Architecture and Plan of Smart hospital based on

Internet of Things(IOT)

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Abstract—*In this paper, we propose an architecture and a plan of smart hospital in view of Internet of Things (IOT) with a specific end goal to beat the detriments of the present clinic data framework, for example, the settled data point, firm systems administration mode et cetera. The key advances and development of smart hospital is displayed in view of comprehension of the meaning and architecture of brilliant doctor's facility. Moreover, taking a third level A clinic for instance, a plan of brilliant doctor's facility is given, and its rationale structure, application system, the development of essential system condition and so forth are depicted in detail. Explore demonstrates that sending of smart hospital can viably take care of the noticeable issues existing the analysis and treatment of clinic and it brings a positive and significant impact for the present conclusion and treatment mode in doctor's facility.*

Key Words—internet of things (IOT), smart hospital, hospital information system (HIS), embedded, electronic medical record

1. INTRODUCTION

In the propelling procedure of hospital informatization, the prevalence and incomplete utilizing of HIS (hospital data framework) has made the hospital accomplish certain level of informatization. Nevertheless, it also has some deficiencies, such as manual input of medical information, fixed information point, fixed networking mode, single function, relatively independent between each department [1] and so on, which seriously restrict the construction of hospital informatization. For solving the problems mentioned above, rapid rise of internet of things has provided a new idea. Internet of things (IOT), the fourth time industry technological revolution of world information, following technological revolution of computer, internet and mobile communication network, is a network connecting any items with internet to implement information exchange and communication, furthermore to implement intelligent recognition, positioning, tracking, monitoring and management, by means of radio frequency identification (RFID), infrared sensors, GPS, laser scanners and other information sensing equipment, according to conventional protocol [2]. Smart hospital, based on technology of IOT and constructed with the vector of various application service systems, is a new kind of hospital integrated the function of diagnosis, treatment, management and decision. The features of IOT, such as comprehensive perception, reliable transmission, intelligent processing and so on provides technique support platform for the construction and implementation of smart hospital. Therefore, in this paper, based on the introduction of medical IOT and other related concepts proposed by some scholars, the connotation of smart hospital is analysed. Furthermore, in light of the presentation of existing three framework architectures of IOT, joined with the characteristics of hospital scene, three-layer framework architecture made out of detecting layer, arrange layer and application layer in smart hospital is likewise talked about in detail. Then, from the aspects of compilation of information specifications and standards, construction of the unified network platform and embedded mobile electronic medical records application platform, the key technology and content in the construction of smart hospital is sufficiently studied. At long last, taking a third level A hospital for instance, from the aspects in outline of logic structure, plan of utilization framework, construction of network condition et cetera, a particular application plan of smart hospital is given, giving important reference to the general usage and augmentation.

2. KEY TECHNOLOGIES OF IOT

IOT will gradually become the main body of the next generation of information network, and it is the internet based on the integration of multiple technologies integrated application, the following describes what the IOT some of the key technologies involved in.

2.1   Internet Technology

IOT, the internet of next generation, is essentially a network, so internet is basic precondition of IOT in order to communicate with any person and object at any time and place.

2.2   RFID Technology

RFID is a kind of non-contact automatic identification technology for objects or articles through the use of non-contact reading and writing devices. RFID technology can be classified into three categories; passive RFID, active RFID, and semi passive RFID [3]. All RFID systems contain three basic components. The first is the RFID tag that is connected to a benefit or thing. The tag contains information about that asset or item and also may incorporate sensors. The second component is the RFID interrogator (also called reader), which communicates with (also called interrogating) the RFID tags. The third component is the backend system, which links the RFID interrogators to a centralized database. The centralized database contains additional information, such as price, for each RFID tagged item. Generally speaking, a RFID system is composed of one or more reader (s) and several RFID tags. Communication between RFID tag and reader takes use of electromagnetic induction method, so direct contact is not needed [4].

