Intelligent Health Nursing System Based on Cloud Platform

Yilin Teng¹, Rui Wang², Hui Xue¹, Chunbo Yang¹ and Jing Xu¹,*

¹Binzhou Medical University, Yantai City, Shandong Province, 264003, China
²Yantai University, Yantai City, Shandong Province, 264003, China

Abstract. The health of the elderly is mainly disturbed by chronic diseases. As the proportion of older persons living alone is increasing, the health problems of elderly have received extensive attention. Now the rapid development of sensor technology and network technology provide a technical guarantee for the realization of real-time health nursing. The existing intelligent nursing system does not reuse nursing data after judging the user's health status and choosing alarm processing. This paper proposes a new intelligent health nursing system architecture, which integrates sensor network and wireless communication network, and uses FPGA cloud platform to complete data storage and processing, which can effectively avoid the loss of function limited by the power consumption and computational performance of the user’s device. In addition, through the deep learning algorithm, the accuracy of abnormal nursing can be effectively improved as well.

1. Introduction

The incidence of hypertension, heart disease, cardiovascular and cerebrovascular diseases is high among the elderly population. However, it is difficult to get timely and effective treatment in the case of sudden onset or emergency. With the development of science and technology, wearable devices have been able to obtain various physiological data of the human body. The traditional nursing system is characterized by data collection and data processing integrated in the user platform, for which reason its maintainability and scalability is poor. In fact, during the development process of nursing system, how to make more effective use of the data obtained by sensors and develop effective deep learning algorithm to make more accurate prediction and judgment is becoming more and more important.

Blood pressure, electrocardiogram and other parameters have been monitored for more than a dozen years. With the need of users’ attention to health issues, a series of real-time monitoring devices for families have come out [1-4]. During the period of elderly living alone, fall was also one of the most important safety hazards. Some manufacturers developed devices for falling monitoring [5-7].

In this paper, an intelligent nursing system architecture based on cloud server is proposed. The monitored data should be divided into two parts: Simple data sets that can directly show health problems and emergencies will be responded at the user client immediately; other data sets will be cleaned, filtered and finally converted into the unified standard format. Then the responded result and the converted data sets will be transferred to the data processing platform. After linking to the cloud platform where the data will be processed by deep learning tools, the health status of the elderly is judged and predicted. Then the cloud sever will return the decision to the user or the health system. The results will as well be used as feedback to improve the nursing system alarm accuracy. At the same time, with the application of the new algorithm, the system functions can be expanded in both the sensor network side and the cloud server side, to avoid the inconvenient of users updating equipment. The diagram of the intelligent nursing system is showed in Fig1.
2. Structure of the Intelligent Health Nursing System

The structure of the intelligent health nursing system consists of four layers from bottom to top: “Data Acquisition Layer”, “Data Transfer Layer”, “Data Processing Layer” and “User Service Layer”. Fig.2 shows the structure.

2.1. Data Acquisition Layer

The data obtained by the intelligent nursing system includes: The first aspect comes from the real-time monitoring devices, including electrocardiogram, body temperature, and fall monitoring parameters data; the second aspect comes from household equipment, including blood pressure, blood oxygen, blood sugar etc.; the third aspect comes from health system data, including physical examination data
and hospital diagnosis data; the fourth aspect comes from user interaction. Users can choose whether to interact with client devices to upload information such as text, voice, image, and video.

Since the wearable devices can obtain data in real time through sensors, at present, the development of wearable devices has received more and more extensive attention. The development of wearable equipment tends to replace household health testing equipment gradually [4]. The variety of wearable devices is increasing while the cost of them is declining. The principle problem at present is how to process and analyse the data obtained effectively with the rise of “big data” technology. In many fields such as the weather forecasting, the equipment and methods for data acquisition did not change much, but it is worth paying attention to how to use new algorithms to make more accurate predictions. Analysing the data includes text, voice, image and video data sets obtained by user interaction is also required by intelligent nursing systems.

2.2. Data Transfer Layer
The role of the data transmission layer is to transfer the acquired data to the cloud. There are three common kinds of sensor transmission methods used in the intelligent nursing system: ZigBee[8], Wi-Fi[9] and Bluetooth[10]. Wi-Fi and Bluetooth occupies majority of the infrastructure, and ZigBee serves as a connection between machines (M2M). ZigBee is particularly suitable for use in wearable devices because of its low power consumption. Wi-Fi is suitable for plug-in devices and interactive devices. Finally, the data sets are collected and uploaded to the cloud through the Smart Gateway.

