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Research on the Application of IOT and AI in Modern Logistics and Warehousing

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Abstract: With the rapid development of technology and the continuous progress of society, the logistics and warehousing industry is facing unprecedented challenges and opportunities. The IOT and AI, as the two pillars of modern technology, have brought revolutionary changes to the logistics and warehousing industries. This article explores in detail the applications of the IOT and artificial intelligence in modern logistics and warehousing, including real-time monitoring and tracking of logistics information, construction of intelligent warehouse management systems, optimization of intelligent distribution systems, and in-depth application of artificial intelligence in supply chain management. Through in-depth research on these technologies, we aim to provide more efficient, intelligent, and sustainable solutions for the logistics and warehousing industry.

Keywords: IOT, AI, Warehousing Management, Supply Chain Optimization.

1 Introduction

Logistics and warehousing are the core pillars of modern economy, and are crucial for the storage, transportation, and distribution of products. With the development of globalization and e-commerce, the IOT and AI technology have brought new changes to logistics and warehousing. The IOT technology enhances the transparency and efficiency of the supply chain through real-time acquisition and transmission of information [1]. Installing IOT devices on goods, transportation vehicles, and storage facilities can monitor and grasp data during the logistics process, such as temperature, humidity, and location. These data are processed by artificial intelligence to provide decision-making basis for logistics enterprises, reduce costs, and improve service levels.

The application of artificial intelligence technology in logistics and warehousing is equally important. Through machine learning and big data analysis, logistics networks can be optimized and inventory management can be improved [2]. In addition, artificial intelligence assistants can also improve customer service and order processing efficiency. In terms of warehousing, the IOT and AI have driven the development of intelligent warehouse management systems. The system realizes automated storage, handling, and inbound/outbound management of goods, reduces labor costs, and improves storage efficiency. Devices such as drones and automatic navigation vehicles have also strengthened the rapid handling and distribution of goods.

However, these technologies also bring challenges such as data security and labor substitution issues. At present, China has achieved significant results in this field, butit still needs to strengthen international exchanges and cooperation, cultivate versatile talents, and promote the globalization of the industry [3].

2. Overview of Logistics Information Monitoring and Tracking Technolog

With the increasing complexity and scale of logistics business, as well as the demand for accuracy and timeliness of logistics information, real-time monitoring and tracking of logistics goods and transportation vehicles has become a core element in improving logistics efficiency and service quality. The application of IOT and AI technology can achieve real-time monitoring and tracking of logistics equipment and transportation vehicles, providing comprehensive monitoring and tracking services for logistics enterprises [4]. The IOT technology can monitor key nodes and equipment in the logistics process. By installing sensors and communication modules on logistics goods and transportation vehicles, key information such as goods location, temperature, humidity, etc. can be obtained in real time, achieving real-time monitoring of goods. At the same time, the status, operation trajectory, and events during transportation of transportation vehicles can also be obtained in real-time through IOT devices [5]. This enables logistics enterprises to monitor key nodes in real time, obtain logistics information in a timely manner, and improve the

visualization and traceability of goods transportation.

AI technology can provide early warning and decision support for the logistics process by analyzing and mining logistics information [6]. Collecting and analyzing logistics data generated by IOT devices, AI can learn and discover patterns and abnormal situations in the logistics process. For example, by analyzing the location of goods and the status of transportation vehicles, predicting the arrival time of goods and potential problems during transportation, issuing early warnings and taking corresponding measures. In addition, by analyzing logistics data, AI can also provide decision-making solutions such as optimal routes and transportation tools, assist logistics enterprises in arranging logistics resources reasonably, improve logistics efficiency, and reduce costs.

Logistics information monitoring and tracking technology based on the IOT and AI can also provide logistics tracking and query services for clients. Through the connection between IOT devices and logistics information systems, logistics enterprises can transmit real-time information such as the location and transportation status of goods to the client, making it convenient for customers to check the location and transportation status of goods anytime and anywhere, improving the reliability and transparency of logistics services, and thereby enhancing customer trust and satisfaction with logistics enterprises [7].

3. Intelligent Warehouse Management System Technology

The intelligent warehouse management system technology, as one of the key technologies for the application of the IOT and AI in modern logistics and warehousing, aims to improve the intelligence level of warehouse management, thereby improving logistics efficiency and accuracy. Firstly, through the application of IOT technology, the interconnection between various devices and goods in the warehouse can be achieved, and a real-time logistics network can be constructed [8]. In this network, sensors and identifiers on shelves, goods, and warehouse equipment can monitor real-time information such as the location, quantity, temperature, and humidity of various types of goods. The integration of logistics information systems and IOT devices further enables real-time monitoring and data collection of logistics processes in warehouses. Therefore, warehouse administrators can obtain real-time location and status of goods through IOT devices, achieve rapid positioning and management, optimize warehouse layout and storage methods, and improve warehouse space utilization.

Secondly, the application of AI technology endows intelligent warehouse management systems with stronger intelligence and automation characteristics. By collecting and analyzing various types of data within the warehouse, AI can learn and optimize the rules and regulations of warehouse operations. For example, by analyzing sales data

of goods and warehouse storage capacity, AI can predict and optimize the timing of goods entering and exiting the warehouse, prepare goods in advance, reduce warehouse vacancy time and inventory backlog [9]. In addition, AI can also achieve the automation and intelligence of logistics processes by automating control and task allocation of equipment in warehouses. For example, using logistics robots, automatic forklifts, and intelligent transportation equipment to achieve automatic sorting, warehousing, and handling of goods, reducing manual operation errors and time costs.

