Implementation and Application of Wearable Devices in Intelligent Medical Treatment

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Abstract -- **The problem of difficult medical services and expensive medical cost has been one of the important factors that affect the social disharmony. It involves a wide range of influence, which greatly limits the development process of China's construction of socialist countries. The paper through the use of wearable devices increasingly mature, combined with the advanced technology of information networking, cloud computing and data processing, analyzes the characteristics and structure of medical wisdom, promote the development of medical and health information industry, greatly promoted the China's medical system reform and progress.**

Keywords -- Wearable device; Intelligent medical treatment; Internet of Things; Cloud computing; Big data processing

I. INTRODUCTION

The shortage of medical resources and uneven distribution has always been the focus of our attention. According to the sixth national census data show that the current China's total population is 1.34 billion, people at the age of 60 or more accounted for about 15% of the population as of 2015, reaching to 215 million. At present, China's population accounts for 22% of the world's total population, but only 2% of the world's medical and health resources, and 80% of them in the city. In addition, according to the relevant data in 2013, the number of Chinese diabetes patients is about 113 million, and 150 million hypertension patients, patients with hyperlipidemia for 220 million people, however 150 million hypertension patients will pay 750 million yuan a year for medical expenses, 220 million patients with hyperlipidemia need medical costs nearly 1 trillion yuan each year. So the problem of difficult medical services and expensive medical cost has become an urgent problem to be solved in the China's medical and health service[1].

With the growing maturity of wearable devices and the rapid development of new information technology, the Internet of things, cloud computing and big data processing will become the key means to solve the needs of China's medical services. Taking the wearable device as an example, which is computer technology combined with a variety of multimedia and wireless communication to not highlight the foreign body sensation input or output instruments such as jewelry, glasses or clothing for connecting the personal area network function, detects a particular situation or a private intelligence assistant, and thus become used in locomotion in information processing tool. According to numerous wearable products on the market at present, they can be divided into

glasses, watches, bracelets, gloves, necklaces, clothing, shoes and other types by its physical form, of which the Google glasses, apple watches, mi band wristband and other are most representative[2]. With the help of wearable devices and a host of new information technology, and combination of Chinese and Western medicine cure disease theory, knowledge base engine and traditional doctor service mode, which can effectively alleviate the currently "difficult medical services and expensive medical cost" medical resource constraints, and construct the intelligent healthcare system that satisfies the development of the urban in the future.

II. THE IMPORTANCE OF MEDICAL BIG DATA

The rapid development of big data has significant influence on the medical research field, the combination of its and wearable devices has the unpredictable effect for the treatment and prevention of chronic diseases. Chronic mainly refers to cardiovascular, cerebrovascular diseases, diabetes, cancer, chronic respiratory diseases and so on, which is chronic non-communicable diseases and have charactistics of high incidence, high mortality, high morbidity. Its pathogenesis is closely related to lifestyle and characteristics include long duration, complex causes, serious social harm and health damage, and it often accompanied by complications and disability. To a certain extent, biomedical data can reflect the outbreak of chronic diseases, such as high blood pressure may cause cerebrovascular disease, coronary heart disease or hypertensive heart disease, high blood sugar will worsen the condition of patients with diabetes, blood oxygen deficiency can cause brain damage, heart disease can cause pulse quickened, etc. So we can continuously monitor the human body indexes such as blood pressure, blood sugar, heart rate, blood oxygen with the help of

wearable devices, using big data technology to analyze fluctuation pattern of horizontal and vertical by continuously collected biomedical data. Horizontal analysis is to analyze health situation and long-term risk of chronic disease by comparing their biomedical data with the data of people who is the same age and gender. Vertical analysis is to analyze their health trends by comparing their own reference value, then can carry out on the risk assessment of body health through these analyses, when an exception occurs, the corresponding warning should be adjusted as soon as possible, to reduce the risk of disease. In addition, we can solve some problems that can not be solved in the past based on such a medical big data. for example, the famous biologist Professor Snyder at Stanford University used iPOP (Integrative Personal Omics Profile) for a person for as long as 14 months of medical tracking, and he tried preliminary feasibility of personalized medicine. In the whole experiment process, iPOP produced a lot of high-throughput omics data, in 20 time points monitored a total of about 3 billion biometrics, and these data had carried on the complex calculation and analysis. Medical big data, therefore, is an inevitable trend in the development of traditional medicine, which will be as a foundation for the future of personalized medicine technology, and combining with the medical wisdom, it can be more convenient for real-time provide medical services to patients.

