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HEARTBEAT MONITORING VIA BLUETOOTH AND GSM MODEM

S.Sakthivel
UG Scholar
EEE Dept, Dr.Mahalingam college of Engineering and technology (Autonomous), Pollachi 642 003

A.M.Aarthi
UG Scholar
EEE Dept, Dr.Mahalingam college of Engineering and technology (Autonomous), Pollachi 642 003

R.S.Maniverma
UG Scholar
EEE Dept, Dr.Mahalingam college of Engineering and technology (Autonomous), Pollachi 642 003

Dr.B.Vinoth Kumar
Associate Professor,
EEE Dept, Dr.Mahalingam college of Engineering and technology (Autonomous), Pollachi 642 003

ABSTRACT

This paper presents the design of simple heart rate measurement system based on Arduino board which displays and simultaneously transmits the data to a Smartphone via Bluetooth and GSM Module. Here the cardiac activity of the patient is acquired by a pulse sensor and the output of this sensor is transmitted using Bluetooth and the same data is transmitted through a GSM Module. By using this system unlike the conventional method, the doctor doesn't need to be present at the time of measuring the heart rate. The system takes the physical input from pulse sensor by placing the patient's finger on the sensor and then the input is processed by Arduino to count the number of pulses and displaying the output in the Smartphone using a Bluetooth application.

KEYWORDS—*Pulse sensor, Bluetooth module, GSM Modem, LabVIEW.*

1. INTRODUCTION

Now-a-days the development and usage of the mobile systems and wireless networks became prominent. There is an enhancement in telemedicine applications and patient monitoring. Normally, heart rate varies from person to person. Normally, the adult resting heart rate is 60-100 beats per minute and for children's is 70-100 for the age 6-15. This heart rate will not be same for the same person throughout a day. If the activity demands more energy, the pulse will increase and it comes to normal after the activity is completed. The heart rate is a primary element to detect heart diseases. If the heart rate is above 100 beats per minute, it refers to Tachycardia. If the heart rate is below 60 beats per minute, it refers to Bradycardia.

In this paper, a system that is developed which is able to monitor and alert's the doctor regarding the patient's heartbeat conditions. It is advantageous in terms of cost, save time, no complicated settings and even very useful for patient who lives alone. There is a need for wireless transmission of heart rate information to handheld devices that are used by medical practitioners. All recorded physiological signal are stored for medical post-processing. If any critical value of the measured parameters occurs, the doctors can be informed by an automatically sent SMS. Therefore a design is presented to measure and transmit the heart rate.

2. HARDWARE DESCRIPTION

2.1. PULSE SENSOR

Fig 2.1 Pulse Sensor

The Pulse Sensor is the original low-cost optical heart rate sensor (PPG) for Arduino and other microcontrollers. It can be used by students who want to incorporate live heart rate data into their projects. The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front a small round hole, which is where the LED shines through from the back and there is a little square just under the LED. The square is an ambient light sensor. The LED shines light into the fingertip and sensor reads the amount of light that bounces back. The other side of the sensor is where the rest of the parts are get started. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

Fig 2.2 Arduino Board

mounted. Before using the sensor we want to insulate the board from our sweaty/oily fingers. It consists of three pins: +5V, GND and analog output

PULSE SENSOR ANALYSIS

Table 2.1 Pulse sensor readings

	Age	Heartbeat rate(bpm)	Heartbeat rate(bpm) after 10 mins
Person 1	21	75	79
Person 2	22	108	98
Person 3	14	80	85
Person 4	40	82	76
Person 5	21	76	99

2.2. ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to

2.3. BLUETOOTH HC-05 MODULE

Fig 2.3 Bluetooth Module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design / development cycle.

2.4. GSM MODEM

GSM Modem is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT command. The

GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS.

Fig 2.4 GSM Modem

It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet etc... through simple AT commands.

The modem needed only 3 wires (Tx, Rx, GND) except Power supply to interface with Microcontroller/ Host PC. The built in Low Dropout Linear voltage regulator allows you to connect wide range of unregulated power supply (4.2V -13V).

3. SOFTWARE DESCRIPTION

3.1. ARDUINO IDE

Fig 3.1 Arduino platform

Arduino is an open source hardware and software, project and user community that designs and manufacturer's single-board microcontrollers and kits for building digital services and interactive objects that can sense and control objects in the physical and digital world.

To feed the program in the Arduino Board, we have to select the port and board from the Tools option. Then compile the program. If any errors occur, it shows on the screen. After the correction of the program, upload the program to the board. Once the program uploaded, we don't want to upload it again while we testing our project.

