On the Application of the Internet of Things in the Field of

Medical and Health Care

Fang Hu, Dan Xie, Shaowu Shen *

School of Information Engineering

Hubei University of Chinese Medicine

Wuhan, 430065, Hubei Province, P.R. China

Email:naomifang@126.com

Abstract—In this paper, through the introduction of the Internet of Things technology, we propose a new concept of the medical Internet of Things. Combing with the bottleneck and challenge which the medical and health care information encountered, we analyse that the Internet of Things has obvious advantages in the perceiving, transmission and application of information, and it will have a broad prospect of application in the field of medical and health care. With the strong support and guarantee for the Internet of Things technology, a kind of intelligent, accessible and communicative system will be the inevitable trend of future development. This article focuses on the specific application of the Internet of Things in the field of medical and health care, including medical equipment and medication control, medical information management, telemedicine and mobile medical care, personal health management, etc.

Keywords-The Internet of Things, Radio Frequency Identification, Medical and Health Care

I. INTRODUCTION

With the development of society and the progress of humanity, people recognize that health is not only one of the goals which social development pursues, but also the basic condition of promoting the economic development. In this process, the medical model has already changed from "biomedical mode" to "biological-psychological-social medical model", and personalized treatment and a variety of interventions have gradually become the trend of medical development. As people's demands for various medical and health care have been growing, the existing public health service and its supportability have been greatly challenged, and the shortage of health resources and the inadequacy of medical resources sharing have become the bottleneck of restricting its development.

Because the Internet of things technology has obvious advantages in the perceiving, transmission and application of information, its application in the field of medical and health care will benefit patients from acquiring the best medical assistance, the minimum medical costs, the shortest treatment time and the most satisfactory health services. Through the Internet of Things, We can monitor the whole process of production, delivery, anti-counterfeit and tracing of medical equipment, manage medical information which includes identification, sample identification, medical records identification and so on, construct service systems which are patient-centered and based on remote consultation and continuous monitoring of critically ill patients and construct a health care management platform, using equipment which can sense, measure, capture and transmit the information of human body.

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II. THE INTERNET OF THINGS

A. The Internet of Things Concept

The concept of "The Internet of things" was put forward in 1999. With a deep understanding of the Internet of things, the connotation of the Internet of things is clearer. The Internet of things can be simply defined as connecting all items to the internet through radio frequency identification (RFID for short) [1] and other information by sensing equipment to achieve intelligent identification and management. In other words, The Internet of things refers to a new technology of splicing all types of sensors and the existing internet [2-3]. Internet of Things supports many input-output devices and sensors like camera, microphone, keyboard, speaker, displays, near field communications (NFC), Bluetooth, etc. The main component is the RFID system. RFID can automatically identify the still or moving entities. The main aim is to monitor and control objects via Internet [4].

B. The Medical Internet of Things

With the development of information technology, the rising of the Electronic medical, and the emergence of the Internet of Things technology, the medical Internet of Things has gradually integrated into ordinary people's life. The so-called medical Internet of Things is a kind of technology that embeds wireless sensors in medical equipment, combines with the internet and integrates with hospitals, patients and medical equipment to promote the new development of modern medical model.

III. APPLICATION IN THE FIELD OF MEDICAL AND HEALTH CARE

In the field of medical and health care, major applications of the Internet of Things include medical equipment and medication control, medical information management, telemedicine and mobile medical care, personal health management, which can be further explained as the following.

A. Medical Equipment and Medication Control

With the help of visualization technology of material management, we can monitor the whole process of production, delivery, anti- counterfeit and tracing of medical equipment and medication to safeguard public medical safety. Specifically, the application of the Internet of Things in the monitoring and management of medical equipment and medication includes the following aspects.

1) The Anti-counterfeit of Medical Equipment and Medication

Identity in RFID tags attached to the product is unique, and difficult to replicate, through which we can easily inquire any information of the product, so it will be an important way to identify counterfeit products. For example, if the medication information has been put into the public database, patients or hospitals can check the tags according to the record set in the public database, and identify the counterfeit medicines easily.

