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GSM Based ECG Tele-Alert System Using LabVIEW to Measure Various Physiological Parameters

Shatabdi Talbar[1], Antara Thombare[2], Pooja Lakkihal[3], D.E.Upasani[4]

Department of E&TC Engineering, Sinhgad Institute of Technology and Science, Savitribai Phule Pune University

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Abstract - *Patient telemonitoring system includes monitoring of patient's physiological parameters from a remote location or within the same campus in optimum time. The various physiological parameters such as Electrocardiogram, heart rate, temperature, and SpO2 are sensed, processed, compared and finally displayed in a graphical user interface. If any of these parameters goes below or above the threshold value then the message will be sent to the registered doctor's cell phone through GSM using MAX232. With the help LabVIEW, all these physiological parameters are displayed in a single window with the patient's personal information like name, age, sex, etc. Hence, this system is economic, user-friendly and provides continuous monitoring in less time.*

Key Words: ECG, Spo2, LabVIEW, Tele-Alert system, GSM, SMS

1. INTRODUCTION

Nowadays, healthcare industry provides better healthcare services to the patients at anytime and anywhere which are very economic and user-friendly. Hence, there is need to improve the patient monitoring equipment and make them more user-friendly. In wired ECG system, the sensed signal is monitored with the huge ECG system and the patient will get a report after some days and thus, the process is time-consuming and complex. The monitoring system can measure only a single parameter. Thus, it will require more time to measure other physiological parameters using different types of equipment. Hence, to reduce time and space, we need to compact the system, make it wireless as well as need to advance the system such that it can measure many parameters. The purpose of this paper is to measure bio-signals of a patient's body and send the values to the authorized doctor's cell phone through SMS (Short Message Service) by using GSM module.

The continuous monitoring of the heart rate is easy to detect the heart-related problems. The other primary parameters such as temperature and Spo2 help to diagnose the patient's health condition. All the bio-signals are in the form of analog signals. LabVIEW is a graphical programming tool which uses icons instead of using text and also displays the result in the waveforms. The LabVIEW software is used to analyze the bio-signals to diagnose the disease. Hence, if there are any abnormalities in the bio-signals then, an alert message is sent to the registered doctor's cell phone and all these signals are displayed on the LabVIEW along with patient's personal information such as Name, Age, and Gender. LabVIEW is a set of tools for acquiring, analyzing and storing data.

2. SYSTEM ARCHITECTURE

In this paper, the proposed system is used to analyze the various bio-signals. The system consists of Pulse oximeter sensor, a Temperature sensor (LM35), Microcontroller PIC16F877A, MAX232, GSM module (SIM900A) and LCD display. The pulse oximeter sensor is used to measure the heart rate of the patient. LM35, a temperature sensor is used to measure patient's body temperature. A 5-volt power supply is required for the working of a microcontroller. The sensed bio-signals from the sensors are displayed on LCD.

If the bio-signals are below or above the threshold value then, this condition is referred as an 'abnormal'. An alert message is sent to the registered doctor's cell phone immediately. The various physiological parameters along with their waveforms are displayed on the PC using LabVIEW software. Hence, the continuous monitoring can save the patient from a disease.

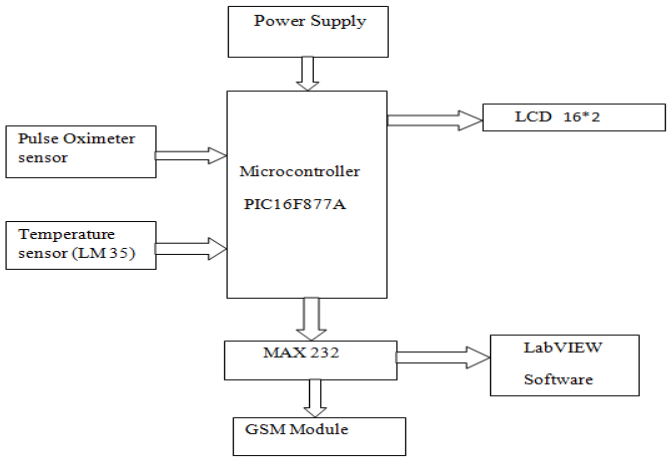

Fig-1: Block diagram of the system

A. Pulse oximeter sensor

The pulse oximeter sensor is used to measure the heart rate by placing it on a fingertip. This sensor works like an IR sensor which consists of two LEDs. One acts as a transmitter and other as a receiver. The IR signal is sent through the finger tip and it reflects back from the blood cells. The IR receiver produces a train of pulses and this is how the heart rate is measured. This signal is amplified by an amplifier and

