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SPO_2Monitoring Android mobile App in Telemedicine System

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ABSTRACT

In the present scenario, there are very large numbers of patients in rural areas need good healthcare support services at home. Tele monitoring is a medical practice that involves remotely monitoring patients who are living at remote locations as a healthcare provider. In some emergency case of apatient,it is necessary to monitor continuously vital signs of which are most important such asPulse rate & SPO_2%.Also,this paper presents development of a remote vital sign monitoring system by using a biomedical sensors and microcontroller unit with Wi-Fi module. The main objective ofpresent work is to develop a body Pulse rate & SPO_2% monitoring system in real time by using a smartphone, the system is tested and implemented successfully.

Index terms –*Pulseoxy meter***,** *SPO_2, Wireless health monitoring, Arduino, Android OS.*

I. INTRODUCTION

A healthy body should never fall below 95% oxygen saturation. Oximeters can detect changes as small as 1%. Before oximeters, clinicians would only notice signs of hypoxia (oxygen starvation) when patients' skin literally began turning blue, with oxygen saturation at about 85%. Pulse oximeters were rapidly adopted by anaesthesiologists as the universal standard of care in operating theatres, emergency, recovery and neonatal units and all wards[1].

Pulseoxy meter is based on the fractional change in light transmission during an arterial pulse at two different wavelengths. In this method the fractional change in the signal is only due to the arterial blood itself, and therefore the complicated and non-pulsatile and highly variable optical characteristics of tissue are eliminated.

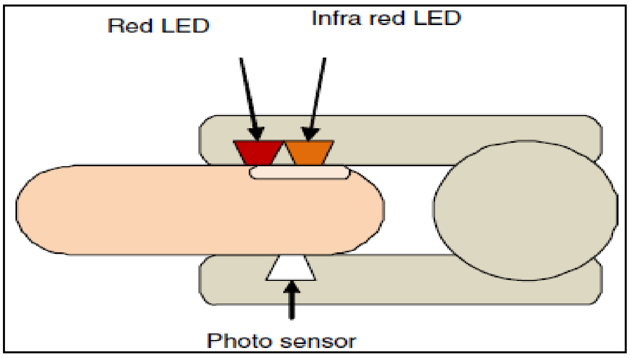

Figure-1: Pulseoxy sensor

Figure-1 shows typical pulseoximeter sensing configuration on a finger. Two light emitting diodes produce beams at red and infrared frequencies (660 nm and 940 nm respectively). There is a photo detector on the other side. The oxygen saturation is estimated by measuring the transmission of light through thepulsatile tissue bed. This is based on theBeer-Lambert law.

II. DEVELOPMENT OF SYSTEM

The block diagram of a remote SPO_2 monitoring system with android app is shown in figure-2 and the system consists of the following units these are

1. Pulseoxymeter
2. ATMEGA328 Controller
3. Wi-Fi module
4. Personal computer
5. Smartphone

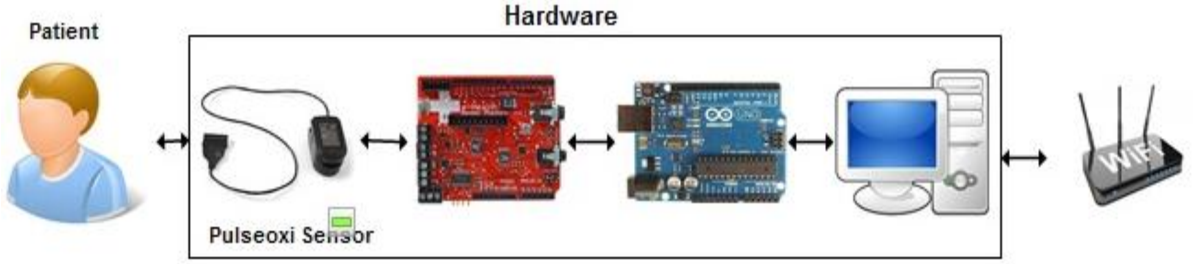

Figure-2: Block diagram of SPO2 monitoring in telemedicine system

2.1.Pulseoxy meter

The Pulseoxymeter is a medical instrument for monitoring the blood oxygenation of a patient. This type of monitoring is especially useful during surgery[2]. This present design report demonstrates the implementation of a single chip portable non-invasivepulse oximeter using the ultra-low power capability of the microcontroller MSP430F5528.

