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A Zigbee Based Wireless Patient's Monitoring System

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Abstract:
The design and development of a Zigbee based wearable physiological parameters monitoring device has been developed and reported in this paper. The system can be used to monitor physiological parameters, such as heart rate and temperature of a human body. The objective of this project is to design and implement a reliable, cheap, low powered, and accurate system that can be worn on a regular basis and monitors the vital signs based on Zigbee technology(IEEE 802.15.4) The device detects if a person is medically distressed and receiver unit that
is connected to a computer plot graph for monitored physiological parameters, of a human body.

Key words: *Zigbee, Temperature Sensor, Heart Beat Sensor, Mat lab*

1. Introduction

Health monitoring systems become a hot topic and important research field today. Research on the monitoring were developed for many applications such as military, homecare unit, hospital, In this paper, we developed the wearable and real-time monitoring system using zigbee technology for heart beat and body temperature This application consists of Zigbee based network, sensors Body Temperature, Heart Beat, It is mainly used to monitor Body Temperature, Heart Beat of patients. all sensors are connected to microcontroller. Data is digitized with microcontroller and send to a computer by using Zigbee transreceiver where Mat Lab based window represent it graphically shows the patients current status at receiver. Patient monitoring refers to the continuous observation of repeating events of physiologic function to guide therapy or to monitor the effectiveness of interventions and is used primarily in the intensive care unit and operating room. At least in India there is no system which continuously monitors the patient when patient is on move. And this motivated us to work in this area.

2. Literature Review

Currently, a number of studies have been proposed to patient's physiological parameter monitoring over wireless transmission. Patient monitoring systems [1] are gaining their importance the fast-growing Global elderly population increases demands for caretaking. These systems use wireless technologies to transmit vital signs for medical evaluation**.** According to Kinsella and He's [2] report from the US Census Bureau, the global elderly population is fast growing and will outnumber the population of children in near future. The aging society is bringing its impact on many developing countries and presents a stark contrast with the low fertility rate of these countries. The changes brought about by the aging society include an increasing demand for caretaking; thus, patient monitoring systems are gaining their importance in reducing the need for human resources. Caretaking homes and hospitals have been planning on the use of biological sensors to effectively minister to their patients. Vital signs, such as body temperature, blood pressure, and sugar level, can be regularly collected and remotely monitored by medical professionals, achieving a comprehensive caretaking system. ZigBee [3] is an open standard technology to address the demands of low-cost, low-power WMNs via short range radio. ZigBee [4] is targeted at RF applications that require a low data rate, long battery life, and secure networking. Its mesh networking also provides high reliability and more extensive range. The ZigBee devices can be combined with WWANs to achieve a seamless platform of wireless patient monitoring. The ECG and heart rate data can not only help the caregivers to know the urgency of the fall-induced injury, but also show the probable reasons of falls. IEEE 802.15.4 is a standard which specifies the physical layer and media access control for low-rate wireless personal area networks (LR-WPANs). It is maintained by the IEEE 802.15 working group.

3. System Overview

This paper describes the wireless body sensor network based on ZigBee technology. It is mainly used for collecting and transferring the various monitoring information using Temperature Sensor, Heart Beat Sensor about the patients in hospitals or in their homes. It is mainly used to monitor patient's Body Temperature, Heart Beat, Matlab based window represent it graphically shows the patients current status.

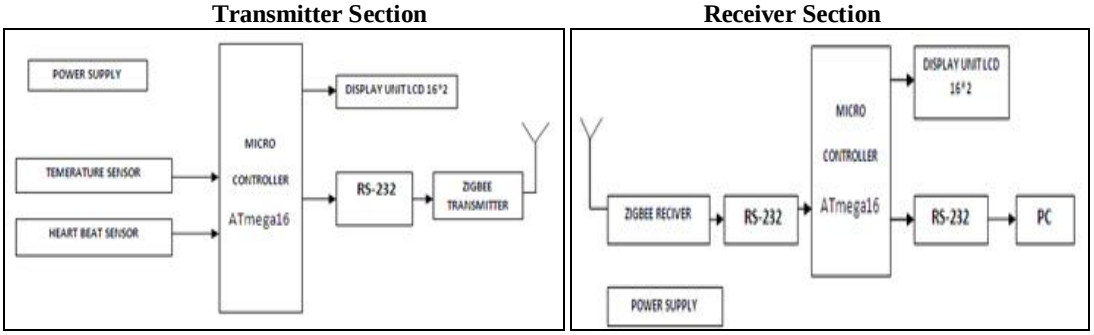

Figure 1: Block Diagram of Transmitter and Receiver for Wireless Patient Monitoring using zigbee

4. Hardware

In above system hardware used is Zigbee, Microcontroller, Heart -Beat sensor, Temperature Sensor. and LCD.

