IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

Sensing as a Service Model for Pulse Oximeter Supported by Internet of Things

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Abstract: The purpose of this paper is an approach to recognize oxygen level in people's blood. Our method uses SPO2 sensor (Blood oxygen saturation level) and msp432. By using SPO2 sensor to sense oxygen level in the blood and Beer's Lambert Laws to get oxygen level value and that oxygen level value display in LCD. The proposed method require less no of hardware so it reduced the production cost.

Keywords: SPO2, MSP432, Power supply, LCD module, Readings.

I. INTRODUCTION

The pulse oximeter is a medical gadgets that identify the oxygen level in the blood. People need to continually check the oxygen level in the blood while they feel with illness. To identify the oxygen level in the blood is more important because some human body organs will be damaged when the oxygen level is not sufficient in the human body. It is more important to monitor oxygen levels because some human organs like kidney, liver will be permanently damaged because lack of oxygen. People analyze the oxygen level. This section contains information on the pulse oximeter function principle and basic physiology information about blood oxygenation. The sensor spo2 is used for measuring oxygen in the blood. The pulse oximeter can find out oxygen level by using red light and infra-red light. a pulse oximeter comprises of two light sources and a photodetector associated with a signal processing unit.

II. LITERATURE SURVEY

In paper [1], for reducing the power consumption they used pulse oximeter adjustive samples an input signal from a sensor in the absence of overriding conditions. For analysis purpose different sampling mechanisms has been deployed and they used tested individually or in combination .One of the method includes reducing the duty cycle of a drive current to a Sensor emitter, intermittently powering-down a front-end interface to a Sensor detector' or increasing the time Shift between processed data blocks. The internal parameters as well as output parameters has been monitored to trigger or override a reduced power consumption state. In such a way, a oximeter power consumption analyzed without considering high noise conditions or oxygen desaturations.

Similarly, in paper [2], recent invention regarding oximeter has been significant improvised and provides a multifunction's. The number of improvements that could be incorporated into a pulse oximeter probe to detect when a probe has become repositioned from a patient and/or to prevent a probe-off condition. A probe-off condition occurs when the optical probe becomes partially or completely repositioned from the patient, but continues to detect an AC signal within the operating region of the pulse oximeter. In one aspect, the present invention provides electrical contacts that contact with the skin of a patient when the probe is properly connected. In another aspect, the present invention provides a number of louvers placed in front of the sensor's photo detector filter out oblique light rays that do not originate from a point in front of the detector. Accordingly, if the emitter and photo detector are not properly aligned, the photo detector will not produce a signal within the valid operating range of the pulse oximeter. In accordance With a method of the present invention the pulse oximeter can sound an alarm or display a warning which determines that the probe is not properly attached to the patient. Pulse oximeter has been most recommended for general anesthetic.

III. PULSE OXIMETER IMPLEMENTATION

The pulse oximeter is implemented using the Freescale MCU Kinetis K53 which embeds the following key features for the pulse oximetry signal treatment, among other medical oriented applications:

- 32-bit ARM® Cortex™-M4 core up to 100 MHz, bus speed up to 50 MHz
- DSP instructions for signal filtering
- Two Operational Amplifiers (OpAmp)
- Two Transimpedance Amplifiers (TRIAMP)
- USB connectivity as host, device or On-The-Go (OTG)

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- Up to four pairs of differential and 24 single-ended 16-bit ADC channels
- 3 x 16-bit Flex Timer Modules (FTM) with PWM capability

The Kinetis K53 integrates most of the peripherals needed for pulse oximeter implementation, although some external components are required. These components are integrated in an external Analog Front End, described below.

