ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Health Monitoring System Using Wi-Fi as a Communication Medium on ARM7

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Abstract

Health monitoring systems become a hot topic and important research field today. Research on health monitoring were developed for many applications such as military, home care unit, hospital, sports training and emergency monitoring system. In this work, a portable real-time wireless health monitoring system is implemented using WI-FI and developed. The developed acquisition system is used for remote monitoring of patients' temperature, heart rate and oxygen saturation in blood i.e. pulse oximetry, pH level of blood. This system allows the physician able to understand patient's scenario on the computer screen by wireless module. Here low cost, low power consumption and flexible network topology WI-FI wireless module is used to sense the remote patient data. All sensor data are transferred within a group of WI-FI wireless module. The goal is to demonstrate the possibilities offered by system-on-chip programmable devices in specific processing systems, where the costs make the use of specific integrated circuits unaffordable. The sensor unit consists of (1) temperature sensor (2)two types of LEDs and photodiode packed in Velcro strip that is facing to a patient's fingertip for pulse oximetry and heart beat (3) three color LED with LDR for pH level (4) Microcontroller unit for interfacing with wireless module, processing all biomedical sensor data sending to base PC.

Keywords: Temperature sensor, heartbeat, pulse oximetry, pH level, WI-FI, ARM7.

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, sports training and emergency monitoring system. In this paper, we developed the wearable and real-time monitoring system of some critical vital signs for elderly people, because the people who ages over 60 years old encounter accidental incidents over 60 percent. That system may help doctor or people in family monitor the emergency alarm from patient or elderly people. The vital signs of health status that are the important parameter in health monitoring system consists of blood pressure, heart rate, oxygen saturation, body temperature and respiratory rate. In this work, we consider five parameter of the vital signs which are temperature, heart rate and oxygen saturation in blood, ph level, ECG. The pulse oximetry data helps to prevent and protect the oxygen lack in monitored patient's blood stream. This condition will occurs when the brain does not receive enough oxygen is called cerebral hypoxia. Wireless technology was developed in many applications that becoming a part of human activities such as agriculture, military, medical care, smart home system etc. Distinctly, wireless sensor networks (WSN) play a crucial role in such a monitoring system application, for the reason that WSN can offer some advantages over other types of wireless systems, especially its scalability, power management and flexibility of architecture

This work was focused on the capability of wireless sensor networks as an efficient tool to monitor health in term of all the sensor data for demonstration. This situation makes it difficult to develop and challenge because many applications in WSNs developed for fixing the position of member in wireless personal area network (WPAN). We adopted the wireless sensor WI-FI for using as a real-time health monitoring system on a patient.

Related Work

Wi-Fi Technology

Wi-Fi is famous for low cost, low power consumption and flexible network topology. After power on the total monitoring system the program is loaded in to the microcontroller. Using hyper link terminal in the PC the data from each sensor is perceived. And the received data of a patient at rest room is transmitted to the doctor using WI-FI.

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Temperature Sensor

The skin temperature measurement is done using an integrated circuit, the LM35 temperature sensor. The Sensor gives an analog output depending on the measured temperature. This voltage has to be measured by the microcontroller using a 10 bit Analog-to-Digital converter (ADC). This sensor is mounted within the wrist strap, positioned in such a way that it is in contact with the skin, allowing it to measure the external temperature of the skin.

Heart beat

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, while older children have heart rates at around 90 bpm. The heart rate rises gradually during exercises and returns slowly to the rest value after exercise. The rate when the pulse returns to normal is an indication of the fitness of the person. Lower than normal heart rates are usually an indication of a condition known as bradycardia, while higher than normal heart rates are known as tachycardia.

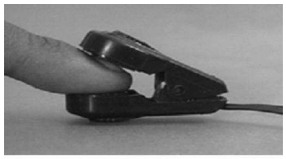

Table 1.AVERAGE HEARTBEAT RATE

AGE	RANGE	AVERAGE RATE
0-1 Month	100-180	140
2-3 Month	110-180	145
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

Heartbeat is sensed by using a high intensity type LED and photo diode. 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 is Very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible.

Pulse Oximetry

The pulse oximetry data are important for doctor to monitor patient's health condition[2,3]. Pulse Oximetry has traditionally be done in two methods: transmittance and reflectance of light. In transmittance pulse oximetry, light is nshone through the tissue using an LED ad is detected on the other end using a photo detector. In contrast, reflectance pulse oximetry uses a photo detector on the same side as the LED to detect the light reflected by the tissue as shown in figure.4.

