


# Chapter 11

## Artificial Intelligence– Enabled Apple Disease Monitoring System for Environmental Protection and Resource Conservation

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### **ABSTRACT**

*The cultivation of apples is an important segment of the worldwide agricultural economy but is extremely susceptible to numerous diseases that are negatively impactful on yield and quality. To prevent such issues, the current study proposes*

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*an Apple Disease Monitoring and Control System from a hybrid AI configuration combining CNN, LSTM, and GAN. The proposed hybrid AI system aims to improve the accuracy of disease identification, optimize disease development prediction, and create synthetic data for generalization. The hybrid AI system uses real-time image data from apple orchards, performs time-series analysis to forecast disease development, and applies GANs to improve training data sets. Experimental results show that our proposed system is more accurate, robust, and minimizes variance compared to conventional machine learning models. The results of this study have the potential to revolutionize precision agriculture through a scalable and automated apple disease monitoring approach, ultimately contributing to increased crop yields and increased economic returns for farmers*

## **I. INTRODUCTION**

Agriculture, as one of the most ancient enterprises of humankind, has always coexisted with the environment, yet today there is increasing pressure on farmers to hold up their end of the bargain — produce more with fewer inputs and, at the same time, reduce environmental impact. The two-sided problem of maximizing crop yield and protecting ecological balance calls for more intelligent, precise solutions. The power of Artificial Intelligence (AI) has branched out from industries and computers to agriculture. This has been a deep dive so far — and AI now has its hands all over the puzzle, from smart irrigation to crop health diagnostics — AI is slowly becoming the keystone of modern sustainable farming. In such a scenario, the establishment of an AI-based apple disease monitoring model ensures a timely and beneficial solution where it not only helps in timely detection of diseases but also plays a significant role in protecting the environment by conserving its resources. Apple (*malus domestica* - the fruit is also called apple), is the most cultivated temperate fruit crop then next to grapes. The widespread cultivation of apple trees in China, the United States, India, Poland, Turkey, and elsewhere is a manifestation of these cherished fruits in terms of nutritional importance and international trade. Most apple-growing regions benefit from a relatively good climate and favorable conditions, but apple orchards are very susceptible to various diseases. These diseases — caused by fungi, bacteria and environmental stressors — are a huge challenge to apple production. Some of the most widely dispersed and harmful apple diseases are apple scab, powdery mildew, fire blight, bitter rot, and black rot. These diseases reduce the yield, as well as the visual and nutritional quality of fruits, which ultimately affect consumer preference and market value. When it comes to the identification of any disease occurring in the apple orchards, it comes with the intervention of manual inspections done either by farmers or by agricul-

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