A. MED-SPO2 Analog Front End

MED-SPO2 AFE includes all the necessary external components (except sensor) to implement a pulse oximeter together with the Kinetis K53 MCU. The AFE functional block diagram is shown and described below

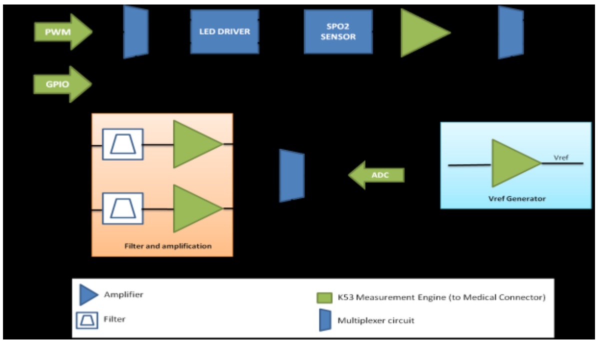

Fig. 1:Front End

B. SPO2 Sensor

The SPO2 sensor is stands for, SPO2 Saturation of Hemoglobin with Oxygen As Measured by Pulse Oximetry. SPO2 defined as a ratio of the level oxygenated heamoglobin over the total hemoglobin level.In pulse oximeter there is two LEDS, one is Red LED and another Infrared LED. The pulse oximeter measure oxygen saturation on the basis of BEER LAMBERT LAW.

C. The BEER LAMBERT LAW

This law states that the linear relationship between absorbance and concentration of species. When the light pass through the finger then on the basis of light absorbance and concentration of species we calculate ratio by BEER LAMBERT LAW and finally get the value of oxygen saturation and heart rate of patient. The PULSE OXIMETER never work without beer lambert law.SPO2 range in between 95-100.

oxygen saturation=hbo2/total heamoglobin.

The heart rate is determined by measuring the elapsed time between peaks of the IR signal.

heart rate=60/periods(sec).

D. Pulse Oximeter MSP432 Board

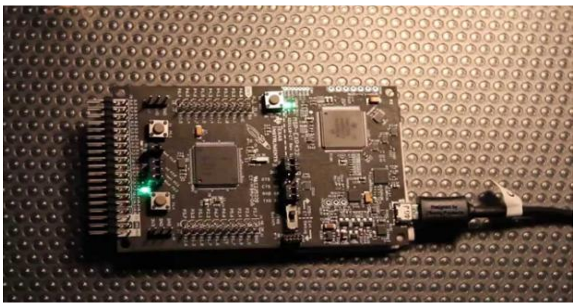

Fig. 2 : MSP 432 Board

The MSP432 Microcontroller is an ultra low power microcontroller, it is very widely used in Pulse Oximeter applications. It is the ARM CORTEX M4 series. It has 32KB ROM and 64KB SROM memory also have 256KB flsh memory. Up to Four 16-Bit Timers, Each With up to Five Capture, Compare, PWM Capability and Two 32-Bit Timers, Each with Interrupt Generation Capability It is an 80 pin Microcontroller consists of 16/32 bit wide timers.

E. 16x2 LCD Display-

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it

DOI10.17148/IJARCCE.2017.6633

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can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Fig. 3 : LCD Display

IV. SYSTEM ARCHITECTURE

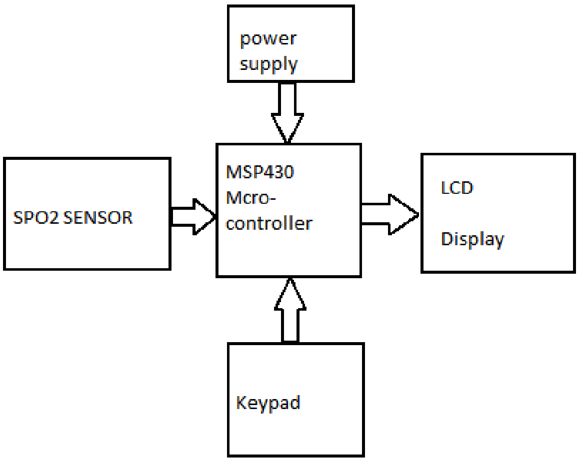

Fig. 4 :System Architecture

A. Sensor Module

SPO2 sensors DB9 pin have connection like 2,3 no pins connected to R and IR sensor. 5,9 no pins connected to photodiode. The sensor emits bio-physical signal on finger and the sensor send the red and infrared led absorbance data to microcontroller.

