

Research on Home Health Care Telemedicine Service System Concerned with the Improvement of Medical Resources Utilization Rate and Medical Conditions

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Abstract—There are a lot of people who need health care at home but can't or needn't go to hospital. This paper introduces a solution of home health care telemedicine service system that is composed of remote client system and service center system. The remote client system gathers the vital signs information and transfers it to the service center through 3G/CDMA communication network or Internet. The multi-parameter monitor & transponder can process the signal real-time and send message to the family, guardian when necessary, and it can work independently without the connection with service center. The service center stores and analyzes the data, and medical analysis report will be published in web platform. The system can provide one to one medical expert service, first-aid support service and assistance of personal electronic health documents creation. The system can also be expanded and applied in rural area to improve the medical service situation.

Keywords—Home health care, telemedicine, medical service

I. INTRODUCTION

There are a lot of people who need health care at home. The children are busy on business and lacking of time to care about the elder people, however, they want to know the health status of the elder people at any time. China has become aged society [1]. The ratio of the age above 60 is 11% by the end of 2005 which is 8.1% in 1990, and by the end of 2008, it is 21.61% in Shanghai city. The ratio of the elder to youth is 30.39% in 2000, this number is estimated to be 25%~32% by the time of middle of 21st century. It is very urgent to solve the problem of elder people's home care.

Some people need monitoring but it is not necessary to go to hospital, but generally there is no medical measurement at home and some of the measurement must be conducted under the doctor's or nurse's support. People want more methods to take home health care outside hospital. They want to check the status of health with the help of some system before going to hospital when necessary because the medical resources are very limited in China and sometimes

people need not go to hospital when they feel not well, which means here is that if it does not get worse and recover by physical exercise and self care, the limited medical resources should be used by those who really need it. If people get serious disease, he should go to hospital immediately.

Most of medical resources are centred in city. More people live in rural area, and they have to pay for not only the medical fee but also the cost of trip and accommodation, and the total cost will exceed that they can afford. The development of medical condition is unbalanced in China because different regions have different levels of economic development. The medical environment condition in rural area is not as good as in city, and people can not be treated as same as those in big city. If the home healthcare system or similar system can be established in rural area, the information collected can be transmitted to the medical experts in city, the medical experts can give the advice whether the people should go to hospital and what should be paid more attention to in daily life. Therefore, the people's medical cost can be reduced and medical treatment can be improved. The limited social medical resources can be used more efficiently.

With the development of telemedicine and other technology, it is feasible and needed to setup home health care telemedicine service system that provides the medical service for these people.[2]-[6]

The telemedicine service system should not only connect the people with the doctor, but it also creates the communication channel between people and medical experts. And let more people share the limited medical expert resource. People can obtain the medical expert support outside hospital. And the system can expand the hospital service and improve the medical resource utilization efficiency.

This paper introduces a solution of home health care telemedicine service system, which can provide medical service to the people who need health care at home but can't or needn't go to hospital. The research on telemedicine technology has a lot of achievements [7],[8], and in the country such as China, USA, etc. infrastructure of 3G/CDMA

communication network or Internet can provide the necessary data transfer support. It is possible to implement the social medical service system. With the development of the infrastructure creation and telemedicine technology, the system can be expanded to applied in rural area and improve the medical situation there.

II. SYSTEM FRAMEWORK

Figure 1 shows the system components and network structure. The network is composed of two sections, remote client system and service center system.

A. Remote Client System

The remote client system is composed of sensors, multi-parameter monitor & transponder and local pc. It provides the solution for vital signs data acquisition and process.

The patient perhaps does some outside activities every day. The multi-parameter monitor & transponder should be portable. Its size should be small and it can be carried easily.

The sensors gather the physical signals of care object. The physical signals include blood pressure, pulse, temperature, respiration, SaO₂, etc. The sensors should be applicable, feasible and manoeuvrable that is fit for medical measurement in home health care. Considering the care object perhaps moves to do daily activities, for example, the people cared perhaps does some house work, goes shopping everyday, the sensors should also be carry-home.

The sensors collect and transfer the physical signals to multi-parameter monitor & transponder. The multi-parameter monitor & transponder analyses the signal and obtains the vital signs. The vital signs are stored in the memory of the multi-parameter monitor & transponder. The memory media used in multi-parameter monitor & transponder should meet the requirement of at least 3 days – one week data storage.

The multi-parameter monitor & transponder can connect with personal computer by USB and transfer the vital signs information to the computer, the vital signs data is stored in

database in computer. The user should backup the information from the multi-parameter monitor & transponder every several days to avoid the memory overflow. The vital signs information stored in database will become the personal health documents database after a long time measurement.