The system requires a pulse oxygen sensor, Analog Front End, Integrated Mixed Signal Microcontroller unit with USB serial link and ATMEGA328P controller. The Telemedicine system can be practically implemented by incorporating the following components. The design consists of hardware and software sections. The Pulseoxymeter device hardware mainly consists of following parts namely

1) Sensor unit
2) Signal conditioning unit- Analog Front End (AFE)
3) Mixed Signal MicroController
4) Output display unit (LCD)

The implementation of the pulse oximeter is by cascading several stages as shown in the figure-3.

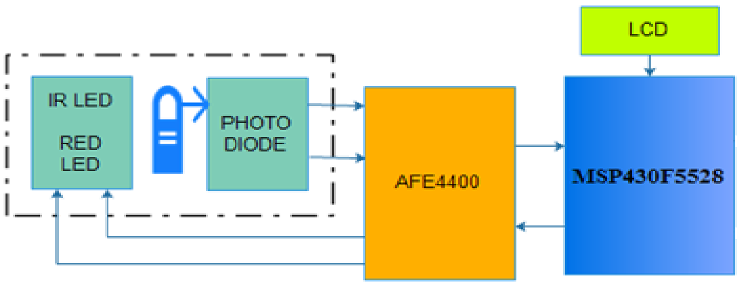

Figure-3: Block diagram of Pulseoxy meter

2.2.ATMEGA328 Controller

The present system Atmega328 microcontroller is used to read the data which is read by the RFID reader and process further. Atmega328 is high performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter.The atmega328p any digital line is used for serial port read and write by software serial command [3]. The serial lines are further connected to the Personal Computer through USB.

2.3. Wi-Fi module

ESP8266 can be used as a wireless network interface card (NIC) in embedded systems that require internet connectivity or device-to-device communication. ESP8266 is a WLAN module supporting IEEE 802. 11 b/g/n standards and operates in 2.4 GHz ISM frequency band. It contains Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor [4].

The use of ESP8266 Wi-Fi module has been increasing in wireless technology and it has potential to offer low cost and gives solution for the users to develop their own networking applications. This Wi-Fi module is suitable for adding Wi-Fi functionality to an existing microcontroller unit via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device. The ESP8266 Wi-Fi module block diagrams in shown in figure-4.

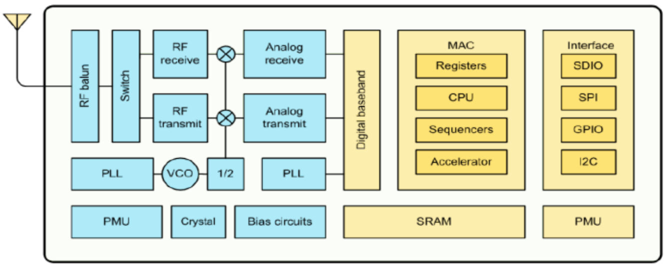

Figure-4: Internal block diagram of ESP8266 Wi-Fi module

2.4. Personal computer

Computer or workstation or laptop acts as a host system for programming, compiling, testing, Personal emulation and debugging to develop and implement the embedded systems.

2.5. Smartphone

A Smartphone based health monitoring system has been presented in this work. By using this system, the healthcare professionals can monitor, diagnose, and advise their patients all the time. The Biomedical sensors like Pulse rate & SPO_2% sensor is interfaced to ARDUINO UNO board which reads sensor data, and this physiological data are stored and published online in Android app[5].

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3. SOFTWARE IMPLEMENTATION

In present work we used ‘C’ and java languages for the development of Pulse rate & SPO_2%measurement system. The ‘C’ programming language is growing in importance and has become the standard high-level language for real-time embedded applications. The PC is the standard computing device for the ‘C’ compiler. The development of C programs for an ATMEGA328 is executing on a PC by using Arduino IDE. The Android App and GUI development for is Telemedicine system implemented in Android studio[6].

3.1. Arduino IDE

In present work The Arduino integrated development environment (IDE) is used to interface biomedical parameter like Pulse rate & SPO_2% sensor. It is a cross-platform application written in C and derives from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. Arduino programs are written in C or C++.

