Embedded Based Patient's Vital Sign Monitoring System using Wireless Methods

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***Abstract*— The Physiological parameter monitoring system is used to monitor the patient's vital signs continuously. This system consists of electronic device which is worn around the patient's hand. The different parameters of a patient such as heart rate, body temperature and body movements are detected and displayed in the host computer. The different sensors are used to measure the vital signs of the person and the data's will be transmitted wirelessly to the host PC. If the person is distressed this system will detect the abnormalities of the person and it will send an alarm to the hospital receiver unit. This system helps to improve the superior quality of medical health.**

Keywords*— *Heart rate, body temperature and body movements, ZigBee, Bluetooth.

I. INTRODUCTION

Sensor networks and the wireless sensors are different from traditional networks as well as computer networks and therefore, the more challenges to solve such as limited energy, restricted life time, etc. Monitoring continuous vital signs to highlight the possibility of designing for alarm management cost efficiency, portability and wear ability.

Many elderly persons are being forced to live with their own children, or in any rest home or in any other sheltered living arrangements. The elderly persons want to live independently and keep in control of their own lives. At the same time they know that there is a highly risk of injuring or even death because of a strokes. Such people immediately need to be monitored continuously and provide an immediate medical help and attention whenever it's required. As a result, there is a need for a comfortable, flexible, accurate, non-invasive, reliable, and low-cost monitoring system which unites all these demands.

The transmission of vital signs in nursing homes and hospitals is usually transmits wirelessly. The parameters can be assorted into emergency messages and regularly possessed information. While the routinely possessed information can be stored and transmitted within a given time period, the necessity messages should be transmitted immediately. The transmission path of parameters can be divided into two types outdoor and indoor. The technology which is wireless wide area networks (WWANs) is used for outdoor transmission, and that of wireless mesh network (WMN) is responsible for indoor transmission.

The patient is continuously monitored by the sensors they are temperature sensor (LM35), Accelerometer module and Heart rate sensor. The data's will be processed and integrated in the microcontroller ATMega16 and serially the data will be sent through wireless modules. If the patient is undergoing distress or any abnormalities this system will easily detect and intimate to the hospitals. The information will be transmitted wirelessly to the host personal computer simultaneously the alarm will be blown for immediate help.

This system is made of electronic devices which will take many inputs from sensors like body temperature, heart rate, body movements to measure the physiological parameters of the patients. The sensor inputs are given to the microcontroller to integrate and process the inputs. The processed inputs are serially transmitted through ZigBee and Bluetooth module the required data's are received in host computer for patient monitoring. The data's will be stored in the system database the measured values are displayed in the computer using graphical user interface (GUI) which is running on a computer. The data will be continuously updated automatically in the computer. If the patient is undergoing any health abnormalities this system will easily detect and the information will be sent to receiver unit, simultaneously the alarm will be generated.

II. OVERVIEW OF THE SYSTEM

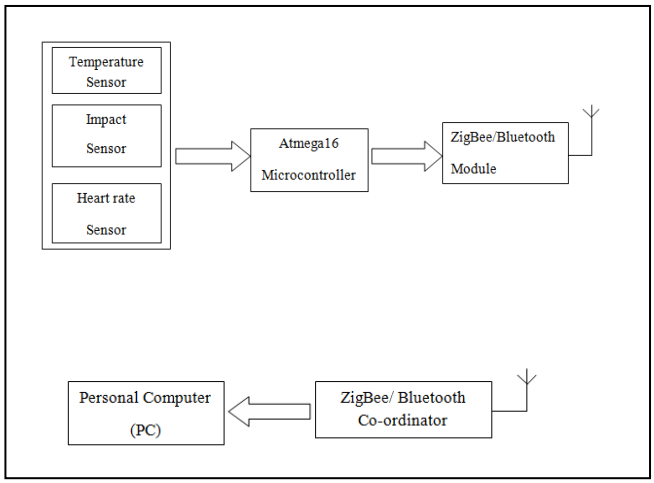

Fig. 1: Block Diagram Overview

The overview of this system is shown in the Fig. 1. The sensor which is given as an input to the microcontroller (ATMega16) the sensor data will get processed and serially it transmits through ZigBee/Bluetooth module. The received data's will be stored in the host computer database where the GUI running on a computer.

