IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 4, April 2016

Patient Monitoring System Using Contact & Non - Contact Method

Mr. R. K. Moje[1], Mahesh Shinde[2], Kiran Dhotre[3], Kailas Kitale[4]

Faculty of Department of Electronics, PDEA's COEM, Pune, India[1]

Student of Department of Electronics, PDEA's COEM, Pune, India[2, 3, 4]

Abstract: In this system we design an embedded patient monitor system for breath detection which monitor and records the patient's breath, electrocardiograph and body temperature then it sends information to the PC. For ECG and temperature measurement electrodes and sensors are used. For the respiration rate measurement, we have used web cam. The image taken by the web cam is process using mat lab software and displayed on PC. If the breath rate is too low or too high or if stop more than 10sec our design system sends out an alarm signal. If the body temperature of the patents increases or decreases than the normal temperature, then the controller sends out an alarm signal. Likewise if pulse rate is too high or too low then it sends the signal to alarm.

Keywords: Hear Rate, Microcontroller, Respiration rate, temperature Sensors, electrocardiograph.

I. INTRODUCTION

Our proposed system is based on producing safe and careful patients monitor system. Currently there is a growing research interest in measuring the important parameters from the body like heart rate, respiration rate, muscle movement etc, for giving the treatment to the patient which is in the critical condition. Measuring these parameters doctor can decide which treatment is to be given to the particular patient. Normally it is difficult to keep track on abnormalities in heartbeat count for patient itself manually. The average heartbeat per minute ranges between 60-100 beats per minute of normal resting person. Body temperature is 37degree Celsius or 98.6 Fahrenheit. Patients are not well versed with manual treatment which doctors normally use for tracking the count of heartbeat.

The traditional way of monitoring a patient's breath rate requires contact with the body by tying a device to it. For example, for Impedance Pneumography the electrode, which is placed on the skin of the chest, sends a high-frequency current and simultaneously uses the receiving electrode to receive any current changes during breathing. Respiratory inductive Plethysmography, which uses elastic bandages to tie wrapped wires on the human body, monitors breathing by checking the changing resistance. Currently most methods require some sort of tying up or other contact with the body. Thus there is a need to design a method of breath detection that avoids this. Our design detects chest expansion and contraction in a way that is similar to the detection of a moving object by image processing. For pulse rate a PPG

Sensor can be used in reflection mode or in transmission mode as shown in Figure6. Normally, a wavelength in the near infrared is used because there we have the strongest modulation of the signal due to light absorption in the haemoglobin in the blood.

For the muscle movement of the patient who is suffering from the paralysis disease .To track the patients movement of muscle we have use the EMG sensors. This sensors are surface electrode made up of silver-silver chloride .The small electrical signal which comes from the active muscles is detected by electrodes placed on the skin directly above the muscles. The procedure that measures the muscle activity from the skin is referred to as EMG. There are many locations in the body where the electrical activity of the muscles surfaces out. Muscle activation is triggered by bioelectrical signals of very low amplitude sent from motor control neurons on our brain to the muscle fibers. Our sensor is especially designed for surface EMG, and works both with pre-gelled and most types of dry electrodes.

II. DESCRIPTION

1. BLOCK DIAGRAM DISCRIPTION

The system can be represented using block diagram as shown below.

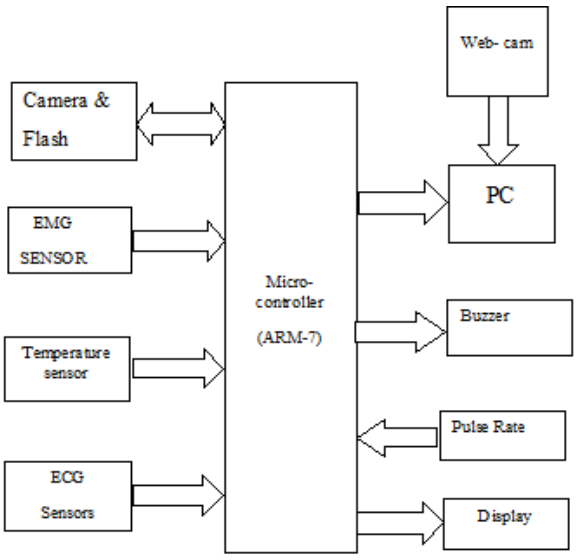

Fig.1. Block diagram of system

1. ARM-7 module: In our system we are using LPC2148. It is controller unit of the system. Input from various sensors like temperature, ECG, EMG, Pulse rate and

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respiration rate is given to this unit on which it process according to the programming and gives output to the display and buzzer to check reference parameter with patients parameter. It needs 3.3V to drive the ARM7 module. It is 32 bit controller and can be program with C language which is easy encode and decode.

