A Hospital Healthcare Monitoring System Using Wireless Sensor Networks

Er.Perumal Sindhu rekha.G[1], Hindhu shree.S[2], Rameena.S[3], Hemalatha.B[4], Anletpamila suhi.P[5]

Manimekalai College Of Engineering, Hosur. Department of Computer Science And Engineering.

ABSTRACT:

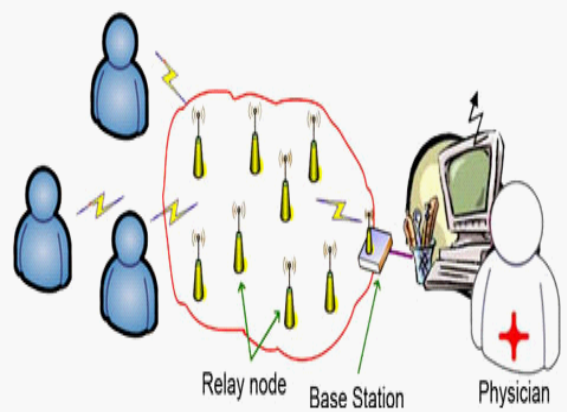
In a hospital health care monitoring system it is necessary to constantly monitor the patient's physiological parameters. For example a pregnant woman parameters such as blood pressure (BP) and heart rate of the woman and heart rate and movements of fetal to control their health condition.. In the proposed system, a coordinator node has attached on patient body to collect all the signals from the wireless sensors and sends them to the base station. The attached sensors on patient's body form a wireless body sensor network (WBSN) and they are able to sense the heart rate, blood pressure and so on. This system can detect the abnormal conditions, issue an alarm to the patient and send a SMS/E-mail to the physician. Also, the proposed system consists of several wireless relay nodes which are responsible for relaying the data sent by the coordinator node and forward them to the base station. The main advantage of this system in comparison to previous systems is to reduce the energy consumption to prolong the network lifetime, speed up and extend the communication coverage to increase the freedom for enhance patient quality of life. We have developed this system in multi-patient architecture for hospital healthcare.

Keywords:

Patient; Blood pressure; Hospital healthcare; Wireless body sensor network; Energy consumption; End-to- end delay; Pregnant woman.

Introduction:

Body sensor network systems can help people by providing healthcare services such as medical monitoring, memory enhancement, medical data access, and communication with the healthcare provider in emergency situations through the SMS or GPRS .Continuous health monitoring with wearable or clothing-embedded transducers and implantable body sensor networks will increase detection of emergency conditions in at risk patients. Not only the patient, but also their families will benefit from these. Also, these systems provide useful methods to remotely acquire and monitor the physiological signals without the need ofinterruption of the patient's normal life, thus improving life quality .



Architecture for proposed healthcare system in hospital.

Loss rate values for the in-house patient:

Distance- obstructions	Packet lost rate
3 m	0.13 %
5 m	0.19 %
5 m-1 door	0.32 %
10 m	0.85 %
10 m-1 door	1.08 %
10 m-2 doors	1.23 %
Moving patient	20.15%

In an example of the application of this system is controlling a pregnant woman. A pregnant woman's blood pressure should be the same as any other person's normal blood pressure. It is important to monitor the blood pressure during pregnancy, to watch for preeclampsia. These women need frequent BP checks. If BP goes too high, the patient may be hospitalized. But, the patient is limited to her bed in hospital.

Multi-Patient Body Sensor Network System Design :

In this paper, a ubiquitous healthcare prototype system for hospitals is designed. The concept of Ubiquitous healthcare system is to place unobtrusive wireless sensors on a person's body to form a wireless network which can communicate the patient's health status with base station connected to the monitoring PC.

The architecture and application of the proposed system are in figure 1. The system consists of four parts:

(1) The WBSN includes four sensors which are responsible for collecting the physiological signals from patient.

(2) The WMHRN(Wireless Multi-Hop Relay Node), consist of a number of wireless relay nodes which is in charge of forwarding the health data to the base station.

(3) BS (Base Station) which receives the relayed data and sends it to the PC through a cable.

(4) The graphical user interface (GUI) which is responsible for storing, analyzing and presenting the received data in graphical and text format, and sending an SMS to the healthcare provider or patient's family in emergency conditions through the GPRS or GSM modem.

Coordinator and sensors nodes:

This section describes the components that make up the WBSN and their functionality.

