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SMART HEALTHCARE MONITORING SYSTEM USING RASPBERRY PI

Engineering

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ABSTRACT

This project work is based on transmitting the patient's health monitoring parameters through wireless communication. To access the patient's medical parameters in local and remote area, healthcare communication using Internet of Things (IoT) method is adapted. In this paper, monitor patient's heart rate, body temperature, Respiration rate using Raspberry Pi. After connecting Internet to the Raspberry Pi board it act as a server.Then the server is automatically sends data to the web server .Then these parameters are monitor using webpage anywhere in the world using laptops,smart phone etc. For ECG, unlike traditional electrodes, an EPIC sensor is a noncontact electrometer, meaning that there is no direct ohmic path from the outside world to the sensor input.Since the EPIC sensor makes a high impedance contact to the skin, any contact-enhancing substances, such as gel, paste or water, are not needed.

KEYWORDS

Raspberry Pi ,Wireless sensors, ECG, Internet of Things.

INTRODUCTION

Advances in computer and communication technologies give electronic healthcare a great opportunity to design monitoring and alarming units that can be integrated with world. Recently, wireless sensor networks have been adopted for real-time monitoring and alarming in healthcare applications. Therefore, it is useful to integrate medical sensors, embedded systems and smart phone to design an embedded system to provide patient, doctor and medical center with real-time health information to save time, cost and life. Wireless communication technology is considered the best way to deal with emergency situations, especially those related to the human life, where patient's health records such as previous medication history, identification and other information are necessary.

Internet of things (IoT) makes these healthcare remote monitoring systems technically feasible (IoT as the concept of a monitor able and modifiable world in which sensors and actuators over living and non-living objects) and the even decreasing cost of sensors makes it economically feasible. Due to the new inventions of smart mobile technology, it is also expected that population is already prepared to accept this kind of solutions collecting in real time people's private and sensitive data such as temperature, blood glucose, heartbeat, pulse rate sensor etc.

In this paper, monitor patient's heart rate, body temperature, Respiration rate and body movements using Raspberry Pi. After connecting Internet to the Raspberry Pi board it act as a server. Then the server is automatically sends data to the web server. Then these parameters are monitor using webpage anywhere in the world using laptops, smart phone etc. If these parameters are goes to abnormal, it will automatically send alert message to the doctor. In addition, while taking ECG of patient, 12 limbs are connected to our body. So in this project, two Epic Sensors are connected for taking ECG.An EPIC sensor is a non-contact electrometer, meaning that there is no direct ohmic path from the outside world to the sensor input. The electrode is protected by a capping layer of dielectric material to ensure that the electrode is isolated from the body being measured.

PROPOSED SYSTEM

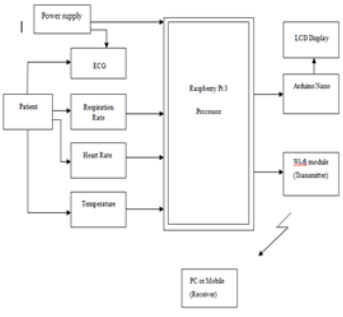

Figure 1: Block Diagram of Proposed System

Heart Rate Detection:-

Heart rate measurement indicates the soundness of the human cardiovascular system. This project demonstrates a technique to measure the heart rate by sensing the change in blood volume in a finger artery while the heart is pumping the blood. It consists of an infrared LED that transmits an IR signal though the fingertip of the subject, a part of which is reflected by the blood cells. The reflected signal is detected by a photo diode sensor. The changing blood volume with heartbeat results in a gain of pulses at the output of the photo diode, the magnitude of which is too small to be detected directly by a microcontroller. Therefore, a two-stage high gain, active low pass filter is designed using two Operational Amplifiers (Op-Amps) to filter and amplify the signal to appropriate voltage level so that the pulses can be counted by a microcontroller. The heart rate is displayed on a 16x2 LCD display. The microcontroller used in this project is Raspberry Pi.

