ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

A Healthcare Monitoring System Using Wireless Sensor Network with GSM

Sunil L. Rahane[1], Prof. Ramesh S. Pawase[2]

PG Students (Microwave), Dept. of Electronics & Telecommunication, Amrutvahini College of Engineering, Sangamner, Maharashtra, India[1]

Assistant Professor, Dept. of Electronics & Telecommunication, Amrutvahini College of Engineering, Sangamner, Maharashtra, India[2]

ABSTRACT: This paper presents the system Architecture for smart Healthcare using Wireless Sensor Network (WSN) with GSM Module and Microcontroller. The paper presents monitoring system to monitor the physiological parameters such as Blood Pressure (BP), ECG, Body Temperature and Respiration etc. The coordinator node has attached on body of patients for collecting the signal from wireless sensors. The wireless sensors send this signal to base station or control room of physician. This wireless sensors form wireless body sensor network (WBSN). Node of each WSN composed of health care sensors and RF tranreceiver which send data to back end sever. Sensors can choose in the range of WSNs, while RF trensreceiver is implemented as a coordinator which manages WSN other than forwards data. The sensing data of each patient are stored in back-end server with each having its own ID. The data analysis, database inquiry, data manning and the system management are processed on the web page of server. The system can detect abnormal condition of patients and send the SMS or e-mail to the physician. It advantageous to patient and associate relative of patient and others who may use the continuous remote health monitoring. By using wireless sensor network this system improves the quality of medical healthcare system.

KEYWORDS: Blood pressure, Energy consumption, End-to-end delay, Hospital healthcare, wireless sensor network, wireless body area network.

I. INTRODUCTION

At present day to make human life more comfortable Wireless Sensor Network (WSN) are used to understand the critical conditions of human body. It is smallest unit which have unique features. The wireless sensor supports reliability, mobility etc. The body sensor network helps to people providing healthcare services like medical data access, medical monitoring and communication with physician in emergency situations through SMS or GPRS. It also provides fully remote method to acquire and detect and monitor the physiological signals without any interruption in patient's normal life. The wireless sensor network improves life quality.

The present monitoring system sensor is placed beside the monitors or PC, which have limitation of patient's bed. But in modern system we used wireless network and wireless devices which removes the limitation of patient's bed.
To make human life more comfortable Wireless sensor networks (WSNs) are an emerging technology in existing research and have the potential to transform the way of human life (*i.e.*, make life more comfortable). A wireless sensor is the smallest unit of a network that has unique features, such as, it supports large scale deployment, mobility, reliability; *etc* 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 [1]. Also, these systems provide useful methods to remotely acquire and monitor the physiological signals without the need of interruption of the patient's normal life, thus improving life quality.

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

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

around but in a limited area from the control room or monitor in the modern system. In this system we also use infrastructure oriented wireless networks such as 3G network or commercial cellular or wireless LAN. But in this case emergency signal may not transmitted from patient to physician because the coverage of infrastructure oriented wireless network changes with location and time.

II. LITERATURE SURVEY

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

During the early 1980s, analog cellular telephone system was experiencing rapid growth in Europe, particularly in Scandinavia and United Kingdom, but also in France and Germany. Each country developed its own system, which was incompatible with everyone else's in equipment and operation. This was an undesirable situation, because not only was the mobile equipment limited to operation within national boundaries, which in a unified Europe were increasingly unimportant, but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized.