2. Power supply unit: To drive ARM7 we require 3.3V and for various sensors and we require 5V to drive LCD sensors etc. So for that we have to build variable power supply unit using voltage divider circuit and regulator ICs like LM7805 and LM1117.

3. EMG Sensor: Electrode for EMG work are usually of the surface type & needle electrode. This electrode is used in clinical electromyography, neorography &other electrophysiological investigation of the muscle tissues underneath of the skin & in the deeper tissue. In our system we have used the silver- silver chloride electrodes. This electrode is also nontoxic and is preferred over other electrodes like zinc-zinc sulphate, which also produces low offset potential characteristics, but they are highly toxic to exposed tissues

.4. Temperature sensor: In our system we have used temperature sensor for measurement of patient's body temperature. For that we used the LM35 to detect or measure the patient's body temperature.

5. ECG SENSOR: An Electrocardiograph (E.C.G.) is the most common cardiac test carried out on cardiac patients. The E.C.G. takes a recording of the electrical activity of the heart. In that we are provided suction cup electrode for measurement of heart rate.

6. WEB-CAM: Respiration is the process of measuring breath taken by the human. In our system we have used single camera which continuously takes the images of patient's stomach. In our design we have uses image processing method for measurement of respiration rate.

7. Buzzer: Buzzer is used in a system to indicate or to grab the attention regarding an emergency situation occurred. Buzzer act as a panic horn which indicates the need of instant attention as the condition goes haywire.

8. Pulse Rate: In our project we have provided the sensor for pulse rate measurement. On that we have measure the heart rate. The working principle of a pulse oximeter is based on the photoplethysmogram (PPG)-an optically obtained plethysmogram. Usually the term plethysmogram is a volumetric measurement of an organ & photoplethysmogram is simply an optical way of measuring such volume.

9. LCD: LCD is used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.

10. RS-232: It is use for the serial communication between two devices. In our system communication between microcontroller and PC is done with this RS-232 connector. All the data given by the sensors to the controller is send to the PC by this RS232 connector.

11. Camera & Flash: In our project we use camera and flash for measurement of heart rate in that we place the finger on camera and flash. After placing finger on camera and flash light pass through tissue of the finger. The changes in opacity affects the color of the skin and can be detected either by analyzing average red components of the RGB values of the frames.

Components List

- LPC2148 controller
- ECG Sensor
- EMG Sensor
- LED
- LCD
- Buzzer
- Temperature sensor
- Web-cam
- RS-232 connector

Software's Used

- Proteus 8
- Keil Micro vision 4
- Mat-lab

2. WORKING

1. ECG SENSOR: The following figure shows two complete cycles of a normal ECG waveform.

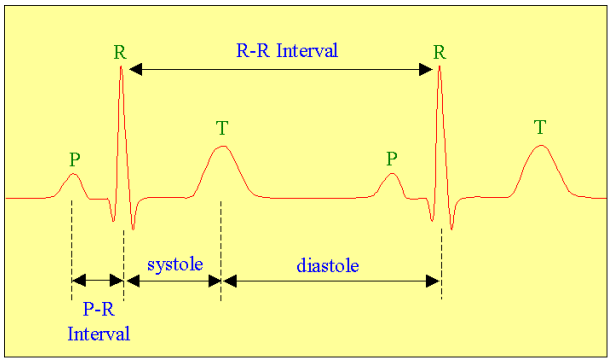

Fig. 2 .Normal ECG waveform

P-wave is produced by muscle contraction of atria.

