

A Study of Intelligent Hospital Environment Monitoring Method Based on the Android Platform

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Abstract—With the development of the medical treatment and public health field, the higher quality of hospital environment is required. This paper presents an intelligent hospital environment monitoring system based on the Android platform to overcome the present monitoring problems, such as incomprehensive monitoring data, delayed alert, lower intelligence of level and etc. This new method introduced will greatly reduce the waste of hospital human resource, improve the service level of the hospital and make a big contribution to further realizing the safe city.

Keywords-hospital environment monitoring; android; safe city; WIFI ;intelligent alarm

I. INTRODUCTION

Hospital is always regarded as a protective umbrella for people’s health. The environment in it directly affected the recovery of patients. The national air quality standard, which is carried in 2002, definitely set the standards for the environment parameters, such as temperature, humidity, noise, gas, inhalable particle, VOC and bacterial total [1]. In 2007, Beijing introduced the hospital infectious disease department internal air quality requirements, in which, the standards of environment parameters are listed in detailed [2]. Moreover, it has been carried out with a strong hand. But for the domestic hospital monitoring, now is still in an artificial periodic period. It remains a lot of inadequacy both in real-time and intelligent information.

According to the report from Canals, which is a market research company, in 2011, it is the first time that the Smartphone won the PC including Tablet PC in global sales [3]. Android mobile platform based on the Linux core, is quickly taking a large share of the global market with its open and intelligent features. In this paper, a system based on Android, combining Android Service and multithread technology, is designed for the hospital environment monitoring. This system can remotely control and get realtime environment information, which definitely can solve previous environment monitoring problems.

II. GENERAL FRAMEWORK DESIGN

In this paper, an intelligent hospital environment monitoring system is designed on the Android platform due to the problems in present hospital monitoring system, such as monitoring not in time, alarming not intelligent, large waste of resources and so on. The overall framework consists

of three parts: the lower computer, the server and the Android platform, which is shown in the Fig. 1. By the multiple sensors, the lower computer collects the data of temperature, humidity, light, CO2, noise and dust particles, and then the datas are transmitted to the server on WIFI. The server part is mainly responsible for analyzing and storing the data by using a double buffer memory, which provides a data accessing interface for Android platform accessing these data. The Android platform, as the core in this design, is mainly divided into four modules: data transceiver module, data analysis module, background monitoring module, and foreground display module. The communication between four modules is realized by Android multi-threaded technology.

The working process of Android platform is as follows: Firstly, the foreground monitoring triggers user event, and then sends command to data transceiver module. Data transceiver module is responsible for communication with the interface of sever. Data returned by the server is committed to the data analysis module through data transceiver module. Then these data which have been analyzed by data analysis module, real-time display in foreground display module through thread intercommunications. Intelligent alarm is handled by background monitoring module. Similarly, data transceiver module is responsible for sending and receiving data, data analysis module is responsible for parsing data. If the analysis result doesn’t meet standard, the system will announce alarm signal and display signal through foreground module. Finally, hospital achieves mobile intelligent monitoring of the environment information.

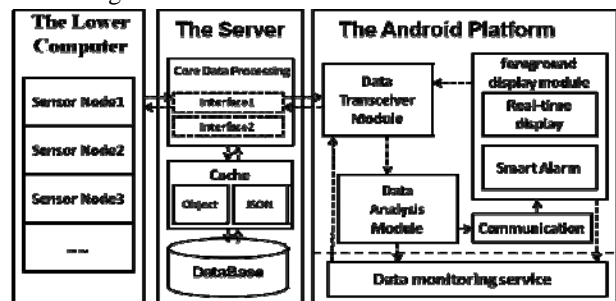


Figure 1. The General Framework

III. DATA TRANSMISSION AND ANALYSIS METHOD

The android application can be connected to the network via GPRS, WIFI and so on. GPRS is a mobile network service provided by the mobile operators. This business primarily use the SIM card on this network for sending and receiving signals between the signal receiving tower and your mobile phone. WIFI is a wireless network composed of the AP (Access Point) and wireless network card. The wireless network card is responsible for receiving the signals emitted by the AP client terminal devices, and the android applications manage and apply WIFI by obtaining access to WIFI. By either way, the communication with the server will be established when the client is connected to the network by using the HTTP protocol. This paper presents a communication protocol consists of two parts: the HTTP protocol in bottom layer and the self-defining communication protocol in the upper layer. The format of the upper layer communication protocol is realized by JSON which is a lightweight data interchange format and also easier to read and write [4]. The whole transfer process is as follows:

First, establish a connection at the terminal of the data transmission module in Android application. Create a HttpURLConnection object and send the parameters to the server via GET or POST method.

