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ATmega32 Based System for Blood Oxygen Saturation and Temperature Monitoring

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Abstract: In this paper, an ATmega32 based system for blood oxygen saturation and temperature monitoring using GSM is developed to measure patient's oxygen percentage and body temperature in real time. Two sensors LM35 and thermistor are used to measure temperature and SPO2 sensor is used to calculate oxygen percentage in blood. Nowadays many 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 devices which can be carried everywhere to keep track on patients health. The system is for home use by patients that are not in critical condition but need to be constant or periodically monitored by clinician or family. In any critical condition the SMS is send to the doctor or any family member so that we can easily save many lives by providing them quick services.

Keywords: Sensors, oxygen saturation, temperature monitoring, patient.

I. INTRODUCTION

Today, most countries are struggling with increased number of patients and increased costs of patient care per patient. 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 patient is located far away from hospital or also in case of old patient who suffering with heart disease and physical disorders, continuous monitoring of patient is not possible.Normally it is difficult to keep track on abnormalities in patient itself manually. Body temperature is 37 degree Celsius for normal human being. Patients are not well with manual treatment which doctors normally used for tracking, so there must be a device which would help patient keep track on their health by themselves.

Today the world contains a hoard of new technologies and the various new techniques which really help a lot while designing a new system. Oxygen gas is necessary for human life. It 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. This module deals with solving above problems. Module consists of heart rate sensor and temperature sensor which measures the heart rate and body temperature and sends SMS through GSM module to the medical advisory for the preliminary.

II. PROPOSED SYSTEM

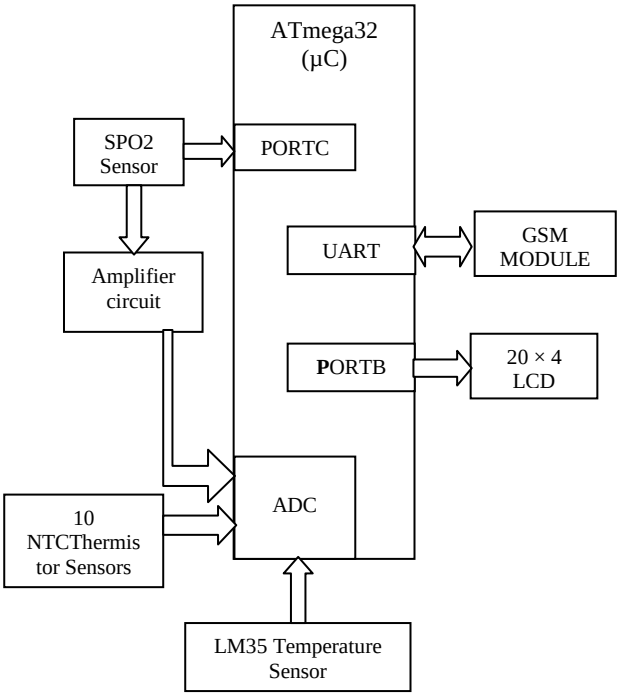

Fig. 1Block diagram of ATmega32 based system for blood oxygen saturation and temperature monitoring

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 levels along with his/her body temperature. The system is build around an 8-bit µC ATmega32. It makes use of commercial probe to measure blood oxygen levels in the patient in non evasive way, i.e., just by contacts and without any needles or blood samples. The room temperature is measured with the use of analog sensor

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LM35.The patient's body temperature is being measured with the use of NTC thermistor of 10k value. The system displays the real time values on the 20x4 LCD screen. The system is also capable of transmitting the measured values to a distance user by means of GSM communication on receiving the request from the user about the same. To achieve this, the system makes use of a separate communication module called SIM900 which is interfaced to the microcontroller at UART.

III. COMPONENTINTEGRATED

A. Temperature sensor

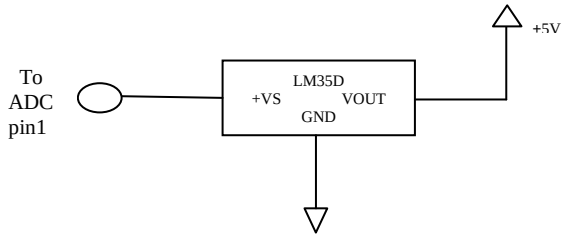

Fig. 2 Temperature measurement circuit

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.

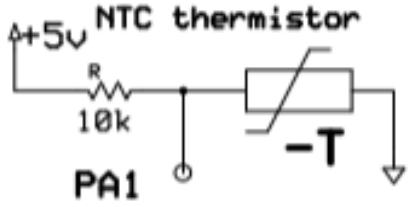

Fig. 3 NTC thermister circuit

Thermistor 10K NTC 1% accuracy, Measuring range -20 to +105 degree celsius, Cable Length 1 meter with 2.54mm pitch 2 pin JST connector. Here, one pin of the sensor is connected to the ground while other is connected to the PA1 (ADC1) pin of microcontroller via a potential divider circuit as shown in the figure above.

