

Design of Intelligent Allocation System for Medical Equipment Based on Internet of Things Technology in Multi hospital Mode

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Abstract

With the continuous development of modern hospitals, the multi-district management mode of one hospital has become the norm, which has greatly increased the operating costs of hospitals and brought many challenges to the management of medical equipment, especially the emergency allocation of medical equipment. This paper designs an intelligent and self-service medical equipment allocation system based on the Internet of Things, focusing on the short-term rental needs of medical equipment. It aims to reduce the human cost of medical equipment in hospitals, reduce the cost of purchasing medical equipment, avoid repeated purchase and idleness of professional equipment, significantly improve work efficiency, realize self-help borrowing, increase humanistic care for clinical users, realize lean management of medical equipment under multi-hospital mode, and promote high-quality development of hospitals.

Keywords

Multi-Hospital Management Model; Medical Equipment Deployment; Internet Of Things; Smart House; Smart Cabinet; Emergency Deployment

1. Introduction

In June 2021, the "Opinions of the General Office of the State Council on Promoting the High-quality Development of Public Hospitals" (No.18 issued by the State Office) was issued, and for the first time, some powerful public hospitals were supported by documents at the national level to build and develop multi-hospital districts on the basis of controlling the size of individual hospitals, and at the same time, to meet the needs of the broad masses of the people. With the rapid development of major hospitals in China, especially public hospitals, there is a general trend of collectivization, forming a multi-hospital management mode[1-3]. Under the multi-hospital integrated operation mode, professional equipment is widely distributed, and the traditional

equipment management mode has been unable to meet the emergency allocation needs of clinical equipment. There is an imbalance in time and quantity in the use of some medical equipment in clinical departments, and there is a sharp increase in periodic demand (such as the peak period of pediatric surgery in winter and summer vacation), but similar to this situation, it is not suitable for clinical departments to directly allocate all the medical equipment needed in the peak period, and the medical equipment emergency allocation center provides short-term leasing to meet the needs of clinical use. Avoid the situation of repeated purchase and low utilization rate after the allocation of clinical departments[4-6].

At present, the deployment of medical equipment relies on manual work, and the inventory of equipment is time-consuming and laborious, so it is impossible to grasp the inventory and location information of equipment timely and accurately. The process of borrowing and returning is cumbersome, which affects the work rhythm of healthcare workers, and lacks efficient billing and overall allocation mechanism, which can not meet the operational needs of modern multi-hospital integrated management[7-10]. In this study, an intelligent and self-service medical equipment allocation system based on the Internet of Things was designed to achieve 24-hour uninterrupted operation and convenient self-service borrowing and return, which greatly shortened the time of equipment acquisition, ensured the timely development of medical treatment, and improved the response speed of medical services. On the other hand, the automatic inventory, positioning and intelligent billing functions supported by the Internet of Things technology can accurately manage equipment, optimize resource allocation, reduce human costs, improve equipment utilization, and enhance the overall operational efficiency and competitiveness of hospitals, which is an inevitable choice for hospitals to move towards modern management and improve the level of medical services.

2. Architecture design

In this study, an efficient intelligent deployment system is constructed through the Internet of Things technology and intelligent terminal equipment, and the whole process automation of equipment access and management is realized by relying on intelligent cabinets and intelligent houses. At the hardware level, the smart cabinet adopts modular grid design, adapts to small devices such as monitors and infusion pumps, and supports rapid opening by scanning or swiping cards. Intelligent house integrates temperature and humidity control and security access control system, which can cover large medical equipment such as ventilator and CRRT, and ensure the compliance of equipment storage environment. The deployment system is called "medical equipment intelligent deployment system", and the overall architecture is shown in Figure 1.

