Application of Artificial Intelligence Robots in Precise Management of Medical Equipment in the Context of the Internet of Things

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Abstract: this article explores a new medical device management model based on information technology to improve the efficiency of medical device management. Based on the analysis of the current status of medical device management, the innovative achievements of information technology such as electronic signature technology, big data analysis technology, internet of things technology, artificial intelligence and cloud services are integrated into the daily work of medical device management; implementation of medical device procurement online approval, application of internet of things technology for intelligent monitoring and maintenance management, and application of information technology and big data analysis to equipment cost-benefit analysis and equipment management. It was found that the new management mode of medical equipment in the information environment can well solve many limitations of hospital medical equipment management, effectively reduce equipment management costs, and improve work efficiency. After using the medical equipment information management mode, the approval time for medical equipment procurement was shortened from 3-5 working days to 2-3 hours; the maintenance response time was shortened from the original 15-20 minutes to 8-10 minutes, and equipment maintenance costs decreased by 13.4 %, clinical satisfaction increased from 80% to 99%. Finally, we conclude that the application of artificial intelligence robots in the field of medical device management in the context of the internet of things can improve the efficiency of medical device management and improve the level of hospital management.

1. Introduction

With the progress of society, information technology has also developed rapidly. The new generation of information technology not only attaches importance to the innovation and development of information technology itself, but also emphasizes the integration of information technology into various fields and industries to create new values.[1] Incorporate new-generation information technology in medical equipment management, optimize medical equipment management, reduce equipment management costs, and improve medical equipment management efficiency. [2]The purpose of this study is to explore new models of medical device management based on information technology to improve the level of medical device management. At present, the understanding of the Internet of Things has expanded from IoT (Internet of Things) to IoE (Internet of Everything). From the sensor network defined at the beginning, it has developed into the era of Internet of Everything. According to IDC analysis, by 2020, there will be 30 billion smart devices connected to the Internet and generate massive amounts of data.[3] As more and more industry-leading companies enter the field of IoT, from the construction of IoT infrastructure, the control of various types of IoT devices, to the analysis and processing of data generated by the IoT, and finally to the IoT based on data understanding. There are many unresolved issues such as integrated application research and development, and there is no unified understanding of the core technologies and technological evolution routes that need to be resolved for the future development of the Internet of Things. At present, the research hotspots of the Internet of Things technology are mainly from the perspective of communication, researching new communication protocols and standards between Internet of Things terminals, such as low power wide area (LPWA) and other new communication technology research.[4] These studies provide basic communication guarantees for low-cost connection of various objects in various scenarios in the future. On the other hand, the iconic applications in the field of IoT have not yet appeared. Although there are cases of autonomous driving and smart meter reading, there have not yet been iconic IoT applications from economic benefits, industry influence, to innovative technology applications. The upgrading of communication technology only solves the networking problem of the Internet of Things, and does not solve the inherent driving force of the development of information technology, that is, the widely recognized application problem. The core technology for solving application problems is exactly the information content understanding and application technology that traditional communication technology R & D institutions are not good at. The Internet of Things is the fourth technological revolution in the world's information industry after computers, the Internet, and mobile communication networks.[3] It refers to the integration of various information sensing equipment, such as radio frequency identification RFID devices, infrared sensors, global positioning systems, and laser scanners. A huge network formed by combining various devices with the Internet [1], the purpose is to connect all items with the network, so that the system can automatically identify, locate, track, monitor and trigger corresponding events in real time. The Internet of Things is extremely versatile, covering many fields such as smart transportation, smart home, medical health, smart grid, smart logistics, industrial and automation control, fine agriculture and animal husbandry, national defense and military, environment and security inspection, finance and service industry, etc. Governments, businesses, and academia have paid much attention. As far as the medical field is concerned, the Internet of Things has a very good application prospect in this field and has always attracted the attention of developed countries such as the European Union, the United States, Japan, and South Korea. The Chinese government is also actively promoting the "One Card" application in the medical field and strengthening the construction of information systems in the health system. In particular, it has introduced many important promotion policies for the promotion of RFID applications.[4]

2. Current Status of Medical Device Management

In the traditional medical equipment management method, due to technical constraints and other factors, a complete information-based medical equipment management system has not been established, and the traditional medical equipment management model that targets asset management is still used, and manual accounting is used to record the medical equipment. Approval, purchase, maintenance and scrapping, etc., this management mode has a large workload and extremely low efficiency, which is not conducive to the dynamic analysis of related data in the later stage.[5] Incomplete information has led to a lack of sufficient economic, economic, and security justifications before the purchase of medical equipment, which has increased hospital operating costs. The measures for the supervision and management of medical equipment, requiring hospitals to strengthen the quality control, maintenance, maintenance, testing, and daily operation management of medical equipment.[4] These tasks not only require the hospital to invest a lot of human, material and financial resources, but also traditional medical equipment management methods cannot fully meet the ever-evolving management needs. Therefore, it is urgent to find a new model that can adapt to the management of medical equipment.

