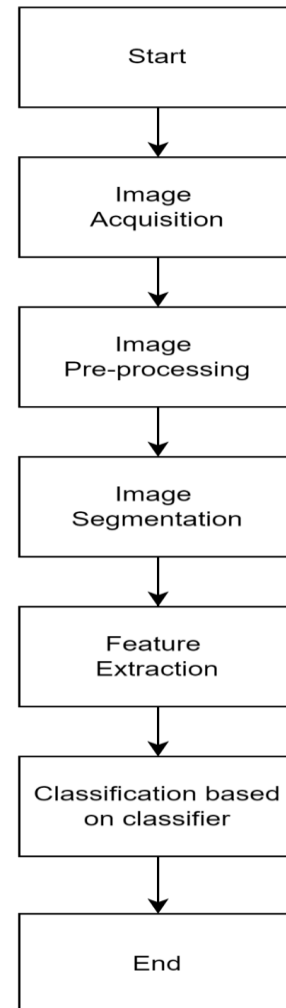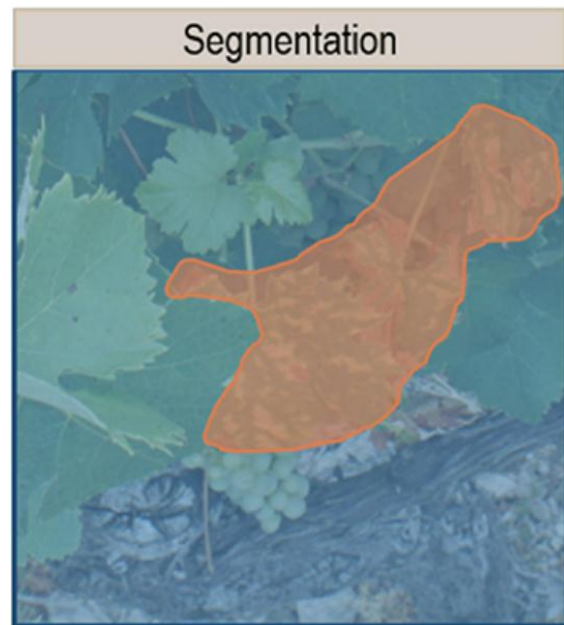

2.2 Convolutional Neural Network (CNN)

Using basic leaf pictures of healthy and unwell plants, CNN models were built using deep learning methodologies to recognize and diagnose plant illnesses. The first user must take a screenshot of the plant leaf from the app. This image will be sent to our AI system via the application. Preprocessing, feature extraction, feature selection, and other processing stages are performed on the picture. CNN, a deep residue with 97.8% accuracy in recognizing four kinds of insects, was successfully trained using an innovative approach to constructing a visual database. Convolutional neural networks may accept data in any format, including audio, video, pictures, speech, and natural language.

CNN is a type of deep, feed-forward artificial neural network (ANN) that has been effectively used in computer vision applications. CNN achieved great precision in the vast majority of the cases in which it was utilized, outperforming other prominent image-processing approaches.
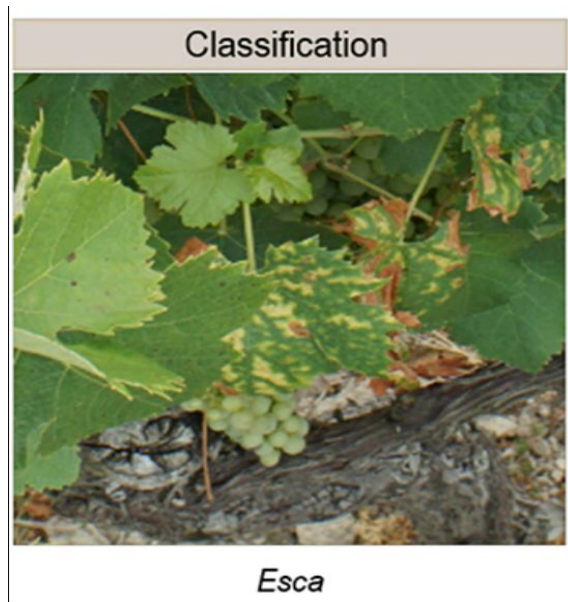

Figure 2: Convolutional Neural Networks for the Automatic Identification of Plant Diseases Accessed 17 April 2022

2.3 Sensors

Agricultural sensors are sensors that are utilized in smart farming. These sensors give information that helps farmers monitor and optimize crops by allowing them to adjust to changes in the environment. Weather stations, drones, and agricultural robots all have these sensors attached. They can be controlled using dedicated smartphone applications. They may be controlled directly through Wi-Fi or via cellular towers and operated using mobile phones and also used in weather stations.

Sensors in this system provide information on soil temperature at numerous depths, air temperature, rainfall, etc. They are employed in a variety of agro-based companies' equipment (e.g., dendrometers) for agricultural or farming purposes such as measuring trunk diameter, leaf wetness, and so on. In agriculture drones, they're utilized to spray insecticides and pesticides. Because of the lower cost of electricity, solar-powered mobile pumps have become increasingly popular. E-fences, which assist protect crops from animals such as elephants, have become popular in rural INDIA.

