Abstract—In combination with 3G technology, multimedia technology, database technology, telecommunication technology, etc, as well as the knowledge about medical diagnostics and emergency treatment, this paper presents a mobile telemedicine system for self-rescue in medical emergency. This system can connect the doctors and patients who are physically separated, and thus help the patients realize self-rescue through the two-way audio/video communications. It provides a referential solution to the medical emergency in outdoor accidents and some Paroxysmal diseases.

Index Terms—telemedicine, medical self-rescue, outdoor accidents, 3G mobile communications

I. INTRODUCTION

With the development of economy, the population becomes more fluid, and in the meanwhile there is also increasing requirement for medical service at anytime and anywhere, especially in mobile environment.

When an outdoor accident or Paroxysmal disease happens, the earliest and most effective rescue is offered not by the medical staffs, but by people themselves. At that moment, if the first-aid instructions can be provided by medical experts, the casualties are expected to be minimized. This led to the development of telemedicine which applied telecommunication technology, computer multimedia technology and other information technology to transmit medical information for diagnosis, monitoring, treatment and education. The medical information usually includes medical images, real-time audio/video, patient records, data outputted by medical equipments, etc.

In 1967, Massachusetts General Hospital (U.S.) first established a telemedicine system. In 1986, Mayo Clinic created the earliest commercialized telemedicine system. In 1991, the Telemedicine Centre of Medical College of Georgia are founded, all rural hospitals and clinics within the state could get access to this centre and got special medical aid from it. In the late 1990s, the forms of telemedicine and mobile medicine diversified, such as mobile home monitoring, mobile electronic records, mobile rescue, etc. The U.S. and Europe were advanced in this field. In their countries, huge investment was laid out on the main direction of tele-consultation and tele-treatment. HIS (Hospital Information System) and EPR (Electronic Patient Record) technology had already been almost perfect in those regions. At the same time, Japan had already constructed large-scale mobile medicine facilities, which covered a great proportion of its land. European Union committed to the establishment of laboratories, and had carried out several large scale experiments on telemedicine. Australia, South Africa, U.K., Singapore and other countries also made great effort in mobile medicine field.

The development of telemedicine and mobile medicine was relative backward in China. We had not set foot in this field until late 1990s. In 1997, China’s Golden Health Care Network formally put in to operation to support the health and related ministries. In 2003, the experts group of the Chinese PLA 253 Hospital first used tele-consultation for military expert consultation. With the development of mobile communication, various studies on GPRS-based mobile medicine took place, which are mainly for community mobile medicine and monitoring. These schemes were on the basis of 2.5G. This concept of mobile telemedicine for emergent self-rescue origins from nowadays rapid development of 3G mobile communication technology, networking technology, and multimedia technology, in combination with the previous telemedicine technology. Through effective integration of these technologies, we hope to establish a complete scheme of mobile telemedicine system that can be accessed via 3G network, to help people realize self-rescue while they are far away from the traditional medical service.

This paper proposes a concept of mobile self-rescue for medical emergent. Emergent self-rescue is in demand when accidental injury or Paroxysmal disease occurs. Accidental injury means physical damage or hurt caused by different kinds of sudden incidents or accidents, including physical, chemical and biological factors. If the public can get helpful first-aid when accidents happen, the casualties can be minimized. Essentially, the mobile telemedicine service for emergent self-rescue belongs to the category of mobile medicine. Telemedicine is an applied subject, using various technologies to transmit...
medical information for diagnosis, monitoring, treatment and education. The medical information includes medical images, real-time audio/video, patient records, data outputted by medical equipments, etc.

II. SYSTEM DESIGN

A. System structure

This mobile telemedicine system for medical self-rescue is an open distributed system. It is composed of six parts: 3G client (user client/call-response client), Call-response Subsystem, E-expert Subsystem, Geographic Information Subsystem, Database Subsystem, and the Response System in medical institutions, as shown in Figure 1.

