On the Application of RFID Technology in the Hospital Fabric Cleaning Process

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ABSTRACT: This paper focuses on the current situation of the hospital fabric cleaning and transportation system, and uses the current more advanced RFID technology to optimize and improve some processes, so as to improve efficiency, reduce loss costs, clarify the responsibilities of all parties, improve the hospital information management level, reduce the contact between personnel and fabrics, personnel and personnel, and reduce risks.

1. INTRODUCTION

As one of the key technologies of the Internet of things, RFID technology has been continuously developed in the field of health care, and was widely used at the end of 2008, IBM to the US government put forward the "intelligent earth" strategy, to establish intelligent infrastructure, which includes the Internet of things technology fully applied to the medical field, to realize the interconnection of medical information. In the field of hospital fabric cleaning and management, according to the Technical Specification for washing and disinfection of hospital medical fabrics (WS / T 508-2016) issued by the health industry in China for the first time, the used medical fabrics should be washed in different stages according to the object, pollution nature and pollution degree of fabrics [1].When recording and using the different property information of different fabrics, RFID technology can better count the status information of the fabric and update each status of the fabric in different links compared with manual recording. Moreover, for some infectious fabrics, RFID can avoid manual cross-infection; especially during the outbreak, enabling contactless information collection using electronic tags and readers on the fabric.

2. ANALYSIS

2.1. How the RFID technology works

RFID technology is a contactless automatic identification technology, enabling contactless information transmission through the spatial coupling of RF signals to achieve the purpose of identification. The main components of the RFID system include a reader, electronic tag and upper management system. In RFID practice, electronic tags hold electronic data in an agreed format, attached to the object surface. The reader and writer can contactless read and recognize the electronic data stored in the tag to achieve the purpose of automatic object recognition [2]. The reader and writer sends a certain frequency RF signal through the antenna, when the tag enters the magnetic field to obtain energy, sends its own coding information, is read and decoded by the reader and decoded to the upper management system, and realizes different functions according to the application requirements.

2.1.1. Electronic tags

Electronic tags are the data carriers of the system that store information about the identified item, usually placed on the item to be identified. The tag is mainly composed of an antenna and an IC chip, which is used to generate a magnetic flux that provides energy to the tag in the form of information transmission and transmits information between the reader and writer and the tag.

2.1.2. Electronic tags classification

Depending on how the electronic tags work, RFID tags are classified active, passive and semi-active. In general, passive systems are passive and active or semi-active. The Active RF system uses its own energy to actively send data to the readers and writers, and the modulation mode can be amplitude modulation, frequency modulation, or phase modulation. The active tag itself has an internal power supply device to supply the power required by the chip to generate external signals; there is no power supply inside the passive electronic tag. When the passive electronic tag enters the working area of the reader and writer, it is inspired by the reader and writer electromagnetic induction to obtain energy. According to the different working frequency of the electronic tags, it can be divided into low frequency (30~300kHz), high frequency (3~30MHz), UHF (300MHz~1GHz), and microwave (above 2.45GHz) [3].

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Table 1. Electronic tags with different frequencies

Frequency	Frequency Band	Read Distance	Advantage	Disadvantage
LF	30~300kHz	<0.5m	Best reaction for metal and liquid environments	Close reading distance, Low speed
HF	3~30MHz	<1m	The world standard, Relatively low frequency	Close reading distance
UHF	300~1000MHz	3~10m	Fast speed, Long reading distance	Poor reaction metal and liquid environments
Microwave	2.45GHz, 5.8GHz	>10m	Fast transmission speed	Needing active resource

As can be seen from the chart, the working frequency of the wireless RF recognition system has a great impact on the working system of the system. From the perspective of identification distance and penetration performance, different frequencies are very different.