analog output stays between 0 to 5 volt. The pulse oximeter sensor senses the signal, determines the heart rate and sends the data to the microcontroller PIC18F877A and then displayed on the LCD.

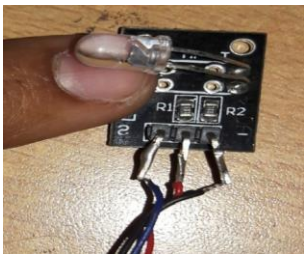

Fig.2: Illustration of Pulse Oximeter sensor

B. Temperature sensor

The LM35 is operated in a range of -55° C to +150 °C. It does not require any external calibration to provide accuracy. It has an advantage as it works in a degree centigrade instead in a degree Kelvin. The LM35 senses the temperature of the signal and sends the value to the microcontroller and then it is displayed on an LCD.

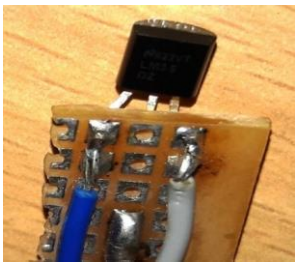

Fig3: Temperature sensor LM35

C. GSM Module

The GSM module SIM900A is a complete dual-band GSM module uses 900MHz with low power consumption and cost-effective.It receives output from MAX232 which is used for serial communication for sending and receiving messages from the patient's body to a doctor.

The different types of commands:

AT+CMGF =set SMS text mode.

AT+CMGS =send SMS command in text mode.

AT+CMGL =list received messages in text mode.

AT+CMGD =delete a received messages

Fig.4: GSM SIM900A

D. LabVIEW

LabVIEW is a Laboratory Virtual Instrumentation Engineering Workbench. It is a graphical programming language which is used to interface real-world signals, analysis of the signals and shares the data and hence, it is used for the patient monitoring system. It uses icons instead of text for processing of signals. The LabVIEW is software which displays various physiological parameters such as temperature, SpO2, and heart rate.

3. SYSTEM DESCRIPTION

The biomedical signals received from sensors such as pulse oximeter which detects the heart rate and SpO2 and temperature sensor LM35 which detects the temperature of patient's body. The microcontroller receives the biomedical signal from the sensors. The received signals are amplified and passed through an analog filter. These signals are converted into digital form by A/D converters which are then easy to process. These signals are displayed on LCD display through microcontroller PIC16F877A. If the sensed signals are abnormal then the message is sent to the registered doctor's cellphone by using GSM module.

If the heart rate is above the threshold value i.e.80 beats per minute then the message displayed on LCD is "Heart rate High" and if it is below 60 beats per minute then it will display "Heart rate Low". Likewise, if the temperature is above the threshold value i.e.40°C then the message displayed on LCD is "Temperature is Excide" and if it is 32°C then it will display "Temperature is Low". The SpO2 measurement is nothing but oxygen level in the blood. Normally, it is 95-99% which is also displayed on LCD as well as on the LabVIEW.

SpO2 measurement:

The SpO2 is the Peripheral Oxygen level in the blood. Oxygen saturation is defined as the ratio of oxyhemoglobin to the total concentration of hemoglobin present in the blood (i.e. Oxy-hemoglobin + reduced hemoglobin). Hemoglobin is responsible for transporting oxygen from lungs to other parts of the body, where the oxygen can be used by other cells. Oxy-hemoglobin (HbO2) is the bright red hemoglobin that is a combination of hemoglobin and oxygen from the lungs. A hemoglobin molecule can carry a maximum of four oxygen molecules. 1000 hemoglobin molecules can carry a maximum of 4000 oxygen molecules; if they together were carrying 3600 oxygen molecules, then the oxygen saturation level would be:

(3600/4000)*100 which is 100% or 90%.