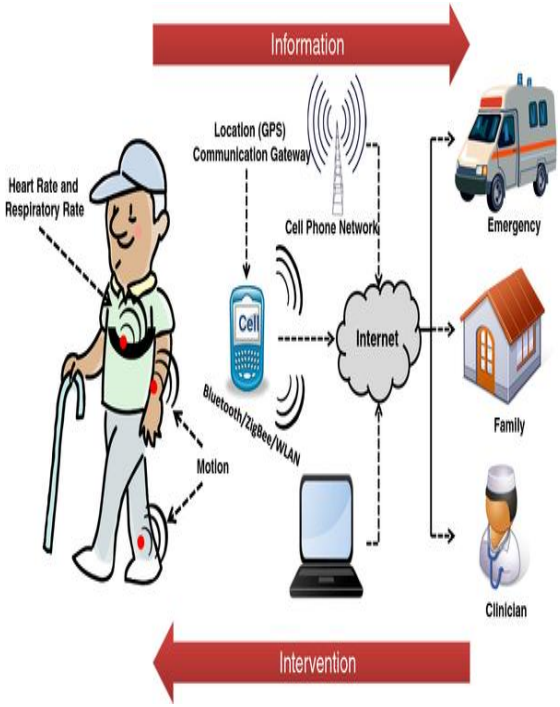
Coordinator Node: The coordinator node is a wireless node in the WBSN which is in charge of collecting and packaging the arrival signals from the other sensors, and send them to the base station. This node attaches on the patient's body and it works with battery

Sensor nodes: Each node in the network has a different role. All the sensors are wireless and sense different physiological parameters in a given interval and simultaneously, the sampling interval is determined by the physician. For example sensors for pregnant woman can be:

1. Motion Detection-Accelerometers: To measure blood pressure, the patient should be seated or lying .So, these sensors can detect patient's position. If the patient is placed in a proper position, it will allow the other sensors to sense.
2. Blood Pressure and Heart Rate: These sensors can return blood pressure and heart rate.
3. Heart rate and Movement of the fetal: Detection of the heart rate and the movement of the fetal used by medical practitioners to assess the health of the fetal.

GPS:

GPS is a space-based satellite navigation system that provides location information about the patient in the hospital which helps to hospital stuffs to finding the patients in emergency conditions. It is always carried by the patient. For example, Fahim et al. presented a smart house to assists elderly people for independent living in their own homes. It facilitates the care giver assistant by tracking the elderly persons in their own homes and avoids certain accidents.



The WBSN design:

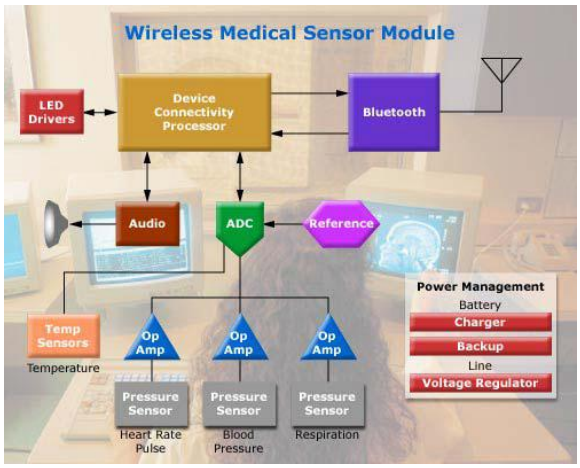
As we mentioned to measure blood pressure, the patient should be seated or lying. So, these sensors can detect patient's position. If the patient is placed in a proper position, the motion sensors by sending a SENSE_START packet will allow the other sensors to sense. To reduce energy consumption, all the sensors wake up simultaneously and wait for a specified time until they receive the SENSE_START packet. If they receive it, they will send their readings to the coordinator node and then turn off their radio. We can observe the operation state diagram of the Blood Pressure (BP) sensor If each sample of data (such as the heart beat, BP etc.) is immediately encapsulated into a frame and transmits, the overhead will be increased and will cause excessive energy consumption. Therefore to decrease the overhead, we have used the burst transmission mechanism .woman heart rate, woman blood pressure, fetal heart rate and fetal movement encapsulate in one frame. In this way, we achieve more energy conservation.

The proposed algorithm to find the minimum path:

After receiving an FMP packet checks and turns on the timer
If (current hop count > previous hop count)
Drop the packet
Else If (current hop count < previous hop count)
Keep it in routing table.
Increase the current hop count by 1.
Add the ID to the Next Hop
And send it to the neighbors.
Else IF(the timer is expired)
send an FMP_END to the BS

sensor:

Architecture :



Literature review:

This work describes the implementation of a complete wireless body-area network (WBAN) system to deploy in medical environments. Issues related to hardware implementations, software and wireless protocol designs are addressed. In addition to reviewing and discussing the current attempts in wireless body area network technology, a WBAN system that has been designed for healthcare applications will be presented in detail herein. The wireless system in the WBAN uses medical bands to obtain physiological data from sensor nodes.

Today's systems need the sensors to be placed bedside monitors or PCs, and limit the patient to his bed. But now,there is no relation between the sensors and the bedside equipment due to the wireless devices and wireless networks.The modern healthcare monitoring system not requires the limitation to the patient's to his bed. The patient can move around but in a limited area from the control room or monitor in the modern system.