2) Constant Real-time Monitoring

In the whole process of medication research, production, circulation and use, RFID tags can be used to carry out all-round monitoring. Especially, when medicines are automatically packed, the readers installed in the production line can automatically identify the information of each medicine, and then transmit it to the database. In circulation, the readers can record all the information in the process at any time and carry out all-round monitoring. The medication quality can be guaranteed by monitoring medicine delivery and storage environment. When medication quality problems occur, we can trace back the defective medicine according to its name, category, origin, batch, processing, delivery, storage, sales and other information.

3) Medical Refuse Information Management

With the cooperation of different hospitals and transport companies and the help of RFID technology, a traceable medical refuse information system can be established, which can track the medical refuse during the whole process of transport from hospitals to refuse processing plants, and avoid illegal disposals of medical refuse. Currently, Japan has launched researches in this area and has made some achievements.

B. Medical Information Management

The Internet of Things has broad application prospects in medical information management. At present, the demands of hospitals for medical information management mainly include identification of patients or doctors, sample identification of medication, medical equipment or laboratory chemicals, medical record identification of the state of illness or signs, etc. Specific applications involve the following several aspects.

1) Patient Information Management

A patient's electronic health profile, which includes medical history, medical examinations, treatment records and drug allergies, etc., may provide some help for doctors to work out treatment plans; meanwhile, doctors and nurses can also constantly monitor the patient's vital signs [5] and test and treatment to avoid the occurrence of using wrong medicines or giving wrong injections.

2) Medical Emergency Management

Under some special circumstances where wounded patients are too many, patients' relatives cannot be contacted or patients are in critical condition, with the help of reliable and efficient information storage and inspection methods of RFID technology, doctors can quickly confirm a patient's identity, which includes his or her name, age, blood type, telephone number, medical history, his or her relatives and other detailed information,

and finish the check-in procedure to save the valuable time emergency treatment.

3) Medication Storage Management

If REID technology can be applied to the storage, using and inspection of medication, it will simplify manual and paper recording, prevent short supplies of medication and made medication recall much more convenient, thereby to avoid the confusion of similar medication names, doses and dosage forms, strengthen medication management and safeguard timely supplies of medication [6].

4) Blood Information Management

If RFID technology can be applied to blood management, it can effectively avoid the small-capacity drawback of bar codes and realize non-contact identification to reduce blood contamination, actualize multi-target identification and increase the efficiency of data collection.

5) Error Prevention Mechanism of Pharmaceutical Preparations

Through the construction of error prevention mechanism in the process of getting medication and dispensing medication and the information management of pharmaceutical preparations in the process of prescription, dosage, medicine distribution, medicine taking, drug effect trace, medication stock control medication purchase and storage life and environment, we can confirm the dosage and type of the medication which a patient has taken and record the flow of the medication and its batch number to avoid the loss of the medication and ensure the patient's safety.

6) Medical Equipment and Medication Traceability

With the accurate records of medical equipment and medication, which includes the basic information of product use, the specific information of the product involved in the adverse

event, the origin of the product with quality problems, the patients who have used the product with quality problems and the regions where the product with quality problems has not been used, we can easily trace the product with quality problems and the patients involved to control all the unused medical equipment and medication and provide strong support for the handling of the accident. In 2007, China firstly experimented with the establishment of a traceable system, which connects medical equipment and patients. This system, which uses GSI standards to identify medical equipment, has been widely used in hospitals in Shanghai City.

7) Information Sharing

Through the sharing of medical information and records, an advanced comprehensive medical network can be formed. On one hand, by using this network, authorized doctors may look over medical records, medical histories, medical treatments and insurance coverages of patients, meanwhile, patients can also freely choose or change their doctors or hospitals. On the other hand, this network support complete exchanges of information between town and community hospitals and central hospitals, and can also help town and community hospitals constantly receive treatment suggestions of medical experts, transfer treatment and medical training.

8) Neonatal Anti-theft System

This system integrates the identification management, neonatal anti-theft management and passageway access to prevent the random coming and going of strangers to provide a practical and reliable protection for babies.

9) Alarm System

Through the real-time monitoring and tracking of hospital medical equipment and patients, the alarm system can help patients send emergency distress signal, prevent patients from leaving hospitals without permission, avert valuable items from being damaged or stolen and protect temperature-sensitive pharmaceuticals and laboratory samples, etc.

