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Application of Artificial Intelligence in Detection of Diseases in Plants: Introduction, Techniques and Future Scope

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Abstract

One of the industries where IoT and automation can have a significant impact is agriculture and contemporary farming. Maintaining healthy plants and monitoring their environment in order to identify or detect diseases is essential in order to maintain a maximum crop yield. The application of cutting-edge technologies such as deep learning, machine learning, and artificial intelligence (AI) has shown to be crucial for sophisticated picture analysis in modern agriculture. Artificial intelligence not only monitors and regulates the environmental conditions in farms, but it also adds time efficiency and the potential to recognise plant disease. Numerous research demonstrated how accurately and sensitively machine learning and deep learning systems can identify plant illnesses by analysing plant leaves. AI-powered farming solutions allow farmers to achieve more with less, improving quality and guaranteeing a quick go-to-market strategy for crops. The current study offers a perspective of how artificial intelligence (AI) may power agriculture's many sectors. It also looks into the difficulties that are expected to arise in the future as well as ideas powered by AI.

Introduction

During the Industrial Revolution in the 19th century, machines were used to reduce or replace human labour. Over time, the development of information technology in the 20th century and the introduction of computers gave rise to the idea of machines driven by artificial intelligence (AI). It is a fact of modern times that artificial intelligence is gradually replacing human employment.

All industrial sectors are greatly impacted by artificial intelligence. Artificial Intelligence (AI) has advanced at an incredible rate recently. Artificial Intelligence has successfully resolved multiple issues and preserved a valuable resource by reducing environmental degradation. Artificial intelligence is revolutionising agriculture by utilising more effective and global-beneficial methods in place of outdated ones. The population is growing significantly, and along with it, so is the interest in food and business. Artificial Intelligence in Agriculture is helping farmers increase crop productivity and reduce negative environmental effects. The primary disadvantage of agriculture is the spread of disease. The quantity and quality of agricultural goods suffer as a result of this disadvantage. Artificial Intelligence (AI) approach is introduced to discover and diagnose agricultural product diseases. The first time a computer programme was utilised to address an issue in agriculture was in 1983. Since then, several methods have been developed to solve a wide range of agricultural-related issues.

Field Of Artificial Intelligence In Agricultural Sector

1. The Internet of things (IoT) driven development
2. Image-based insight generation
3. Disease detection:
4. Expert System:
5. Field Management :
6. Robotics in Agriculture:
7. Automation techniques in irrigation and enabling farmers:
8. Crop health monitoring:

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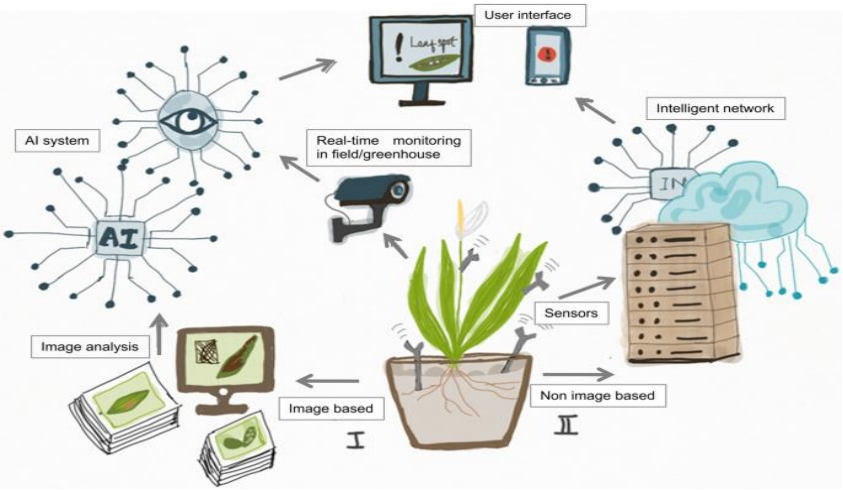


Different disease detection techniques and classification in different crops.

Paddy, 1.Brown Spot 2.Bacterial Blight 3.Leaf Blast 4. Tungro Paddy Fields of Indonesia using Digital Camera Internet and Digital Mobile Phone.