The multi-parameter monitor & transponder has a buzzer installed. And when the vital signs value exceeds the permitted scope, the buzzer alarms the patient to be careful and the patient can check the reason caused the alarm and take right action. The multi-parameter monitor & transponder can send the short message to the family and guardian same time to avoid that the dangerous thing happens.

There is application software installed in the computer. It can display the monitoring result and analyse the signs in more detail. The user can check the data contrast with the reference value. It also can provide the vital signs information management function and help the patient to establish the personal electronic health documents.

The application software installed in the computer makes the system flexible. If the user doesn't want to order service from service center, the remote client system can work independently. With the application software, the remote client system can work separately without cooperation with the service center system. The application software can provide the general view functions that the user can used to check the vital signs information.

The application software can upload the vital signs to the service center database through Internet. The service center can provide the health status analysis report and health suggestion based on the information. The patient can take more scientific and reasonable activities in his daily life.

When the patient does outside activities, the multi-parameter monitor & transponder can transfer the data through 3G or CDMA communication network real-time. The service center can communicate with the multi-parameter monitor & transponder to control it when necessary.

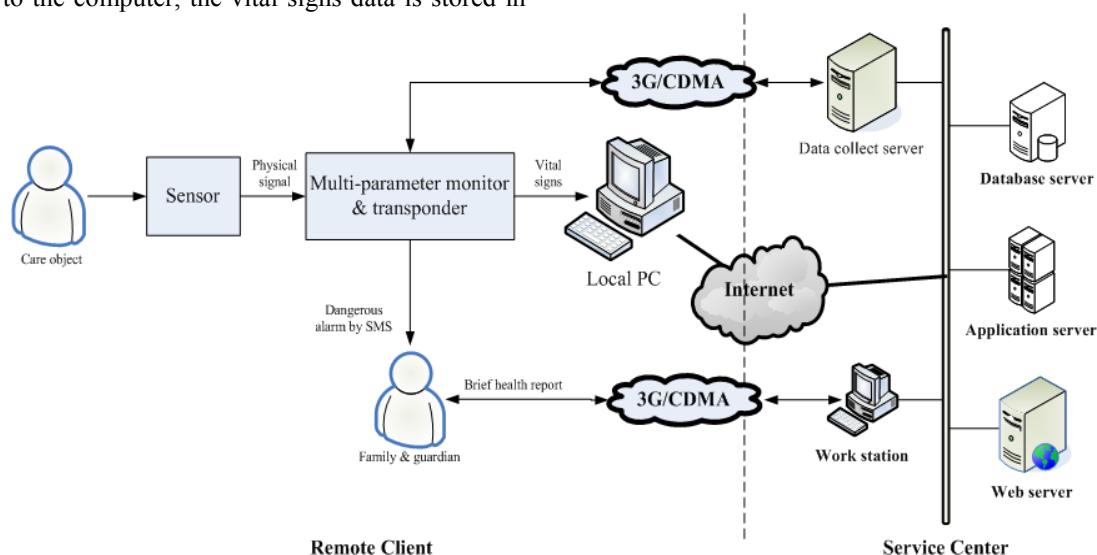


Figure 1. System Structure

The multi-parameter monitor & transponder has a GPS module installed and can provide the position information. The family and guardian can locate the patient when necessary.

The multi-parameter monitor & transponder work flow is shown in Figure 2. The original signal data and process results are stored in memory. All the information will be transferred to service center or backup to home PC. Service center sends control information to the multi-parameter monitor & transponder according to the information uploaded by it or some necessary reasons else. The work flow of the real line part can work independently without the dash line part.

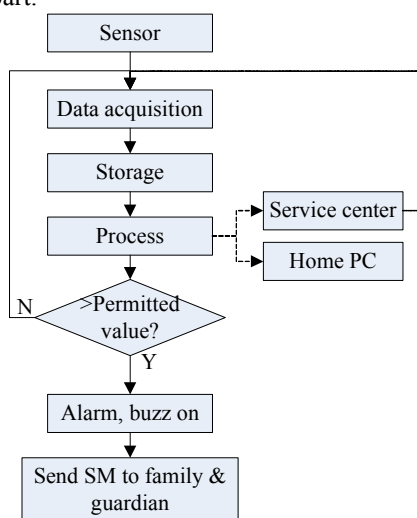


Figure 2. Multi-parameter monitor & transponder work flow

B. Service Center System

The service center system is composed of data collect server, database, application server, web server and workstation. It provides the solution for data collection, health status analysis and web service.