The Europeans realized this early on, and in 1982 the conference of European posts and telegraphs formed a study group called the group special mobile (GSM) to study and develop a pan-European public land mobile system. The proposed system had to meet certain criteria. Good subjective speech quality. Low terminal and service cost. Supports for international roaming. Support for range of new services and facilities. Spectral efficiency and ISDN compatibility.
In 1989, GSM responsibility was transferred to the European Telecommunication Standards Institute (ETSI), and phase I of the GSM specifications were published in 1990. Commercial service was started in mid-1991, and by 1993 there were 36 GSM networks in 22 countries, with 25 additional countries having already selected or considering GSM. Although standardized in Europe, GSM is not only a European standard. GSM networks are operational or planned in almost 60 countries in Europe, the Middle East, the Far East, Africa, South America, and Australia. In the beginning of 1994, there were 1.3 million subscribers worldwide. By the beginning of 1995, there were over 5 million subscribers. The acronym GSM now aptly stands for Global System for Mobile communications. The developers of GSM chose an unproven (at the time) digital system, as opposed to the then-standard analog cellular systems like AMPS in the United States and TACS in the United Kingdom. They had faith that advancements in compression algorithms and digital signal processors would allow the fulfillment of the original criteria and the continual improvement of the system in terms of quality and cost. The nearly 6000 pages of GSM recommendations try to allow edibility and competitive innovation among suppliers, but provide enough standardization to guarantee the proper interworking between the components of the system. This is done by providing functional and interface descriptions for each of the functional entities defined in the system.

III. DESIGN OF PATIENT BODY SENSOR NETWORK SYSTEM

The architecture of patient's body sensor network is shown in figure 1. It consists of four parts. First part consists of the Wireless Body Sensor Network (WBSN). The WBSN includes four types of Sensor which are used for collecting the physiological signals from the patient's body. Second part consists of the Wireless Multi-Hop Relay Node (WMHRN). The WMHRN consist of wireless relay nodes which are used to forwarding heath data of patient from WBSN to base station. Third part consists of base station (BS). The base station receives the data from relay node and this data is send to PC of control room via cable. Fourth part consists of graphical user interface (GUI) [2]. By using GUI, we can is used to store, analyze and present the received data in graphical and text format. The GUI sends SMS to physician or patient's family through GSM module.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

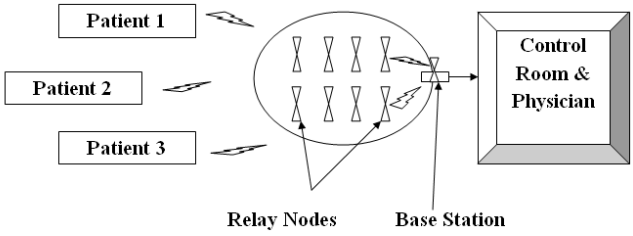

Fig. 1 Architecture for healthcare system in hospital.

A. Sensor nodes

The sensor nodes in the network have a different role. The sensor used in the system are wireless and sense the different physiological parameters simultaneously in an interval of time. The sampling interval can be determined by physician. For example the blood pressure and heart rate of patient can be measured by sensor. The sensor also detects the motion of fetal in case of pregnant women.

B. Coordinator Node

In the wireless body sensor network the coordinator node which is wireless node are used to collecting and packaging the arrival signal from other sensor and send this signal to the base station. The coordinator node attached on patient's body and work with battery. To identify each patients in the network each coordinator node is identify by unique ID.

C. GPS

Global Positioning System (GPS) provides the location information of the patient in hospital which helps to staff of hospital to find the patients in emergency condition. The GPS system is always carried by patient.

IV. ARCHITECTURE OF HEALTHCARE MONITORING SYSTEM

Architecture of health monitoring shown in fig 1 which consist of two different node with sensing parameter such as BP & heart rate monitor, ECG, temperature, SPO2 sensor.

A. Wireless sensor network

SPO2 Sensor

To monitor Pulse Ox meter, Heart Rate Meter, SPO2 sensor are used. The Heart Beat signal is obtained by LED and LDR combination. Blood flow though hands interrupts the Light reaching the LDR and this signal is converted into digital by ACD which then read by microcontroller.

ECG Sensor

To monitor appearance of waves, duration of waves, segments and intervals, amplitude of waves, rhythm of heart cycles and plot or process ECG signals, ECG sensor is used. Two thumbs hold on the board and you start getting output in analog form as well as pulse output form. To get clean ECG signal the optocoupler are used to isolate ECG signal from sensor [4].