III. THE CONCEPT AND COMPOSITION OF INTELLIGENT MEDICAL TREATMENT

A. The Concept of Intelligent Medical Treatment

Intelligent medical is intelligent medical information service platform that integrate the Internet of things, cloud computing and big data processing and other advanced technology, combined with the traditional medical model, and implements various collaboration of patient data collection, storage, processing, extraction and exchange. Cores of it are "Sence, Knowledge, Behavior", "Sense" means through the Internet of things, combined with a variety of sensors to track and process body data of patients, and transmit them to the medical data center by the wireless network; "Knowledge" refers to the use of big data storage and processing technology, through data mining to model and analyze massive medical data, to get the conclusion that is helpful for patients' rehabilitation treatment. "Behavior" refers to providing analysis data to the therapeutic personnel for reference by the way of cloud services, or as a health care plan for patients, to speed up the recovery [3]. Therefore, the intelligent medical has the following characteristics:

Interconnectivity

Doctors can easily and quickly browse the patient's medical history, treatment measures and precautions, and patients can also replace their doctors or hospitals at any time and seek a more efficient and comprehensive treatment program.

(2) Cooperation

Patient information no longer takes hospitals as a unit, but through the cloud services to integrate all the information into a comprehensive professional medical network.

(3) Preventability

Real-time monitoring patients' vital signs, then through analyzing it to predict the illness state of patients, which can quickly and effectively implement treatment measures, so as not to delay the disease.

(4) Universality

Supporting all hospitals nationwide seamless connection, whether it is a well-known hospital in the city, or a poor rural small clinic, all of them can get real-time expert advice and accept the professional training through central hospital.

(5) Innovativeness

Doctors make diagnoses and give treatments by real-time video communication, and combined with professional advices which other doctors put forward to help to enhance the ability of knowledge and process processing, and further promote the clinical innovation and research.

(6) Reliability

Doctors can search, analyze, and cite a large amount of scientific evidence to support the diagnosis.

B. The Composition of Intelligent Medical Treatment

Intelligent medical treatment through various types of health sensors, combined with new information technology, designed to provide monitoring, alarm and health assessment and other functions for all kinds of diseases, so it is mainly composed of five parts, as shown in figure 1.

Perception layer

Perception layer is mainly used to collect all kinds of vital signs data by Internet of Things, such as heart rate, blood pressure, body temperature, body posture and so on, which mainly consists of wearable devices, including smart glasses, intelligent bracelet watches, smart clothes and more mature products on the market, at the time using their built-in accelerometer, gyroscope, magnetic sensors, galvanic skin sensors, temperature sensors, and blood pressure sensor to real-time record data[4].

Transport layer

Transport layer is mainly used in wireless, wired, 4G, 5G or Bluetooth and other ways to collect the data from the perception layer and send them to the workstation or intelligent terminal. Because the data must satisfy the real-time, so the data transmission speed has great demands, and data transmission must be accurate without

any loss, the results of the analysis of massive data can be realized with medical value based on this.

Storage layer

Storage layer is mainly used to store monitoring data that all kinds of sensors continuously transmit, the data size is enormous and growth speed is very fast, data types may also have each different, so the traditional database technology can not effectively carries on the management and process. At this time we need a new way of data storage, HDFS (Hadoop distributed file system), GFS (Google File System), Lustre and Amazon S3 are currently well known on the market, because they do not need predefined mode, in addition, they have flexible extension and high speed of search, so they have great advantages in big data storage[5].

Decision layer

Decision layer is mainly based on the use of cloud computing technology, relying on electronic health records, health monitoring platform database and medical expert knowledge base, combined with wearable devices

to collect vast amounts of patient information as references, and provides multi-angle, multi-level data mining and contrast, to achieve take different treatment to different patients, provides a solid foundation for personalization of intelligent medical treatment.

