Personal Healthcare System Using Smart Phone

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Abstract: Mobile health care is to provide health care services to anyone at anytime, overcoming the constraints of place, time and character.A huge number of people are suffering from Alzheimer's disease or mental,chronically ill andCardiac disease. Moreover,Elderly increase gradually and they are only staying in their home.So,Patients can feel lonely and they are spare-men.But,the patient who use these system can get immediate medical attention, use their times outside freely and work for their family as much as they can and they feel more confident than the past.This system is designed heart rate puse sensor,GPS receiver and accelerometer sensor which are included in the patient's senor node.And then, the smart phone analyses in real-time sensor's data and determines whether the person needs external help or not.Moreover.it can automatically send current location andmedical information as a message topre- assigned people who could be the patient's family and friends, and call the ambulance of the emergency centre when a patient is faced in emergency condition.It also acts as the personal health information system and the psychological data ferom the patient store into mobile database.

Keywords: Mobile Health care, Heart rate pulse sensor, Accelerometer sensor, GPS receiver, Android smart phone,mobile database

1. Introduction

Mobile health care system can be divided into two parts: smart heart monitoring system and traditional health monitoring system. In smart health monitoring system, remote health monitoring system,mobile health monitoring system and wearable health monitoring system are included. This system is combined mobile health system and wearable health system not including monitoring portion. This system provide patients smarter and more personalized because they can save their valuable time, satisfy their desire for personal control over their own health, and lower the cost of long term medical

2. System Architecture

This system is categorized into two main structures:patient's sensor node and mobile application.Figure 1 shows a simplified view of the health care system.

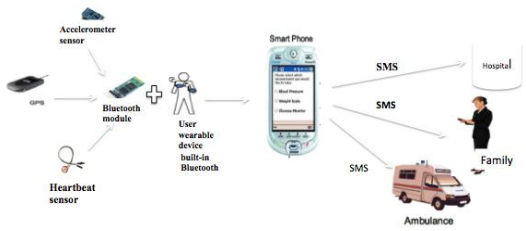

Figure 1,*System Architecture of system*

The patient has three sensors attached to his/her body.Accelerometer sensor is used to measure the acceleration of the patients and the heart-rate pulse sensor is applied to test the heart rate of the patients.The last one is GPS receiver that is use to know the location of the patient.The circuit diagram of the patient's sensor node is as follow:

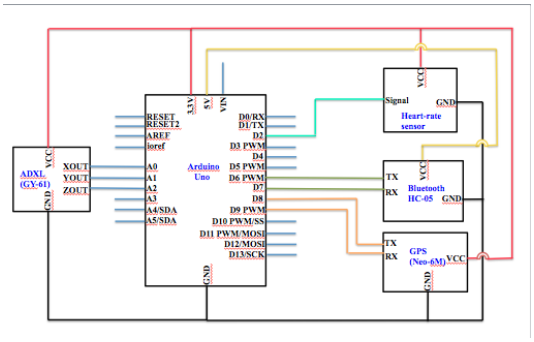

Fig2: *Circuit diagram of the patient's sensor node*

The implementation of the system is that firstly, the sensors collected physiological data from a patient and transmit them to smart phone via bluetooth.Three sensors are connected to controller and the bluetooth module is also connected to controller as interface device. And then,these current physiological data are examined and compare with the threashold data in mobile application and stored into database in smart phone.According to the comparision result, it automatically determines whether generate message or not,if the patient is emergency situration. The smart phone stores the patient personal health record information in an SQL Server which is a compact database for mobile devices.The required components that used in patient's sensor node are as follow

GPS

GPS sensor which is applied to track the patient's location. The MAX-6 module series brings the high performance of the u-blox 6 position engine in the ultra miniature MAX form factor. These receivers provide high performance and a high level of integration capability in a tiny package.

Accelerometer

Accelerometer sensor is applied to measure proper acceleration that is felt by people and objects. The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

Heart rate pulse sensor
Pluse sensor XD-58Cis used to test heart rate of the patients.Sensors can be worn on the finger or earlobe.It also has an open-source app program.In essence,a heart rate sensor integrated optical amplifier and noise elimination circuit.

Arduino-uno
The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, a 16 MHz crystal oscillator, a USB connection, a power jack.It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno and version 1.0 will be the reference versions of Arduno. The Uno is the latest in a series of USB Arduino boards.