Fig 3: Types of Sensors Accessed 17 April 2022

Sr.no	Paper Title	Publisher	Year	Outcome	Link
1	Artificial Intelligence (AI) in Agriculture	IEEE	21 May 2020	An outcome on Crop Monitoring, Data Science, Disease Detection, Food Quality, Predictive Analytics	https://ieeexplore.ieee.org/abstract/document/9098011
2	Artificial Intelligence in Agriculture	Research Gate	May 2018	During the early 1980s and 1990s, the rule-based were extensively used whereas from 1990 onwards, artificial neural network models and fuzzy inference systems have taken the dominant role. In present years an uprising use of hybrid systems such as neuro-fuzzy or image processing coupled with artificial neural networks is being used.	https://www.researchgate.net/profile/Gouravmoy-Banerjee/publication/326057794_Artificial_Intelligence_in_Agriculture_A_Literature_Ssurvey/links/5b35ab970f7e9b0df5d83ec6/Artificial-Intelligence-in-Agriculture-A-Literature-Survey.pdf
3	Multi-Task Cascaded Convolutional Networks	IEEE	14-15 Feb. 2020	The data responsible for the plant growth is obtained using different sensor units like DHT11, LDR, DS18B20, Soil Moisture sensors, Noir camera, single-board microcontrollers, and Application Programming Interfaces (APIs).	https://ieeexplore.ieee.org/abstract/document/9122894

4	Artificial Intelligence Techniques for Agriculture Revolution: A Survey	Annals of Rscb	2021	This article discusses a systematic review of studies and describes its limitations and strengths. This article presents different applications of AI-Powered solutions and the products available in the market for providing services to farmers. In addition, we discussed the future of AI-Powered agriculture and the practical and technical challenges ahead	https://www.annalsofrscb.ro/index.php/journal/article/view/2796
5	Smart Solution for Leaf Disease and Crop Health Detection	Springer	May 2021	The key steps that we addressed in this paper are image pre-processing, extraction of features, classification, and analysis of the results provided by the technique.	https://link.springer.com/chapter/10.1007/978-981-16-0695-3_23
6	AI-based Detection of Pest Infected Crop and Leaf	IEEE	13-14 May 2021	Image processing methods are used to analyze the crops, further convolutional neural networks are applied to differentiate the healthy crops from the ones that are infected by some disease and also show some visual remarks.	https://ieeexplore.ieee.org/abstract/document/9451698
7	Plant Disease Identification using Artificial Intelligence: Machine Learning Approach	*International Journal of Innovative Research in Computer and Communication Engineering*	14 Jan 2021	The focal point of pretty much every nation has moved towards the mechanization of agriculture to achieve exactness and precision and to serve the consistently expanding request for food. Among the significant difficulties in agriculture, plant disease detection is a critical factor influencing the result of cultivation. The quality of vegetables, organic products, vegetables, and grains is influenced by plant disease, and hefty misfortune is underway, and therefore monetary losses are watched, so there is a prerequisite of quick and viable plant disease detection and evaluation strategies. This paper investigates the manners by which machine learning models can be applied to improve the cycle of plant disease detection in the beginning phases to improve grain security and manageability of the agro-biological system.	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3729753
8	Artificial Intelligence to Improve the Food and Agriculture Sector	HINDAWI	22 Apr 2021	Due to several challenges in the future for the agriculture and food sector and various factors such as climate change, population growth, technological progress, and the state of natural resources (water, etc.), it is urgent	https://www.hindawi.com/journals/jfq/2021/5584754/

					to use digital technologies at different stages of the agriculture supply chain such as automation of farm machinery, use of sensors and remote satellite data, artificial intelligence, machine learning for improved monitoring of tooter, for agriculture food product traceability.	
9	AI-Based Automatic Crop Disease Detection System	IEEE	9-11 July 2021	The main aim of this project is to design an AI-Based disease detection system that detects the type of disease present in tomato leaves by clicking the images of various leaves through the camera and spraying the respective pesticide on the diseased part of the plant.	https://ieeexplore.ieee.org/abstract/document/9622700
10	Artificial Intelligence and Its Applications in Agriculture With the Future of Smart Agriculture Techniques	in global	2019	including seven steps, namely crop selection, soil preparation, seed selection, seed sowing, irrigation, crop growth, fertilizing, and harvesting; and how these digital technologies are helpful for the crop cycle	https://www.igi-global.com/chapter/artificial-intelligence-and-its-applications-in-agriculture-with-the-future-of-smart-agriculture-techniques/268026
11	Application of artificial intelligence techniques in irrigation and crop health management for crop yield enhancement	ELSEVIER	2021	To improve the basic requirement of water supply level and water for the particular crop at different stages of growth to predict the water level requirement and their performances can be compared.	https://www.sciencedirect.com/science/article/pii/S2214785320378330

3. Conclusion

The current review study covers the various applications of artificial intelligence in agriculture. The primary 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. The report also covers numerous pieces of literature that reflect various approaches to detecting agricultural diseases. In line with the literature, artificial intelligence is an extraordinary device for a country's agronomics. As a result, future researchers should compile a comprehensive dataset spanning all aspects of agriculture and improve present technology to boost primary sector production.

In this paper, a well-timed correct evaluation of plants is being finished with the assistance of Image Processing and CNN. This can result in development withinside the agriculture field. Data Augmentation in this situation has provided super results for the model as it reduced the overfitting.

4. Future Scope

India's population is expected to acquire more than 1.6 billion through manner of approach of 2030. With this big hike in the populace, you'll be able to anticipate a large call for agricultural intake as well. With the development withinside the carrier zone, there may be a massive migration of a team of workers from the number one zone

to the tertiary zone. In addition, the lack of awareness of growing illnesses in plants is lowering the yield of cultivation as well. Food being the primary necessity of human life, future researchers need to take the course for reviving the agriculture arena. Artificial Intelligence must be the foremost gear for the researchers to cope with the above-stated issues. With the exceptional variety in agronomy species, an in-depth database desires to be acquired for numerous quantities of agriculture. With the usage of the right gear of synthetic intelligence and with the right dataset, farming may be made greater green for farmers. These techniques may be taken into consideration because the foremost implementation is to clear up the destiny crisis.

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