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Research on Internet of Things-driven Digital Commerce Empowering Rural Revitalization

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Abstract

The foundation of Internet of Things (IoT) is data collection, which is applied to production process of agricultural products. The purpose of digital commerce is circulation and trading, which is applied to sales process of agricultural products. The two are organically coordinated and mutually reinforcing, jointly improving agricultural production efficiency and agricultural product trading, and promoting implementation of the rural revitalization strategy. IoT and digital commerce have a high degree of consistency in information flow and information collection, laying a solid foundation for combination of the two. The significant effects of IoT driven digital commerce on rural economic growth, farmers' income improvement, and sustainable agricultural development.

Keywords

Internet of Things; Digital Commerce; rural revitalization.

1. INTERNET OF THINGS (IOT)

Internet of Things (IoT) is another information technology revolution after computer technology and the Internet. The Internet of Things connects items with the Internet according to the predetermined protocol through sensors, radio frequency identification, global positioning system and other information sensing equipment to realize information exchange of networked items, so as to realize intelligent identification, positioning, monitoring and management. In the field of agriculture, IoT technology has promoted the transformation of agricultural production methods and provided impetus for rural revitalization.

1.1. Technical and functions of IoT

The typical structure of IoT is a three-layer structure, consisting of a perception layer, a network layer, and an application layer. The perception layer is mainly composed of data acquisition devices, mainly various sensors, used to collect information from the real world. The main function of network layer is data transmission, which uses wireless networks and the Internet to transmit the data to the application layer. Wireless network is used for data transmission from sensing node to information relay node, and the Internet is mainly used for data transmission from relay node to the application layer. The main function of the application layer is data analysis and processing. The application layer has two main functions, one is data analysis. The other is decision-making advice and feedback control. The application layer uses data analysis algorithms and intelligent algorithms to process data, obtain analysis results or prediction results, and propose next steps or control automation equipment based on the results [1,2].

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In field of agriculture, the perception layer of IoT collects environmental information about crop growth, such as light, moisture, soil, atmosphere, etc. Also collect information about the crops themselves, such as plant height and fruit condition. By analyzing this information at the application layer, it is possible to determine whether crops are growing normally and to control automated equipment for crop growth interventions, such as watering, fertilizing, and increasing lighting. IoT has achieved full automation control of crop growth., as illustrated in Figure 1.

In field of agriculture, the role of IoT technology can be summarized into four aspects: firstly, the collection of data on crop growth environment and on crops themselves. The second is analysis of whether crops are growing normally and prediction of whether crops can continue to grow normally. The third is intervention in crop growth to promote rapid crop growth. The fourth is cost reduction, which reduces labor and other costs.

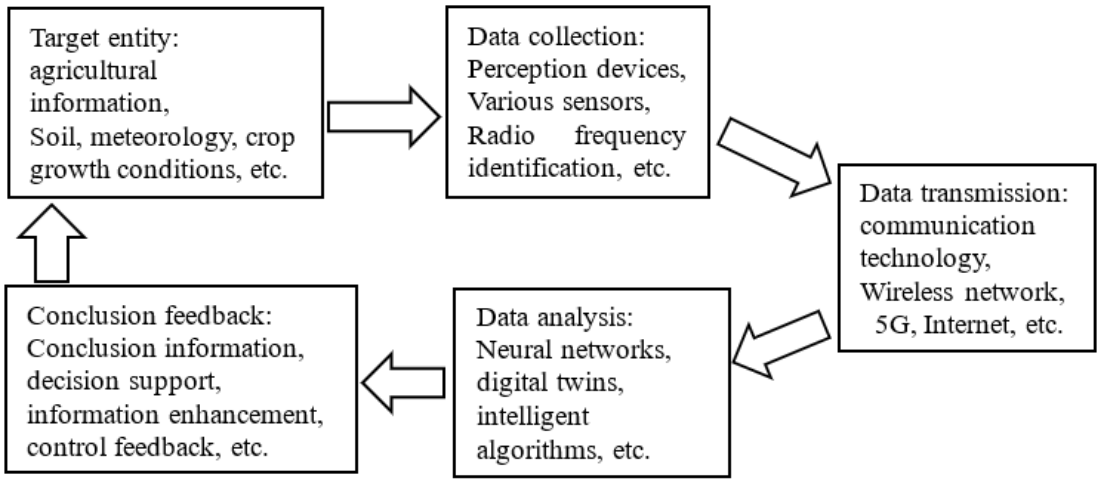


Figure 1. Application of Agricultural Internet of Things

1.2. Current status of IoT application in agriculture

Table 1. Application Fields and Functions of IoT in Agriculture

Application areas	Main technologies	Implemented functions
Smart greenhouse	sensors, 5G network, integrated water and fertilizer management	environmental monitoring, intelligent irrigation, precise temperature control
Field planting	Beidou navigation, drones, remote sensing monitoring	precision sowing, variable rate fertilization, pest and disease early warning
Aquaculture	Underwater sensors, intelligent aeration, feed feeding	Water quality monitoring, automatic aeration, precise feeding
Livestock farming	Electronic ear tags, intelligent weighing, automatic feeding	individual identification, health monitoring, precise feeding