2.1 Analysis of the Development Stages of the Internet of Things

With the development of the Internet of Things, after the Internet of things operating system solves the problem of data upload and manipulation of the Internet of Things terminal, these artificial intelligence-capable platforms will realize the devices and information generated by the Internet of Things through friendly human-computer interaction interfaces such as voice semantic understanding and command generation for IoT terminal manipulation applications. Its logical level

is basically divided into three layers of architecture, the structure from top to bottom is open capabilities, management layer, algorithm layer, data layer, as shown in Figure 1. The development of the Internet and the mobile Internet is essentially to provide information understanding and application problems, and the value is generated by the application of information. The development of the Internet of Things is similar to the Internet and is divided into the following stages.

1) In the development stage of network technology, the connection requirements of the Internet of Everything have brought about the upgrade and evolution of network infrastructure.

2) The development stage of a single application technology to solve the problem of the application of the Internet of Things terminal.

3) Application integration development stage to achieve the integration of IoT applications. The core of this stage is the understanding of massive IoT information and research on application technology. The IoT information here mainly includes three aspects: the expression information of the IoT terminal and the IoT. Generate understanding of data content, semantic expression and analysis of IoT terminal manipulation information. When the Internet of Things develops to the third stage, it will truly usher in a period of rapid development.



Fig.1 Artificial Intelligence Processing Capabilities Platform Abstract Architecture for Iot Applications

2.2 Comparative Analysis of the Application of Semantic Understanding Technology between the Internet of Things and the Internet

The understanding of data content in the Internet field has mainly gone through three stages: the portal site, the classified navigation site stage, and the search engine stage.[6] From the perspective of information transmission, the portal website is not much different from traditional newspapers and televisions. The website directly provides content and users passively accept it. When a single portal website cannot meet the diverse information needs of users, a classified navigation website appears. The main technical feature of the classified navigation website is to use a similar method to the traditional library classification directory to establish a category directory with the core words as

the core, manually evaluate the content of each website, and then group each website under the keyword category directory to facilitate users. use. With the explosive growth of Internet information, this method is not suitable for the organization and application of information on the Internet. There are three main disadvantages:

1) The speed of manually organizing information cannot keep up with the growth of Internet information;

2) The standards for manually organizing information are not uniform. Although the classifications with the core words as the core can be defined as a unified standard, the development of Internet content does not follow a certain classification system. The content on the Internet often covers different classification areas.

3) The understanding and recognition of information by different individuals is limited by their knowledge level and educational background, which objectively also causes different people to categorize information inconsistently. With the explosion of Internet information, and the precise matching of information by people's needs, the search engine represented by Google appears.

2.3 Defects in Application Research of Semantic Understanding Technology At the Current Stage of the Internet of Things

The Internet of Things needs semantic understanding technology. Compared with the development history of the Internet, it is still in the early stage of the second phase. Similar to the classification and navigation directory stage, it mainly applies the ontology in natural language processing technology to achieve the semantic definition and standard reference of the Internet of Things terminal and application.[6] Ontology is a general conceptual description of a certain field and solves the problem of what kind of objects, processes, attributes and relationships are essentially in a certain field. However, the application of ontology in the field of IoT solves the problem of semantic understanding of IoT information. There are the following defects:

1) The application of artificially constructed ontology resources is not suitable for massive information on the Internet. These ontology describes the basic concepts of the Internet of Things field in a coarse-grained manner, which is limited by the speed of artificial construction and is not suitable for the rapid development of Internet of Things technology.

2) The Internet of Things equipment, information generated by the equipment, and similar equipment in different application fields are currently difficult to correspond with ontological methods, that is, standards for information expression.[7] If there is no practical application value, it is difficult promote; and the current standard generally only specifies the communication format, and there is no uniform standard for functional content descriptions.

3) There is no context similar to the Internet world, and the required parameters for the correlation calculation between IoT information are missing.

3. Application of Information Technology in Medical Equipment Management

3.1 Application of Electronic Signature in Online Approval of Medical Equipment Procurement

The purchase application, demonstration and approval of medical equipment is the starting point of medical equipment management. There are a large number of approval links in the daily management of medical equipment. The commonly used traditional paper approval forms are signed and approved by the in-charge leaders. In addition, it is difficult to access related information, the process is complicated and verbose, the efficiency is extremely low, and the shortcomings of the management model are extremely obvious. In order to ensure the integrity and non-repudiation of the signed information during the network transmission process, a strict identity authentication system was established using digital certificates and the use of asymmetric cryptosystems. A digital certificate binds the public key and the real identity of its holder, just like the digital ID of a user in the online world, except that it is no longer a paper certificate, but a piece of information that contains the identity of the certificate holder and passes through The electronic data issued by the certification center can verify that the document is indeed signed and sent by the sender, and can determine the integrity of the document. If the document signed with the digital certificate is changed, the fingerprint of the digital digest will also change [1].

In order to achieve higher security requirements, an electronic signature verification server can be deployed. The content for the online approval system is: Identity authentication. Only those authorized legal users have access to use system resources [2]; Permission control, users determine and control their permissions when using the system, and grant different approval permissions according to different levels of role users; Information security guarantee, providing electronic signature and verification, digital encryption and decryption, and certificate validity verification for the hospital approval system Features.

