RESEARCH ARTICLE OPEN

User-Friendly Vital Signs Recording System for Home Tele monitoring Applications

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Abstract:

In this paper, an ATmega16 based system for vital signs recording using GSM is developed to measure patient's Heart Rate, Blood oxygen saturation percentage ,Body Temperature & also records ECG in real time. Nowadays people are dying because of various health problems so a device will be designed to keep track on patient which should be easy to use, portable, light weighted, small size so that it gives freedom of mobility for patient. The system is for home use by patients that are not in critical condition but need to be periodically monitored by clinician. At any critical condition the SMS is send to the doctor so that quick services can be provided.

Keywords — **ECG, CHF, Telemonitoring.**

I. INTRODUCTION

Today, most countries are struggling with increased number of patients and increased costs of patient care. This is happened because of unhealthy lifestyle, habits, including stress which increasingly leads to chronic illness such as heart disease even in younger age. Also it is difficult for doctors to monitor particular patient for total working hours. In many critical conditions such as one where patient is located far away from hospital or also in case of old patient who is suffering with heart disease and physical disorders, continuous monitoring of such patient is not possible. Normally it is difficult to keep track on abnormalities in patient itself manually so there must be a system which would help patient to keep track on their health by themselves.

The world has lot of new technologies and new techniques which really helps a lot while designing a new system. The Heart is a two stage electrical pump and the heart's electrical activity can be measured by electrodes placed on the skin. The ECG can measure the rate and rhythm of the heartbeat, as well as provide indirect evidence of blood flow to the heart muscle. Oxygen is integral for countless biological processes. The transport of oxygen throughout the human body is performed by the circulatory system, and more specifically, hemoglobin in red blood cells. Critical medical information can be obtained by measuring the amount of oxygen in blood, as a percentage of the maximum capacity. Pulse oximeter is a medical instrument that can detect heart-rate and oxygen saturation as signatures of our level of health condition. It can be implemented as a small device, and therefore, has been used widely in different applications. The designed Module solves above problems. Module consists of Spo2 sensor, ECG sensor , temperature sensor which measures the blood oxygen saturation, heart rate & body temperature resp.

II. PROPOSED SYSTEM

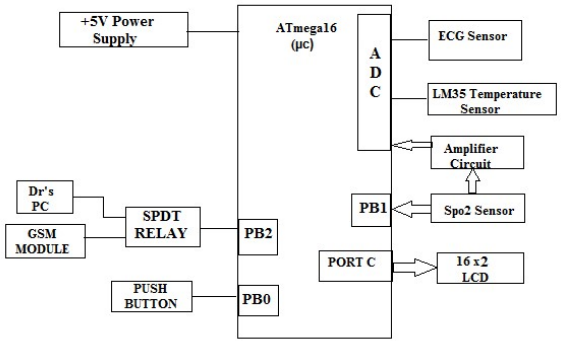

Fig.1Block diagram of System for User-friendly Vital Signs Recording

The system described in the above block diagram is about a monitoring of vital parameters in a hospitalized person requiring constant measurement of his/her blood oxygen saturation levels along with his/her body temperature& ECG. The system is built around an 8-bit microcontroller ATmega16.It makes use of three electrodes to record ECG, LM35 analog sensor to measure body temperature & photoplethysmography technique incorporated in

Spo2 sensor to measure blood oxygen saturation level in non-invasive way i.e., just by contacts and without any needles or blood samples. The system displays the real time values on the 16x4 LCD screen. The system is capable of transmitting the measured values to a distance user by means of GSM communication also it displays ECG plot on Dr.'s PC. To achieve this, the system uses a separate communication module called SIM900 which is interfaced to the microcontroller at UART.

III. COMPONENTS INTEGRATED

A. Temperature sensor

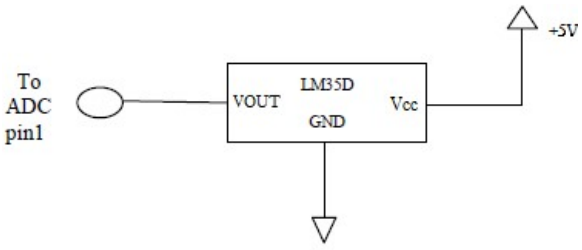

Fig.2 Temperature measurement circuit

LM35 used as temperature sensor which gives voltage variations for changes in the ambience temperature. The pin 2 which is output pin is connected at ADC0 pin of the microcontroller, while the pin 1 and 3 are Vcc and ground respectively.