Temperature Sensor:-

LM35 is an analog sensor that converts the surrounding temperature to a proportional analog voltage. The output from the sensor is connected to one of the ADC channel inputs of the PIC microcontroller to derive the equivalent temperature value in digital format. The computed temperature is displayed in a 16×2 character LC D, in both °C scales.
The LM35 series of temperature sensors are produced by National Semiconductor Corporation and are to operate over a -55 °C to 150°C temperature range.

2 X 16 LCD Modules:-

HD44780 based LCD displays are very popular among hobbyists because they are cheap and they can display characters. Besides they are very easy to interface with microcontrollers and most of the present day high-level compilers have in- built library routines for them. The interface requires 6 I/O lines of the microcontroller 4 data lines and 2 control lines.

EPIC Sensor:-

Plessey Semiconductors Electric Potential Integrated Circuit (EPIC) product line targets a range of applications. The PS25255 is an ultra-high impedance solid state ECG (electrocardiograph) sensor. It can be used as a dry contact ECG sensor without the need for potentially dangerous low impedance circuits across the heart. The resolution available is as good as or better than conventional wet electrodes.

The device uses active feedback techniques to both lower the effective input capacitance of the sensing element (Cin) and boost the input resistance (Rin). These techniques are used to realize a sensor with a frequency response suitable for both diagnostic and monitoring ECG applications.

Raspberry PI Development Board:-

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many

applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs. The Raspberry Pi Model B+ incorporates a number of enhancements and new features. Improvement in power consumption, increased connectivity, greater IO are among the major improvements to this powerful, small and lightweight ARM based computer.

Respiratory Rate:-

Respiration rate is measured by thin leads. There are two thin leads in between them. One is from output and one is from input. Input is 5v and when people are breathing then the thin leads under the respiratory moves. The typical respiratory rate for a healthy adult at rest is 12–18 breaths per minute. The respiratory centre sets the quiet respiratory rhythm at around two seconds for an inhalation and three seconds exhalation. This gives the lower of the average rate at 12 breaths per minute.

Wi-Fi Module:-

Espressif Systems Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.ESP8266EX offers a complete and self-contained.

Arduino Nano:-The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

Website For Receiving Parameters:-

According to developers, ThingSpeak is an (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

PERFORMANCE ANALYSIS

Analysis of IOT parameters showed on LCD Display and after showing parameters on LCD then it is shown on website through IOT. So analysis part of hardware is that, when the parameters shown on LCD, then the parameters shown on website should be same.

Figure 2: Parameters shown on display

Now Website which is created, parameters shown on website through IOT:-

Three parameters are shown on LCD which are directly shown without any patient connecting to sensors:-

- Heart rate is 233 bpm(beats per minute).
- Respiratory is 13 bpm(breaths per minute).
- Temperature is 22.87ºc