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A. *Temperature Sensor*

The temperature measurement is done using LM35 sensor is precision integrated circuit with the output voltage is linearly proportional to the centigrade temperature. Body temperature can vary with other factors such as drinking hot or cold water or sitting in a cold room. The normal core body temperature of a healthy adult human being is stated to be 98.4 degree Fahrenheit or 32.0 degree Celsius [6]. This sensor does not need any external calibration or trimming to give accurate value of -55C to +150C temperature range. The hand temperature is significantly below the body temperature, and there is no fixed relationship between the two. Temperature which is extremities change with ambient, health and physical conditions [5].

$$\text{Temperature}(C^{o}) = \text{Vout}*(100^{o}C/V) \quad (1)$$

B. *Accelerometer Sensor*

The body movements will be detected with this sensor using x- axis and y- axis of accelerometer module. The consumption of current is low 500 µA. This device works on 5V power supply. This module can be used to sense motion or tilt. It offers several integrating features are analog to digital convertor (ADC), digital low pass filter and the sensitivity ranges ±2g, ±4g, or ± 8g.

$$\text{Acceleration} = \frac{\left(\frac{t1}{t2}\right) - \text{ZeroGBias}}{\text{Sensitivity}} \quad (2)$$

Zero G Bias =50%nominal
Sensitivity =30% /g nominal.

C. *Heart Rate Sensor*

The heart rate is measured by using an inflatable finger cuff. The heart rate also referred to as pulse rate which is (BPM), has been recognized as a vital sign since in the beginning of medication, which is directly related to a person's cardiovascular health. Easy Pulse is a pulse detecting sensor that uses the principle of transmission photo-plethysmography (PPG) to sense the pulse signal from a finger tip. The sensor output is read by the ATmega16 board, which then transfers the data to the PC through a serial interface. The Easy Pulse sensor is designed for hobby and educational applications to illustrate the principle of photo-plethysmography (PPG) as a non-invasive optical technique for detecting cardio-vascular pulse wave from a fingertip. It uses an infrared light source to brighten the finger on one side, and a photo detector placed on the other side measures the small variations in the transmitted light intensity. The variations in the photo detector signal are related to changes in blood volume inside the tissue.

III. MICROCONTROLLER

A. *ATmega16*

The ATmega16 is a low power CMOS 8-bit modified Harvard RISC architecture in a single chip microcontroller which was developed by Atmel in 1996. It is a high performance microcontroller, it has a non-volatile program and data memories. The ATmega16 combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly attached to the Arithmetic Logic Unit (ALU), allowing two independent registers to be promoted in one single instruction executed in one clock cycle.

IV. COMMUNICATIONS

A. *ZigBee Module*

The patient or elderly person is equipped with a sensor node to acquire vital signs from the sensor module. The vital signs are then encapsulated in packets and transmitted by the ZigBee module.

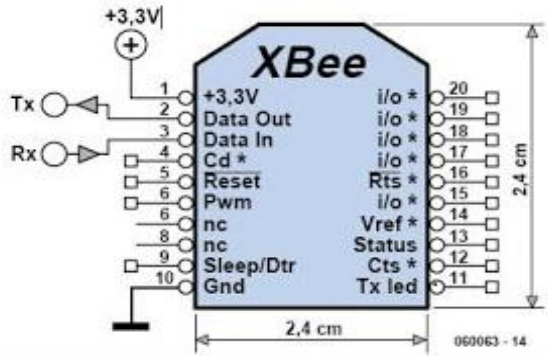

Fig. 2: Pin configuration of Zigbee module

Each ZigBee module has a data receiver list to store the addresses of the data receivers. Communication between the wrist units and the coordinator unit is wireless. The data measured by the sensor is saved by building a network between the sensors and to set up a computer receiving and storing the values. It is powered by a 9v battery, and ports uses 3.3V, from where sensor and ZigBee modules are powered. The power supply (3.3V), ground, TX and RX of the microcontroller are connected to VCC, GND, DIN and DOUT of the ZigBee module. ZigBee is a wireless standard used in hospitals and orphanages due to its ability of low-cost, low-power, fault tolerance and superior quality of service [1].