3.2. Android Studio

Android Studio is an integrated development environment (IDE) for developing on the Android platform with Android SDK tools. It is freely available and downloaded easily from internet. It is based on Jet Brains' IntelliJ IDEA software, the Studio is designed specifically for Android development [7]. It is available for download on Windows, Mac OS X and Linux. Hardware’s that support Android is mainly based on AVR architecture platform.

The interface software program is written in Arduino IDE environment and entire APP is developed using Android JAVA backend and front end is developed using XML on Android KitKat 4.4.2 Operating System.

3.3. XAMPP

XAMPP is used in present work for development of Database storage and maintenance of server. XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server – server application (Apache), database (MySQL), and scripting language (PHP) – is included in a simple extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows[8].

3.4. Algorithm of Pulse rate & SPO_2 % measurement system with android App

- To Initialize central processing unit of microcontroller ATMEGA328
- To Initialize Ports, Enable interrupts.
- To Measure Pulse rate & SPO_2%and transfer data to microcontroller ATMEGA328.
- To Initialize the Serial port of the Arduino UNO board.
- Readthesensor data in Arduino UNO serial monitor and receive the sensor data from Arduino UNO and save it to the database server.
- Start receives the sensor data from Wi-Fi and sends it to GUI Android App in Smartphone and exit from the APP and disconnected the serial port connection.

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3.5. Flow chart of Pulseoxymeasurement system with android App

The flow chart of the Pulseoxymeasurement system with Android app is shown in figure-5.

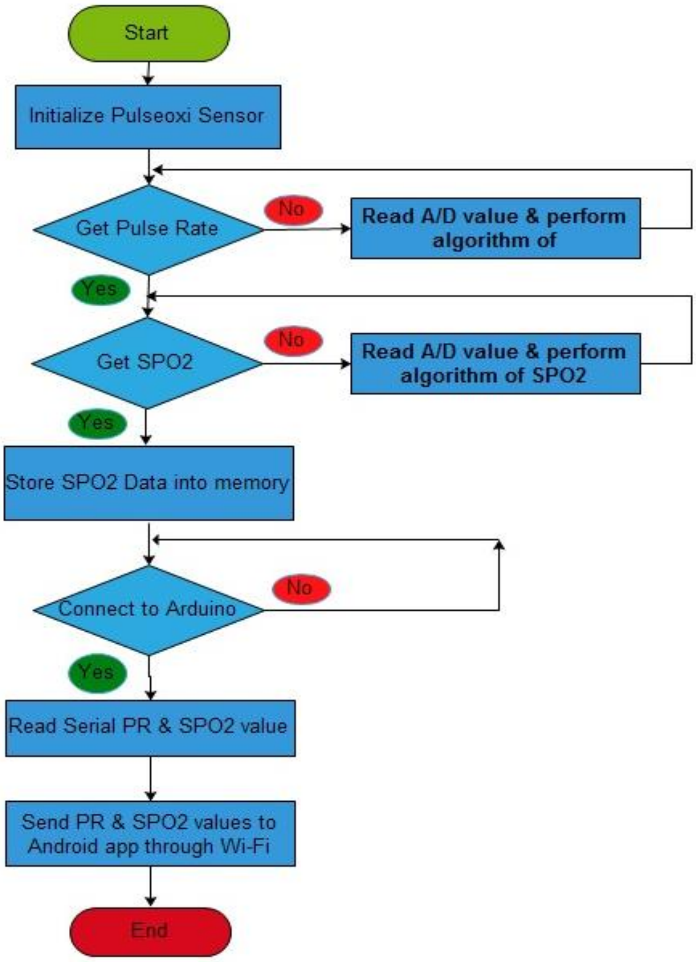

Figure-5:Pulseoxy measurement systemflowchart

IV. RESULTS AND DISCUSSION

Results are obtained using Arduino Uno, Androidand a smartphone. The output of the SPO_2sensor is processed in Arduino Atmega328 controller and send to serial output in PC as shown in Figure-6.

