Chapter 9
Role of IoT Technologies in Agricultural Ecosystems

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ABSTRACT

Increasing demand for food quality and size has increased the need for industrialization and intensification in the agricultural sector. The internet of things (IoT) is a promising technology that offers many innovative solutions to transform the agricultural sector. Research institutes and scientific groups are constantly working to provide solutions and products for different areas of agriculture using IoT. The main objective of this methodological study is to collect all relevant research results on agricultural IoT applications, sensors/devices, communication protocols, and network types. The authors also talk about the main problems and encounters encountered in the field of agriculture. An IoT agriculture framework is also available that contextualizes the view of various current farming solutions. National guidelines on IoT-based agriculture were also presented. Finally, open issues and challenges were presented, and researchers were highlighted as promising future directions in the field of IoT agriculture.

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INTRODUCTION

The agriculture industry is essential to the world's food security and plays a crucial role in the economy of many countries. However, traditional farming methods often require a significant amount of manual labour, which can be time-consuming, inefficient, and prone to errors. The IoT technology has brought a significant change in the agricultural sector, providing farmers with access to real-time data and automation tools that can help them optimize their farming operations. This paper explores the role of IoT technologies in the agricultural ecosystem, its benefits and challenges, and how it has transformed the industry.

IoT TECHNOLOGIES IN AGRICULTURE

IoT technologies in agriculture have brought about significant changes in the way farmers manage their farms. IoT technologies, such as sensors, drones, and automation systems, have helped farmers in monitoring and managing their farms more efficiently. For instance, sensors can collect data on soil moisture levels, temperature, and other environmental factors, providing real-time information on the crops' health (Farooq et al., 2020). Farmers can use this information to optimize their farming practices, such as irrigation and fertilization, to ensure maximum yields. Drones equipped with cameras can also provide farmers with aerial images of their fields, enabling them to monitor crop growth and identify potential issues such as pest infestations or plant diseases.

IoT (Internet of Things) is a modern technology that integrates sensors, communication, and automatic control, and is now being widely used in various fields, including agriculture, transportation, industry, and medical treatment. The combination of IoT and modern agriculture has brought smart agriculture into practice, enhancing crop yields, work efficiency, resource conservation, and crop quality in Figure 1 shows IoT agriculture eco system. The intelligent agriculture systems based on IoT encompass various aspects, such as agricultural production information collection, data storage and management, information analysis, and decision-making. The integration of advanced technology with agricultural production enables the scientific monitoring of crop growth, changes in the soil and air environment, temperature, humidity, and soil conditions, which contributes to improving the overall benefits of agricultural production. The adoption of new information technology, such as sensors, communication, and automatic control, has resulted in the widespread use of the Internet of Things (IoT) in various fields, including agriculture. The combination of IoT technology and modern agriculture has revolutionized the concept of smart agriculture, resulting in improved crop yield, work efficiency, resource savings, and crop quality. The primary components of intelligent agriculture systems based on IoT include the collection of agricultural production information, data storage and management, information analysis, and corresponding decision execution. The use of IoT in agriculture combines advanced science and technology with agricultural production, enabling the scientific monitoring of crop growth, changes in soil and air environment, temperature, humidity, and soil environment, ultimately improving the overall efficiency of agricultural production.

The integration of greenhouses with IoT technology has enabled real-time monitoring of crops, improved agricultural production management, and reduced labour resources and production costs. Research and application of IoT in smart agriculture is still in its early stages in China, and the technology gap between China and Western countries is yet to be bridged. The intelligent agriculture system has generated a