During the early 1980s, analog cellular telephone system was experiencing rapid growth in Europe, particularly inScandinavia and United Kingdom, but also in France and Germany. Each country developed its own system, which wasincompatible with everyone else's in equipment and operation. This was an undesirable situation, because not only wasthe mobile equipment limited to operation within national boundaries.

The design of a wearabledevice that can remotely monitor vital signs of users. Thisdevice is implemented using existing technologies. Theinformation from this device is sent to a base station which isconnected to a computer. The information will be received bymedical personnel and/or family members. Several patients may be monitored from a single base station. The system is

designed so that it is easy to use and set up in medical facilities (such as hospitals) and residences.

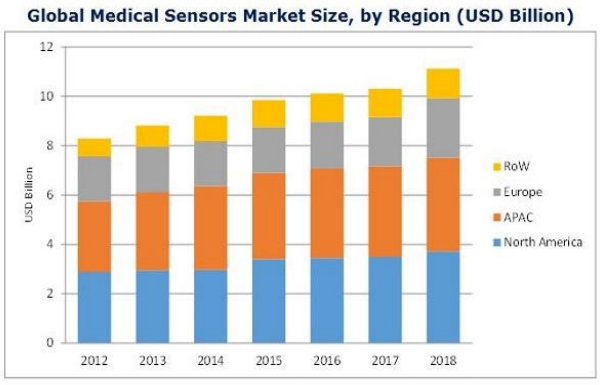
By enabling new inexpensive diagnostic capabilities,these sensing technologies promise to revolutionizehealthcare both in terms of resolving publicZigbee, and near-field radios to communicatewirelessly to nearby computers, personal digitalassistants, or smartphones, and long range, such asWiFi or cellular communications, to communicatedirectly with cloud computing services.

There is Healthcare Monitoring system using WSN with Zigbee. But main drawback of this system is that we canmonitor the patients for 100 meter distance only. The There is Healthcare Monitoring system using WSN with GSM wecan monitor the patients any where across the world.

The design of Patient's Side Device (PSD) consists of a contact-type microphone to detect patient's heart sound, a signal processing hardware for signal conditioning of heart sound and calculating heart rate and a Zigbee module to communicate with the Centre Monitoring System (CMS) periodically.

While preserving resident comfort and privacy, the network manages a continuous medical history. Unobtrusive area and environmental sensors combine with wearable interactive devices to evaluate the health of spaces and the people who inhabit them.

Authorized care providers may monitor residents' health and life habits and watch for chronic pathologies.



Source: Company's Annual Report and MarketsandMarkets Analysis

Conclusion :

Wireless BSN technology is emerging as a significant element of next generation healthcare services. In this paper we proposed a mobile physiological monitoring system, which is able to continuously monitor the patient's heart beat, blood pressure and other critical parameters in the hospital. The entire system consists of a coordinator node to acquire the patient's physiological data, a WMHRN to forward the data and a BS to collect the data. The system is able to carry out a long-tem monitoring on patient's condition and is equipped with an emergency rescue mechanism using SMS/E-mail.

Also, we have simulated the proposed WBSN in OMNet++ simulator and have compared this with existing WBSN systems in terms of coverage, energy consumption and delay time and we have observed the proposed system has better performance than others existing WBSN systems.

References:

1. **Media Aminian1 and Hamid Reza Naji2***Department of Computer, Science and Research branch, Islamic Azad University, Kerman, Iran
2. Hande A, Polk T, Walker W, Bhatia D (2006) Self-Powered Wireless Sensor Networks for Remote Patient Monitoring in Hospitals. Sensors Chung WY, Mo An S, Lee SC (2012) Real Time Multi-hop Routing Protocol for HealthcarSystem Based on WSN, 14th International Meeting on Chemical Sensors, Nuremberg, Germany.
3. Yuce MR (2010) Implementation of wireless body area networks for healthcare systems. Sensors and Actuators A: Physican.
4. By JeongGilKo, Chenyang Lu, Mani B. Srivastava, John A. Stankovic, Fellow IEEE, Andreas Terzis, and Matt Welsh
5. Sunil L. Rahane1, Prof. Ramesh S. Pawase2 PG Students (Microwave), Dept. of Electronics & Telecommunication, AmrutvahiniCollege of Engineering,Sangamner, Maharashtra, India1
6. NIK NUR FARAH AYU BT CHE HAMID,(JUNE, 2012)Faculty of Electrical &Electronics Engineering Universiti Malaysia Pahang
7. G. Virone, A. Wood, L. Selavo, Q. Cao, L. Fang, T. Doan, Z. He, R. Stoleru, S. Lin, andJ.A. StankovicDepartment of Computer Science, University of Virginia.
8. Edward Teaw, GuofengHou,Michael Gouzman, K. Wendy TangAmy Kesluk *Department of Electrical and Computer Engineering Computer Science Department Stony Brook University Hofstra University Stony Brook, New York 11994, USA* Hemstead, New York 11549, USA {wtang,mig,guhou}@ece.sunysb.edu