An Android-Based Emergency Alarm and Healthcare Management System

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***Abstract*—this paper presents an emergency alarm and healthcare management system, which is mainly deployed in an android-based phone that is conveniently used and carried. So our system is suitable for most of the people. With the help of the GPS and GSM network, the system can make sure the location of the users when they are in trouble and trigger the alarm. When the doctor or family receives the alarm message, they can immediately take measures to rescue the user. It can also manage the health record of the user. The user can take online medical to send their physical condition and then get prescription from doctor who will send the prescription on the user's phone . After that the life reminder system can remind the user to take medical on time and so on.**

Keywords- healthcare; emergency alarm; life reminder; healtcare management; Android

I. INTRODUCTION

Now with the growing social pressure and the life more and more quick steps, most people are facing with health problems, especially a lot of high-level personnel who are in sub-health. And modern social accidents occur frequently. It is more important to design a health security system for people. As mobile phones play more and more important role for people, it is the best choice that the system will be deployed on mobile phones.

Normally, a healthcare emergency alarm system is deployed on an independent device, wired or wirelessly linked to a gateway, and then connected to the hospital or emergency center, such as [6] and [8].But the disadvantage of such systems is obvious: once getting out of the coverage of the gateway, the system won't work anymore.

A healthcare management system has two main functions. The one is life reminder system. The other is On-Line medical. However the life reminder function is useful and helpful for the senior people and chronic patients to give a friendly reminder for medicine and so on, such as [9]. But most of the healthcare management system is separated from the emergency alarm system, which means the users have to keep two systems at the same time. Apparently it is not convenient at all. According to these disadvantages, deploying the systems on cell phone is undoubtedly a better choice.

As a carrier of emergency alarm and healthcare management system, there are some advantages for cell phone. First, the cell phone is convenient to carry. People always carry a cell phone with them, so they can trigger an alarm or get the prescription from the HIS at everywhere and everytime. Second, open operating systems on cell phones, such as iOS, Android and Symbian have many applications and easy to extend by developing application. Third, by the cell phone, user can make a phone call to their friends and family, and with the help of GPS chip, their location can be acquired. Finally, the phone can make fall detect by gravity sensor. For example, if an old man accidentally falls down, the phone can automatically trigger an alarm.

In this paper, we choose GPhone (Google Phone) [10] as our platform. The GPhone is a smart phone just like iPhone, but based on Android [10]. Android is a mobile operating system initially developed by Google. Compared with iOS, Android is an open source system, so we can modify it to fulfill the specific needs by changing or rewriting the source code.

Our system has two main functions: emergency alarm and healthcare management. Emergency alarmsystem can be triggered manually or automatically when the unexpected event happens, for instance, the myocardial infarction. The alarm action will send emergency messages and calls to the user's family and the doctors. And the emergency message can include the location information, in order for the rescue stuff to locate the user. The whole methodology is shown in Figure I.

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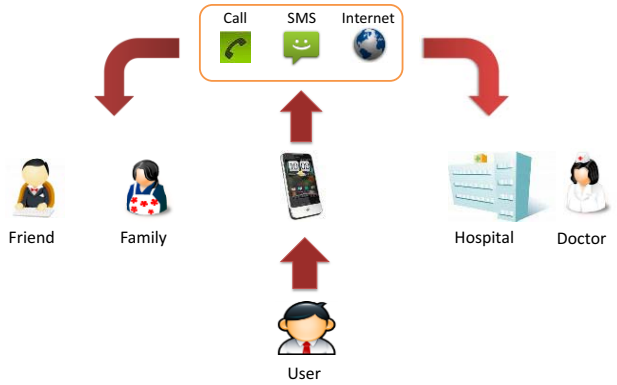

Figure I: The emergency system

The life reminder function that is one of healthcare management's functions can help user to remind when to have medicine and some other things which we often call as doctor prescriptions. It is fairly useful for the chronic patients. Furthermore, by linking to the Hospital Information System (HIS), doctors can push directly the prescription to the reminder system for each individual patient via specific interfaces.

Now mobile phones support Internet access, so when the user is not feeling well, he can log in the system, their status will be sent to the server. The server receives the user's information and reminds the on-line doctor that the on-line user needs treatment. According to the user's conditions, doctor sends the prescription to the user's phone in order to protect the user timely to get treatment. After the prescription is sent to the user's mobile phone, the life reminder alerts the user to take medicine on the time and so on. The work flow is shown as Figure II:

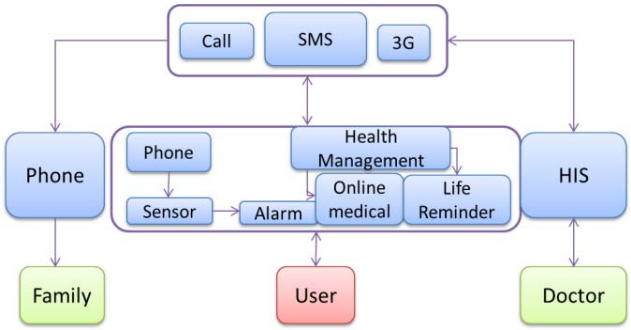

Figure II: The work flow

The rest of the paper is organized as follows. Section II introduces the general design and system architecture. Section III gives the detailed design and implementation of the system. Finally, Section IV and V present the user study and the conclusion respectively.