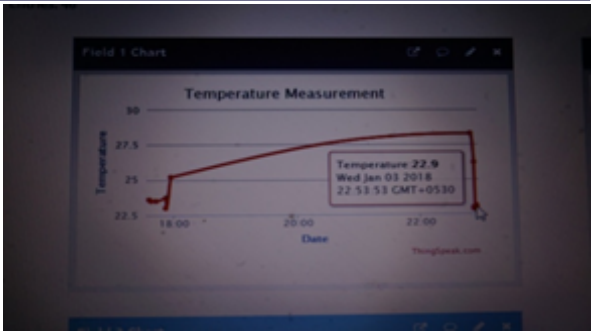

Figure 3: Temperature Measurement

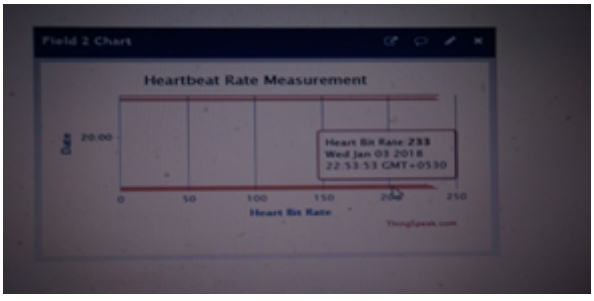

Figure 4: Heart Rate Measurement

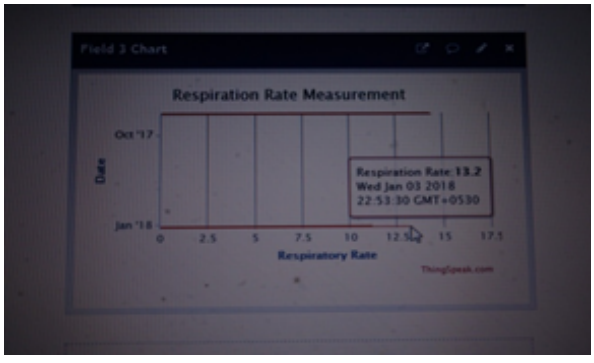

Figure 5: Respiration Rate

As shown on LCD there are readings on website and timing is also approximately same in all three parameters.

Now ECG through Epic sensor:-

Figure 6: Connected Epic Sensor

Above figure shows Epic Sensor are connected to arms for ECG which is shown on DSO.

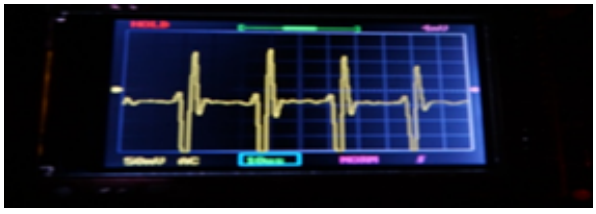

Figure 7: ECG

Database of Different people:-

Normal Range of parameters for Health monitoring:

Respiratory Rate – 12 to 15bpm (breaths per minute)
Heart Rate – 60 to 100bpm (beats per minute)
Temperature - 36º to 40ºc

- **Test Results on various patients:**

1st Person: Temp-40ºc,BPM-90bpm,Resp.rate-13bpm
2nd Person: Temp-38ºc,BPM-78bpmResp.rate-12bpm
3rd Person: Temp-32ºc,BPM-66bpm,Resp.rate-11bpm
4th Person:Temp-35ºc,BPM-200bpm,Resp.rate-14bpm
5th Person: Temp-40ºc,BPM-61bpm,Resp.rate-13bpm

As per the detection of parameters in 4th person bpm is shown 200 i.e. wrong. It should be under 100.Again in 3rd person respiratory rate is shown 11.It should be more than 12.

- By using various location through website:-

Patients	Using PC			Using Laptop			Using Mobile		
	Temp	Heart rate	Resp. rate	Temp	Heart rate	Resp. rate	Temp	Heart rate	Resp. rate
Patient-1	39°c	70 bpm	14 bpm	39°c	70 bpm	14 bpm	39°c	70 bpm	14 bpm
Patient-2	40 °c	55 bpm	13 bpm	39.9°c	55 bpm	13 bpm	40 °c	55 bpm	13 bpm
Patient-3	37°c	90 bpm	14 bpm	37°c	90 bpm	14 bpm	37°c	90 bpm	14 bpm

Figure 8: Patient checking on various location

As the project is tested on different people, sometime it shows error in readings. Parameters coming on website are delayed because of Internet speed. Sometime one parameter gets posted early on website and others get delayed. For ECG, epic sensor is working properly. We can hold the heart wave for watching the ECG of patient. In figure 8 on different various location and different devices had taken for checking the parameters. As there is no change when we are watching on different devices and location.

SYSTEM SPECIFICATION:-

1. Heart beat sensor:Invento INVNT 11
2. Respiratory rate:airflow sensor (breathing) CH-004
3. Temperature: LM35 temperature sensor
4. ECG: Epic Sensor with DSO
5. Raspberry PI:Raspberry Pi 3 model B processor
6. Arduino nano
7. Wi-fi module: ESP8266 wifi module
8. LCD display: 2x16 LCD display
9. Power supply

CONCLUSION

This project concludes that all parameters have implemented for patients using WSN-Temperature Sensor, Respiratory rate, Heart rate detection sensors and ECG through epic sensors. Thus, data sensed by sensor which is sent wirelessly via WSN. The data is updated using Raspberry PI. After connecting Internet to the Raspberry Pi board it act as a server. Then the server is automatically sends data to the web server .Then these parameters are monitor using webpage anywhere in the world using laptops,smart phone etc.

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