R-wave marks the ending of atrial contraction and the beginning of ventricular contraction.

Finally, **T-wave** marks the ending of ventricular contraction. The magnitude of the R-wave normally ranges from 0.1 mV to 1.5 mV. A narrow and high **R-wave** indicates a physically strong heart.

The **R-R interval** measures the period of heart beat. Its inverse is the heart rate:

$$HR = \frac{60000}{R-R} \quad (\text{bpm}) \qquad (1)$$

where HR is the heart rate measured in beat-per-minute (bpm), R-R is the R-R interval measured in millisecond (ms). For example, if R-R is 800 ms, the heart rate is 75 bpm. The R-R interval should be relatively constant from beat to beat. A changing R-R interval indicates irregular heart rate.

The P-R interval is a measure of the time from the onset of a trial contraction to the onset of ventricular contraction. It

DOI 10.17148/IJIREEICE.2016.4473

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normally ranges from 0.12 to 0.20 second. An abnormally prolonged P-R interval often indicates a special heart disease called "First Degree Heart Block". The R-T interval represents the ventricular systole (muscle contraction) and the T-R interval represents the ventricular diastole (muscle relaxation).

Suction Cup Sensors: Sensors used here are known as Removable Suction Cup Sensors. Electrodes are attached by small suction cup or adhesive patches. A sensor in the pads detects the electrical activity of your heart. The test is usually performed while you lie still.

Fig3. Removable Suction Cup Sensors

Advantage of choose this sensor is its Price/Performance Ratio , Accurate Measurement , Fast Responses and it is easy to Clean and Repair.

2. 2. Temperature sensor: The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in **o**C) .You can measure temperature more accurately than a using a thermistor. The sensor used LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

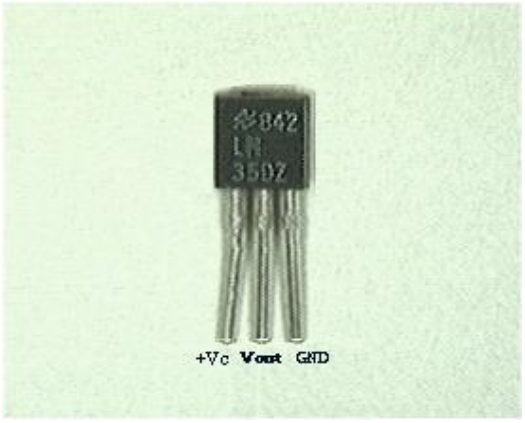

Fig.4. Temperature sensor -The LM35

It has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/ºC The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ºC at room temperature and +/- 0.8 ºC over a range of 0 ºC to +100 ºC. The normal body temperature of human is 37^0C. Sensors senses the body temperature and compare it to the normal body temperature. When patients body temperature high or low to the set point buzzer will be activated.

3. **WEB-CAM:** We use both an embedded system and Webcams to design an embedded monitor system for breath detection (EMSFBD) which monitors and records the patient's breath and sends the information to a PC by serial communication. Our design uses image processing methods to monitor and record human breath fluctuation and to calculate the breath rate. If the breath rate is too low, too fast or if an individual's breathing stops for more than 10 seconds, our design sends out an alarm signal. Webcam are used to capture images and to transmit them to the PC. And by image processing program we can detect chest expansion and contraction to determine the breath rate.

4. **EMG Sensor:** Small electrical currents are generated by muscle fibres prior to the production of muscle force. These currents are generated by the exchange of ions across muscle fibre membranes, a part of the signalling process for the muscle fibres to contract. The signal called the electromyogram (EMG) can be measured by applying conductive elements or electrodes to the skin surface, or invasively within the muscle. Surface EMG is the more common method of measurement and can be conducted by personnel other than Medical Doctors, with minimal risk to the subject. Measurement of surface EMG is dependent on a number of factors and the amplitude of the surface EMG signal (EMG) varies from the µV to the low mV range. EMG signal are dependent on factors such as:

- The timing and intensity of muscle contraction
- The distance of the electrode from the active muscle area
- The properties of the overlying tissue (e.g. thickness of overlying skin and adipose tissue)
- The electrode and amplifier properties
- The quality of contact between the electrode and the skin

