Design and Development of a Wireless Remote POC Patient Monitoring System Using Zigbee

A.B.Tagad[1], P.N.Matte[2]

[1]G.H.Raisoni College of Engineering & Management, Chas, Ahmednagar, India.

[2] Departments of Electronics and Telecommunication Engineering.

Abstract

A scrutinizes of patient during the crucial situation plays a vital role in every house. Point-of-care (POC) patient monitoring refers to near patient testing, usually outside the central hospital or primary care facility. Sometimes, poc testing is performed by a hospital employee by regular visits to the patient's home to monitor vital parameters or the state of a patient in the recovery process of rehabilitation. Remote patient monitoring is an alternative to regular home check-ups of patients with certain special medical conditions or the elderly who are unable to regularly visit a healthcare facility. Here we used wireless technologies to reduce the number of home visits which are now only required when special attention is needed.

In Home section, patient monitoring unit with parameters such as ECG, movement sensing and body temperature. The measured parameter data will be transferred to the central receiving unit through Zigbee communication. The Central receiving unit fed the parameter values into the PC In the remote section, parameter data will be displayed and stored into the database.

Keywords— Electrocardiogram (ECG) signals, Wireless signal (Zigbee), GSM, PIR Sensor, Temperature sensor

1. Introduction

RECENTLY, in many cases, the reason for a patient staying in the hospital is not that he or she actually needs active medical care. Often, the principal reason for a lengthy stay in the hospital is simply continual observation. Therefore, efforts have been made to avoid acute admissions and long lengths of stay in the hospital. In recent years, emergency admissions and long lengths of Stay have become extremely costly.

Now days, with aging trend in global community, the average life span of people is much longer. For example, Taiwan becomes an aging society since 1994. Thus, the chances get more for age-related chronic diseases such as heart disease, stroke and high blood pressure. For this reason, the financial and staffing cost in hospital and nursing house will be huge challenge. Restricting in large size of medical equipment, patients should be back to hospital for healthy examination frequently. It is unfavorable in tracing health condition of patients, because it is inconvenient and wasting a lot of time for every patient. Therefore, the concept of Point of care patient monitoring system is proposed in this paper as Fig.1
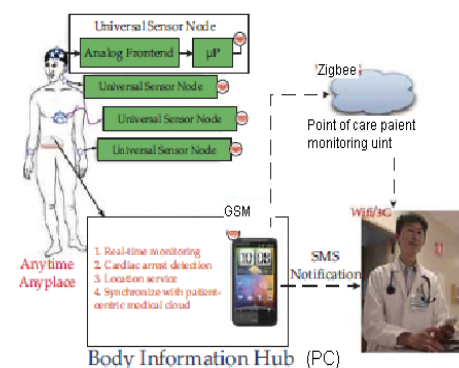

Fig. 1. The proposed poine of care paient monitoring system

In recent years, the world is facing a common problem that the number of elderly people is increasing. Hence, the problem of home-care for elderly people is very important. Sometimes, Point-of-care testing is performed by a hospital employee by regular visits to the patient's home to monitor vital parameters or the state of a patient in the recovery process of rehabilitation. Remote patient monitoring is an alternative to regular home check-ups of patients with certain special medical conditions or the elderly who are unable to regularly visit a healthcare facility.

In recently, wireless sensor networks are used to structure home-care system in many researches. Wireless sensor networks application for physiological signals communication

transmission has many technologies, such as the Infrared, Bluetooth and Zigbee, etc. Because the angle limit problem of the infrared transmission, and the infrared have not be used for Physiological signal transmission. Although Bluetooth is better than Zigbee for transmission rate, but Zigbee has lower power consumption. Hence, Zigbee is generally used for 24 hours monitor of communication transmission systems.Currently, some wireless monitoring systems have been designed which commonly use a PC, a personal digital assistant (PDA), or a mobile phone at the patient's side.

In these systems, the vital signals are transmitted to the hospital via mobile networks. In this paper, we present a wireless sensor network where a group of sensors monitor and transmit medical signals. Sensors are tailored to a specific condition. In this case, we observe a patient who has suffered a heart attack and is considered at risk for having another attack. This patient would be fitted with electro.cardiogram (ECG) sensors that monitor the heart activity, heart rate, and so on. Wireless communication protocol is used to set up a simple wireless sensor network in which all the sensors transmit sampled ECG signals to a wireless-access point located in the patient's home.

These nodes are then connected to a central node which is installed in the hospital. Clinicians are then able to monitor their patients' conditions, detect any abnormalities, and take appropriate action (e.g., contact the patient to give some advice or send an ambulance to their home).In this proposed system I going to observe another to more parameter that are Temperature and movement of that patient. And if any change is in above three parameter then also send SMS of Doctor's mobile.

2. System Description

2.1. Main Unit

2.1.1. Home Section:

In Home section, patient monitoring unit with parameters such as electrocardiogram, movement sensing and body temperature. In Home section consists of two units. The first unit is the patient monitoring unit for parameters such as electrocardiogram, movement sensing and body temperature. The measured parameter data will be transferred to the central receiving unit through Bluetooth communication or Zigbee Technology.