II. SYSTEM ARCHITECTURE

This system consists of two parts: the client and the server.

The client is deployed on an android-based cell phone. There are two parts: The Emergency Alarm and The Healthcare Management System. Both the two are Android applications.

The server is deployed on a computer, which may be located in a hospital, and be operated by a doctor. It also contains two subsystems: The Emergency alarm and The Healthcare Management System. The Healthcare Management System contains the receive user medical information module and the push prescription module. The architecture is shown in Figure III.

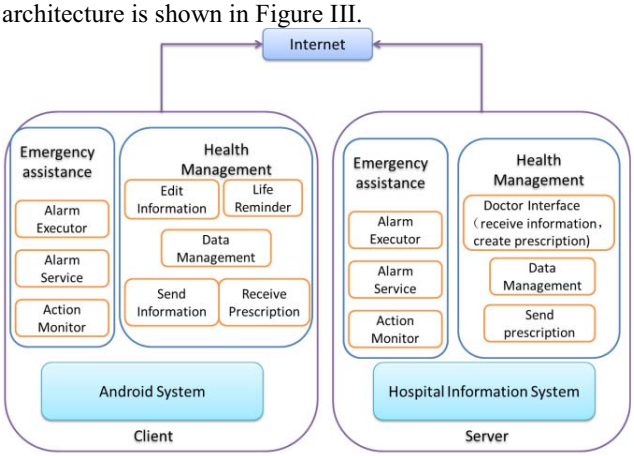

Figure III: System Architecture

As shown in Figure III, the client side consists of two parts, The Emergency Alarm and The Healthcare Management System, both of which are based on Android 2.2 system and designed for mobile devices.

For the first part, the Emergency Alarm system is employed for user to make an emergency alarm at some emergent occasions. It has three functional components. These components work together to detect user action and make the decision of whether to start an alarm. After that, if it decides to send an alarm, the Alarm Executor will perform the alarm actions.

For the second part of client, the healthcare management system can be an active reminder application to remind user to have medicines and can also be a doctor for the user. By linking to the HIS, the prescription can be sent by the doctor at the server side.

Similarly with the client, the server has two parts. For the first one, the Emergency Alarm System is the interface between the doctor and the patient. When the Alarm Receiver receives the alarm message, it sends out the message to the Alarm Executor to perform the alarm action, for example, playing an alarm sound to inform doctors that someone has triggered the alarm. And the second part of server is the healthcare management system, allowing doctor create a prescription and push it to the client side for automatically reminding the user to take medicines or other actions as prescriptions say and see a doctor conveniently by mobile phone.

III. IMPLEMENTATION

In this section, the detailed design and implementation of the system are presented.

A. *Client part I: Emergency Alarm*

This part of system gives the user a convenient way to send an alarm to their family and doctors. It is an android application, and consists of three modules. First, the Action Monitor is designed to detect the user action on the phone. However, due to the original design metric of the Android system, no application can receive the key-tapping messages when the screen turned off, which will cause the alarm not triggered by key-tapping while the screen off. So we have to modify the Window Manager Service in order to catch the key-tapping message and let the system know (In Android, it calls *broadcasting*). Once detecting the appropriate pattern of operations, an alarm is supposed to be triggered. Then a global broadcast is pending. The real implemented service interface is shown in Figure IV.

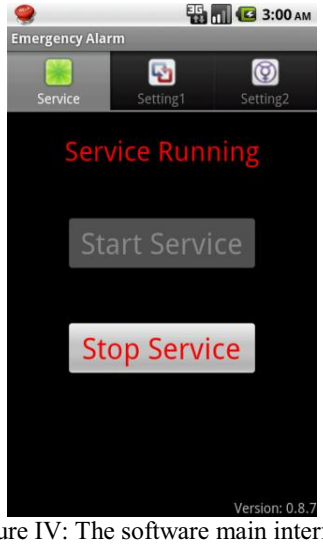

Figure IV: The software main interface

As shown in Figure IV, the Emergency Alarm works as an Android Service which is an application component and runs in the background to perform a longer-running operation. This service is designed for monitoring the user's action, in order to judge whether the user is aim to trigger an alarm. User can manually choose whether to run it or not.

The second one is a monitor module. Once receiving the broadcast of the first module, it respects that the user has triggered the alarm. Then it will activate some necessary service such as location service, to get the location of the user at this moment and so on.

Figure V shows a system setting interface which is employed to modify some critical system attributes, such as Startup delay and so on.

Figure V: The system setting interface

The third part is the Alarm Executor. It will perform the actual work of alarming when the user starts it, for example, making a phone call to family and doctors, sending a message to the server in the hospital, and so on. Who will receive the alarm messages and calls is manually predefined by users, as shown in Figure VI.