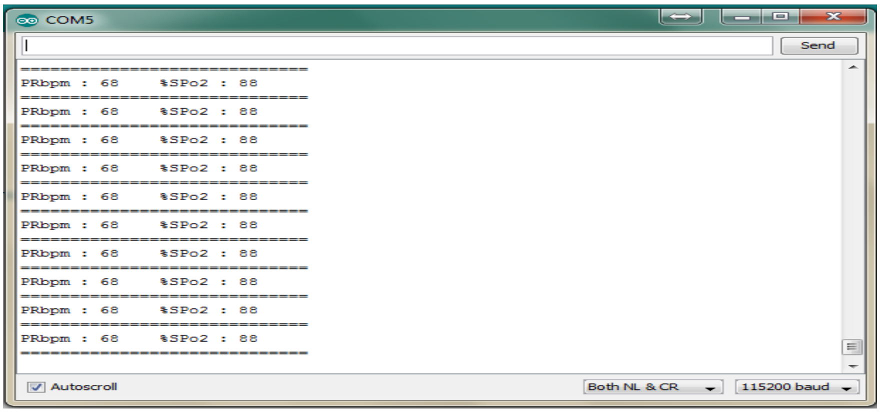

Figure-6: Arduino Uno serial output data of Pulseoxy

Practical tests have been conducted to evaluate the real time performance of the wirelessSPO_2 monitoring system. The main aim and objective of this work is to develop an Android based Patient care Monitoring system with Pulse rate &SPO_2% measurement. Hence an attempt has been made by the author to develop a Pulse rate &SPO_2% measurement system using the advanced micro controller ATMEGA328 and Android development Tools.

The TCP/IP protocol suit is used to communicate between the server and Android mobile device to display the Pulse rate &SPO_2% values on a Smartphone screen in real time. The Pulse rate &SPO_2displayed values on Smartphoneandroid app is shown in figure-7 and the total setup of pulseoxy measurement for telemedicine system is shown in picture1.

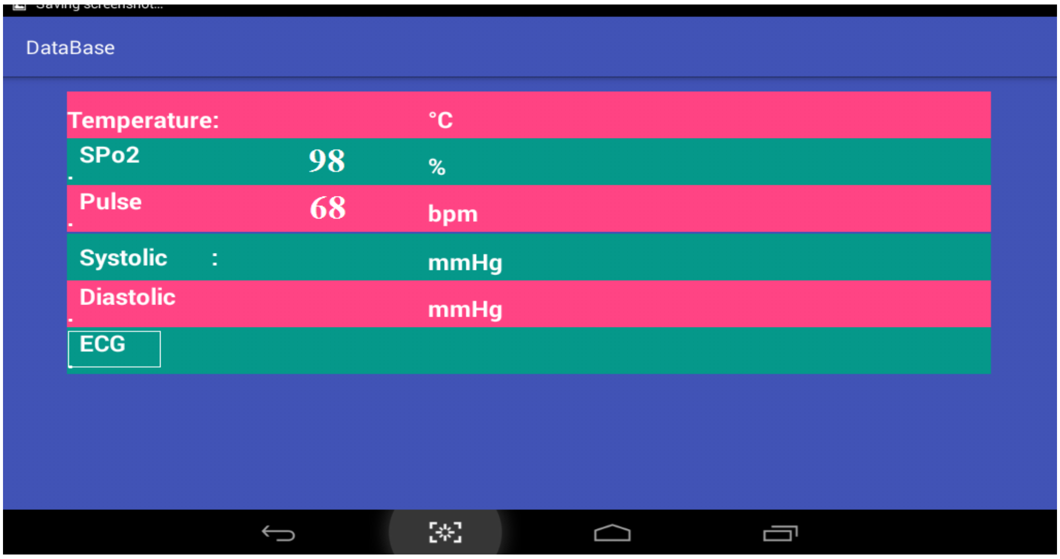

Figure-7: Pulse rate & SPO_2 %display window on smartphone

Picture1:Setup of pulseoxy measurement for wireless Telemedicine system

V. CONCLUSION

The remote Pulse rate &SPO_2% measurement system is calibrated with a non-invasive pulseoxymeter, the system is tested and implemented successfully for the measurement of patient SPO_2 remotely as a part of telemedicine system. The Pulse rate & SPO_2%values measured from the sensor can be displayed on doctors Smartphone andsimultaneously the valuesare saved in database.

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