Second, the required environmental data will be assembled and sent to the Android terminal as JOSN format in the server.

Last, the data analysis module analysis the JSON data stream in the android terminal, and the Specific analytic process is shown in Figure 2.

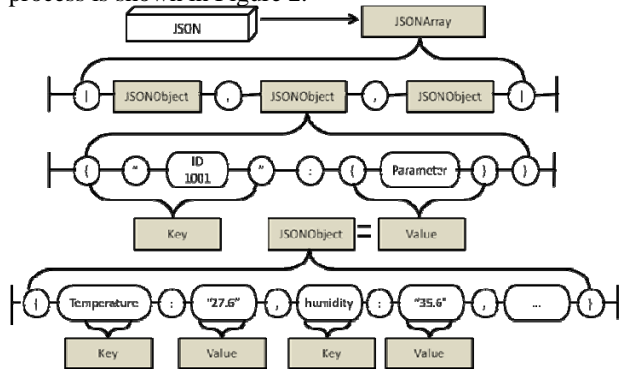


Figure 2. JSON Data Analytic Process

IV. DATA MONITORING SERVICE IN BACKGROUND

After Connecting with server, the environment monitoring method can be executed. In order to enhance the experience of user, we select background service from the monitoring methods; this design can guarantee the environment monitor when user begins some other operation. Specific method is shown in Fig. 3.

First, start the background service promptly when the user presses the service button, and meanwhile register broadcast receiver for monitoring the illegal environment information and then update UI. When the background

service is open, another broadcast will be registered for monitoring the end service event, and at the same time open a new thread to communicate with server. The server will send the environment information of the department regularly based on the authority of the user. After passing through the transceiver module and analysis module, the data will arrive at the alarm strategy module. The system will give a feedback of the alarm strategy to user by analysis the environment data through data fusion technology. During operating the system, some other user events will not influence the monitoring service when the background service in the open state. The service will not stop until the user trigger the stop service button. It is noteworthy that multithread must be needed when the background service designed. Besides it needs stop both the service thread and monitoring service in foreground Activity in order to obtain information form the server regularly.

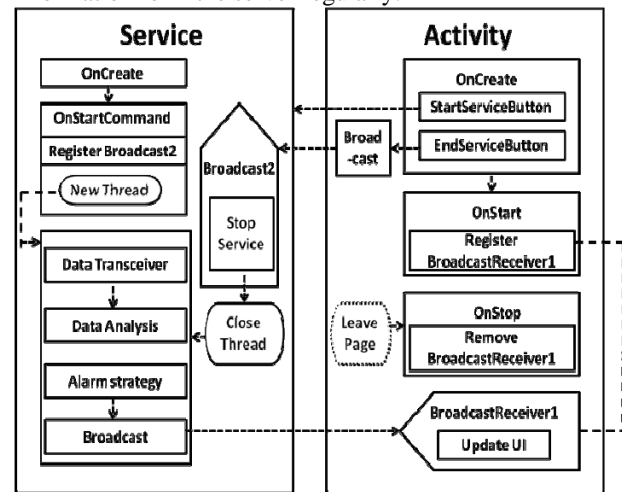


Figure 3. The Processes of Date Monitoring Service

V. INTELLIGENT ALARM METHOD

The environment intelligent alarm module is a key part of the method. Most of intelligent alarm method design is used currently in certain occasions in domestic, such as the fire scene alarm method which is mainly concentrated in the neural network algorithm and fuzzy system algorithm [5] [6]. The transitional environment thermal comfort evaluation model based on BP neural network proposed by Xu Hongbo etc.[7] and the Indoor environment comfort modeling and simulation method based on neural network proposed by Li Ting etc.[8] excellently solved the problem of the indoor Environment Monitoring. Research on environment intelligent alarm is also developing rapidly abroad. In 2009, University of Rostock, Germany studies on intelligent hospital and proposed the mobile real-time data acquisition technology in the field of preventive medicine. The method is to real-time monitoring through the physical parameters of people heart disease and their environment [9]. The University of Colorado in 2011 proposed a mobile personalized Indoor Environment Monitoring System, which has referential significance. CO2 as the environment

parameter is mobile monitored. The CO2 concentration and the number of times of air circulation are the significant basis to define Indoor air quality standards. Finally, four levels of standards are divided to launch Intelligent Alarm [10]. Analyzing domestic and international environmental alarm method, we find that prediction method based on BP neural network is the most prevalent. In this paper, on the basis of the Indoor Air Quality Standards and Hospital Infectious Diseases Indoor Air Health Quality Requirements, we propose hospital environment intelligent alarm method based on BP neural network method in wards. Wards Environment concrete parameters are presented in Table 1.