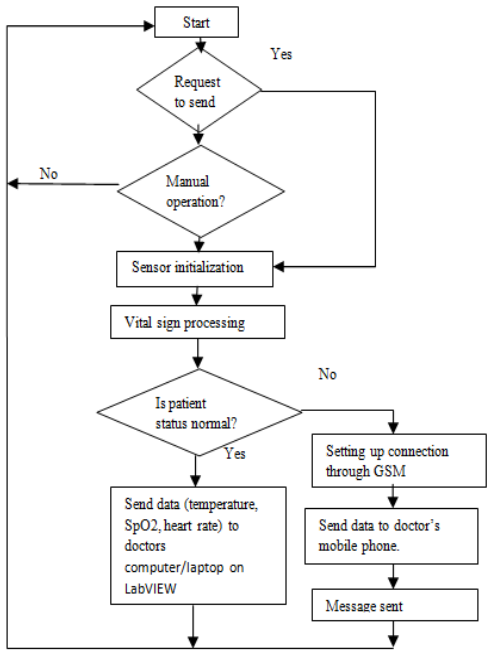

Fig.5: Flowchart of the system

4. RESULTS AND DISCUSSION

The bio-signals are sensed through the sensors are displayed on LCD and analyzed through LabVIEW. The signals sensed by pulse oximeter sensor and temperature sensor LM35 measures the heart rate, temperature, and SpO2. If the heart rate is above the threshold value i.e.80 beats per minute then the message displayed on LCD is "Heart rate High" and if it is below 60 beats per minute then it will display "Heart rate Low". Likewise, if the temperature is above the threshold value i.e.40°C then the message displayed on LCD is "Temperature is Excide" and if it is 32°C then it will display "Temperature is Low". The SpO2 measurement is normally in the range of 95-99% which is nothing but the oxygen level in the blood which is also displayed on LCD as well as on the LabVIEW. The GSM module acts as an alert system which sends SMS to the registered doctor's cell phone via GSM module.

Fig.6: Normal parameters

Fig.7: LCD displaying low heart rate condition

Fig.8: LCD displaying increase in temperature

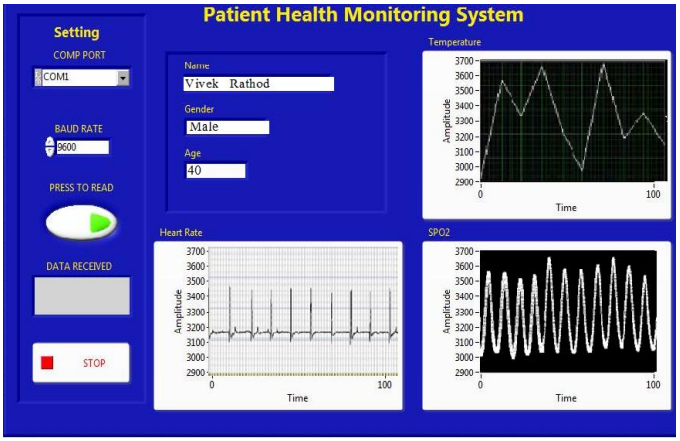

Fig.9: LabVIEW displaying temperature, heart rate, and SpO2

5. CONCLUSION

In this paper, the bio-signals are sensed by sensors are processed, analyzed and displayed on the LCD. If there are any abnormalities present then, it is informed to the doctor by using GSM module. The heart rate, temperature, and SpO2 are analyzed on the LabVIEW software which is installed on the laptop or computer in the form of numerical values and waveform. With the help of this, the time required for the basic treatment reduces and the patient can get the further treatment earlier. LabVIEW also stores the patient's personal information such as name, age, and gender on a single window which reduces the complexity, time and cost.

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