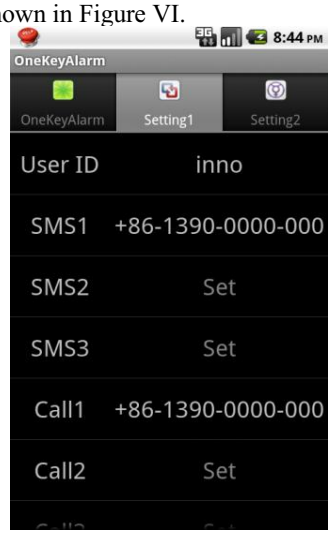

Figure VI: The system setting interface

B. *Client part II: Healthcare Management System*

a) Life Reminder: This part of system seems like a calendar, which is designed for medical information reminder. Through the interface between the client and the HIS on the server, doctor can push prescription to user's phone. Then the life reminder will remind user to take medicine at right time.

A prescription is a Java class, defined for a certain prescription created by a doctor. It is defined as follows (write in Java):

```
public class Prescription {
    String med_name;
    String med_disc;
    String doctor;
    date [] when;
    int [] count;
    String comment;
    int vali_days;
}
```

After received the Prescription objects, the reminder parses the data first, and then writes them into local database. When the set time arrives, it will automatically remind user to take medicine.

b) On-Line medical: This part of system seems like Query Online, which is designed for the user to see a doctor conveniently and quickly. After the user sends his information to the server, the doctor will receive the information and create prescription to push the user's phone.

The information is a Java class, created by the user. It is defined as follows (write in Java):

```
public class Information {
    String user_name;
    String send_time;
    String doctor_name;
    String type;
    String comment;
}
```

After received the information from the user, the doctor creates prescription and send to the user, like as the life reminder system.

C. Server part I: Emergency Alarm

This system is designed for the hospital to receive the alarm message sent by user. Once received the alarm message, this system will play alarm sound and display the information of the user.

The content of alarm message is defined to a string, in formation of JSON [3], shown as follows:

```
{
    "Message":"Alarm",
    "User":"username",
    "LocationSource":"GPS",
    "Longitude":"longitudeValue",
    "Latitude":"latitudeValue",
    "Timestamp":"timestamp"
}
```

Because the content is a string, it can be sent by Internet or SMS.

Another function of server is to turn off the alarm proceeding at the client side. Once user triggered the alarm, the proceeding will not automatically stop until someone turns it off. This person could be the user himself or the server side. The purpose of this design is to avoid this occasion: the patient has already sent the alarm message, but no one received. So the alarm won't automatically turn off unless some one do it.

D. Server part II: Healthcare Management System

a) Prescription Push: Actually, this system is a part of HIS. Doctor can create and edit a prescription and then push it to the user's phone.

A long-lasting connection between the server and the client is established since the client connected to the server. Then at the server side, the doctor could see that the patient is online. Doctor can review the user's prescription and decide whether to change, create new one, or delete it. After the doctor modifies the prescription, the Data Manager will send it through the prebuilt connection by Prescription Sender.

The connection is managed by Prescription Sender. It uses heartbeat packages to keep the connection alive. If after a long time the server has not received the heartbeat package, it will deem that the client is offline.

The doctor could create prescription on the web page, and press the sending button to push the prescription to the user's phone.

b) Receive Information: The user sends his condition to the server through phone. First, the on-line medical system gets the doctor name and the type from the message sent by the user. Then it will send the message content to the doctor. Last, we will continue to update the doctor's web page and make a signal to remind the doctor there are users need treatment. Of course, the message would be stored in the database of the server. It's better to check the user's past physical condition so that the doctor creates the better prescription for the user.

We have used SSH framework in the server. SSH could improve the efficiency of development and better adapt to constantly changes of the user's needs. At the same time, we have used ExtJS to develop the web page. ExtJS contains many components that also improve our efficiency.

IV. USER STUDY

In this user study, we deploy two servers that are placed in our laboratory and twenty cell phones to test the reliability of the system.

We made the test of the emergency alarm system in subways, the running cars (speed less than 80kmph), suburbs and rural places for stability verification. Total 199 successful tests out of 200 tests are achieved during the experiments. The only failure is finally figured out for network issues. This shows that using a mobile phone as the client of alarm system is very reliable. At the same time, compared to conventional equipment's, mobile phones have the advantage of moving anytime and anywhere. The detailed test data are shown in Table I.

TABLE I. TEST DATA

location	Test Times	Succeed Time	Failed Times
School	40	40	0
Subway	35	35	0
Car	45	45	0
Suburb	50	50	0
tunnel	30	29	1

However, due to lack of HIS support of our Prescription Push so far, the experimental results in real hospitals have not been got yet except for some lab trials.

But our system has actually used by some people; they feel it very helpful and reduce their trouble, especially the senior people.

V. CONCLUSION

In this article, we present an android-based Emergency Alarm and Healthcare Management System, which is practically deployed on android-based Phones. The system can give emergency help at anywhere and anytime, can remind users for medicine or response by the doctor's prescription, and can provide the function of seeing a doctor to the user. This does not only undoubtedly provide the senior people and the chronic patients the more convenience and safety, but also provide most of people.

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