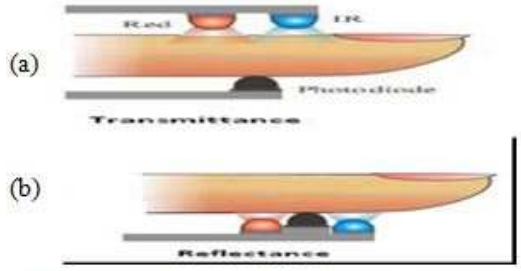

Fig.1(a) Transmittance and (b) Reflectance configure rations of transducer

The data helps to prevent and protect the oxygen lack in monitored patient's blood stream. This condition will occurs when the brain does not receive enough oxygen is called cerebral hypoxia. Moreover, pulse oximetry data can predict the patient's disease and accident situation. Measurement of the pulsatile component would eliminate the variable absorption of light by bone, tissue, skin, pigment, etc from analysis. The most important premise of pulse oximetry therefore, is that the only pulsatile absorbance between the light source and the photo detector is that of arterial blood

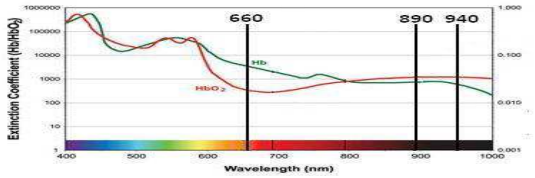

Fig.2 Light absorption characteristics of HbO2 and Hb at different wavelengths

Two wavelengths of light are used; 660 nanometers (red) and 940 nanometers (near infrared). At 660nm, reduced hemoglobin absorbs about ten times as much light as oxyhemoglobin. At the infrared wavelength, (940nm), the absorption coefficient of oxyhemoglobin is greater than that of reduced hemoglobin as shown in Fig.2

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PH level

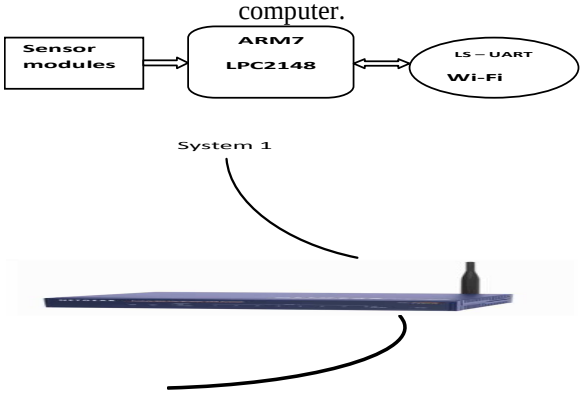
Most living things depend on a proper pH level to sustain life. All human beings and animals rely on internal mechanisms to maintain the pH level of their blood. The blood flowing through our veins must have a pH between 7.35 and 7.45. Exceeding this range by as little as one-tenth of a pH unit could prove fatal. These ph levels measured using three colors LED with LDR. For ph sensor we are using three Led's red, green and blue, one LDR. *LDR color sensor:* A Color sensor using a standard LDR and the RGB Color Model.

One way of building an active color sensor is to use the RGB color model, which defines all colors as an additive combination of the primary colors: Red, Green and Blue. The sensor consists of a normal Light Dependent Resistor (LDR), surrounded by Red, Green and Blue Led's.

The exterior of the sensor is covered in black insulating tape, to cut out all ambient light from interfering with the LDR[4]. This is important, as ambient light can wreak havoc on the readings. The LDR is connected with an appropriate resistance, so as to divide the reference voltage (5V) between itself and the fixed resistor. As the light intensity varies, so does the voltage across the LDR. The key idea is to record the voltage across the LDR when the object is illuminated by one of the three colors, and use that to figure.6 out the color of the object.

System Implementation

The system has been designed to take several inputs to measure physiological parameters of human such as temperature, heart rate, and detection of any fall. The inputs from the sensors are integrated and processed. The results are sent through the Wi-Fi Module to a host computer, which stores the data into an Access Database. The values can then be displayed on the running on a computer.