Application layer

Application layer is mainly geared to ordinary patients and health care professionals, which services in the form of the client or the web page, and uses cloud computing to show results on wearable devices, so users can timely change their medical regimen. At the same time, it also provides real-time consultation to solve all kinds of problems encountered in the treatment of patients. Application layer usually provides health data real-time monitoring, parameter exceeded caution, health assessment, advises of doctors, alarm when old man lost and other applications, to some extend it alleviates the problem of "difficult medical services and expensive medical cost" in our country.
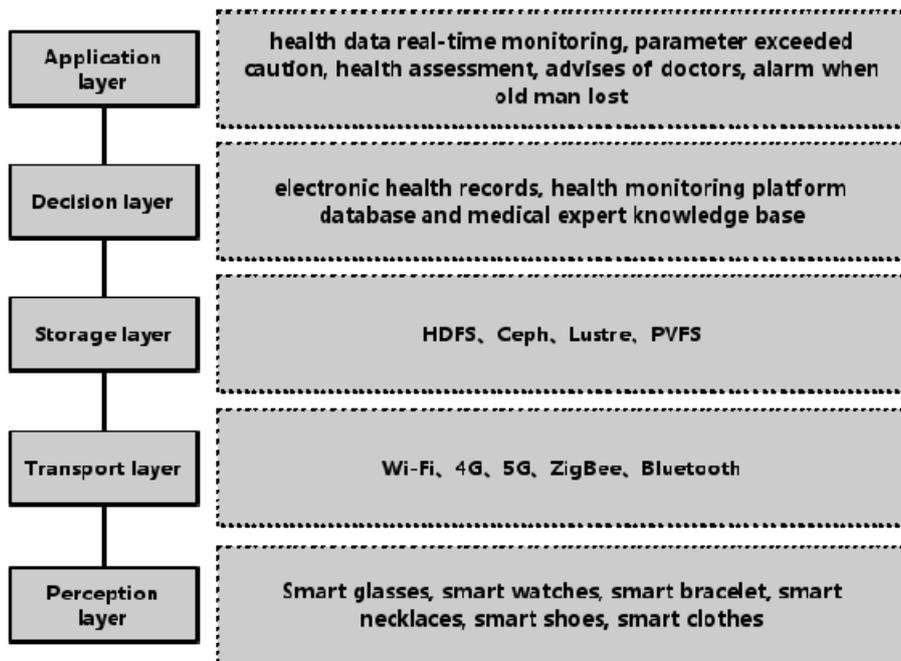

Fig. (1). The Structure Of Intelligent Medical Treatment

C. Wisdom Medical Operation System

The perfect wisdom medical operation system mainly consists of three parts, the central hospital system, the regional health system and the home health system. At the same time, the cooperation and communication between them will be fully provided by the cloud computing services to ensure to form a safe and reliable social security system. Figure 2 is the composition of wisdom medical operation system.

The home health system includes a variety of household diagnostic instruments and wearable devices, which can upload the user's physical sign parameters and emergency monitoring to the data center by the network, in order to provide the patient with high quality health services and comprehensive health management.

The regional health system can provide effective disease management, health management and health education according to parameters of users. At the same time, the regional health system needs to implement the initial rescue and diagnosis when monitoring the

emergency situation, so as not to miss the best treatment time. Then decide whether to transfer patients to the central hospital for treatment according to their condition development.

The central hospital system mainly provides the treatment of major diseases such as malignant tumor, serious cardiovascular, serious cerebro-vascular diseases,

brain injury and so on. At the same time, it can also provide remote medical services to patients through the comprehensive personal electronic health records, and users will be able to accept the personalized treatment conveniently and effectively. To a certain extent, it solves the imbalance of medical resources and the crowded situation of large hospitals.
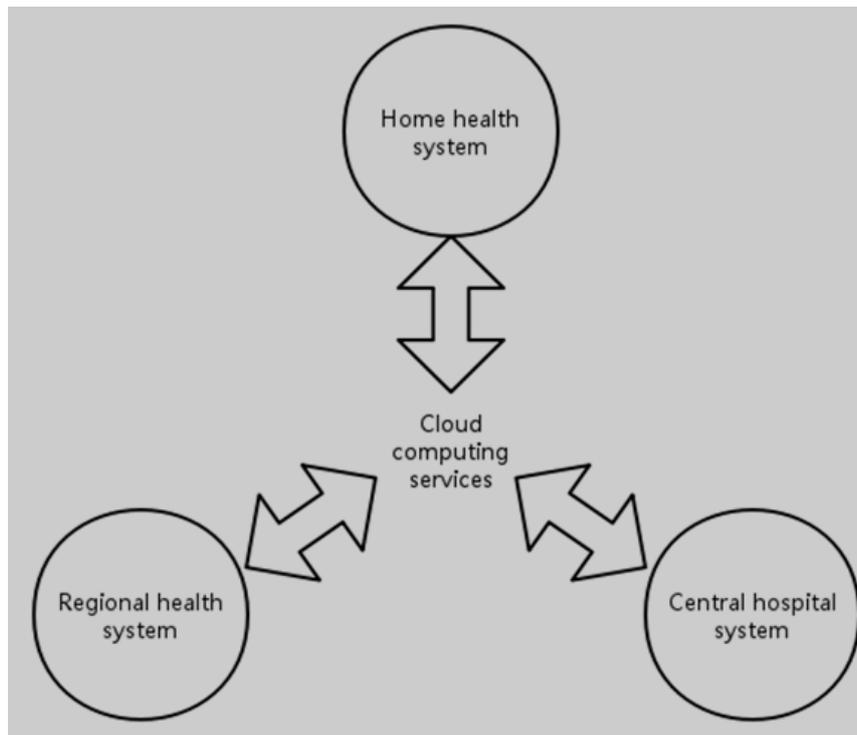