B. Spo2 sensor

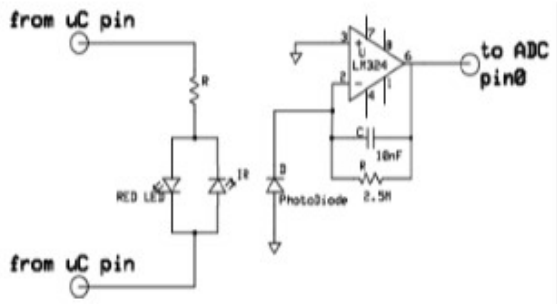

Fig.3 Pulse oximetry measurement circuit

This sensor is useful in making Pulse oximetry, which is a test that measures what proportion of the oxygen-carrying molecules in the blood (called hemoglobin) are actually carrying oxygen. This is known as oxygen saturation or SpO2. One hundred percent oxygen saturation is attained when all hemoglobin in the blood is completely saturated with oxygen. This simple test does not require a blood sample and is called non-invasive. A pulse oximeter is a medical device that indirectly measures the oxygen saturation of a patient's blood and changes in blood volume in the skin, producing a photoplethysmograph. It is often attached to a medical monitor so staff can see a patient's oxygenation at all times.

Internally it consists of IR and Red LED on one side and Light Detector on other side. A finger pulse oximeter is composed of two light emitting diodes (LED) for sensing blood volume and blood oxygen saturation in the finger.

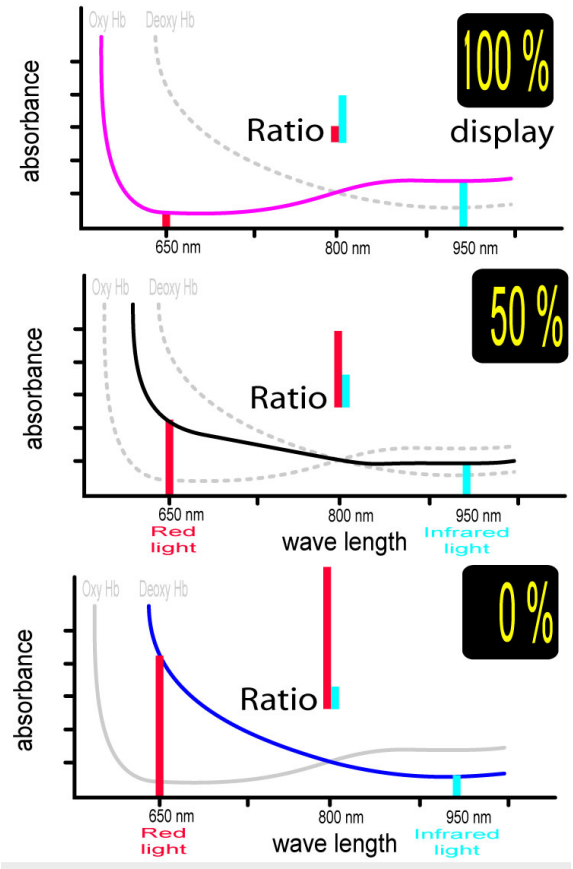

Fig.4 Sensor showing saturation and ratio

At 0% saturation, there is only deoxyHb. The absorbance ratio (i.e. comparing how much red light and infrared light is absorbed) will therefore be same as that seen with the deoxyHb absorbance curve.

At 50 % oxygen saturation, the absorbance pattern is different to when the saturation was 75 %. The ratio of red light and infrared light absorbed is also therefore different and the pulse oximeter uses this to calculate the saturation as 50 %.

At 100% saturation, the absorbance ratio (i.e. comparing how much red light and infrared light is absorbed) will be same as that seen with the oxy Hb absorbance curve.

C. ECG sensor

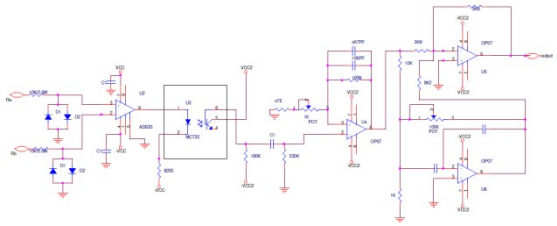

Fig. 5 ECG Recording Circuit

The electrocardiograph (ECG) is an instrument which records the electrical activity of the heart. ECG provides valuable information about a wide range of cardiac disorders such as the presence of an inactive part (infarction) or an enlargement (cardiac hypertrophy)of the heart muscle. Electrocardiographs are used in catheterization laboratory, coronary care units and for routine cardiac diagnostic applications in cardiology.

The ECG Leads:-Two electrodes placed over different areas of heart and connected to the galvanometer will pick up the electrical currents, resulting from potential difference between them.

There are two types of ECG leads as follows,

- Bipolar leads
- Unipolar leads

We are using three electrodes as ECG leads. Two of them will be connected on the body and the third one will be used as ground.

D. ATmega16 Microcontroller

The Atmel's ATmega series microcontrollers are based on RISC architecture, which facilitates single cycle execution for most instructions. Also, the maximum allowed operating frequency of these controllers is 16MHz, thus allowing 16 million instructions execution in a single second @ 16MHz. It has two UARTs (Universal Asynchronous Receiver and Transmitter) hardware which makes it easier to interface it with the GSM modem.