2.1.3. Application of this system

In conclusion, for the use of hospital fabrics, a passive UHF electronic tag was selected for the RFID washing management of fabrics. The tag not only meets the requirements of tag washing life and read error rate in daily washing, drying, ironing and disinfection, but also does not interfere with the nuclear magnetic examination of other medical equipment or patients [4]. At the same time, the electronic tag should also allow the reader to read and write about it, such as EEPROM, and the reader can change the information inside the programmable memory. We can use the electronic tag described below: the chip surface of this tag is "visually coded", consistent with the electronic code inside the chip can trace identity information; the electronic tag can use soft small, body comfortable silicone material, which can also achieve washing resistance, chemical resistance, high temperature resistance, high pressure dehydration resistance to 60bar.Electronic tag washing resistant 200 times, performance has passed the JIS standard test; size is 55mm * 7mm * 1mm and weighs 1g.In order to achieve non-contact scanning, electronic tags should also be able to achieve a large batch, unpacked penetration and fast scanning.

Figure 1. Electronic tag

2.2. Reader and writer device

2.2.1. reader-writer

A reader and writer is a device that reads or writes to the electronic tag information. Reader generally consists of control unit, RF signal transmitting unit and high frequency receiving unit. When the RFID system is working, the reader transmits a specific inquiry signal, the electronic tag receives the inquiry signal and feedback the answer signal, and sends it back to the reader and writer. The reader receives and processes the electronic tag, and then returns the processed information to the external host.

2.2.2. How the reader and writer works

The working principle is that the reader and writer encode the signal after a certain processing on the carrier signal at a certain frequency, and then sends the signal to the electronic tag by the antenna. The electronic tag receives the pulse signal and sends out the response signal; the reader sends the demodulation, decoding and decryption to the upper management system for processing [5].

2.2.3. Application of this system

Depending on the application scenarios, the structure and appearance are varied. In the actual hospital fabric cleaning process, we will apply to the logistics cabinet when sending and receiving the quilt in the hospital department. The RFID antenna on the partition of each grid can read the RF signal of the electronic tags, so as to record the item information and location status stored in the cabinet in real time. At the same time, in order to prevent the misreading between the electronic tags, the wall of the logistics cabinet can be made into two layers, the outer layer uses materials with high electrical conductivity, increase the reflection effect, the inner layer uses materials with high magnetic conductivity, increase the vortex effect, thus constitute the electromagnetic shielding space. The cabinet door of the logistics cabinet is controlled by the electromagnetic lock, and the micro switch is equipped on the door side to sense the switch state of the door. The upper layer of the logistics cabinet is the control unit, with the internal industrial control machine, touch display screen, multi-channel RFID reader, IO controller, IC card reader, etc. At the same time, the top of the cabinet is equipped with monitoring equipment and

alarm devices [6]. Logistics cabinets can be divided into distribution cabinets and recycling cabinets according to different functions.

Figure 2. Recycling the fabric

Figure 3. distributing the fabri

In the process of transferring the fabric from the hospital warehouse to the logistics company, we can use the RFID scanning cabinet. On the side walls of the scanner chamber is the RFID scanner with an antenna to receive and send signals. After closing the cabinet door, the RFID scan is started. Using the anti-collision ability of the scanning cabinet, we can accurately count the number of goods in the scanning cabinet with the RFID in a very short time. Using the reflection principle of the metal to the RF signal, the closed metal cabinet is used as the scanning space to produce the superposition effect of the signal in the space and ensure the intensity of the signal. At the same time, when the RFID system works, the movement of the RFID antenna is used to increase the intensity of the RFID electronic tag receiving signal through the changing angle and direction of the electromagnetic wave radiation, and improves the reading efficiency and accuracy of the device to the electronic tag [7].

Figure 4. RFID scanning cabinet

In this stage of initializing the fabric information, we will use the RFID desktop device. Put the fabric with the RFID electronic tag on the RFID desktop machine, and use the computer to input the asset registration, change and scrap information of the fabric, etc.

Figure 5.RFID desktop device

This RFID workbench we can use during department distribution or delivery sessions. The fabric is sorted by scanning the electronic tag of the fabric to obtain information from the department of the position.