4.1. ZIGBEE

ZigBee (IEEE 802.15.4) is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Range of Zigbee is from 30 meters-1km ZigBee devices are actively limited to a through rate of 250Kbps,

IEEE 802.15.4

IEEE 802.15.4 is a standard which specifies the physical layer and media access control for low-rate wireless personal area networks It is maintained by the IEEE 802.15 working group. Its license free frequency bands are:

- 2.4 GHz (16 channels with baud rate of 250 kbps)
- 902 MHz – 928 MHz (10 channels with baud rate of 40 kbps)
- 868 MHz- 870 MHz (1 channel with baud rate of 10 kbps)

4.2. ATMEL

ATmega16 microcontroller

The Atmel combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), also consists 8-bit Microcontroller, Advanced RISC Architecture,131 Powerful Instructions – Most Single-clock Cycle Execution, Up to 16 MIPS Throughput at 16 MHz,16 Kbytes of In-System Self-programmable Flash program memory,512 Bytes EEPROM,8-channel, 10-bit ADC , Programmable Serial USART, Operating Voltages 4.5V - 5.5V for ATmega16.

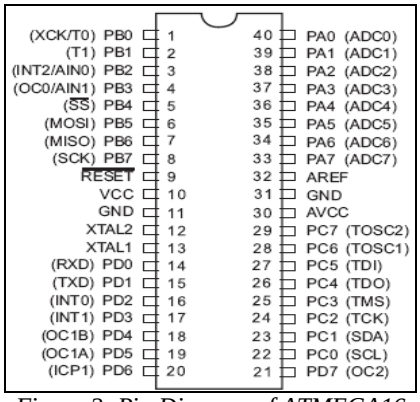

Figure 2: Pin Diagram of ATMEGA16

4.3. Heart Rate Measurement

Heart rate measurement is one of the very important parameters of the human cardiovascular system. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm). Athletes normally have lower heart rates than less active people. Babies have a much higher heart rate at around 120 bpm,

AGE	RANGE	AVERAGE RATE
0-3 Month	100-180	142
4-12 Month	80-180	130
1-3 Years	80-160	120
4-5 Years	80-120	100
6-8 Years	70-115	92.5
9-11 Years	60-110	85
12-16 Years	60-110	85
>16 Years	60-100	80

Table 1: Average Heartbeat Rate

Heartbeat is sensed by using a high intensity type LED and photo-diode it is shown in figure 3. The change in volume caused by the pressure pulse is detected by illuminating the fingertip's skin with the light from an LED using a photodiode sensor. With each heart beat, a surge of blood is forced through the vascular system, expanding the capillaries in the finger, and changing the amount of light returning to the photo detector. Very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible. Valid pulse measurement therefore requires extensive preprocessing of the raw signal. A super bright LED is suggested in the circuit as it can also perform well as light sensor. Photodiode, whose resistance changes in response to amount of light shining on it.