TABLE I. WARD ENVIRONMENT PARAMETER

Name	Parameter	Unit	Standard	Notes
Ward	Temperature	°C	21~24	
	Humidity	%	30~60	
	Light	lx	>=50	according to needs
	CO2	%	<=0.10	daily mean
	Dust (PM10)	mg/m3	<=0.15	daily mean
	Noise	dB(A)	<=55	
...

For the alarm module, first of all judge whether the value of the parameter is more than the threshold value, because the instantaneous value can not be used as the alarm of the full basis, local decision judgment is necessary. After meet the requirements, then enter into the decision inference module for intelligent alarm processing. For local decision process, uses the mutative threshold algorithm:

$$\text{LocalDecision}_j = f(x_j - k * \text{FM}_j)$$

Among them, the LocalDecision_j is parameter j local decision results; x_j is parameter j input value; FM_j is parameter j benchmark threshold; k is the environment compensation correction; $f(x)$ is the unit step function. According to different monitoring departments, in different time, each parameter value is different. When any parameters in the local decision result called LocalDecision_j appears 1, it means the environment parameters is abnormal, and the system will immediately enter into the alarm analysis module for alarm recognition. Alarm recognition decision uses the BP neural network algorithm, as shown in Figure 4.

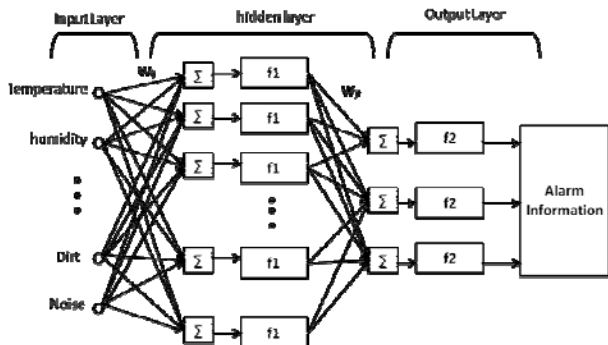


Figure 4. The Neural Network Model

Network input layer mainly includes temperature parameters, humidity parameter, light parameters, CO2

parameters, dust particles parameters and noise parameters, the parameters normalized operation is needed before the input. Hidden layer design principles is $n = \sqrt{q + i} + a$, the n represents hidden node number; q is for input node number; i is on behalf of the output node number; a is a constant between 1 to 10. By repeatedly collecting samples of the study, we find that the network convergence speeds is faster when the number of neurons in the network input layer is 10 and the output layer nodes are three. The output layer environmental information display as the following form: hot and humid (001), hot and dry (010), gloomy and cold (011), freezing and cold (100), noise (101), dusty (110).

The study of alarm method, according to the analysis of the research from Paris University Department of Psychology, is tied up with alarm sound. The volume, the tone and the rhythm should be various with the environment changing [11]. The system, which is mainly applied in the quiet hospital, is designed with a short alarm sound combining vibration and various rhythms. In the intelligent warning, the prompt is described as two short vibration and a gently alarm sound. However, in the intelligent alarm, the vibration becomes longer and the rhythm has an obvious change. It strengthens the level for the incident with long time hanging.

VI. RESULT

The development environment of this method is EclipseSDK3.5.2 and ADT11.0.0, test machine is selected Samsung s5830. Testing time that mobile phone connecting to the server is less than 5s through repeated test. Commanding response time between Remote server and mobile is less than 3s. Basically completed the mobile commonly access and control function. Figure 5 shows the function interface of this method, include the background monitoring service interface, the detailed department environmental information interface, the real-time environmental curve information interface.



Figure 5. Main Function Interface

VII. CONCLUSION

The intelligent hospital environment monitoring method based on the Android platform mainly adopts service, thread communication, JSON technology and so on. The data fusion method is mainly applied on the server for analysing the environment alarm information. The whole design method conforms to the national environmental monitoring

standard. While the dust particles sensor module exists some shortcomings due to the hardware design, for example the accuracy is not high, acquisition time is a little long, which will be improved in the future. Later work mainly focus on the analysis of the hospital environment. This intelligent hospital environment monitoring method provides an effective all-round, multi-angle solution for the hospital environmental monitoring in the future, which will make a great contribution for realizing the safe city.

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