Figure 6. RFID workbench

2.3. Hospital fabric cleaning process

After the new fabric is sent to the hospital, the hospital manager pasted the electronic tag on the fabric and scanned the RFID desktop, e. g., the fabric number, the

current business link of the fabric, the organization where the fabric belongs, the fabric washing date, etc.; the staff sorted the fabric on the RFID workbench, and transported the fabric to the organization and department. When put into the distribution cabinet, The RFID reader scans the electronic tag of the fabric, The type and status of the current fabric are recorded, Change the information within the electronic tag, such as the current business link of the fabric, And display on the IOT cabinet Kanban of the distribution cabinet; After the patient and his family members received the quilt and clothes in the distribution cabinet, Can be put into the recycling cabinet; The reader automatically scans sick clothing and bedding with RFID electronic tags, Send the fabric information to the database of the upper management system for summary, And to change the information of the electronic tag; Hospital cleaning personnel open cabinets and clearance, At this time, the staff of the hospital department can calculate the electronic tag data information in the upper management system, Summarize it into a recycling sheet; Hospital cleaners sent the dirty clothes to the hospital warehouse. In the warehouse, Managers can put dirty clothes with electronic tags into the RFID scanning cabinet, Change the electronic tag information, And check the amount of fabric, And is the comparison with the quantity information of the recycling list collected by each department; After the correct confirmation, The logistics company sent the dirty clothes to the washing factory by the hospital; After entering the washing plant, Put the dirt clothes into the RFID scanning cabinet for admission scanning, Count the quantity and change the electronic tag status information, After confirming the quantity before loading, The washing factory can disinfect the dirty clothes, washing and drying procedures; After the washing plant has packed the cleaned fabric, It can be placed on the RFID workbench for review and scanning, And input the status of the fabric and the fabric washing time and other relevant information. After confirming that the quantity is correct, the logistics company will send the fabric back to the hospital warehouse; similarly, the warehouse manager sends the fabric into the RFID scanning cabinet for quantity counting and status information change, sort the fabric organization, and send it to the distribution cabinet of each department and organization in batches. In this way, an efficient, standardized, clean, accurate and non-contact fabric cleaning process is realized.