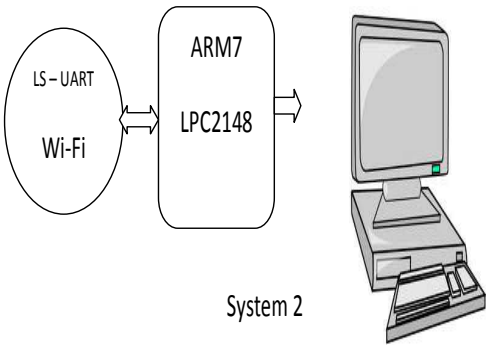
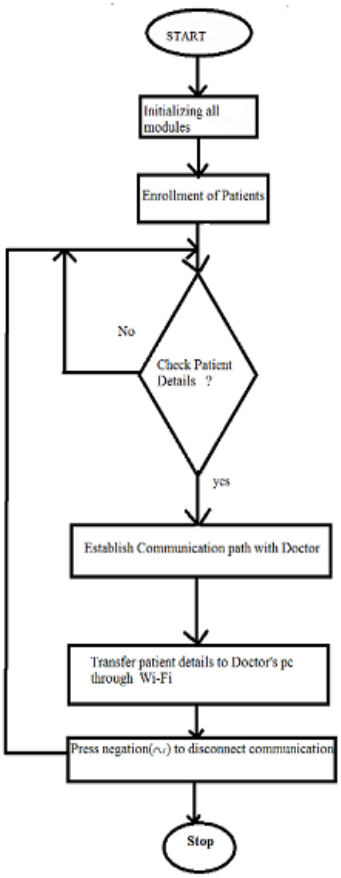


Fig.3 Block diagram of monitoring system

Flow Chart



Results Analysis

By the implementation of portable wireless health monitoring system these are the results we can find using hyper terminal in PC. The Wi-Fi wireless module is used to retrieve data from the remote patient. The first window we can find in the PC is s shown in Fig.4. Select parameter to check the health condition of a patient i.e temperature, heartbeat, oxygen concentration in blood, pH level, shown in Fig..3 there by the instant

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action to be taken by a doctor and the patient life is extended to some period.

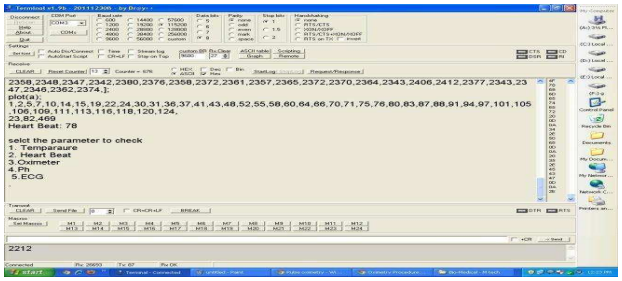

Fig.4.Parameters ready to sense data perceived in PC.

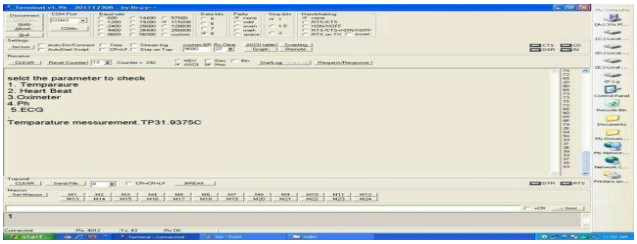

Fig5. Sensed data from temperature sensor.

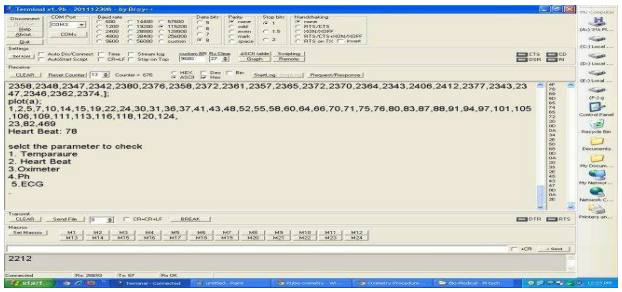

Fig 6. Sensed data from heart beat sensor unit

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Conclusion

This paper presents implementation and design of wireless sensor network for real-time health monitoring system by using WI-FI wireless standard... The maximal throughput of the A/D conversion and the data transmission is about 40 Kbits per second, thus, limiting the applications to low-frequency signals, such as ECG, EMG, and EEG. Further advantage of this device is its low-power consumption, which is attractive for portable applications. Moreover, this part was also layout on a motherboard to increase its mechanical strength. The change of different front-end modules is thus speeded up. We hope that the system should be adapted for minimizing the device's size and allow for daily life usage. We also plan to include other health monitoring module such as; EMG, EEG for completing the system, and we hope that the system should be adapted for minimizing the device's size and allow for daily life usage.

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