Bio-medical Monitoring System

Mr.Raunak A. Deshmukh,Mr. Sushank B. Marla
Department of Electronics Engineering,
Datta Meghe College of Engg. ,Airoli

Abstract

The biomedical monitoring system is a generic real-time wireless communication system that was designed and developed for short and long term remote patient-monitoring .The system allows on-line monitoring of body temperature, pulse and stress. The people who fall in the forty and above age group require continuous monitoring of health. Also the body parameters like temperature and pulse gives the doctor a primary idea of the patient's health. There are ring-type pulses monitoring sensors available in the market in which the measured data are displayed in the LCD and cannot be transmitted out of the ring. But it was not possible to monitor a patient's health from a distant location. Hence a real time patient monitoring system based on a wireless protocol was the need of the day and that is exactly what has been developed. The system is also interfaced with a buzzer to notify the doctor about critical conditions.

1. Introduction

Today we come across different diseases and ailments like cancers, diabetes, high blood pressure etc which aggravate because of late diagnosis. Hence it becomes very important to have a regular body check-up .In India 30% of the population is based in the rural areas where very few medical facilities are available. This system allows us to communicate with doctors even at distant locations, thus rendering efficient patient monitoring. Also the system deals with temperature, pulse rate and stress which are the basic diagnostic parameters to monitor human health.

In case of emergency and dangerous situations we have to alert the doctor immediately. For this a wireless network is used for doctor- patient communication in the hospital and even to communicate and indicate the status of the patient. Each patient will be given this module and with the help of this module the patient health condition is monitored and if there is any change in the condition of the heath then it immediately sends that changed data through the wireless module to the local system where the main module is connected to a buzzer to inform the medical staff about the irregularity with the patients health.

Thus, as there is a strong need for investigating the possibility of design and implementation of an interactive real-time wireless communication system, this wireless system allows a medical check-up of the patient at home itself, rather than travelling to the doctor. So it is quite user friendly.

The heart beat is monitored with the pulse rate of the body. The high intensity light sensor senses the expansion and contraction of the heart with the help of the nerves. That beam will transmit the signal to the receiver and the minute change in the pulse is noticed as the heart beat. The controller is fixed for a number of pulses initially. If there is any change in the any of the pulse count then it considers as a malfunction of the heart and then it transmits the pulse count with the patients ID to the doctor in the hospital and at the same time it sends the data to a fixed number in the microcontroller. This is convenient process to monitor the patient's health conditions from the prescribed wireless range. Since ZigBee module is used the range of transmission and reception is limited to 100m.A temperature sensor is used to measure the body temperature and this is monitored regularly and is reported to the doctor. Also a new and innovative technique to measure stress has been implemented based on the concept of galvanic resistance. So in-short a cost effective, real-time system to monitor important diagnostic parameters of the human body has been developed and tested.

2. Limitation of available products

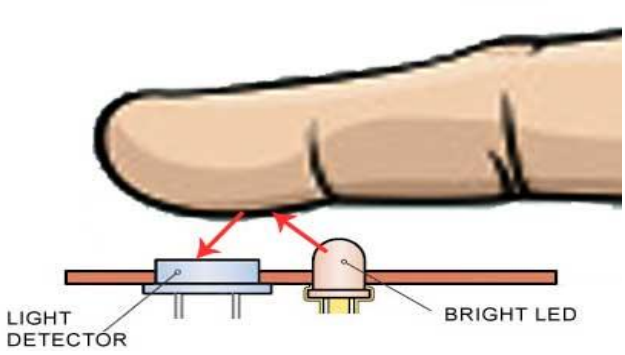
We have ring sensors available but which cannot transmit data outside the ring. Also different devices have been used to measure different parameters, so there was a need to establish a more cogent and coherent device. Also rural areas have only one medical centre, so the cost effective characteristic of the device will help establish a full-proof medical care and rural development. In hospitals too, the doctor had to visit each patient to get his/her report, now it is possible to monitor patients easily. Also ready updates become available on the patient's health. Being user-friendly, now it is possible for patients to send their reports through web/GSM modules.

3. Working of Heart-beat Sensor

Heart beat is sensed by using a high intensity type LED and LDR. The finger is placed between the LED and LDR. As Sensor a photo diode or a photo transistor can be used. The skin may be illuminated with visible (red) light using transmitted or reflected light for detection. The very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible. Various noise sources may produce disturbance signals with amplitudes equal or even higher than the amplitude of the pulse signal. Valid pulse measurement therefore requires extensive pre-processing of the raw signal. The new signal processing approach presented here combines analog and digital signal processing in a way that both parts can be kept simple but in combination are very effective in suppressing disturbance signals.

The setup described here uses a red LED for transmitted light illumination and a LDR as detector. The detectors photo current (AC Part) is converted to voltage and amplified by an operational amplifier (LM358).

Output is given to another non-inverting input of the same LM358; here the second amplification is done. The value is preset in the inverting input; the amplified value is compared with preset value if any abnormal condition occurs it will generate an interrupt to the controller ATmega8535**.**



This circuit made from an infrared phototransistor and infrared LED. This transducer works with the principle of light reflection, in this case the light is infrared. The skin is used as a reflective surface for infrared light. The density of blood in the skin will affect on the IR reflectivity. The pumping action of heart causes the blood density rises and falls. So that we can calculate the heart rate based on the rise and fall of intensity of infrared that reflected by skin.