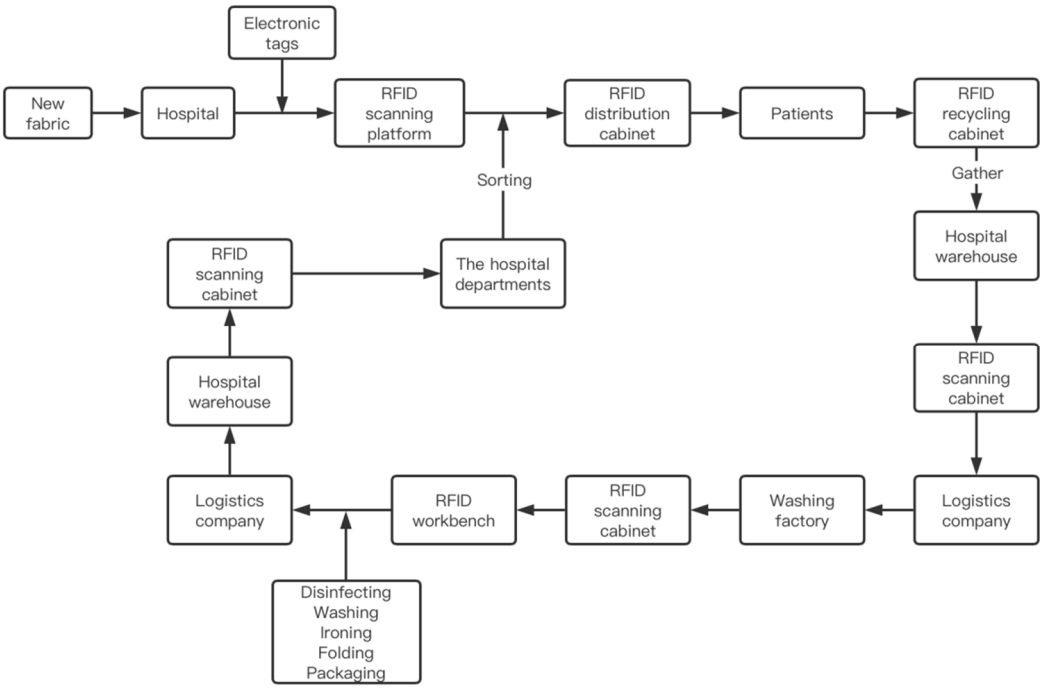

Figure 7. The hospital fabric cleaning process

2.3.1. The advantages of the system

2.3.1.1. Fabric ownership is clear, marked clean and standard

In the traditional hospital fabric cleaning process, hospital fabric is often marked by patients and their families, such as name, after rinsing will be printed and dyeing on the fabric, make the fabric looks not tidy, when there is no unified recycling and distribution box, the fabric will bring great inconvenience to the staff, causing waste of manpower and time, reduce efficiency.

After the use of RFID technology, the electronic tag recorded a large amount of information, convenient to quickly identify the fabric belongs, conducive to sorting and receiving, and the computer printing information, beautiful, standard, convenient for the hospital unified image management, avoid handwritten information of employees, avoid the clothes contaminated by handwritten notes.

2.3.1.2. The system has no contact throughout the whole process to improve the work efficiency

In the process of traditional soiled fabric sorting, hospital department and warehouse staff need to separate the packaged soiled fabric together, count the number and record. In this process, medical institutions in the diagnosis and treatment process, the use of clothing, bed sheets, surgical towels and other reused medical fabrics, they are contaminated by the blood, body fluids, excreta and other infectious diseases of patients, the risk of transmission of infection, must be cleaned and disinfected procedures [8].In addition, with the normalization of COVID-19, the person-to-person handover process in each link increases the possibility of COVID-19 to spread; at the same time, the process also wastes a lot of time and increases labor costs.

Because RFID scanning is collision-collision, readers and writers can scan multiple electronic tags in a short time, such as an RFID scanning cabinet can scan 800 pieces within 20s, so hospital staff can count the number and change the status information without unpacking, avoid the infection of dirty fabric, and reduce the possibility of polluting hospital air. And the handover process in each link can be completed by only one person, which also saves the handover time and improves the efficiency.

2.3.1.3. Fabric track tracking, clear responsibility

In the traditional fabric cleaning process, the fabric loss in each link is prone to unclear responsibility and prevarication; at the same time, the fabric needs to be scrapped after a certain number of cleaning, and the traditional manual records cannot accurately count the number of washing times of each fabric.

The fabric after the electronic tag logo is easy tracking and tracing, with one-to-one details, including the number of delivery and scrapping costs, reduce the loss disputes between the hospital and other outsourcing companies, clarify the responsibilities of all parties and eliminate the unknown loss related to hospital staff and daily service activities; the staff can also analyze and process the data changed in the electronic tag to know which fabrics need to be replaced in order to maintain the quality standard.

3. CONCLUSIONS

This paper focuses on the implementation of the combination of RFID technology and hospital fabric cleaning process, and makes process planning, but there are still areas that need to be improved in the implementation of specific links. For example, in some links, patients, their families and hospital receiving and dispatching managers can't get the details of fabrics in real time, such as fabric quantity, fabric status, etc., and patients can't reflect the demand for specific fabrics, Hospitals are also unable to distribute fabrics on demand. In view of the shortcomings of the above links, we can solve this problem by designing an application connected to the hospital fabric management system. The system can regularly send the daily situation of the Department's fabric to the patient through the application program, such as storage, collection, recovery, transportation, etc. The sending time and data selection range can be customized by the patient, and when the data of the IOT cabinet changes, the change details will be sent to the hospital manager through the application program in time. The above optimization process will reduce disputes between departments, clarify responsibilities, save more time to improve clinical services for patients, comprehensively improve the efficiency and level of hospital fabric management, and bring patients a better humanized medical experience.

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