C. Telemedicine and Mobile Medical Care

1) Telemedicine

Telemedicine [7] is a kind of new medical service, which through the combination of computer technology, communication technology, multimedia technology and medical technology, aims to improve the diagnosis and medical level, reduce health care costs, meet with the health requirement of people and construct a patient-centered service system to carry out remote consultation and continuous monitoring of critically patients. With the progress of the remote technology, advanced sensor has been able to effectively communicate within the Body Sensor Networks [8] of patients. Telemedicine Monitoring has also gradually changed from focusing on improving peoples' lifestyle to providing life-saving information and timely exchange of medical programs [9].

2) Mobile Medical Care

Mobile medical care can establish a database for each customer by monitoring vital signs. This database includes information of body state, such as weight, cholesterol, fat content, protein content, etc. The information of body state can be analysed in real-time, and the results will be retroacted to the community, nursing or related medical units. Those institutions can provide the advices of dietary modification and health care for customers, and also provide scientific data for hospitals and research institutes.

D. Health Management

The health management is a process and

methods, whose purpose is to prevent and control the appearance and development of disease, reduce medical costs, and improve the quality of life. It finds out factors harming health status which is related to individuals and groups, and continues to improve them through systematic detection, assessment and intervention.

The human body signs (e.g. heart rate, blood pressure, respiration, blood oxygen, ECG, EMG, mode of action and other data) can be collected by medical terminal equipment, and then transmitted to the household devices (e.g. mobile, computer) through the wireless transmission equipment, finally classified and transferred to health management systems, call centers, specialty hospitals, research institutions and so on. The process is shown in figure 1 as follows.

IV.   CONCLUSION

The Internet of Things technology has huge application potentials in medical and health care field. It can enable hospitals to actualize intelligent medical treatment and management, which involves digital collecting, handling, storing, transmitting and sharing medical information, equipment information, medication information, personnel information and management information within hospitals. It can also help hospitals to achieve goals of visualized material management, digitalized medical data processing and medical treatment, scientifically-based medical process and humanized service and communication. Furthermore, it can better satisfy the need of intelligent management and monitoring of medical and health care information, medical equipment and supplies and public health security to help solve the currently existing problems in medical platform construction, medical service level and medical production safety. To sum up, the application prospect and scope of the Internet of

Things are very bright and broad, and in the future, a much more intelligent and interflowing medical system will become the trend, which will benefit people at large.

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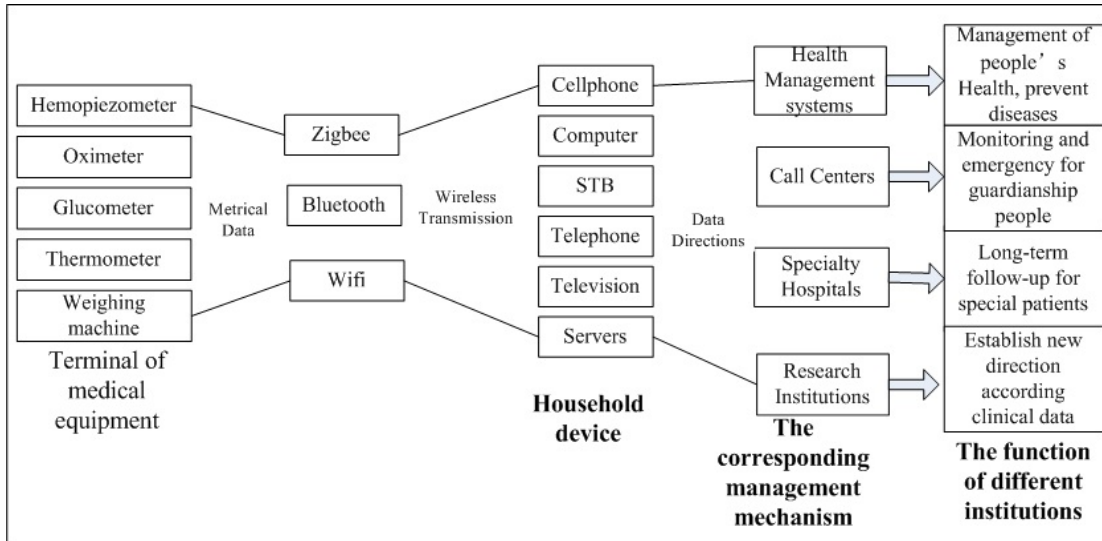
Figure 1. The relationship of Internet of Things and Health Management.