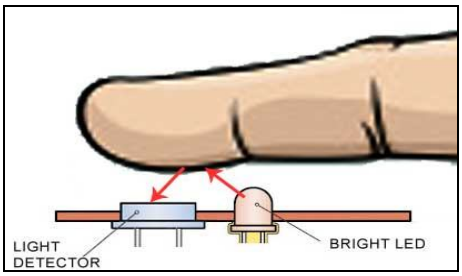

Figure 3: Heart rate measurement

4.4. Heart Beat Monitor

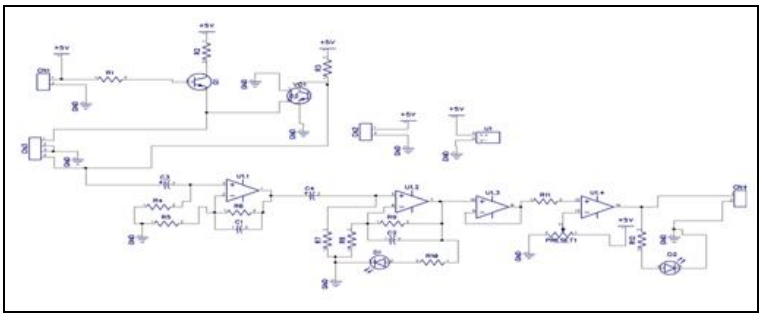

Figure 4: Circuit Diagram of Heart beat monitor

4.5. Temperature Sensor

LM35 is a precision IC Temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.. The output voltage varies by 10mV in response to every oC rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ oC.

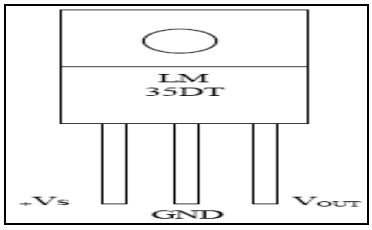

Figure 5: Temperature Sensor LM35

4.6. LCD

The LCD is used to visualize the output of the application. It is used to check the output of different modules interfaced with the microcontroller. Thus LCD plays a vital role to see the output and to debug the system module wise in case of system failure in order to rectify the problem.

5. Software

Matlab (Matrix laboratory) is an interactive software system for numerical computations and graphics. In this project receiver of zigbee connected to PC via RS-232 Cable and Matlab window in PC plot patients parameter graphically shows the patients current status at receiver.

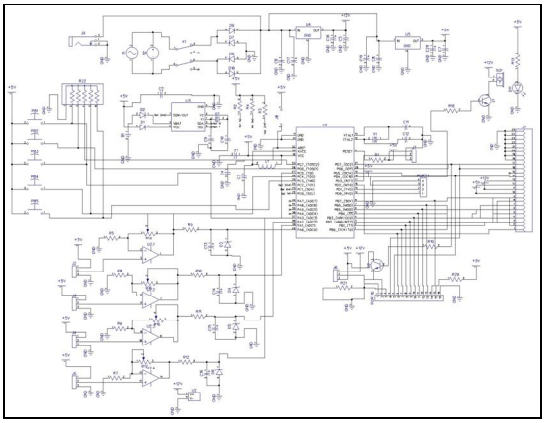

Figure 6: Circuit diagram for Wireless Patient Monitoring

6. Result

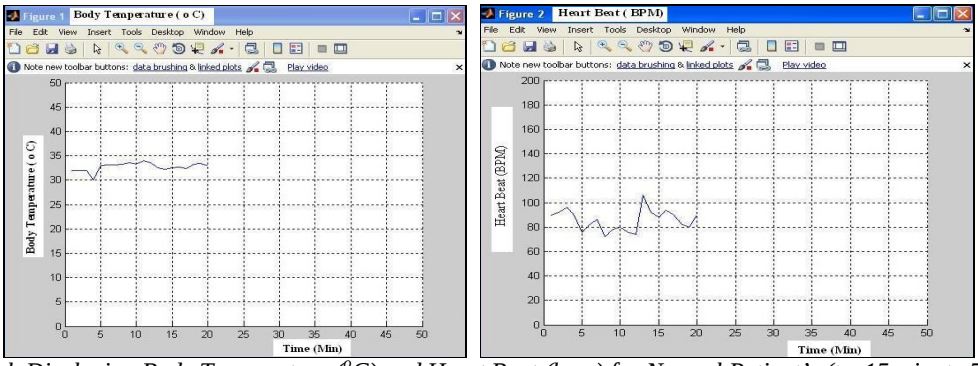

Figure 7: Graph Displaying Body Temperature (^oC) and Heart Beat (bpm) for Normal Patient's (t= 15 min.,t=5 to t=20 min.)

7. Conclusion

Thus the zigbee based wireless Heartbeat and Temperature monitoring system is designed and implemented using microcontroller atmega 16, in which all signals directly measured from the human body and all parameters values displayed on LCD on the transmitter side. This data is transmitted to the receiver wirelessly through ZigBee. The received signal send to pc via RS-232 cable in which Matlab window display graph of patient's Physiological Parameters.

8. References

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