In addition, intelligent warehouse management system technology can also provide a more intelligent and convenient operating interface and services. By associating with internal logistics management systems, suppliers, and customers, automatic order processing and real-time information transmission can be achieved. Warehouse administrators can monitor and manage warehouse operations in real-time through intelligent terminal devices. In summary, with the support of the IOT and AI, intelligent warehouse management system technology has brought warehouse management into a new era of efficiency and intelligence [10].

4. Intelligent delivery system technology

Intelligent distribution system technology can effectively improve the intelligence level of logistics distribution, improve distribution efficiency and accuracy. The application of IOT technology enables distribution systems to achieve real-time connections with various links. By installing sensors and identifiers on vehicles, goods, and warehouse equipment, logistics information during the distribution process can be monitored in real time, such as the location, quantity, temperature and humidity of goods. The IOT technology can also achieve real-time monitoring and management of delivery vehicles, such as real-time transmission and recording of vehicle location, speed, route, and other information. The distribution center can schedule and manage delivery vehicles through IOT devices, achieving real-time monitoring and data collection of the delivery process. The application of AI technology also makes intelligent delivery systems more intelligent and automated. By collecting and analyzing logistics information, AI can conduct data mining and analysis, learn and optimize delivery rules and regulations. For example, by analyzing historical delivery data and traffic conditions, AI can optimize delivery routes and vehicle scheduling, reduce delivery time and costs. AI can also predict and optimize delivery needs through machine learning and prediction algorithms, arrange the delivery time and quantity of vehicles and goods reasonably according to needs, and achieve automation and intelligence of intelligent delivery through AI technology, improving delivery efficiency and accuracy [11]. In addition, intelligent delivery system technology can also provide a more intelligent and

convenient delivery management interface and services. By associating with logistics management systems, suppliers, and customers, automatic order processing and real-time information transmission can be achieved. Delivery personnel can input and manage the delivery process in real-time through intelligent terminal devices, such as scanning QR codes to confirm the delivery of goods. At the same time, customers can also check the delivery status and signing status at any time through terminal devices such as mobile phones, improving the transparency and convenience of delivery services [12].

5. The Application of AI in Supply Chain Optimization

The application of AI in supply chain optimization is undoubtedly one of the key areas of modern logistics and warehousing technology based on the IOT and AI. By utilizing AI technology, intelligent management and optimization of various links in the supply chain can be achieved, thereby improving the efficiency and flexibility of the supply chain. AI can predict future demand by analyzing historical sales data and market trends, thereby assisting enterprises in precise demand planning and inventory control. In addition, real-time monitoring of various links in the supply chain is achieved through data analysis and result feedback to achieve dynamic adjustment and optimization of the supply chain.

AI can also be applied to optimize transportation and distribution. With the help of IOT technology, real-time monitoring and management of logistics vehicles and goods are implemented, thereby achieving real-time optimization of transportation routes and vehicle scheduling, reducing logistics costs and time. Based on AI technology, intelligent delivery has become possible, allowing for reasonable allocation and distribution of goods based on customer needs and real-time data, improving delivery efficiency and accuracy.

In addition, AI helps optimize supply chain inventory management. By analyzing historical inventory and sales data, AI can predict inventory demand, reduce inventory backlog and costs. Meanwhile, based on real-time sales and supply chain data, real-time optimization of inventory is achieved to ensure timely replenishment of inventory and avoid stockouts. The application of AI in supply chain optimization is also reflected in risk management and prediction. Through big data analysis and pattern recognition, AI systems can predict and identify potential market, production, and logistics risks. This can not only help enterprises prepare response strategies in advance, but also optimize risk management processes and reduce unnecessary losses.

At the same time, AI can also establish smart contracts with all parties in the supply chain, ensuring transparent and compliant transactions, and automatically executing contract terms. This not only improves trading efficiency, but also reduces contract risks caused by human factors. On the other hand, AI can continuously improve the management and operation of the supply chain through continuous learning and optimization [13]. This self optimization ability enables the supply chain to adapt and make adjustments faster in the face of complex and ever-changing market environments, maintain efficient operations, and play a more important role in supply chain management.

6. Conclusion

This article studies the application of the IOT and AI in modern logistics and warehousing. The IOT technology enables real-time acquisition of goods information by connecting sensing devices, helping enterprises predict risks and reduce losses. AI provides precise logistics planning and improves transportation efficiency through big data analysis and machine learning. In terms of intelligent warehouse management, IOT technology enables fast and accurate handling, while AI optimizes cargo scheduling and inventory management. [14] The intelligent delivery system utilizes unmanned devices to improve delivery efficiency, while AI optimizes routes and traffic prediction. In terms of supply chain optimization, AI provides decision-making support for enterprises and achieves collaborative optimization. With the maturity of technology, the IOT and AI will play a greater role in logistics and warehousing, and enterprises should actively adopt them to improve efficiency and reduce costs. The government and all sectors of society should also increase their research and support efforts to create favorable conditions for its development. In the future, these two technologies will bring broader development space to the logistics and warehousing industries [15].

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

The original contributions presented in the study are

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included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Conflict of Interest

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Author Contributions

Not applicable.

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