Bluetooth
HC-05 module is an easy to use Bluetooth Serial Port Protocol module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

3. Flow Chart for the system

Patient's sensor node portion
At first,it is needed to initiate to open the serial to send data from sensors to controller.GPS module takes the raw data information from satellite and then send these to controller. The controller converts NEMA data into a readable format by stuffing the character sequences into variable. HPRS sensor senses the heart rate pulse and transfer these sensing information to controller.It transform analog to digital value and calculate the heart beat in one second by the following equation:

Heart_rate = 600000/(temp[10]-temp[0];

For human fall detection system, the controller read the analog values from xyz pins of accelerometer sensor and then that is converted to gravity values by the following equation:

Xg =((3.3*xRaw)-1.65)/0.3)
Yg =((3.3*yRaw)-1.65)/0.3)
Zg =((3.3*zRaw)-1.65)/0.3)

These three sensors values are transmitted to smart phone via bluetooth.

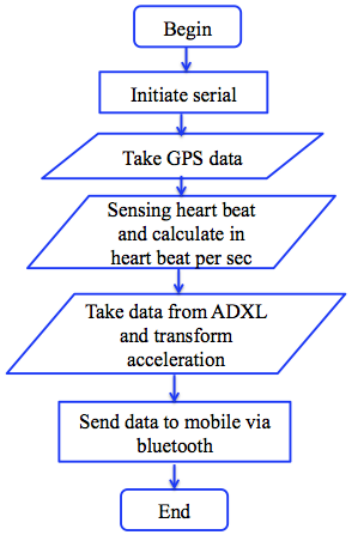

Figure 3, *Flowchart of the patient's sensor node*

Software implementation in controller
In controller,programming language C is used.It is intended for use in embedded systems.MicroC/OS allows defining several function in C,each of which can execute as an independent thread or task.Each task runs at a different priority,and runs as if it owns the CPU.The advantages of MicroC are simple,powerful and flexible,reliable and independent of hardware.

MOBILE PHONE APPLICATION
Nowadays, smartphones are becoming more powerful with reinforced processors, larger storage capabilities, richer entertainment functions and more communication methods. Bluetooth, which is mainly used for data exchange, add new features to smartphones.In recent years, an open-source platform Android has been widely used in smartphones. Android has a complete software package consisting of an operating system, middleware layer, and core applications.This system is used Java language and then it is converted to android applicalion.Software IDE is eclipe.The application size of the system is 1.33MB and database is SQLite.Android version can be used above 3.1. In mobile phone,it needs to select the bluetooth device firstly and then the sensor's node data are taken from bluetooth serial.These data are processed in healthcare application.Moreover,the accelerometer value are calculated in mobile application .The average changes of the human action and which direction is varied so fast and these values are calculated by the following equation:

smv=sqart(pow(Xg,2)+pow(Yg,2)+pow(Zg,2)

dif = smv –tmp

Avg=Vint + (dif*0.25)

Tmp=smv

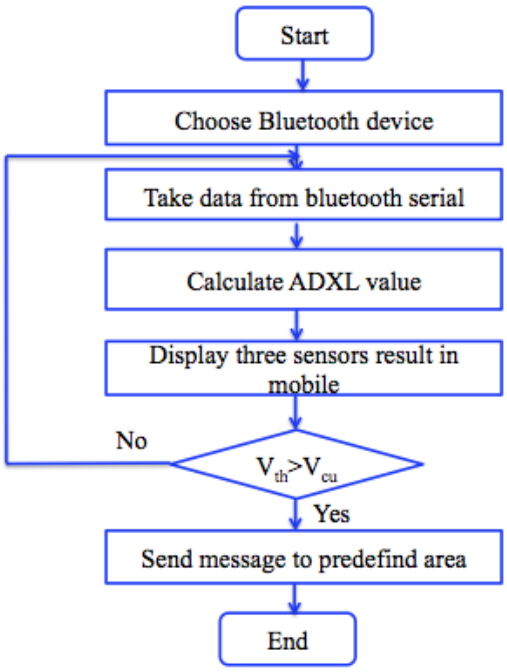

Figure 4, *Flowchart of the mobie phone portion*

Moreover, the pitch and roll of the human action are determined by the following equation

Pitch =atan2((Xg*Yg)+(Zg*Zg))
Roll = atan2(-Yg-Zg)
pitch = Pitch*(180/PI)
roll = Roll *(180/PI)

The mobile phone sofware compare the current values and the threashold values in the system and determines whether message need to send or not.If the current values are greater than the threashold values,the mobile automatically sends messages to predefined area within 10 seconds. This situation is called emergency situation. Threashold values depend on types of human.So,the doctor needs to fill the patients medical record firstly.