3.2. LabVIEW

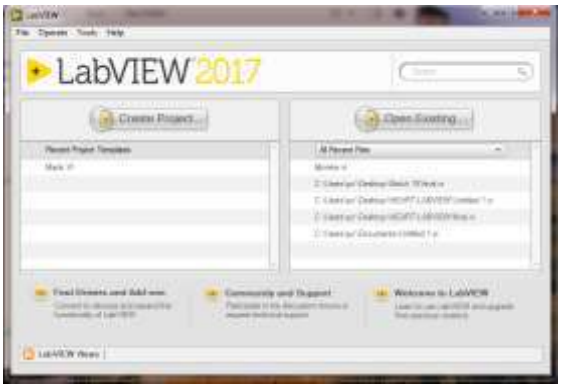

Fig 3.2 LabVIEW Platform

LabVIEW is a graphical programming language**.** Applications developed in LabVIEW are called VI's. VI stands for Virtual Instrument but LabVIEW can be used for much more than virtual instrumentation. LabVIEW is an application development environment for visual programming. The LabVIEW environment is used for creating, debugging and managing applications.

4. IMPLEMENTATION

The pulse sensor has 3 pins. Among them one is connected to A0 in the Arduino UNO Board which reads pulse from the finger tip. Then in the Arduino software, by giving appropriate programming the software give us heart beat rate. The program has to be dumped in the Arduino board by connecting it with the PC. Before that we have to select the board from the Tools option and then by selecting the respective name, it can be saved in the Arduino board for further use.

Now the heart beat rate will be send to the Smartphone by using the Bluetooth module. It consists of 6 pins. Connect the TX and RX pins of the Bluetooth module to the RX and TX of the Arduino board. Also connect the GND and V_{IN} to the Arduino board. To see the heart beat rate in the Smartphone, we have to install the Bluetooth Terminal application in the Smartphone. Switch on the Bluetooth in the Smartphone and then connect it with the HC-05 Module. Then in the application connect HC-05. When we place our finger on the sensor, it shows the heart beat rate in the display.

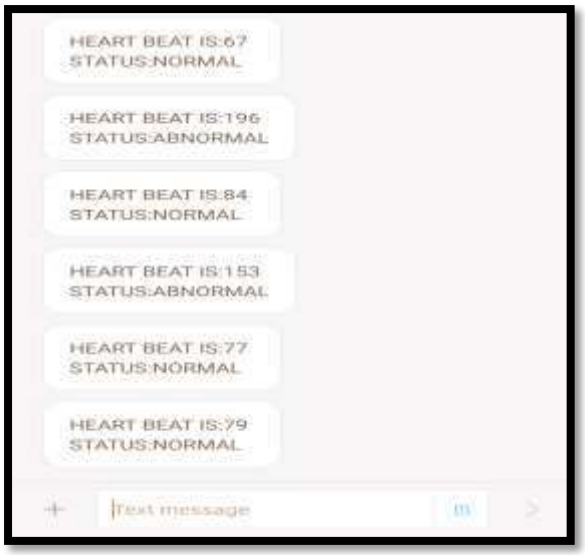

Fig 4.1 SMS about heartbeat rate in the Smartphone

Alternatively, the heartbeat rate is displayed using labview in the PC. In the LabVIEW, the signal received from the sensor is processed and it will display the heartbeat in the waveform. According to the beat, it will intimate us whether the heartbeat is low, normal or abnormal.

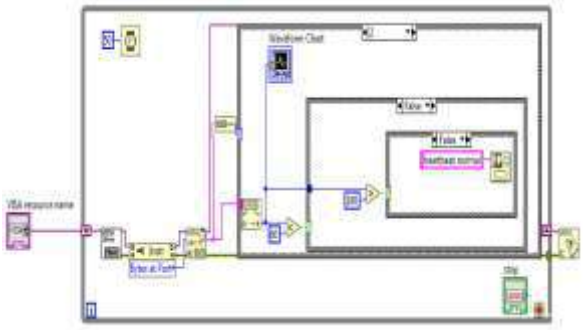

Fig 4.2 LabVIEW process the heart rate

5. CONCLUSION

In this paper, the heart rate measurement and monitoring system using pulse sensor is designed. It also presents a development in Arduino wireless communication and heart rate monitoring system based on SMS for biomedical applications. This system is developed by integration of both hardware and software components. The developed system is to send SMS by interfacing with Bluetooth and GSM Modem using AT commands. This paper can be further modified to obtain the waveform of the heartbeat. This can be stored and compared with the existing signals to obtain the information about the heart condition of the patient.

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