2.3. Data Processing Layer
Before the birth of internet, computer needs to accomplish all the functions related to data collection, data processing and data storage. What’s more, data in a stand-alone computer cannot be associated with data in other computers. Nowadays, virtualization allows terminal devices to be streamlined by reducing device costs and power consumption. Cloud deployment can accomplish data comparison and analysis more comprehensively, and where data processing methods are easy to expand.

2.3.1. Middleware. Direct data access faces the difficult that different health information data structures of different clients which are lack of a unified data interaction platform, resulting in maintenance difficulties during later period. The use of middleware could block the underlying differences and help protect the user's privacy. There should be middleware of data storage, middleware of message push and middleware development tool.

2.3.2. Cloud Platform. Due to the complex and diverse forms of health data information, the extremely large amount of real-time monitoring data, the data processing algorithm based on deep learning is updated constantly. The traditional CPU mode cannot cope with rapid changes. FPGA (Field Program Gate Array) can reform different functional hardware by reconfiguring the resources on the chip. FPGA is also suitable as a chip for protocol and interface conversion since it provides rich IO interfaces. Therefore, FPGA + Cloud platform whose architecture is as Fig 3, is used in the data processing layer of the intelligent care system.

When FPGA configure Block A, other resource Blocks do not suspend working, so it can implement data parallelism and streaming parallelism, and achieve both high throughput and low delay time to meet the requirements of real-time care.
Figure 3. FPGA cloud platform

2.4. User Service Layer
User Service Layer includes home terminal, medical system terminal and personal Terminal. The cloud platform will make a decision based on the data processing results and send the alarm log or monitoring results to the terminal.

3. Conclusion
By studying on the intelligent nursing system based on cloud platform, this paper puts forward the four-layer architecture of the system and discusses the technical support scheme for each layer. The advantage of this architecture is that it can easily deploy more nodes; its cloud platform is more convenient for older people without installing software and configuration is easy.

With the vigorous development of the intelligent home industry, more and more health data will be collected. Through the big data analysis, users’ health status is able be predicted, the process of sub-health development to disease can be discovered and aborted as early as possible.

Moreover, cloud platform can greatly shorten the deployment cycle of new business of "nursing system", provide unified software and hardware resource services for business, and greatly save investment cost and reduce maintenance cost.

4. References
[1] Chang Chien, Jia Ren, Cheng Chitai, “Handheld electrocardiogram measurement instrument using a new peak quantification method algorithm built on a system-on-chip embedded system” Review of Scientific Instruments, 2006, 77(9) 09156-1~7
[2] Weichi Hu, FengShuo Chang, Shih-hao Jo, et al.”Two-cuff Noninvasive Blood pressure waveform monitoring system for dynamic blood vessel characteristic study”, Proceedings of the 1st Distributed Diagnosis and Home Healthcare(D2H2) Conference Arlington, 2006,87-90
[3] Tamura T., Mizukura I., Sekine Masaki, et al “Monitoring and Evaluation of Blood pressure changes with a home healthcare system”, IEEE Transactions on Information Technology in Biomedicine. 2011, 15(4), 602-607
[4] Wang Yong, Portable ECG Blood Pressure Detector Based on ARM Processor. *Application of Electronic Technique*, 2006, 32(7): 71-73

[5] Yu X. Approaches and principles of fall detection for elderly and patient. 2008, *Proceedings of the 10th IEEE International Conference on e-health Networking, Applications and Services*, 2008:42-47.

[6] Bourke A K, Lyons G M. A threshold-based fall-detection algorithm using a biaxial gyroscope sensor, *Medical Engineering and Physics*, 2008, 30 (1) :84-90.

[7] Xin Shi, Tao Zhang. Design of a wearable fall detection device. *Chinese Journal of Scientific Instrument*, 2012, 33 (3) :575-580.

[8] Shahin Farahani. Zigbee Wireless Networks and Transceivers. 2008

[9] Zimu Zhou, Chenshu Wu, Zheng Yang, Yunhao Liu. Sensorless Sensing with WiFi[J]. Tsinghua Science and Technology, 2015(01)

[10] Qian Zhihongm Liu Dan, “Bluetooth Data Transfer Overview”, *Journal on Communications*, 2012(04)