2.3   Sensor Network Technology

Sensor network is the center of IOT and it can participate with RFID frameworks to better track the status of things, i.e. their area, temperature, developments, and so on. Sensor networks comprise of a specific number (which can be high) of detecting hubs imparting in a remote multichip design. For the most part centers report the delayed consequences of their distinguishing to a humble number (all things considered, only a solitary) of remarkable center points called sinks. With the ceaseless improvement of science and innovation, the conventional sensors are in the method of microminiaturization, intellectualization, informationization, and being networked. Utilization of sensor networks has been proposed in a couple application circumstances, for instance, common watching, e-prosperity, wise transportation frameworks, military, and mechanical plant checking [5].

2.4   Wireless Communication Technology

In IOT, it is through wireless communication technology that it automatically transmits the information stored in RFID tag to central information system, so wireless communication technology is core technology in IOT and several common wireless communication technologies mainly include Bluetooth, WIFI (wireless Fidelity), UWB (untrawideband), ZigBee, IrDA (Infrared Data Association) and so on.

2.5   Embedded Technology

In essence, IOT is an embedded system based on internet. Just because more and more intelligent terminal products have the requirements to network, it hasten the production of IOT concept [6], so IOT is the inevitable outcome of embedded technology development and it cannot do extensive use without embedded technology supporting.

3. SMART HOSPITAL

On the technology of IOT applied in the medical field some scholars put forward IOT in medical care [7], medicine based on IOT [8], IOT in health care [9] and other related concepts, which have the same essence, only different in angle and range of description. Smart hospital, based on the technology of IOT and constructed with the vector of various application service systems, is the concentrated reflection of IOT applied in the special place of hospital and it is a new kind of hospital integrated the function of diagnosis, treatment, management and decision. And also, integrating the concepts of informative hospitals, intelligent hospital [10] and digital hospital [11], it is the more specific, comprehensive, dynamic description about hospital. Through the implementation of smart hospital, it can implement the application system based on digital environment and people can fast and accurately obtain the relevant service information, thus it can realize diagnosis informatization, management standardization and scientific decision. At the same time, through the integration and fusion of application service, it can realize information acquisition, sharing and service in hospital, so as to promote the implementation process in smart diagnosis, smart treatment, smart management, smart decision and smart service.

4. ARCHITECTURE OF SMART HOSPITAL

Many researchers have carried out relevant research on networking architecture, and there are three kinds; the architecture based on EPC Global [12], on the basis of RFID technology, the application architecture based on sensor network [13], mainly referring to WSN, the application architecture based on M2M (machine-to-machine) [14], having the most extensive application scope and including partial content of EPC Global and WSN. In the medical field, though there are no literatures to directly mention the

architecture of smart hospital, some related articles have appeared, for example a model of sensing hospital having no boundaries proposed by [15], a model of digital surround intelligent hospital proposed by [16]. In view of the current existing research foundation and the actual environmental characteristics of hospital, smart hospital takes the third architecture mentioned above, composed of perception layer, network layer and application layer, as shown in figure 1.

4.1   Perception Layer

Perception layer is divided into two sub layers, which is respectively data collection layer and access layer. Data acquisition layer is to identify hospital networking nodes, perceiving and acquiring related data, such as identity information about doctor and nurse, identity information and medical information about patient, basic information and location information about pharmaceuticals, medical equipment and medical waste, physiological information and location information about inpatient, the environment information around hospital and so on. Access layer is to transmit the data acquired from sub layer and access it to the backbone network, namely global object-conjunction network. There is a variety of access ways, such as by mobile network, by wireless network, by fixed network, by cable TV network [17] and so on, where the access by mobile network will become the main way to access to smart hospital because of its wide coverage, low construction cost, convenience deployment and mobility characteristics. In practice, it needs to be determined by concrete conditions, for example, system with fixed using location, like outpatient management system and medical technical management system, is suitable to adopt access by fixed network, and hospitalization management system is suitable to adopt access by mobile network or wireless network, using wireless medical with unfixed workstation for physician and nurse.

4.2   Network Layer

Network layer is divided into two sub layers, which is respectively network transmission platform and application platform.

Network transmission platform is the backbone of hospital network, having real- time, barrier-free and high- reliable transmission of information perceived by perception layer, using technology of Ethernet, mobile communication, M2M and so on. Application platform is to implement the integration of various data, including description of unified data, unified data warehouse, technology of data middleware, and on this basis to constitute a service platform to provide an open interface for the various services of application layer [18], so that the third party can develop various applications on this platform for medical staff, patients and other related personnel to use.