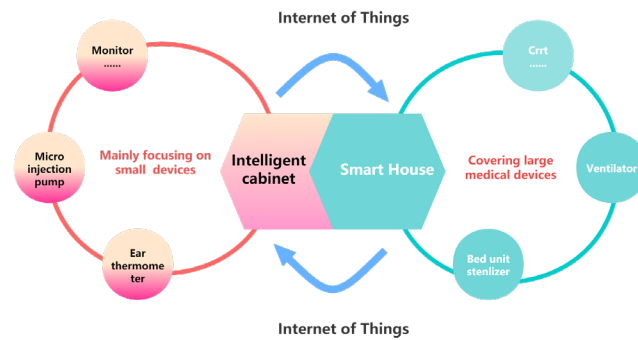


Figure 1. Basic architecture of medical equipment intelligent deployment system

3. Technical route and allocation system process

At the technical level, each device is embedded with Bluetooth or RFID positioning tags, combined with the multi-hospital Internet of Things base station network, to achieve real-time location tracking and status monitoring (such as online, fault, lending). In the process of borrowing and returning, the healthcare workers completes identity verification by swiping cards (employee cards), mobile scanning or face recognition, and the system automatically records the borrowing time and updates the inventory data without manual intervention. At the level of system integration, the intelligent terminal and the background management system are deeply linked, relying on the cloud data platform to realize the visualization of multi-hospital equipment resources, dynamically analyze the key indicators such as borrowing frequency and equipment idle rate of each department, and intelligently recommend the allocation scheme. At the same time, the system has built-in automatic billing module, which calculates the rental cost of departments according to preset rules, and directly connects with the hospital operation system to realize the automatic calculation of rental cost, and to realize the differential collection of rental fees for different equipment. Through the above technical route, the closed-loop management of "storage-fetch-management-use" of medical equipment is thoroughly opened up to provide technical support for the efficient sharing and precise allocation of medical equipment resources in multiple hospitals. The overall process of the intelligent allocation system of medical equipment is shown in Figure 2 below.

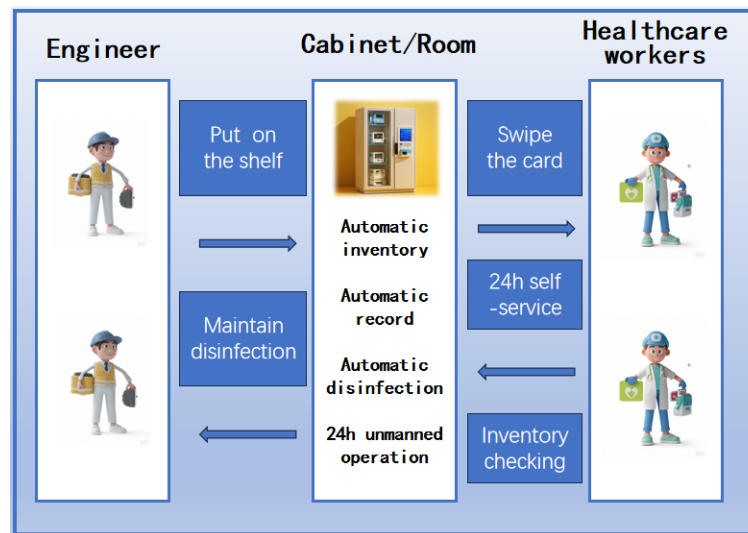


Figure 2. Flow of 24-hour unmanned intelligent medical equipment allocation system

4. Expected effect

Medical equipment is one of the basic components to greatly improve the efficiency of medical services, and at the same time, the supply of medical equipment is an important part to reflect the humanistic care for patients and the sense of medical experience. In the intelligent allocation system of medical equipment, through intelligent resource planning and real-time monitoring, the accessibility and efficiency of medical equipment can be improved, the precise supply and rapid response of medical equipment in emergency treatment can be guaranteed, the efficient operation of medical service process and the timeliness of patient treatment can be ensured, and the clinical healthcare workers and patient satisfaction can be increased. The specific expected results of the medical equipment intelligent deployment system are as follows:

- (1) Realize intelligent inventory: with the help of the automatic inventory function of the Internet of Things, the equipment inventory can be accurately grasped in real time;
- (2) Realize intelligent positioning: real-time positioning and deployment of professional equipment location and use status, greatly improve management efficiency;
- (3) Realize unmanned operation: 24 hours X 365 days of unmanned operation, which can greatly reduce labor costs;
- (4) Improve efficiency: the use of departments do not need to submit applications, to achieve self-service borrowing and return, greatly improving efficiency;
- (5) Realize information exchange: build channels for information exchange and asset transfer of idle equipment;
- (6) Optimize allocation: provide scientific basis for procurement and al-

location decisions, optimize and balance multi-hospital resource allocation according to equipment borrowing duration, frequency, idle equipment requisition and allocation and other data.

5. Sum up

With the expansion of hospital scale, multi-hospital operation has become the norm, and the medical business is also increasing year by year, so the workload of medical equipment allocation management is bound to increase, while the quality requirements are constantly improving, actively responding to the needs of digital reform, designing and building equipment management system based on Internet of Things technology, and improving the allocation efficiency in an all-round way. Build unattended mode, through the synchronous use of intelligent cabinet and intelligent house, combined with cloud platform management, break the deadlock of difficult allocation and large investment, promote the cooperation between management departments and clinical departments, optimize the overall planning of resources, shorten the time of medical and nursing equipment borrowing and returning, bring great convenience to clinical use, especially night emergency allocation, and ensure the smooth development of medical business. It is also to increase the humanistic care for clinical users and patients. At the same time, it can achieve precise management and cost control, automatic inventory, automatic recording of equipment information, reduce human and operating costs, and help hospitals develop with high quality.

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