Wheat Leaf Rust Fields using High Resolution Camera ,Wheat 1.Powdery mildew 2.Leaf rust 3. Leaf blight China fields using Nikon D80 Camera Betel vine Rot Chhattisgarh fields using Flatbed Digital Scanner.

Betel vine Powdery Mildew High Resolution Camera.

Soybean 1.Frog eye 2.Rust 3. Bacterial Blight 4. Downy Mildew 5. Sudden Death Syndrome Mobile Phone Camera.

Tomato Early Blight Captured at greenhouse, Columbia.Tomato 1.Powdery Mildew 2.Early Blight From farms using High Resolution Camera.

Sugarcane 1.Sugarcane Ring 2. Rust 3.Yellow spots Fields in Indonesia using Digital Camera.

Cotton Leaf Spot Digital Mobile Phone camera. Grape 1.Scab 2. Downy Mildew 3.Powdery Mildew Digital Camera and Internet.

Cucumber 1.Downly mildew 2.Powdery mildew 3.Anthracnose Digital Color Camera.

AI based techniques for Plant Disease Detection and Recognition

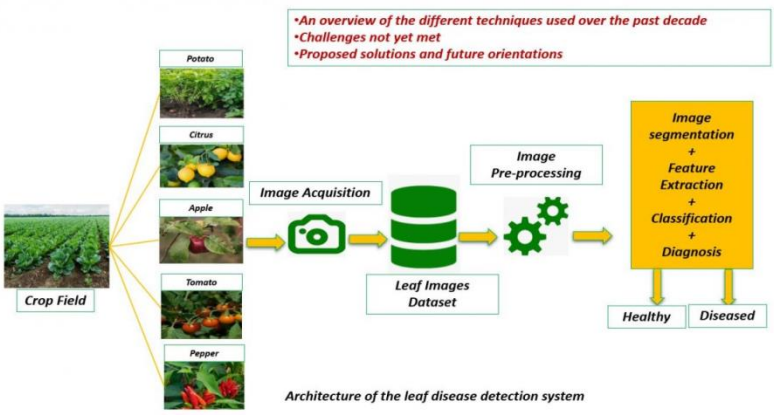
1. **Image Acquisition**
2. **Image Preprocessing**

3. Image Segmentation

- **Region based techniques -** They are immune to noise, better for homogeneous regions but are complex and slow.
- **Watershed segmentation -** These techniques are computationally sound but sometimes does over segmentation.
- **Edge based techniques -** They work well for good contrast images, but are more immune to noise, are inaccurate and complex.
- **K-means approaches -** They are faster, provides tighter segments but it is difficult to predict kvalue.
- **Histogram based thresholding techniques -** These techniques are less complex but spatial details are not considered.
- **Neural Networks based approaches -** These approaches are fast, less complex but they have long training time.

4. Feature Extraction

5. Image Classification



Architecture of the leaf disease detection system

Future scope:

India population is expected to reach more than 1.6 billion by 2030. With this huge hike in population, one can expect massive demand for agricultural consumption as well. With the

advancement in the service sector, there is a big migration of workforce from the primary sector to the tertiary sector. In addition, the ignorance of rising diseases in crops is decreasing the yield of cultivation as well. Food being the primary necessity of human life, future researches need to take direction for reviving the agriculture arena. Artificial Intelligence should be the major tools for the researchers to address the above-mentioned issues. With the great diversity in agronomy species, a detailed database needs to be obtained for various portions of agriculture. By using proper tools of artificial intelligence and with the proper dataset, farming can be made more efficient for farmers. These methods can be considered as the major implementations to solve the future crisis.

Conclusion:

Digital images are more reliable for disease recognition in comparison to human eyes, many diseases have similar features at times it is difficult for human eyes for identifying them moreover recognition is totally dependent on eyesight of human expert. This work discussed several Machine Learning and Image Processing techniques which are useful in identifying and classifying diseases of different crops but still there is lot of scope of improvement in this domain so that manual disease identification methods can be replaced for benefit of all. For future work large and high-quality image samples can be used for proposing a robust and reliable technique which can overcome limitations of existing techniques.

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