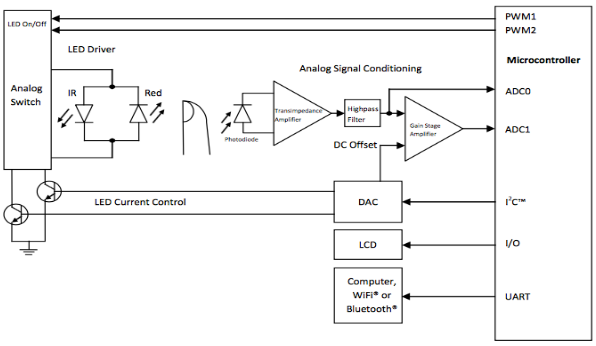

Fig.5: Sensor Module

B. Data Processing Module-

The data processing module contains a MSP432 pulse oximeter board used for processing the signal to calculate oxygen saturation and heart rate.The incoming signals are amplified by using internal op-amps and Microcontroller unit seperates the infra-red and red components and apply beer lambert law on basis of absorbance and concentration calculate ratio.The proposed pulse oximeter consists of pulse oximeter MSP432 board connected to a MSPFET430UIF JTAG Debugger for debugging process.The system require 5v DC power supply .According to the Beer-Lambert law (or Beer's law) which states that there is a linear relationship between absorbance and concentration of an absorbing species. In general Beer-Lambert law statement is usually written as:

$$A = a(\lambda) * b * c \qquad (1)$$

Where A is defined as the measured absorbance, a(λ) is a wavelength-dependent absorptivity coefficient, b is the path length, and **c** is the analyze concentration. When working in concentration units of molarity, the *Beer-Lambert law* is written as:

$$A = \varepsilon * b * c \qquad (2)$$

Where ε is the wavelength-dependent molar absorptivity coefficient with units of M^{-1} cm^{-1}.Data are frequently reported in percent transmission ($I/I_0 * 100$) or in absorbance [$A = \log (I/I_0)$].

C. Display Module-

The system having 16x2 LCD display module.The output of SPO2 sensor and MSP432 microcontroller is display on LCD. Keypad, LCD, SPO2 sensor connected to the MSP430FG439 microcontroller.

V. APPLICATIONS

This section provides about a review of applications of wearable and ambient sensors and systems that are relevant to the field of rehabilitation. The material is organized in five sub-sections devoted to summarizing
applications focused on:
1) health and wellness monitoring,
2) safety monitoring,
3) home rehabilitation,
4) assessment of treatment efficacy, and
5) early detection of disorders.

VI. CONCLUSION

In this project we used Beer's lambert law to get oxygen level and this will show on LCD. This will used two wavelength of light like 990 nm for red light and 660nm for infrared light. Two wavelength are used because the absorptivity of oxy hemoglobin and reduced hemoglobin differ.

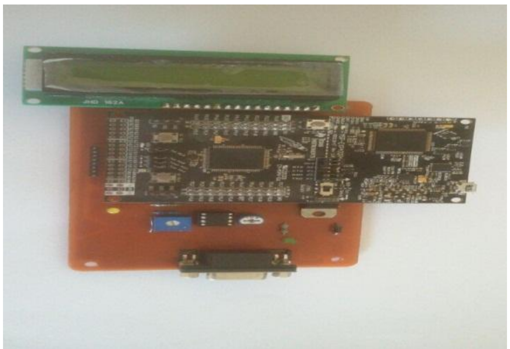

Fig. 6 :Pulse Oximeter

VII. FUTURE SCOPE

In future, heart rate and respiration rate [8] can also be measured by pulse Oximeter along with SpO2 providing further functionality to the project. Also, different sensors like blood pressure sensor and ECG sensor can be added to measure other parameters as well. Further, by integrating GSM with our project, we can send notification messages to a medical expert helping in immediate alert in case of emergencies. Provision of information regarding prescription and reminder for medicine intake can also be included.

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