Chapter 13
IoT-Integrated Machine Learning-Based Automated Precision Agriculture-Indoor Farming Techniques

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ABSTRACT

Precision agriculture driven by the integration of the advanced technologies like internet of things (IoT) and machine learning (ML) is revolutionary precision agriculture, especially the indoor farming techniques. This chapter explores the comprehensive application of IoT and ML in automating indoor cultivation practices, examining their diverse benefits and practical uses in comparison with the traditional farming methodologies. IoT enables the indoor farmers to create controlled environments through interconnected sensors, monitoring crucial variables but not limited to temperature, humidity, and light intensity. Complemented by ML algorithms, data analysis becomes efficient, providing predictive models for crop growth, pest detection, and disease outbreaks. Automated environment climate control systems optimize resource utilization, while precision irrigation minimizes water usage. Real-time monitoring and early detection of plant health issues reduce crop losses, ensuring high-quality produce.

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INTRODUCTION

Agriculture is one of the key sources that plays a significant part in the life of the country's economy. Traditional agriculture refers to the conventional farming methods that have been practiced for centuries, relying on manual labor and basic tools. In traditional agriculture, farmers often work in small plots of land using traditional seeds and farming practices passes down through the generations while traditional agriculture has played a crucial role in meeting food demands, it does have it disadvantages. One significant drawbacks is its relatively low efficiency and productivity. Manual labor-intensive tasks can be time-consuming and labor demanding, leading to potential wastage of water, fertilizers and pesticides. Moreover, traditional agriculture is more susceptible to the adverse effects of unpredictable weather conditions and environmental factors which can result in lower yields and economic losses. Meanwhile, food security is a global challenge and impacted by rapidly compounding effects of climate changes, population trends and supply chain shortcomings.

Agriculture's global impact cannot be overstated, as it remains the primary source of food for humanity. Despite the fact that the human population continues to grow, agricultural land remains static (Virk et al.2020). The authors (Mesgaran et al. 2017) also discovered that the ever-changing climatic conditions significantly reduce agricultural product output in conventional agricultural systems. As a result of the varying nature of farming resources and poor management, farmers continue to experience low agricultural output.

Drawbacks of Traditional Farming

Due to the low degree of automation in the farming area, the current state of the art in agriculture, particularly conventional agricultural systems, still confronts significant hurdles in terms of sustainability, labor-intensity, and energy efficiency needs. Also, the production level of the crops to be considered. Scalability problems also taken into account since the population explosion is the major cause.

Precision Agriculture and Smart Farming

In order to overcome the limitations and challenges faced in the conventional farming systems, the advent of the smart farming and precision agricultural sector to automate the farming processes towards achieving many goals towards sustainable agricultural systems. Some of them are listed below:

- High quantity of crop yield
- Better quality of the crops
- Efficient resource utilization
- Effective to handle climatic conditions
- Decision making in cropping patterns
- Environment and user-friendly
- Easy maintenance
- Minimized crop losses
- Easy to handle pests, diseases, weeds
- Minimize the crop growth time duration
- Early prediction on the crop loss or gain

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