Currently, IoT technology has been widely applied in agricultural. In Huanggang City, Hubei Province, an agricultural technology company has established over 700 smart greenhouses. By utilizing IoT technology, they have achieved data collection within greenhouses, data

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transmission to central control system, and intelligent decision-making production methods, effectively enhancing vegetable quality and output efficiency.

In Jingshan City, High-Quality Smart Agriculture Demonstration Pilot Project construct a farming service center, an intelligent seedling cultivation center, a smart field production area, and a digital management system. The smart field planting area will promote new technologies such as Beidou navigation for sowing and drone-based plant protection, driving surrounding over 5,000 acres of farmland to achieve standardized production. Application of IoT in agriculture is shown in Table 1.

2. DIGITAL COMMERCE

As a new business model in digital economy era, digital commerce has changed the form of traditional business activities, reconstructed the industrial chain, value chain, and supply chain, and provided a new path for rural revitalization. In the field of agriculture, digital commerce has not only changed the way agricultural products are distributed, but also profoundly influenced agricultural production structure and rural economic form.

2.1. Existing models of digital commerce in rural revitalization

Digital commerce is a new business model that realizes digitalization, networking and intelligence of business activities through Internet, IoT, big data and other technologies. Its core features include data driven, technology integration and process transformation.

In rural areas, digital commerce has formed multiple mature models: one is platform based model, which relies on large E-commerce platforms to establish sales channels for agricultural products. Through an point-to-point digital supply chain system covering prediction, production, warehousing, distribution, and sales, entire process from product procurement to store operation is optimized; The second is supply chain integration model, which reconstructs agricultural product supply chain through digital means, relies on warehousing logistics and convenience store takeout, and constructs a full industry chain supply chain system from the field to the dining table; The third is the ecological model of industry, which aims to create a digital driven agricultural industry ecosystem and empower entire industry process [3, 4].

2.2. The role of digital commerce in promoting rural economy

Digital commerce promotes rural economy through reshaping the circulation system, enhancing brand value, and promoting industrial integration[5,6].

In terms of circulation system, digital commerce reduces intermediate links and enables direct transactions between producers and consumers, effectively reducing circulation costs and improving circulation efficiency.

In terms of brand building, digital commerce greatly strengthens brand building and enhances product added value through the rational organization of production areas, direct sales processes, and more consumer awareness of products, as well as purposeful product promotion. In China, many agricultural products are highly regarded by the general public, and the place of origin has indirectly become the brand of a certain local agricultural product. Digital commerce is more effective in promoting the brand building of such products.

In terms of industrial integration, digital commerce promotes the deep integration of agriculture with tourism, culture, education and other industries, expanding the multifunctionality of agriculture. Industrial integration has been achieved through the development of leisure agriculture and rural tourism.

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3. IOT AND DIGITAL COMMERCE IMPROVE INFORMATION FLOW

Although IoT has a wide range of application scenarios and various implementation methods, its process involves the collection, transmission, and processing of information. The initial purpose of IoT was to enable things to be connected to the internet, to communicate with people and other things through the internet, and its essence has always been flow of information.

Essence of digital commerce is business activities. From ancient times to the present, commerce refers to economic activities of human society that achieve circulation of resources and products through exchange of goods, and circulation is its essence. In today's society, the rapid development of technology has made physical products and product information relatively equal.

3.1. Improve timeliness of information circulation

Both IoT and digital commerce have high requirements for real-time information flow. IoT collects information through sensors, RFID and other devices, and transmits it to processing center. In most cases, collecting information does not trigger subsequent response operations. This is not because information in IoT is not timely, but rather because it has not triggered feedback conditions; Digital commerce requires real-time monitoring of market changes, inventory dynamics, and logistics status in order to quickly respond to market demand. Both require information to form an information flow loop of "real-time collection real-time transmission timeliness analysis failure decision-making".

In agricultural product supply chain, IoT sensors monitor growth environment, production situation, and initial processing information of agricultural products in real time. These data are transmitted to digital commerce platform in real-time, enabling platform to accurately understand product status and provide it to consumers. The timeliness of circulation can not only reduce pressure of preserving agricultural products and maintain their freshness, but also promote rapid sale of agricultural products and increase merchant profits. This real-time information collection and processing capability significantly reduces supply chain response time and improves efficiency compared to traditional models.