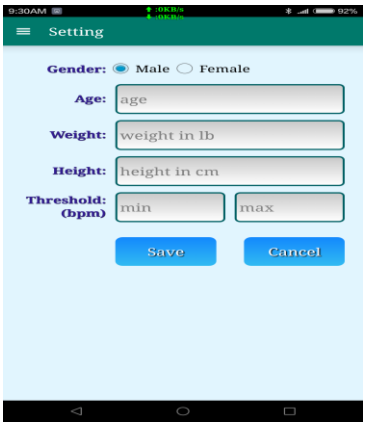

Fig5: *patient's medical threshold information*

4. Test and Result

The threashold values of the system is that maximum and minimum value of heart rate are from 110 to 80 and the changes human activity are from 0.5 to 2.5 of average velocity.If the patient is sitting down or sleeping,the average velocity is 0.5 and if he is walking the average velocity is 2 and if he is upstair the average velocity is 2.5.These above values are normal condition for accelerometer sensor.If thecurrent values are exceed the threashold values,mobile automatically sends message preassigned places. In this system,we use the supply voltage is 9V and the smart phone is sony xpria Z3.

Figure6: *Normal condition of the system*

In this above result figure,the heart rate of the patient is 98 bpm and the activity status is normal.The current location of the patient is shown as latitude and longtitude.The contition of the patient is normal,so ,the smart phone does not send message.

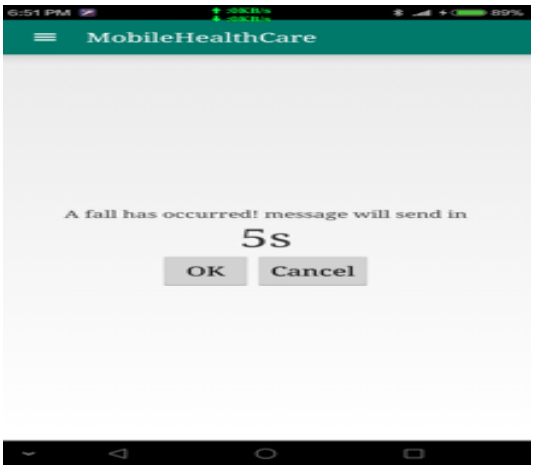

Figure7: *Emergency condition of the system*

If the patient is faced in emergency condition that is either the heart rate or the final velocity of the patient exceed , the smart phone alarms within 10 seconds.This condition is shown in figure7.If the patient wants to cancel this situration, he or she can press the cancel-button.If not,smart phone sends message automatically to preassigned area that is shown in figure8.

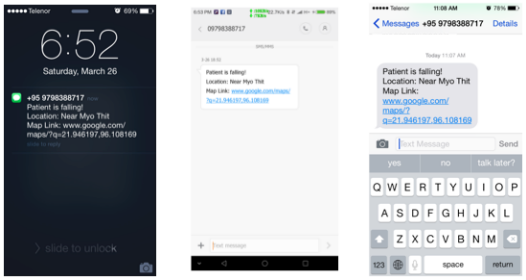

Figure8: *Sending message to predefined area*

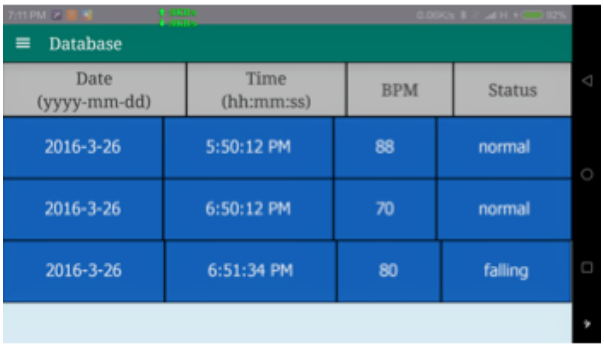

Figure9: *Database in the mobile application*

The database page of the mobile phone application is shown in figure9.By storing the medical record of the patient,the doctor can determine and know the condition of the patient easily.

5. Conclusion

Indeed, the service offers complete heart rate monitoring, automatic fall detection and user localization on GPS module both for indoor and outdoor use. The system, composed by a patient's sensor node worn by the user and a mobile phone to analyze and save the information, has been developed as easy to use and reliable, and final user requirements have been taken into account on every stage of the development.

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