Fig. (2). The Composition Of Wisdom Medical Operation System

IV. KEY TECHNOLOGIES OF INTELLIGENT MEDICAL TREATMENT

A. Information Fusion Technology Of Wearable Devices

Information fusion refers to the process and technology of multi level, multi aspect and multi level that handles data from multiple sensors, which uses a variety of sensors to simulate human sensory organs (eyes, ears, nose, tongue, body and etc.) for wearable devices in order to understand things from the outside world, and it combines all kinds of information to accurately identify the environment or object parameters. Because wearable devices need to collect data in the complex and changeable environment, so all kinds of information may have a certain degree of uncertainty, contradiction or error, at this time we can make use of information fusion technology complement each other and confirm the information, which can get the relatively complete and reliable monitoring data in time[6].

B. Storage Technology of Big Data

Due to various types of sensors are used to continuously collect real-time data, so storage platform is required high scalability, at the same time to satisfy the high capacity and high availability, it is necessary to adapt to different access requirements, mainly including small amount of data reading and writing, and a large number of data read (generally not involved in the write), so different application scenarios need to meet the needs of the back-end storage are not the same. Based on this kind of service demand, in the hardware aspect with a large number of inexpensive servers to form the non - sharing cluster pattern has gradually become the mainstream. The storage structure is easy to achieve high availability, high performance and progressive expansion, also due to the tight coupling of storage and computing resources, so computing power will be strengthened when capacity is expanded at the same time. In the aspect of software, file storage can be used as the most basic way of data storage,

its advantage is simple interface to access, file format without strict limitation, so the file storage is usually used as a senior underlying storage structure of data management system. In this time relatively well-known large data file storage system on the market, which have no shared architecture, automatic maintenance of data redundancy, high concurrent access to the throughput and other features [7].

C. Massive Data Processing

There are many scenarios for complex data analysis, such as counting medical data, searching for similar medical records, medical data mining and prediction, and so on. These complex analyses and queries often need to read a large amount of data, so the computational time is very long; In addition, complex analyses and queries may involve a number of disciplines and fields, so its queries are relatively flexible and unpredictable, and its analyses also require the cooperation of experts in various fields to complete. At present, there are two main types of data analysis tools, such as parallel analysis database and data analysis tool based on MapReduce, which are suitable for large data analysis. The parallel analytical database is based on the relational data model, its storage structure and query algorithm are optimized in terms of data read. The MapReduce simplifies the design and implementation of parallel data processing algorithms, which allows users to not care about the task scheduling, resource management and error processing in parallel execution. In general, when the computing nodes are not more than 100, the performance of parallel analysis database is significantly higher than MapReduce because of its optimized storage structure and query algorithm; When computing nodes are more than 100, because the compute node error rate is higher, and MapReduce have better support for error problem of the normalized, so it can easily manage thousands of nodes[8]. So it has a vital role for building intelligent medical complex analysis by integrating their advantages.

D. Multiple Concurrent And High-Performance Computing Technology

In order to provide the individual oriented medical and health care services, intelligent medical technology must be implemented in real time data mining and analysis techniques. Therefore, the business that deals with health care of patients needs from the perspective of virtualization technology, such as calculate virtualization, storage virtualization, network virtualization and application virtualization, and using them to achieve a high performance technology breakthrough, at the same time through the combination of parallel computing technology, distributed storage technology, fault

processing technology to complete the application and deployment of its functions[9].

E. Information Security Technology

One aspect of intelligent medical treatment needs to focus on patients' personal privacy, so how to prevent the information from a variety of medical data from leaking is an inevitable challenge. Currently medical privacy problems depend only to the law to restrain the retention, dissemination and use of sensitive information, but for the intelligent medical treatment is far from enough, so it must deal with related privacy issues through technical means, so as to can usually start from two aspects:

(1) Using interference, encryption, and anonymously to form a new data set, and maintaining distribution characteristics of the original data to protect the contents of the privacy data.

(2) Through the authority centralized management can effectively reduce the possibility of data leakage, to prevent unauthorized use without authorization information, and controlling privacy data to spread in the safety range [10].