These systems are organically combined to fulfill the self-rescue process, which includes rescue initiation, response, solution selection, deployment, GIS positioning, etc.

![Figure 1. Mobile telemedicine system for medical self-rescue](image)

B. Subsystems

Besides 3G clients, which can be realized through secondary development to the module of 3G phone, there are mainly four subsystems in this mobile telemedicine system.

1. Call-response Subsystem. Call-response System is the entrance to the whole system through 3G client. It delivers the required information from E-expert Subsystem or real experts directly to users through computer automatic answer equipments or by the operators, providing salvation instruction and the related information. It plays the role of “information provider” in the whole system, and enables the service demanders to obtain useful information conveniently and quickly. It is a crucial system which connects various subsystems and provides interactive services for users through all kinds of modern communications.

The flow chart of call-response system is shown in Figure 2.

2. E-Experts Subsystem. Medical problems are usually complex, and it is not unusual to be trapped in the dilemma while information is uncertain. E-expert system can utilize the relative experience and rules in obtaining reasonable judgments, providing suitable solutions, and making effective forecast. With the 3G mobile communication, expert system can deal with the problems more effectively and quickly.

3. Database Subsystem. The database subsystem provides data support to various subsystems. It provides the seats and online experts’ information to call-response system, which makes it possible for the call center to connect to right information source quickly. And it combines with the E-expert subsystem to offer comprehensive data to support the expert network. GIS system is also connected.

4. GIS subsystem. GIS is mainly used to identify the geographic information from the caller end.

![Figure 2. Flow chart of the call-response system](image)

III. CORE TECHNIQUES

The design and implementation of this system require the coordination of various kinds of technologies. Here we briefly introduce some core techniques.

A. 3G’s interflow with fixed network

3G’s interflow with the fixed network is definitely in huge demand as the popularization of handheld terminals and high speed bandwidth. 3G standards set 3G-324M as
the protocol standard for communication systems and terminal devices; MPEG-4 is recommended to be the video protocol standard. While in fixed network, most video business is on the basis of H.323 in packet network and SIP. Protocol H.323 is the Internet and LAN communication standard, made by ITU-T. SIP is the multimedia circular order protocol standard, set by IETF. The interflow process is as follows: 3G end initiates the requirement for connection, and build conversation links with 3G gateway (VIG) through 3G-324M protocol; then VIG build conversation links with IP network via H.323 protocol, or with soft-exchange network via SIP. The transformation of protocols is done in VIG, which perfectly overcomes the bottleneck in implementing the interflow between 3G and fixed network.

B. Streaming Media Technology

In wireless environment, because the influence of multi-path attenuation, noise and other factors, the channel error rate is usually high and the error rate changes with the external environment. Therefore, the video/audio data flow should be compression coding in 3G network transmission process, to ensure data quality and display speed during decoding. The transmission form of video/audio frequency in 3G network is streaming media. It decomposes the source into small packages, use cache technology to weaken the effect of delay and vibration, and ensure the order of these packages.

C. Computer Telecommunication Integration

CTI supports a wide range of operating systems such as WINDOWS/LINUX. It is featured with high reliability, large connect capacity (of single point) and great expandability. CTI products are established on the distributed architecture, and are composed of modules. CTI middle-ware offers a standard platform, supporting ordinary calls, IP calls, Email calls, SMS calls, Web calls and other calling channels. CTI middle-ware is applied to both switch mode call centers (such as Avaya, Alcatel, Nortel, Siemens), and card mode call centers. The whole calling process is continuously managed and monitored.

IV. APPLIED EXAMPLE

The 3G-based mobile medicine system for emergent self-rescue can be applied widely. Here an example of sports injury is provided, and by comparison with the traditional 120 first-aid, the new emergency treatment measure has its unique advantages.