A ZigBee network consists of at least two ZigBee, one should set to Coordinator, and the other set to end devices.

a) *Configuration and Setup:* To configure the ZigBee Modules, the provided X-CTU software is used. To set up a network and the following conditions have to be fulfilled.

- Each network needs to have one Coordinator and can have several End-Devices.
- All modules should have the same firmware and PAN-ID.

If the setup is correct, the coordinator establishes a connection to the End-Devices automatically.

The Coordinator sends Commands Broadcast, and the End-Devices can send the data to Coordinator only.

b) Communication Protocol: To avoid the corrupted data and to know which unit is sending the data, an own communication protocol is needed.

c) *Graphical User Interface (GUI):* The GUI was programmed in C# and captures the serial communication. The string received as a serial data which splits into five parts (the address and sensors) and saved in an Access Database.

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B. Bluetooth Module

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the industrial, scientific and medical (ISM) radio band from 2.4 to 2.485 GHz) from a fixed mobile devices and building a personal area networks (PANs).

A master Bluetooth device can communicate with a maximum of seven active slave devices. There are up to 255 slave devices can be inactive, or parked, which is the master device can bring the active status at any time.. The devices can switch the roles, by agreement, and the slave can become the master. UART is initially configured to work at 9600 bps baud rate, 8-bit, no parity and 1 stop bit. The host can reconfigure the UART by issuing the appropriate commands.

V. COMPARISONS

Table 1: Comparison Analysis of Wireless Methods

	ZigBee	Bluetooth
Range	10-100 m	10 m
Operating Frequency	2.4 GHz	2.4 GHz
Data rate	250 Kb/s	11 Mb/s
Power	Low	Medium
Complexity	Low	High
Application	Monitoring and control	Cable replacement, Medical devices

VI. RESULT AND DISCUSSION

The physiological parameters of the patient will be monitored continuously with this system. The measurements are made continuous time. The patient's parameters will be displayed in the LCD display and also in the GUI (Graphical User Interface) which is running in the host PC. The body temperature, body tilt movements and heart rate in (BPM) will be displayed and updated in the GUI. If any distress is detected by this system the alarm will be generated to the co-ordinator system.

The vital signs can be categorized into emergency messages and regularly collected information. While the regularly collected information can be stored and transmitted in a given time period, the emergency messages must be transmitted immediately [12].

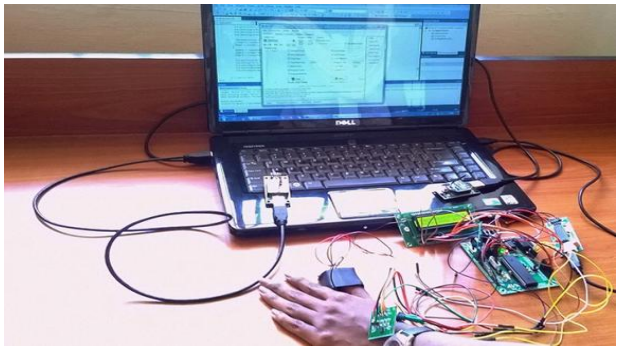

Fig. 3: Result of Physiological parameters

VII. CONCLUSIONS

Thus this system is used as a superior quality of medical application to monitor the patient's vital signs continuously. The data will transmit through wireless module to the receiver unit for health care. This system works successfully reliable, portable and low cost.

VIII. REFERENCES

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