4. Temperature Sensor

Several temperature sensing techniques are currently in widespread usage. The most common of these are RTDs, thermocouples, thermistors, and sensor ICs. The right one for your application depends on the required temperature range, linearity, accuracy, cost, features, and ease of designing the necessary support circuitry. The sensor that we are using in our project is a thermistor. In thermistor when the temperature increases, the resistance of the thermistor decreases, thus allowing current to flow through the thermistor. All we need to do is place our finger on the pad and the corresponding temperature is displayed on the LCD display of the device.

5. Stress sensor

Stress is a response to particular events. It is the way our body prepares itself to face a difficult situation with focus, strength and heightened alertness. When we perceive a threat, our nervous system responds by releasing a flood of stress hormones, including adrenaline and cortisol. These hormones rouse the body for emergency action. In some cases it is necessary to collect feedback in order to control this symptom because it can become dangerous in certain situations. Therefore, it is necessary to build a device to detect stress.

For this objective, we have designed a Galvanic Skin Response (GSR) device in order to detect the different conductance of the skin when a person is under stress or when not. It uses just two electrodes which are placed on the fingers and act as if they were the two terminals of one resistance.

This device sends different data to a coordinator via ZigBee and, at the same time, this coordinator will send the information to a computer. The final objective is to implement this GSR into an application which controls different medical devices.

This means of communication has been used before in healthcare applications. In order to verify the stress sensor, we carried out different trials with 16 adult subjects. The idea was to establish one threshold for each person because there are people who are more nervous than others, so there could be cases where the results are not reliable. So a threshold count was determined and was implemented thoroughly in the device.

6. Technical Aspect and Working

The basic idea of the project works with the interfacing of the temperature, heartbeat and stress sensors with the micro-controller.

The circuit diagram of the project consists of transmitter and receiver circuits. Heart beat sensor is designed to give digital output of heat beat when a finger is placed on the finger pad. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. The Temperature sensor is designed by using a thermistor which gives a digital output when the finger is placed on the same finger pad. The stress sensors are designed to measure the stress as per the threshold count by placing our finger over the GSR electrodes. Thus a digital output is recorded in this case too.

Temperature, pulse signals and the stress are measured from the temperature, heart beat and stress sensors respectively and are processed by a built-in microcontroller. The processed data are then transmitted by ZigBee wireless transmission. Finally the received data is sent to the microcontroller at the receiver module. At the receiver module the microcontroller is interfaced with a LCD where the required data is displayed. In case .of any abnormal health conditions the microcontroller sends a signal to the receiver microcontroller to alert the medical staff through a buzzer which is connected at the receiver section. It can facilitate doctors in diagnosis and improve the efficiency and quality of medical administration. Embedded C is used for programming the controller unit. This project presents a system that provides a continuous health monitoring service for the people.

7. Major Electrical Components

The ATmega8535 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing instructions in a single clock cycle, the ATmega8535 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The sensors used are temperature, heart-beat and GSR or stress sensors.

The wireless device used is the Zigbee module for transmission of data under a range of 100m.

8. Results

The result of the project is successful working of the cost-effective Biomedical Monitoring System. Working includes the determination of important body parameters like temperature, heartbeat/pulse and stress by using human body specifically the human hand as the reference input.

9. Acknowledgement

This project cannot be considered complete without mentioning Asst Prof. Mrs. Roshani V Bhaskarwar, Datta Meghe College of Engg, Airoli. We wish to express true sense of gratitude towards her valuable contribution. We are grateful to her for constant encouragement and guidance in the fulfillment of the project activity

10. References

[1] Yu-Chi Wu, Wei-Hong Hsu, Pei-Fan Chen, Cho-Hsu Chang, "Physiological signal measuring system via multiple communication protocols", *Prognostics and Health and Management Conference*, Jan 2010 .

[2] Jovanov. E,O'Donnell Lords.A., Raskovic. D, "Stress monitoring using a distributed wireless intelligent sensor system",*IEEE Trans. in Medicine and Biology*,vol.22, no.3,pp.49-55,June 2003 .

[3] Mao-Cheng Huang,Jyun-Ciang Huang,Jing-Cyun You, "The Wireless Sensor Network for Home-Care System Using ZigBee", *International Conference in Intelligent Information Hiding and Multimedia Signal Processing* ,pp.643-646, Nov. 2007 .

[4] Istepanian, R.S.H, Jovanov, E., Zhang, Y.T , "Guest Editorial Introduction to the Special Section on M-Health: Beyond Seamless Mobility and Global Wireless Health-Care Connectivity", *IEEE Trans. in Information Technology in Biomedicine*, vol.8, no.4,pp.405-414, Dec 2005 .

[5] Hongliang Ren,Meng, M.Q.-H, Xijun Chen, "Physiological information acquisition through wireless biomedical sensor networks",*IEEE International Conference in Information Acquisition* July2005.