AI-Based Disease Detection in Vegetable Crops: A Smart Solution for Modern Farming

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ABSTRACT

Artificial intelligence is changing the way we diagnose diseases in vegetables. It allows for fast and accurate diagnosis of various fungal, bacterial, and viral diseases through the use of advanced technology that involves image recognition, machine learning, deep learning, and computer vision using smartphones, drones, and smart cameras. This article aims to identify how AI works, its applications, its role in education through teachable machines, and the use of AI in encouraging precision farming. In summary, AI technology in disease detection provides an excellent solution for minimizing crop losses and increasing productivity in vegetable farming.

INTRODUCTION

Vegetables are vital for human nutrition and food security. Crops like tomato, chilli, cucumber, brinjal, and cabbage are extensively grown, providing valuable nutrition and income for millions of farmers. Vegetables are also very susceptible to various plant diseases due to fungal, bacterial, and viral infections. These plant diseases can spread fast, causing poor crop quality and low yields. Due to the succulence and perishability of vegetable crops, they greatly endure losses from infections that occur in the field and those that develop after harvest. According to Nand Tripathi *et al.* (2022), who provide a review of global vegetable crop losses and field disease incidence for different types of vegetables, it has been observed that the percentage of incidence for Phomopsis Fruit Blight in brinjal is around 40% to 60%, Sclerotinia and

Alternaria rots in tomatoes is 30%, fruit rot in chili is 20%, and bacterial black and soft rots in cabbage and cauliflower is 10% to 19%. Traditionally, the crop disease diagnosis has mainly been done by visual observation and the knowledge of farmers. While there exists the establishment of KVKs and the availability of extension officers, the conventional public extension system in India has inherent limitations. The working ratio per farmer varies between 1:2,000 and 1:5,000, which is much larger compared to the international standards recommended for effective person-to-person advice (Yadav *et al* 2022). The vast geographical area of India makes it difficult for small and marginal farmers in remote areas to access the institutional expertise and agricultural scientists.

However, recent developments in AI have provided innovative solutions to the problem. Disease identification techniques based on artificial intelligence employ various techniques like image recognition, machine learning, and computer vision to detect diseases at an early stage in vegetable crops. Mobile connectivity coverage among rural Indian households is now roughly 83.3% (Kotu 2026). The rise in the use of smartphones, smart cameras, and other digital farming technologies has enabled the use of artificial intelligence to become prominent in contemporary agriculture. The technology will be instrumental in managing diseases and minimizing crop losses.

What Is AI-Based Disease Detection?

The process of detecting plant diseases through AI techniques involves the analysis of the captured images of the plant leaves, stems, and fruits by the trained artificial intelligence algorithms. AI-assisted disease identification makes use of various technologies, such as machine learning, deep learning, and computer vision. Machine learning facilitates learning by computers from large amounts of data. Deep learning helps the computer recognise the patterns associated with diseases with the help of neural networks.

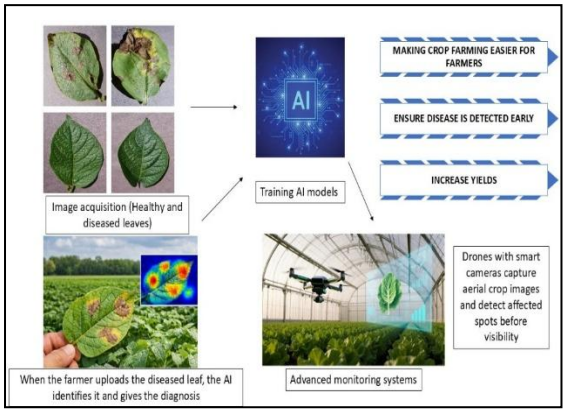
How does the technology work?

AI disease detection takes place through the training of the AI system with images of plants, including both healthy and diseased ones. This whole process normally starts with the farmer taking a photo of a part of the plant, such as its leaves, stem, roots or fruit, using either a smartphone or a digital camera. This image is then uploaded onto an application that uses artificial intelligence to detect crucial elements such as curling, spots, wilting, tumour, discolouration or unusual growth patterns from the photograph. After analyzing the image, the AI-based program compares it to thousands of previous examples of diseases stored in its database. With the use of machine learning and deep learning techniques, the program is able to determine which disease the plant suffers from.

Advanced systems use drones with smart camera that allow monitoring of large vegetable fields through automatic detection. AI can be trained continually to enable it to work fast, accurately, and be able to identify various diseases that affect diverse vegetable crops.

Many diseases can attack vegetable crops, which can easily be diagnosed using artificial intelligence. For instance, early blight and late blight are two of the most common diseases for tomato plants, which can be diagnosed with dark spots and discolorations in the leaves. Other diseases that may occur is chilli leaf curl disease, powdery mildew on cucumber and bacterial wilt in brinjal. With the help of artificial intelligence, diseases can be detected earlier in order to minimize the damage to crops.

Fig.1 AI disease detection in vegetable crops



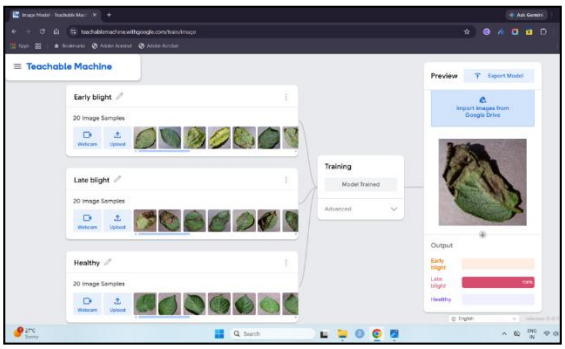
Role of Research and Educational AI Tools

Today, scientists, agriculture students, and AI technology engineers are using basic AI applications for the creation of disease detection models. One of these basic AI platforms is Teachable Machine, which is an online program created by Google, making it easy for people to build image recognition models without having any programming skills. With the help of uploading pictures of healthy and sick leaves of vegetables, scientists can train AI systems to identify vegetable diseases on their own. Once the model is successfully trained, the generated code can also be exported and integrated into mobile applications, drones, smart cameras, and other agricultural monitoring systems for real-time disease detection and field management.

Challenges and Limitations

However, despite having many advantages, AI technology-based disease detection technology has some drawbacks as well. About 40% of farmers living in rural areas cannot access information through the internet (Kotu *et al* 2026). Moreover, accuracy depends upon proper quality images and appropriate training datasets. Furthermore, farmers might need some technical expertise to use these technologies.

Fig. 2 AI-Based Detection of Early Blight and Late Blight in Potato Leaves Using Teachable Machine



Future Scope

In the coming years, AI is anticipated to be significant in sustainable and efficient farming. AI will enable quicker and cheaper diagnoses of crop diseases thanks to improvements in machine learning and mobile technologies.

CONCLUSION

With the application of artificial intelligence, disease detection in agriculture is changing. With the help of AI, it is possible to detect any disease early in the crops. In this way, AI will help save crops from losses and contribute toward the improvement of production as well as sustainable development.

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