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

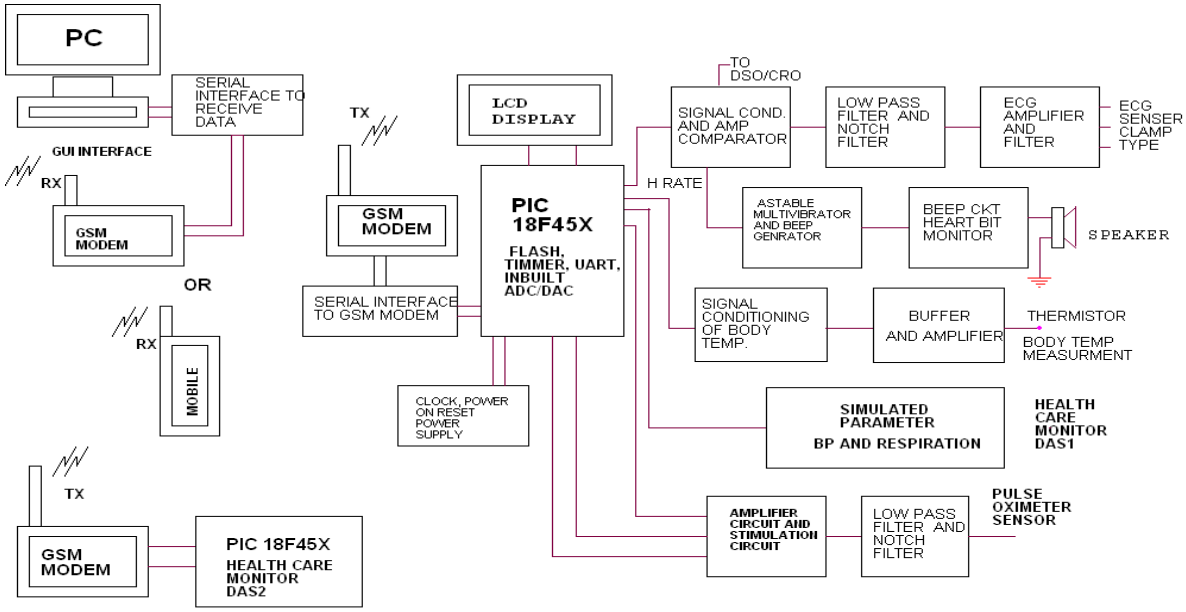

Fig. 2 Block Diagram of Healthcare Monitoring System using Wireless Network System with GSM.

A. Signal conditioning & ADC

All sensor collect data from patient body data is in analog form and very small in strength so that there is need to signal conditioning block that used amplifier and filter that remove the noise added in signal These signal converted into digital form by high precision analog to digital converter which has minimum 8 simultaneous channel. We cannot use the ADC in microcontrollers because all signals from patient body area very small strength thus high precisions are required.

B. Temperature sensor

In critical condition of patient to measure the temperature we use temperature sensor.

C. Microcontroller

For processing the data from ADC is send to Microcontroller. The amplified and conditioned Heart Rate signal is fed to input port of the microcontroller. The microcontroller reads the BP, ECG, heart rate and temperature sample stored in the RAM of the through the ADC. It is then converted and stored in the memory as two 8-bit unsigned integers. The microcontroller constructs the SMS messages and packs the data samples after completion of signals acquisition. Then communicates with the mobile phone using at-commands on its GSM modem port to send the messages [3].