The second unit is the central receiving unit. Here information will be fed into PC.

2.1.2 Remote Section

In this section all measure parameter will be display on PC and also on LCD. Also SMS will be sending on Doctor's mobile. If any problem in any parameter then alarm is in on condition. Because of SMS and alarm doctor or any other familiar person can take proper action. e.g., contact the patient to give some advice or send an ambulance to their home.

2.2. General System Model

In Home section consists of two units. The first unit is the patient monitoring unit for parameters such as electrocardiogram, movement sensing and body temperature. The measured parameter data will be transferred to the central receiving unit through wireless communication. For transferring data through wireless node I am going to use ZIGBEE technology. The second unit is the central receiving & remote communication unit. Here information will be fed into Ethernet. In Remote section, the measured parameter data will be displayed with the help of Ethernet communication.
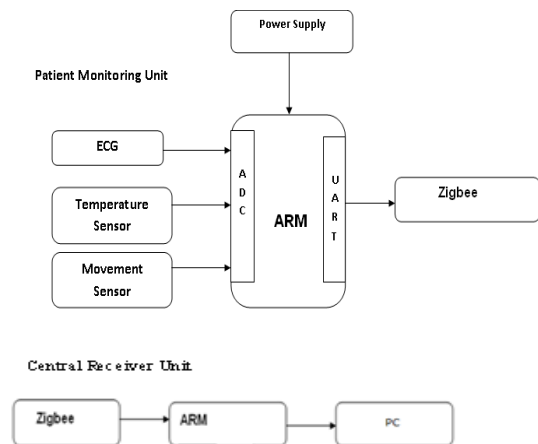

Figure 2.Home Section
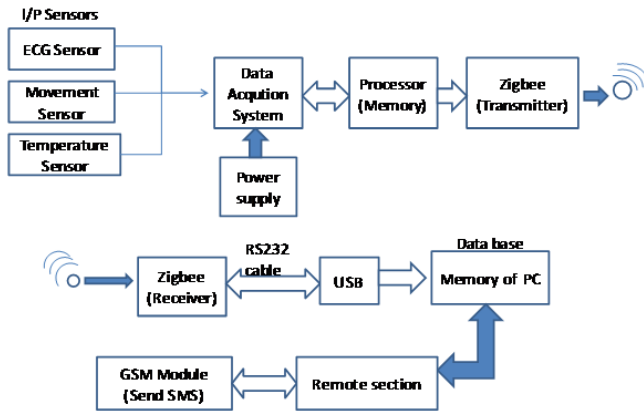

Figure 3.Remote Section

3. Prototype Diagram

Figure 4.Block diagram of proposed system

In this project I am going to monitor as well as control the three parameters i.e. ECG, Temperature and movement of that particular patient. This health monitoring system consisted of three sensors that we are going monitor. Then this data is send to the ADC through processor. The measure parameter data will be transferred through wireless node to PC. In this system Wireless node is nothing but the Zigbee which is connect through the RS232 cable to USB (Serial communication) and send data to ARM Processor as well as PC in that select COM1. Then measure parameter data will be display. Also in this system we are going to send SMS to the Particular Doctor's mobile.
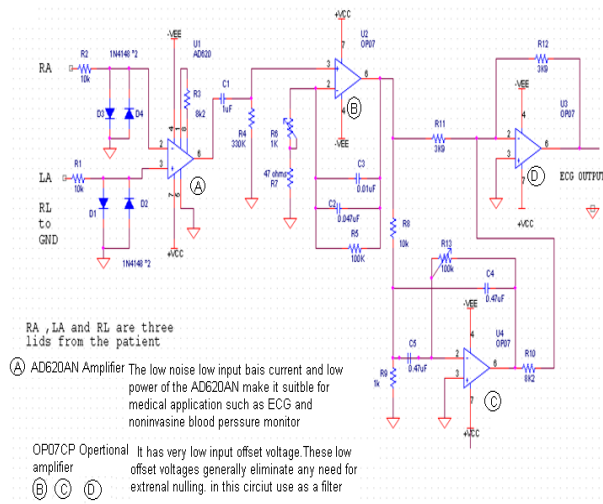
3.1 I/P Sensors

3.1.1. ECG sensor

Figure 6.ECG Sensor Circuit Diagram

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through ear lobe. As the heart forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. The sensor shines a light lobe through the ear and measures the light that is transmitted. The clip can also be used on a left wrist or on above the chest and back side of body. The signal is amplified (AD620AN), inverted and filtered (OP07CP), in this circuit i.e. Fig no. 7. By graphing this signal, the heart rate can be determined, and some details of the pumping action of the heart can be seen on the graph in Fig No.11
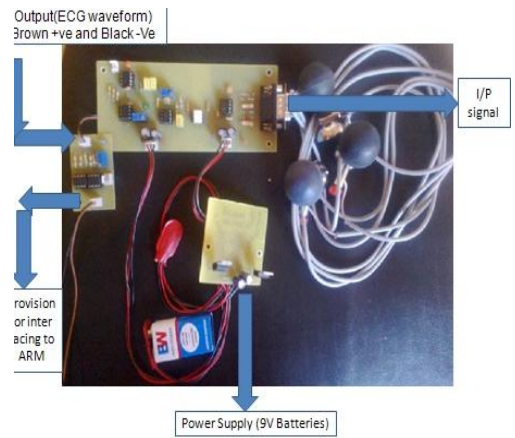