The data collect server receives the data uploaded from remote client system by Internet or 3G/CDMA communication network, and the data stored in the database server. If the data is uploaded through 3G/CDMA communication network directly, the data collect server must connect with the necessary peripheral equipment. However, the volume of the information is limited when transferred through communication network directly, and the system takes this manner to transfer control and alarm information by SMS concerned about the time limited. The system transfers a great deal of information by WAP. In this case, the information receiver is connected with the data collect server.

The vital signs analysis application is installed in application server and processes large amounts of data to generate the health status report with the support by medical experts.

The vital signs of the patient and health status report are published in the web server. The patient, family and guardian who has bought the service and obtained the user account

can login in the system, and browse the vital signs and health status report. This is very helpful to the family who don't live with the patient together.

The service center system can send the necessary information to the patient, family and guardian through a special workstation. The information includes vital signs exceeding permitted value alarm, the health status report, the position of the patient, etc. The system can also provide brief health status information to the family and guardian by SMS.

Work flow of the whole service system is shown in Figure 3. The system can meet the need of real-time communication and information analysis afterwards. The original vital signs information is the most important to the service system. The information exchanged between local data storage and service center data storage is mainly original vital signal data. All the vital signs and medical expert analysis report are submitted to the web service platform, the family and guardian can logon the platform to view the information when they are informed by SMS.

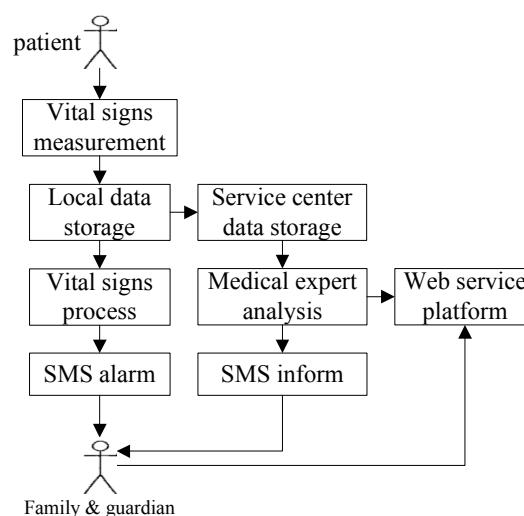


Figure 3. System work flow

Vital signs data acquisition is the foundation of the system, but the integration of vital signs information of patient and medical analysis is one of the important keys of the whole system. The system integrates the patients with medical experts by the support of information technology, and expands the real-time medical service out of hospital.

III. SERVICE PROVIDED BY THE SYSTEM

The home health care telemedicine service system is an open system that can provide the health care and medical service to patient and other people that requires the similar service, such as elder people, etc. The user can order the customized service from the system.

A. Personal Electronic Health Documents

The personal electronic health documents are very important to the patient. It can record the detail information of personal health status and the vital signs variety in a long time.

Generally, the case history of a patient is stored in the hospital where he has visited. One patient perhaps has several

case history documents in different hospitals. And the doctor can only view the case history documents stored in the hospital where he works, and can't consult the case history documents stored in other hospitals.

The personal electronic health documents can provide a lot of reference information when he goes to see doctor. The doctor can make a diagnosis based on the personal health documents and improve the veracity.

Usually, one patient perhaps goes to several hospitals to see doctor. When the patient goes to see doctor in different hospitals with the personal health documents, the doctors can view the health status in a long time to make a right diagnosis.

The personal health documents can also provide suggestion to the patient what habits and customs he should care about, and how to adjust the physical exercise.

B. Abnormity Alarm to Family and Guardian

The system establishes the real-time communication among patient, family, guardian and service center. The multi-parameter monitor & transponder monitors the vital signs of the patient and when the value exceeds the permitted scope, it can buzz on and inform the patient something happened and the abnormity alarm will be sent by SMS to family, guardian and service center at the same time.

The multi-parameter monitor & transponder has auto-check module installed and when it doesn't work properly, the message also can be sent to service center, and the service center will inform the family and guardian.

The family and guardian can decide whether they need the abnormity alarm service provided by the service center. The alarm information provided by the multi-parameter monitor & transponder is free that only needs to pay the fee of the short message service.

C. Brief Health Status Report by SMS

The service center can provide brief health status report that includes only general vital signs value and the range, such as temperature, pulse, etc. because the number of characters of the short message is limited.

This is very helpful when the family who don't live with the patient or the elder together. Even when they are on business trip, they still can obtain the health status of whom they care about.

The user can set several mobile phone numbers and the brief health status report can be sent to these people by SMS.

D. One to One Expert Service

The service center will invite some medical experts who can examine the vital signs data at intervals of fixed time. The experts will analyse the health status information and give suggestion to the patient. From the report, the patient, family and guardian will understand what aspect should be strengthened, what should be avoided, etc.

This type of service can provide long-term one to one expert service that can't be obtained in hospital considering the cost. This service gives the chance to the most people who need the expert suggestion but can't afford the fee.