D. BP sensor

To measure the blood pressure which is pressure on wall of arteries when heart contract and relax BP sensor are used. The systolic is high blood pressure on wall of arteries when heart is contract and diastolic is low blood pressure when heart is relaxed. Use the correct cuff size for accurate reading. The Wireless Blood Pressure Monitor includes a Medium cuff. If cuff size is too large then it will produce a reading that is lower than the correct blood pressure and if cuff size is too small then it will produce a reading that is higher than the correct blood pressure.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

E. Server

As a web server the back-end server is programmed which delivers a web page when requested by a web browser. Both the data collected by sensors and the software of the system administration, data processing and analyzing, are stored on the server. Administrator can manage the whole system by accessing the web page on server. The monitored person can inquire his health status on web server through mesh router. Back-end users, such as doctors, health care advisors or relatives of patients can also inquire the health care monitoring data on the web page.

F. GSM Modem

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. It delivers performance for voice 850 MHz, SMS 900 MHz, Data1800 MHz, and Fax 1900MHz in a small form factor with low power consumption. SIM900 can fit in small space requirements such as M2M application due to its slim and compact demand of design. SIM900 is a quad-band GSM/GPRS module. The operating on different frequencies like as GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900 provide GPRS multi slot class 10 class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. SIM900 small size GSM module which meet almost all the space requirements in User's applications. SIM900 GSM module which is designed by SIMCom which is designed for global market [3].

G. Back End Computer and human interface

One or more nodes connected to the backbone are dedicated databases for long-term archiving and data mining. Sometimes absent nodes on the backbone may serve as in network databases. Patients and caregivers interface with the network using PDAs, PCs, or wearable devices. The PDAs, PCs, or wearable devices are used for data management, querying, object location, memory aids, and configuration, depending on health monitoring for patient. There should be minimum interactions are supported with the on body sensors and control. These health monitoring may provide memory for patient history, alerts, and emergency communication channel. Real-time interfaces provided by PDAs and PCs. Doctors use these to specify medical sensing tasks and to view important data of patient.

V. RESULT

With the help of Healthcare Monitoring System using WNS with GSM we monitor the patient's ECG, Temperature. Pulse etc. from anywhere with the help of GSM.

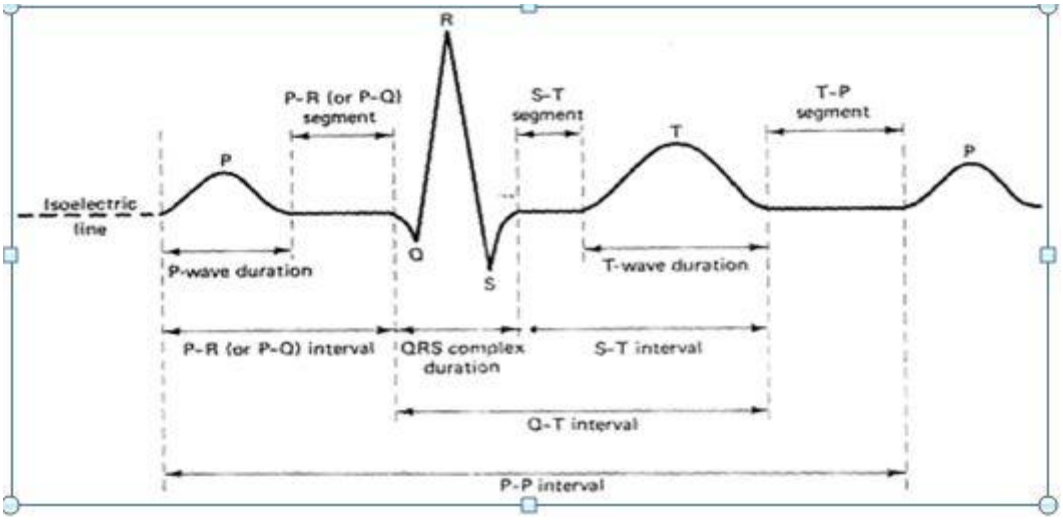

Fig. 3 Cardiac cycle for ECG

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

Cardiac cycle for ECG is shown in figure. It is basic ECG waveform .the P Q R S T waves reflect the rhythmic electrical depolarization and repolarisation of the myocardium.