Fig 5. EMG Sensor

5. **Pulse Rate:** pulse (heartbeat) detector in heart rate monitors consist of the two parts: a pulse sensing unit and a heart rate displaying unit. Our device uses LEDs and a photo-sensor to measure ones heart rate through the change of blood reflectivity on the index finger. The power transmitted by the LEDs is matched with the photo sensor in such a way that the resistance will vary within the range of the photo sensor after attenuations through the index finger. Since attenuations vary depending on the person using the device, our specifications assume that the attenuation is, 80 percent, on average, of the light transmitted. A resistance network is used with the sensor to transform the changes in resistance to the changes in voltage. The voltage varies between 0 and 10 mV with respect to each heart pulse. Fig. shows a clip sensor which consists of two high intensity LEDs that illuminate the tissue and a Light Detective Resistor (LDR) whose resistance changes according to the amount of light transmitted from the tissue.

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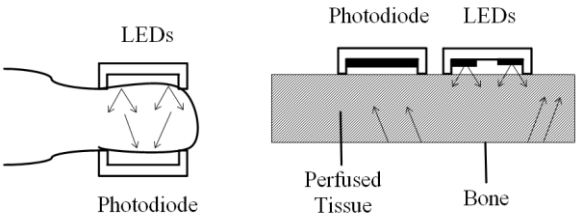

Fig6. Finger positioning on the HRM device

III. ADVANTAGES

- It is portable and reliable system that enables the recording of patient's ECG at home.
- It is small in size. Therefore, it is very portable and easy to use.
- It can control the recorder hardware and get the digitized ECG data from the hardware via serial port.
- Non-contact respiration measurement.

IV. APPLICATIONS

- It enables the recording of ECG at home and development of software to receive the ECG data from the recorder.
- Home health monitoring.
- Patient monitoring in hospital.
- Neonatal non-contact respiration monitoring.

V. RESULTS

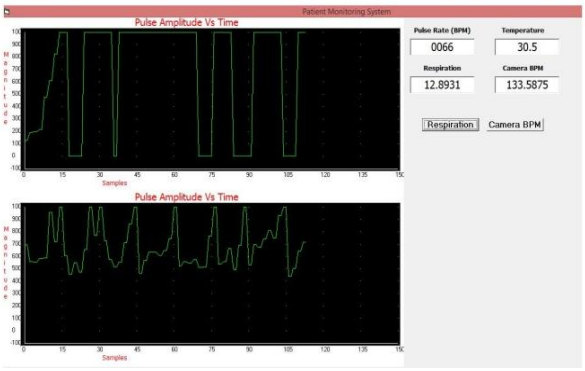

Figure shows the output of parameters which are sensed by the all sensors. The two figures in the output shows the waveform of ECG and EMG. The upper waveform is of EMG sensor and the lower waveform is of ECG which is known as the QPRS waveform. In the right tabs shows the output of pulse oximeter, temperature sensor respiration rate and heart rate count by using camera.

VI. PROPOSED SYSTEM

In this proposed system we are developing patient monitoring system in that we are taken two parts- contact and non-contact. In contact we are going to use the sensors which are to be attached to the patient's body for continuous measurement. In non-contact we are going to use web-cam for the respiration measurement. This will lead to the patients comfort by not attaching the multiple sensors on the patient's body.

VII. CONCLUSION

Patient monitoring system with body sensor network is an effective solution for monitoring home patients. It reduces cost as well as saves times of both doctor and patients. At a time doctor can monitor multiple patients. The different body sensors continuously collect the body parameters and

Immediately transfer it to the doctor. In this way quality of treatment improves. Proposed hardware is able to measure body temperature, pulse rate, ECG, EMG and respiration rate.

ACKNOWLEDGEMENT

We should like to thank **Prof. R.K. Moje,** Assistant Professor Electronics Engineering Department, in PDEA's College of Engineering Manjari, Pune, Maharashtra, India for their useful guidelines. We would also like to thank Electronic department who supported us and helped in implementing this hardware. Finally our thanks to college for providing excellent lab facilities and to our friends who encouraged us to complete this paper successfully.

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