E. First-aid Support Service

Usually, people worry about the patient that once the patient has some life-threatening happens. The first aid should be available immediately. Accordingly, the first-aid center should know who needs help just in time, and where he is.

Based on the GPS module installed in the multi-parameter monitor & transponder, the system can give the current position of the patient. This is very helpful when the emergent medical event happened. The system can inform the family, guardian where the patient is now.

In order to provide the first-aid service, the system should cooperate with first-aid centers. Usually, there are several first-aid centers in a city. Once the vital signs exceed the permitted value, the monitor will send the information along with the position of the patient to the service center right away. The service center accepts the information and finds out which first-aid center is the nearest to the patient, and sends the emergent message at the same time. The first-aid center will send the doctors and ambulance to the position according to the information provided by service center. It can save more precious salvage time.

IV. THE HEALTHCARE STATION IN RURAL AREA

The service system mentioned above mainly focuses on the people who live in the city. But there is a huge of people who live in rural area who can't access the expert medical service easily.

And if the manufacturing cost of the multi-parameter monitor & transponder can decrease enough, it can be applied in the economically underdeveloped areas and let the people there share the experts service as the people in city of developed areas.

The functions of the multi-parameter monitor & transponder can be different according to the medical examine requirement. And a serial of multi-parameter monitor & transponder can be developed to meet the different kinds of requirement. The manufacturing cost of the multi-parameter monitor & transponder can be decreased.

In order to provide the medical service to the people who live in rural area, the medical service station can be established where the people can measure the vital signs and provide the necessary information to do medical examination, shown as in figure 4. For example, people can go to the station every day and measure the vital signs for about one or several hours and gather enough information for medical examination. The vital signs data can be transferred to the service center and analysed. Thus these people can also obtain the medical expert support.

The service must be carried out based on some foundational condition, such as internet access, 3G/CDMA communication network access, etc.

If the service expands to the country wide area, it needs fund support. The necessary fund can be obtained from government and enterprises. The government can provide the fund to establish the medical service station in rural area. The enterprises that provide 3G/CDMA communication network service can reduce the cost of information transfer to a level that can be afforded by most of people in a long-term period.

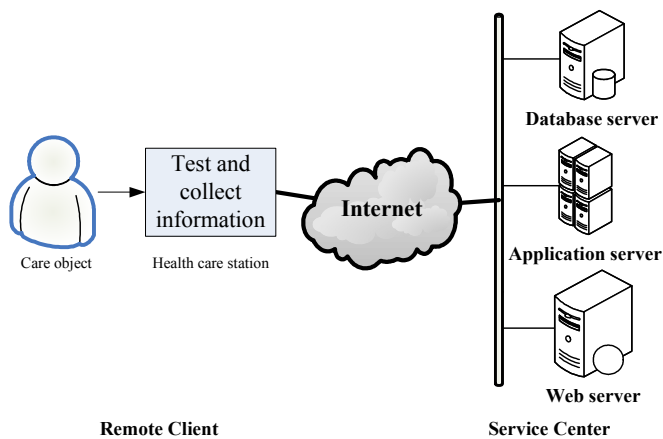


Figure 4. Healthcare system in rural area

If the service expands to the country wide area, the service network should be redesigned based on the framework introduced in this paper, because the load of the platform, volume of information will be larger than applied in a city area.

V. CONCLUSIONS

Social people oriented telemedicine service system is introduced in this paper. The system integrates the patients and medical experts together, and provides the medical service in more large scope, especially to the people who can't or needn't go to hospital. The system can also be expanded and applied in rural area to improve the medical service situation.

The system can monitor the vital signs of people real-time. The data can be stored in the memory of the multi-parameter monitor & transponder, and the data can be transferred to the service center through 3G/CDMA communication network real-time. In case that 3G/CDMA communication network can't be accessed, the multi-parameter monitor & transponder can connect with home pc offline and backup data, and the data can be uploaded to the service center database through Internet. And the data stored in the home pc will establish the personal health documents.

The multi-parameter monitor & transponder can process the signal real-time. When the vital signs exceed the permitted range, it can send message to family, guardian and service center by SMS. And it can work independently without the support of service center. It is very convenient for the people who wants to know the health status and doesn't need medical expert support.

The service center system can provide one to one medical expert service. It provides the chance that a small quantity of medical expert resource can be shared by more people. The medical expert analyzes the vital signs information at intervals of fixed time, and gives advice to the monitored people. When the report is ready, the system can inform the user by SMS.

The vital signs information and medical analysis report can be published in website. The user can logon the service platform to view the result. It is very convenient for the people who don't live with the monitored person together even thousand miles away.

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