3.2 Intelligent Monitoring of Device Operation Status Based on Internet of Things Technology

Under the traditional medical equipment management mode, the operating status of medical equipment cannot be monitored in real time by the management staff. The hospital also dispatched medical engineering technicians to the equipment use department to inspect the equipment in use to grasp the operating status of the medical equipment. However, the performance degradation of some medical equipment may be hidden. Without professional testing equipment, it is difficult for inspectors to detect the problem. In order to meet the needs of real-time monitoring of key medical equipment and improve the safety of medical equipment use, this research developed a real-time monitoring system for medical equipment operation, consisting of software and hardware [3]. Radio frequency identification (RFID) [4] technology and various types of sensors to monitor various parameters and operating conditions of medical equipment [5-6]; use RFID readers and hospital wireless networks to collect. The data is uploaded to the cloud server, and the uploaded data is recorded, analyzed, and processed in the server, and the real-time monitoring information is transmitted to the monitoring screen of the equipment department. The system's operation realizes the real-time monitoring of the hospital's key equipment and key parts, and it is easy for maintenance personnel to perform maintenance and equipment failure analysis, which greatly improves the efficiency of equipment management.

3.3 Wechat Applied to Medical Equipment Maintenance Management

In the past, the equipment for repairs in the health center was sent to the equipment department by phone or clinically to fill out the maintenance contact form, and then the equipment department sent engineers to visit the maintenance mode. Disadvantages of this model are: Equipment engineers are prone to omit repairs during busy work, which affects clinical work; Unclear description of equipment repairs by clinical staff, which affects engineers' judgment of failures; Engineers cannot check the history of the equipment on site maintenance information and maintenance information [7].

3.4 Cost-Benefit Analysis of Information Technology Applied to Medical Equipment

Scientific and reasonable analysis and evaluation of the cost-effectiveness of medical equipment can provide a scientific basis for the cost control of hospitals and the planning and procurement of medical equipment. However, the cost-benefit analysis of medical equipment basically stays in the manual operation mode due to its complex data collection and other reasons. Since the charges in the hospital information system are charged according to the charge items, it is not possible to directly collect the charge information of a certain device.[5] In addition, equipment maintenance It is also very difficult to collect information such as expenses, consumables expenses, and depreciation expenses, and many data are not reliable and random, and the results of cost-benefit analysis of medical equipment cannot truly reflect the equipment use status. With the rapid development of information technology, the use of information technology to optimize the current status of cost-benefit analysis of medical equipment has become an inevitable choice. Rich and authentic data sources are the fundamental and key to cost-benefit analysis of medical equipment. By analyzing the work processes and working methods of each department, it is recognized that the collection of basic data is a systematic project that involves both the hospital business department and the Involving hospital administrative, management and logistics departments.

3.5 Application of Big Data Analysis in Medical Device Management

At present, the hospital has launched a medical device management cloud platform, and a large amount of data is generated during the operation of the cloud platform. These data include department purchases, plan demonstrations, equipment selection, bidding and procurement, inspection of income pool, maintenance, clinical use, repair testing, and measurement and quality control until the equipment is scrapped. These data are growing rapidly every day. Traditional database technology can no longer effectively manage and process them, and their complexity is getting higher and higher. The cognitive ability of managers is limited by traditional visualization forms, and is hidden behind these data. It is difficult to play its due role. In order to be able to quickly mine valuable information from a large amount of equipment management data, the hospital introduced a data mining system to scientifically present the characteristics of the data itself from two aspects of data analysis and data prediction [6].

4. Application Effects of Information Technology in Medical Equipment Management

After the new model of medical device management under the information environment was put into use, the average approval time was shortened from 3-5 working days to 2 hours, which truly achieved the goal of "data running more and approving less legs"; knowledge-based medical treatment The whole process management of equipment maintenance system shortened the response time of medical equipment maintenance from the original 15-20 minutes to 8-10 minutes, and shortened the maintenance response time by 86.2%. The annual maintenance cost of equipment decreased from 3.89 million yuan to 3.24 million yuan. Expenses decreased by 14.5%; clinical satisfaction increased from 80% to 99%; real-time monitoring system for medical equipment operation for one year in time to early warning equipment operation. The results of the study show that various indicators are significantly better after information technology is applied to medical device management, indicating that information technology can effectively improve the efficiency of medical device management.

5. Conclusion

The application of the Internet of Things technology in the medical field has attracted widespread attention at home and abroad. This article discusses in detail the application and research status of the Internet of Things technology in the medical field, and points out the key issues to be resolved in the medical field of Internet of things research. The author firmly believes that the good and broad application prospects of the Internet of Things in the medical field will surely cause more scholars at home and abroad to pay attention to and engage in related research in this area. Only in this way can we provide safer and more effective medical and health services for humanity of "smart healthcare" that benefits the whole society, thereby further promoting the development of the Internet of Things industry. Information technology is an advanced productivity that will bring profound and significant changes to the management mode of medical equipment. We must fully understand the profound impact of information technology on the original medical equipment management mode and actively explore the role of information technology in new content, new methods and new models in medical equipment.

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