3.2. Strengthen interactivity of information flow

Both IoT and digital commerce require information to have interactivity, that is, different systems and platforms can operate and collaborate with each other. IoT requires various devices and systems to be interconnected and form a unified IoT platform; Digital commerce requires information exchange between different enterprises and platforms to achieve supply chain collaboration.

Interactivity requires efficient collection of real-time operational data required by IoT, breaking data silos in traditional production scenarios. This interactive capability provides a complete and consistent data foundation for digital commerce, achieving a fully digital closed-loop from data collection, transmission to analysis and application.

4. SMART GREENHOUSES AND DIGITAL COMMERCE JOINTLY DEVELOP RURAL ECONOMY

As a typical application of IoT technology in agricultural field, smart greenhouses not only increase the yield of agricultural products, but also accelerate the production speed of agricultural products. They also provide full chain information of agricultural products for digital commerce, realizing the full process information from production to consumption, greatly enhancing the competitiveness of agricultural products on digital commerce platforms.

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4.1. Smart greenhouses and digital commerce Comprehensive information

Both IoT and digital commerce require comprehensive collection of relevant information to support system operation and decision-making. IoT requires comprehensive collection of various types of data in its application scenarios to fully perceive physical world and make the most accurate decisions; Digital commerce requires a comprehensive understanding of market, supply chain, customer and other data to accurately grasp business environment.

In field of agriculture, comprehensive information collection is reflected in the entire production process. The information sources of IoT range from macro climate to local microenvironments, from soil and water to plants themselves, from disease and pest warning to human intervention, and so on.

4.2. Application cases of intelligent greenhouses

At the ecological agriculture company in Huanggang City, Hubei Province, more than 700 smart greenhouses have been established. The greenhouse system can collect real-time information on crop growth factors such as light, temperature, and soil moisture; Simultaneously display the growth progress of crops derived from algorithm inference; It can also display information on the Shouguang vegetable market and the daily prices of mainstream vegetables. This comprehensive information collection, processing, and display capability provides rich and accurate product information for digital commerce.

Intelligent greenhouses have achieved complete human control over crop production through various equipment and technological means. The production of crops in smart greenhouses has completely broken away from the traditional agriculture's dependence on the weather and reached the current stage of human control. The full chain information of agricultural products in smart greenhouses is displayed to consumers through digital commerce platforms, enhancing product credibility and purchasing desire.

4.3. Intelligent greenhouse supports precise marketing of digital commerce

The detailed product information collected by intelligent greenhouses provides a data foundation for precise marketing in digital commerce. By analyzing consumer preferences and market demand, digital commerce platforms can recommend suitable agricultural products for different customer groups, improving marketing efficiency and customer satisfaction.

Intelligent greenhouses have a great impact on all aspects of crop production, and determining the production of qualified crops is only the most basic operation. The production of off-season vegetables in intelligent greenhouses is no longer a new thing. Through smart greenhouses, agricultural products can be launched at any time they want. Controllable crop production provides the foundation for precise object selection in digital commerce.

4.4. The synergistic effect of smart greenhouses and digital commerce

The synergy between smart greenhouses and digital commerce has formed a virtuous cycle: the high-quality and standardized agricultural products provided by smart greenhouses enhance the competitiveness of products on digital commerce platforms; The market feedback and consumer demand collected by the digital commerce platform guide the production optimization and variety adjustment of smart greenhouses. This synergistic effect significantly enhances the market competitiveness of agricultural products and the efficiency of agricultural operations.

Intelligent greenhouses have a huge impact on crop production, reducing production costs, lowering production risks, significantly improving agricultural production efficiency, effectively solving labor shortages, and increasing economic benefits. Intelligent greenhouses achieve

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precise management and purposeful production. These improvement effects can become marketing highlights for digital commerce platforms, attracting more consumers to purchase.

5. CONCLUSION AND OUTLOOK

IoT and digital commerce share a high degree of consistency in information circulation and collection needs, with IoT data driving the further development of digital commerce. In agricultural sector, smart greenhouses provide digital commerce with high-quality agricultural products and comprehensive information on the entire agricultural product supply chain. IoT drives digital commerce to assist in the modernization of agriculture.

With the development of technologies such as big data, artificial intelligence, and 5G, the effect of IoT driven digital commerce empowering rural revitalization will further deepen and expand. On the one hand, technological innovation will accelerate the digitalization process of agriculture, gradually reduce agricultural production costs, continuously improve the quality of agricultural products, and further expand the scale of production; On the other hand, model innovation will promote the reconstruction of the agricultural value chain, and the deep integration of the Internet of Things and digital commerce will promote the expansion of agriculture from a single production function to multiple functions such as ecology, culture, and tourism, achieving the integrated development and value enhancement of rural industries.

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