4.3   Application Layer

Application layer includes two parts, which is respectively hospital informatization application and management decision and application.

Hospital informatization application includes informatization of outpatient management, hospital management, medical technology (inspection, examination, radiology, pathology, physical therapy and so on) management, drug management, equipment and material management, medical management, financial management and so on.

Management decision and application is the senior application, such as disease analysis (onset time, geographical distribution and treatment cost of various diseases), patients analysis (regional distribution, age distribution, proportion of free medical service and visiting time of patients), clinic analysis (outpatients visits , inpatients visits and doctor visits in each time quantum), drug analysis (amount, quantity of consumption and profits of various drugs) , department analysis (cost for diagnosis and treatment of every department in different periods) and so on.
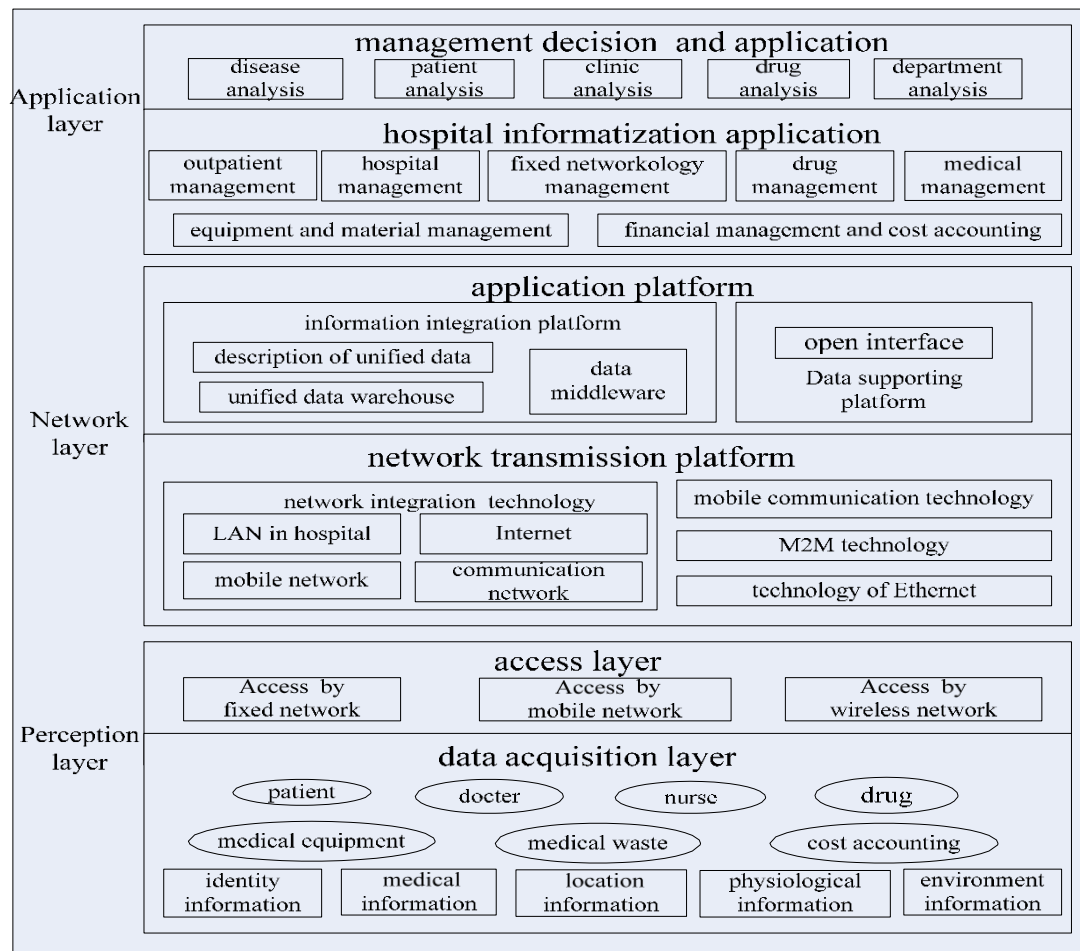
Figure 1. Architecture of smart hospital