Sports injuries are injuries that occur to athletes participating in sports events. Bruise, muscle strain, ligament sprain, dislocation and facture are common sports injuries. In recent years, with the popularization of sports, the incidence of sports injury increases. The harm of sports injury is nonnegligible. Inappropriate or late treatment will cause great pains to the injurer; what’s more, sports injury may deteriorate into permanent or chronic diseases. Therefore, effective and timely treatment to sports injury is very necessary.

A. 120 first-aid system

Traditionally, when sports injury occurs, people first resort to 120 first-aid. However, with the development of modern economy and the rapid progress of urbanization, the increasing density of buildings and traffic make it difficult to carry out timely and effective medical treatment at the accident scene. This is mainly due to inaccurate or late report, traffic block, or inappropriate treatment by medical staffs. Besides, 120 first-aid system itself has many shortages, such as outdated equipments, slow response, lack of geographic positioning abilities and so on. The traditional 120 first-aid process is described in Figure 3.

B. 3G-based mobile medicine system

3G-based mobile medicine system for emergent self-rescue is greatly different from the traditional 120 first-aid system. It is a comprehensive system composed of 3G communication, video/audio, GIS, call center system and the like, and takes the advantages of 3G technology to guide and supervise the client end.

By using this mobile medicine system, the medical staffs and experts can make quick and accurate situation assessment, for they can not only hear from the injurer, but also see what happens and the surrounding environment. This system also helps to give effective on-site guidance for emergent treatment, thus creates a green life channel for the patients.

The mobile medicine first-aid process is presented in Figure 4. As it shows, all steps are bidirectional, which means continuous communication between the patients and the medical service provider.
Figure 4. The workflow of 3G-based mobile medicine system for emergent self-rescue

The advantages of 3G-based mobile medicine system for emergent self-rescue are: (1) it can check the on-site situation effectively by 3G audio/video methods, and make the most direct diagnosis about the injurer’s situation; (2) the switches between operator seats and professional (expert) seats can help offer a more authoritative guidance and advice; (3) it can make optimal path analysis within certain geographic range around the caller’s exact position; (4) rescue decisions are more scientific and reliable by real time positioning and navigation, along with affluent information from both online experts and E-experts.

V. CONCLUSION

3G, as the new generation of data communication technology, is and will be applied in various fields, such as communication, medicine, manufacture, living and so on. This paper analyzes and designs a 3G-based mobile medicine system for emergent self-rescue. Also, an applied example is provided, and compared with traditional 120 first-aid method. The theoretical and practical significance of this paper are:

Research on 3G and related technologies in detail, and make perfect combination of these technologies to set up a new 3G system; crucial and difficult techniques are considered, such as streaming media, 3G compatibility problems and E-expert system.

Design a 3G-based mobile medicine system on the basis of 3G communication technology, streaming media technology, neural networking technology, database technology, as well as GIS and CTI.

Explore a new and meaningful application field of 3G technology and mobile medicine. Through this 3G-based mobile medicine system, traditional emergent treatment barriers are smoothed, the bidirectional video/audio communication supported by abundant and accurate information database makes the emergent self-rescue not only possible, but also timely and effective.

Introduce E-expert system to the self-rescue system. The traditional simple “person-person” self-rescue mode is extended by “person-machine” mode, which greatly increases the efficiency and the accuracy. What’s more, the BP neural networking enables E-expert system with the ability of self-learning, thus continuously enhances the diagnosis level.

The 3G-based mobile medicine system for emergent self-rescue is a comprehensive application of various technologies in medical self-rescue field. It is an interdisciplinary research area, and related researches are both at in and abroad. This paper is an active exploration and a beneficial attempt to the field. With the popularity of 3G terminals, mobile medicine systems have great market potentials. Still, there are issues calling for in depth study and consideration, such as the information safety problem, the profit model, technology standards uniformity, etc.

ACKNOWLEDGMENT

This research is supported by Shanghai Leading Academic Discipline Project (No.B210).

REFERENCES