Figure 7.ECG Sensor Prototype

3.1.2. Temperature sensor (LM35)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 output is shown in fig. No.12
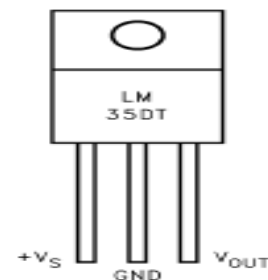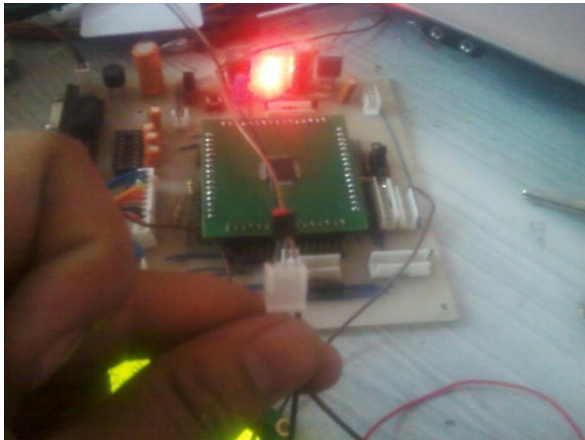

Figure 8.LM 35Temperature Sensor

Figure 9.Temperature Sensor Prototype

3.1.3. PIR sensor (Movement sensor)

The PT8A2620 is a CMOS mixed signal LSI designed for low cost applications using PIR as motion sensor. The PIR sensor detects infrared power variations caused by motion of a human body and transfer to a voltage variation. If the PIR output voltage variation conforms to criteria, the lamp is turned on for an adjustable duration. CDS can enable or disable output with external voltage divider.

Figure 10.PIR Sensor

3.2 Wireless Module

3.2.1. Zigbee

The XBee/XBee-PRO RF Modules are designed to operate within the Zigbee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band

3.2.2. GSM Module

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz

3.2.3 RS232 Communications

Information being transferred between data processing equipment and peripherals is in the form of digital data which is transmitted in either a serial or parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computers and other peripherals. Serial transmission involves the sending of data one bit at a time, over a single communications line.

3.3 Processor

3.3.1. Arm Processor (LPC2148)

LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller manufactured by Philips semiconductors (NXP).

3.4 Software Module

The patient's information from Patient monitoring system goes to the central receiving and remote communication unit via Zigbee then from the internet goes to the remote sensing unit where the information of the patient is stored in the database. Through microcontroller the data goes to the ECG, temperature sensors all this information is passed

into the data base where the doctor can access the patient information from the PC. So to do all this in this project i am going to use Keil uv4 for programming purpose, for monitoring purpose use front end as C programming and downloading the program in to processor use flash magic. For designing PCB use express PCB.

3.5 Result

Figure 11.ECG Sensor Output waveform

Figure 12.Temperature Sensor Output

CONCLUSION

Many hospitals and physicians have requirements for an integrated and reliable wireless monitoring system to observe real time physiological signals from patients outside the hospital with high and reliable accuracy. Currently available systems for monitoring physiological signals suffer from technical limitations, resulting in the under exploitation of potentially life-saving data. In this paper, a novel wireless sensor network structure to monitor patients with their own home through a remote monitoring system of

physiological signals was presented. In this paper I have completed the two sensors i.e. ECG and Temp. as shown in fig.no.11 and 12

References

[1] "IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS, VOL. 5, NO. 4, AUGUST 2011 "Wireless Sensor Networks for Monitoring Physiological Signals of Multiple Patients" By Reza S. Dilmaghani, Hossein Bobarshad, M. Ghavami, Sabrieh Choobkar, and Charles Wolfe

[2] 2009 International Conference on Advanced Information Networking and Applications Workshops "An RFID-based System for Emergency Health Care Services " by Cristina TURCU, Cornel TURCU, Valentin POPA

[3] Second International Symposium on Intelligent Information Technology Application "The real-time monitoring system for in-patient based on Zigbee" by Ping Wang

[4]"Universal Architecture Prototype for Patient-Centric Medical Environment" by Yun- Yen ChenWu, Hsi-Pin Ma, Chaitali Biswas† and Dejan Markovic

[5] "A Simple set Up for the Measurement of Patient Response Time in fMRI" by Ali Demir Ali U¨mit Keskin, Mehmet U¨nsal, Ali Bayram