5. CONCLUSION

In this paper, based on the sufficient analysis of smart hospital's connotation, architecture, key technology and construction, combined with the implementation about smart hospital project of First Affiliated Hospital of Anhui University of Traditional Chinese Medicine, we propose a concrete application scheme and it changes the existing hospital clinic model, having achieved satisfactory result. Next , based on the perfection and integration of original application system in HIS, with the breakthrough point of embedded mobile electronic medical records application platform, we will have related research on the marking format and data format in embedded mobile electronic medical record, so as to lay the solid foundation for overall implementation and extension of smart hospital.

6. ACKNOWLEDGMENT

7. REFERENCE

[1] Yu Lei, Lu Yang, Zhu XiaoLing etc., Research advances on the technology of internet of things in medical domain [J], Applications and Research of Computer, 2012, 29 (1) , pp. 1-7

[2] Gu JingJing, Chen SongCan, Zhuang YI, Wireless sensor network-based topology structures for the internet of things localization [J], Chinese Journal of Computers,2010, 33 (9) , pp. 1548-1555

[3]   Guicheng shen, Bingwu Liu, Research on Application of Internet of Things in Electronic commerce, 2010 Third International Symposium on Electronic Commerce and Security, pp. 13-16

[4]   Wen Hao, "RFID, EPC and Things of Internet", RFID Technology and Application, No. 5, 2009, pp. 17-20.

[5]   Luigi Atzori, Antonio Iera, Giacomo Morabito, "The Internet of Things; A survey", Compute Networks,No.54, 2010, pp. 2787-2805.

[6]   Liu Xiaohui, Internet of Things and Embedded Technology, Computer Study, 2011, 4 (2) , pp. 27-28

[7] He QianFeng, Breakthrough point of IOT applied in medical domain is object management [A], Chinese International smartcard and RFID exposition in 2010, 2010.06.18

[8] Bai ChunXue, Medicine on IOT [A], 7th international Symposium on Respiratory Diseases , 2010.10.17

[9] YU Meng Sun, Medical reform and IOT in health care [A], Summit forum IOT in health domain of china, 2011.5

[10] Ma Jin Jun, A brief talk on the problem in integration of hospital intelligence and information and developing direction of intelligence [J], Intelligent Building & City Information, 2010, (158) , pp. 94-96

[11] Fu Zheng, Liang Ming HuI, Conspectus of digital medicine [M]. Beijing; People's Medical Publishing House, 2009

[12] MICHAEL M, DARIANIAN M. Architectural solutions for mobile RFID services for the internet of things [D]. Helsinki, Finland; University of Helsinki, 2007.

[13] FRAMLING K, NYM AN J. Information architecture for intelligent products in the internet of things [EB/OL].[2010-05-22]. http; // citeseerx.ist .psu. edu / view doc/download? doi=10. 1. 1. 159. 6646& rep= rep1& type= pdf.

[14] GRNBK I., M2M architecture with Node and topology abstractions [M], 2nd ed. Os lo, Norway; Telektronik k,2009, pp. 89-110.

[15] Cheng ZhiHong, JiaoYahui, Liu Li, et al., Prospects for applications of RFID technology to realize boundary less sensing hospitals [J], Chinese Hospitals, 2010, 14 (8) , pp.8-9

[16] LI Jing, Zhang Hong; Wang ZhiQi, et al., Research of digital ambient intelligence hospital by RFID technology[J], China Medical Devices, 2009, 24 (7) , pp. 44-46

[17] Zhu HongBo, Yang LongXiang, Zhu QI, Survey on the internet of things [J], Journal of Nanjing University of

Posts and Telecommunications (Natural Science), 2011,31 (1), pp. 1-9.

[18] Zhang Shen, Ding EnJie, Xu Zhao, Hua Gang, Part III of lecture of internet of things and sensor mine—characteristics and key technologies of sensor mine internet of things [J], Industry and Mine Automation, 2010, (12) , pp. 117-121