The heart of the project is micro controller PIC18F4520. The project is divided into different block. The heart beat is sensed by the clamp type sensor. Where the signal is achieved from clip type sensor is very low will be in micro volt. The maximum differential signal from the sensor at R wave is up to 1.2mv. Hence the signal should be applied to the instrumentation amplifier for the faithful amplification and S/N level improvement. The suitable gain of the amplifier is decided by the resistance used in the circuit.

The amplified signal is applied to low pass filter for the faithful nature of ECG signal. The cutoff frequency of the low pass filter is decided to be 150Hz to pass the element of all ECG signal. The signal is then applied to notch filter to filter the noise of line frequency 50Hz. One more stage of amplifier is inserted and finally signal is applied to the comparator for the detection of R wave. This signal is applied to the comparator to detect the R pulses. After detection of the R pulses the signal is applied to monostable multivibrator. The output of monostable is the sharp spike having very low on time with respect to off time. These pulses are regularly generated as the ECG nature is coming from the sensor part. The duration between two conjugative pulses is inversely proportional to the heart beat rate. As the duration is long the heart beat rate will be low. And if the duration is low then the heart beat rate will be very high. The normal heart beat rate is varying from 70-120 bpm.

VI. CONCLUSION

By using Wireless sensor networks we make patients' life more comfortable and provide viable solutions. The security is very important in monitoring of healthcare which may provide by wireless sensor network. So it is an emerging research topic and it is worth studying. This paper provides a clearly comprehensive study of security research in healthcare application using WSNs. This paper presents the design, deployment, and evaluation of a wireless pulse-oximetry monitoring system in a hospital unit. The study presented in this paper involves real patients monitored in a clinical setting. The patients were monitored in situ to realistically assess the feasibility of WSN technology for patient monitoring.

Our research is kind of network architecture named Health monitoring network which integrates WSNs into internet. Each WSN is organized as a mobile ad-hoc network with one allocated mesh router connecting with internet. The health care data collected by sensor node are all transmitted to mesh router, then forwarded to back-end web server through internet. The whole network administration including working mode setting for sensor node, sensing data managing and analyzing are processed on back-end server. A test bed is constructed to test the performance of Health Care Monitoring Net, where sensor node measures blood pressure, ECG, heart rate, temperature.

REFERENCES

[1] Media Aminian and Hamid Reza Naji "A Hospital Healthcare Monitoring System Using Wireless Sensor Networks,", Department of Computer, Science and Research branch, Islamic Azad University, Kerman, Iran and College of Electrical and Computer Engineering, Kerman Graduate University of Technology, Iran, vol 4,2013.

[2] G. Virone, A. Wood, L. Selavo, Q. Cao, L. Fang, T. Doan. He, R. Stoleru, S. Lin, and J.A. Stankovic Department of Computer Science, University of Virginia An Advanced Wireless Sensor Network for Health Monitoring (2011).

[3] Singh, Sr. Asst. Prof. Ravi Mishra 1(ME II Year VLSI Design, Department of EC, SSCET, Gunwani, Bhilai Nagar (C.G), India) 2(Sr. Asst. Prof. Department Of EEE, SSCET, Gunwani, Bhilai Nagar (C.G), India) Microcontroller Based Wireless Temperature and Heart Beat Read-Out Nisha (2008).

[4] Cirkovic, Predrag, Aleksic, Anda Processing of Medical Signals (ECG) in Wireless Sensor Networks (2007).

[5] C. E. Perkins, E. M. Royer, "Ad-hoc on-demand distance vector routing," Second IEEE Workshop on Mobile Computing System and Applications, 1999, proceedings. WMCSA'99, pp.90-100, Feb. 1999.

[6] WHO: "Connecting for health global vision, local insight report for the world summit on the information society" (WHO 2005).