E. LCD Display

Fig. 6 16 x 2 text LCD Display

The LCD display shall be used to continuously display various status/error information in the GSM operation thus making us easy to debug the problems if any. Also, the LCD screen will display the actual real time sensor data. We used 16x4 text LCD screen.

F. GSM modem

Fig. 7 GSM modem

GSM (Global System for Mobile) is an open source system which allows access to code. GSM operates on the 900 MHz, 1800 MHz and 1900 MHz.GSM is now a worldwide standard.
GSM uses Time Division Multiple Access technology as their air interface standard. GSM uses Digital Communication System and is the world's main 2G standard.A GSM module is used for communication between patient and a doctor.

IV. IMPLEMENTATION

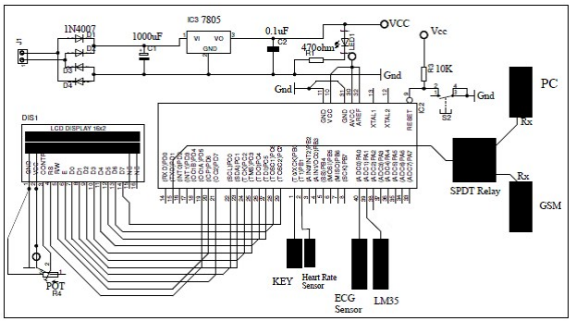

Fig. 8 System Circuit Diagram

V. SIMULATION MODULE

I have used MATLAB software to plot the ECG of patient on Dr's PC. It is an excellent integrating platform for acquiring, processing, and transmitting thephysiological data. I choose MATLAB for the project because of the following reasons:

- It can model and analyze a large data set generated from a variety of measurements coming from sensors.
- It provides very strong data acquisition tools, data analysis tools, and data visualization tools.

The program starts by receiving the readings from the ECG Electrodes connected to the patient's body through wires. The acquired data is then sent to the programming environment (i.e.,MATLABSoftware). The program analyzes and displays the data regarding the ECG and heart rate.

VI. EXPERIMENTAL RESULT

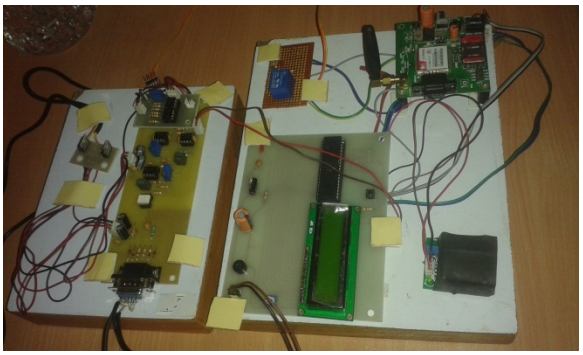

Fig. 9 The Hardware Setup

Fig. 10 Heart Rate and Spo2 % of Patient Indicated on LCD

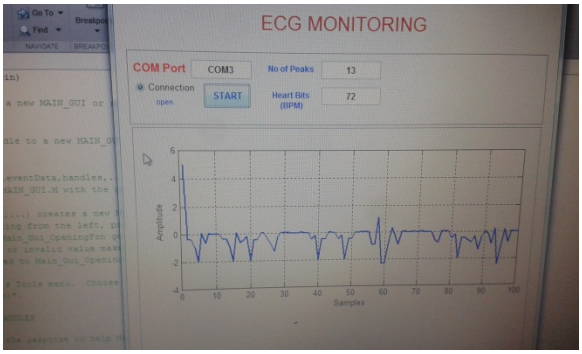

Fig. 11 Patient's ECG acquired and sent to Doctor

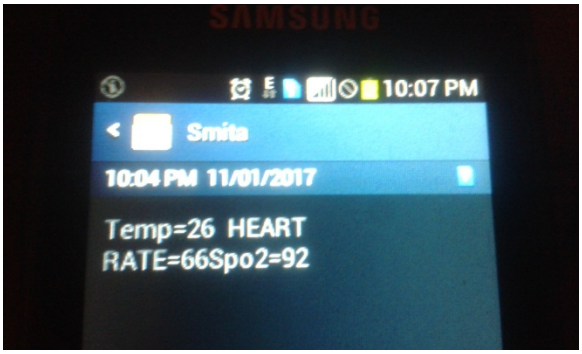

Fig. 12 Message sent through GSM

VII. CONCLUSION

The proposed system fulfills the objective to measure the patient's Heart Rate, Blood oxygen saturation percentage, Body Temperature & also ECG Recording in real time with less expense without using time consuming and expensive clinical pulse detection systems. The system is for home use by patients that are not in critical condition but need to be constant or periodically monitored by clinician. In any critical condition the SMS will be send to the doctor so that we can easily save many lives by providing them quick services.

VIII. REFERENCES

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