V. TYPICAL APPLICATIONS

A. The Heart's Real-Time Monitoring

Cardiovascular disease is the leading cause of death in the world, only in China, the number of deaths from cardiovascular disease is more than half of the total, accounting for half of all deaths according to statistics, so it is high value to monitor the changes of ECG in patients with wearable devices. At present, the traditional instrument can not collect the patient's heart rate data for a long time because of the inconvenience of carrying, but using health sensor in the wearable device, and the combination of wireless network communications and cloud computing technology makes it possible to collect uninterrupted. Generally speaking, the data collected by the sensors can use wireless network real-time transmit to the data center, data center analyzes and processes the data after receiving it, and abnormal information feedback to the attending physician and patient. Then the doctor put forward suggestions and advice to the patients in combination with the historical records, to achieve personalized medical services[11].

B. One-Step Medical Services

Patients usually need to go through registration, waiting, payment, examination, treatment and referral, which not only needs to spend a lot of time waiting in line, to a certain extent it affects the patient's treatment effect. At the same time, it may cause a great burden on the normal operation of the hospital, so that its image is

greatly reduced. The rise of intelligent medical treatment can be achieved intelligent triage, mobile phone registration, mobile payment, online doctor counseling, testing a single interpretation, drug use guidance and other functions, which achieves a one-step medical service for patients, point to point connection of patients and doctors, to improve the efficiency and results of hospital treatment[12].

C. Personal Health Records Management

In general, if patients want to know the history of their own medical records or diagnostic results, there is no choice in addition to read paper records, so the lookup efficiency is not only very low, but also it is easy to loss of records. The rise of intelligent medical treatment information can store information in the data center, and patients can understand the relevant information by wearable devices when they want to review history, including diagnoses, drug history, treatment situation and related expenses, etc. It simplifies the patient's medical procedures in many cases, to a certain extent, improving the possibility of self-inspection of patients.

VI. THE CHALLENGE FOR THE WISDOM MEDICAL TREATMENT

Wisdom medical treatment is a medical system which is formed with the existing medical resources and advanced information technology. So it needs a new business model and service methods to integrate the relationship of interests, adjust the structure and distribution of interest. At present, the implementation of the wisdom health also faces the following problems:

A. The Problem of Wisdom Medical Products

Now the wisdom medical system is still lack of relatively mature products. Most products are only to achieve a unilateral personal physical sign data monitoring and recording, and there is no connection with the existing medical resources to form a personal electronic file. At the same time as a result of various brands on the market to apply a lot of standards, which leads to new enterprises difficult to gain market share, to a certain extent affect the formation of market fairness.

B. The Problem of Key Technology Innovation

The wisdom medical technologies include perception, communication, data processing, information fusion, the Internet of things, and other fields. Therefore, it needs a lot of time and money in the process of research and development to continue the integration, breakthrough and innovation, which greatly restricts the investment of small and medium enterprises, but also hinders the

progress and development of intelligent medical technology.

C. The Problem of Industry Standardization

Wisdom medical technologies including multiple fields, so the formation of the standard is also complex, which lead to the professional standard of many related products on the market of technology, which has led to a large number of professional standards of related products on the market. At the same time, with a large number of outdated standards, the new standards need to be reestablished, which caused the problem of historical legacy is more serious, the negative impact has become increasingly prominent.

D. The Problem Of Service Operation And Management

Health care system because of its resource tension has been a hot industry. But with the popularity of the wisdom of health care, it will greatly change the layout of the existing medical resources. At the same time, the innovation and change of the business model will cause great pressure on the traditional practitioners and institutions, forcing them to change the traditional mode of operation. So how to solve the negative effects brought by the medical system reform is a problem that can not be ignored.

E. The Problem of Privacy Security

With the popularization and application of wisdom medical treatment, a complete personal electronic health file will be the basic module, which is required to collect real-time data then transmit, analyze, summarize and file. Therefore, it is a serious problem to ensure users to both enjoy the perfect health care services in the process of using and they can have a comprehensive protection of personal privacy measures, which is an urgent need to be solved for the government through the development of relevant laws and regulations.

VII. CONCLUSION

Through the integration of wireless communications and networking, cloud computing, data processing technology, integrated with the existing hospital information system, combined with wearable device for convenient and efficient, constructing the comprehensive functions of ecological environment of intelligent medical treatment, to achieve the monitoring in time, service fast, reliable quality, disease prediction and other purposes, to solve the medical status of "difficult medical services and expensive medical cost", advocating the right attitude of "a minor illness need to inquiry firstly, then serious illness need to go to hospital".

CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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