B. SPO2 sensor

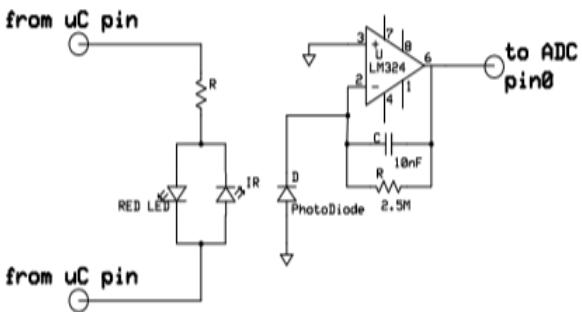

Fig. 4 Pulse oximetry measurement circuit

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.

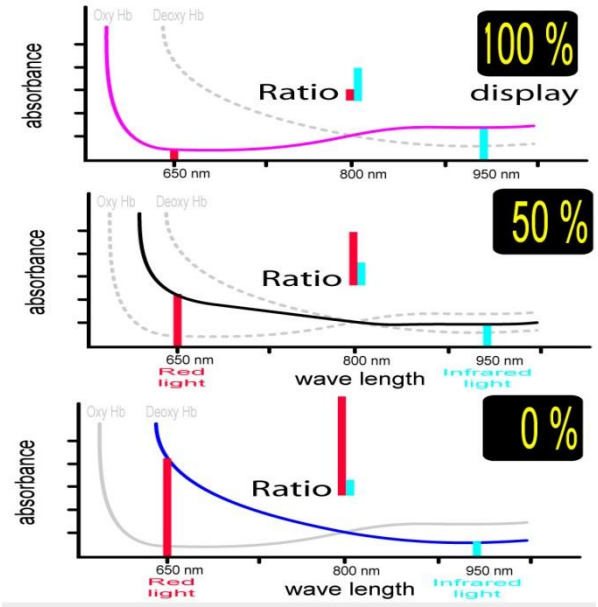

Fig. 5 Sensor showing saturation and ratio

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.

TABLE I: THERMISTOR SELECTION GUIDE

MODEL	R@25^{0}C	10µA RANGE	100µA RANGE
TCS605	5kΩ	-55 to -2^{0}C	-20 to +33^{0}C
TCS610	10kΩ	-45 to +13^{0}C	-8 to +50^{0}C
TCS10KS	10kΩ	-45 to +13^{0}C	-8 to +50^{0}C
TCS620	20kΩ	-35 to +28^{0}C	+6 to +69^{0}C
TCS650	50kΩ	-18 to +49^{0}C	+25 to +92^{0}C
TCS651	100kΩ	-6 to +67^{0}C	+41 to +114^{0}C

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C. ATmega32 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.

D. LCD screen

The LCD screen 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 20x4 text LCD screen.

Fig.6 20x4 text LCD screen.

E. 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 Accesstechnology 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

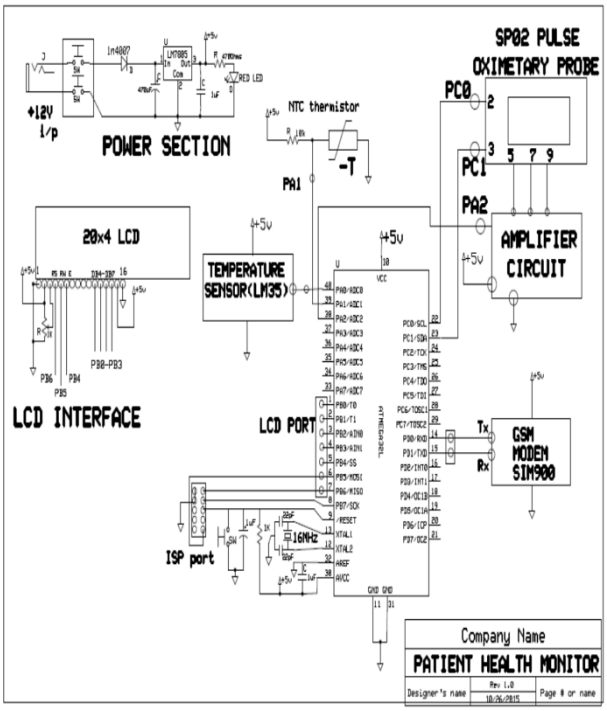

Fig .8 System circuit diagram.

V. EXPERIMENTAL RESULT

The results are displayed on LCD as shown in figure.

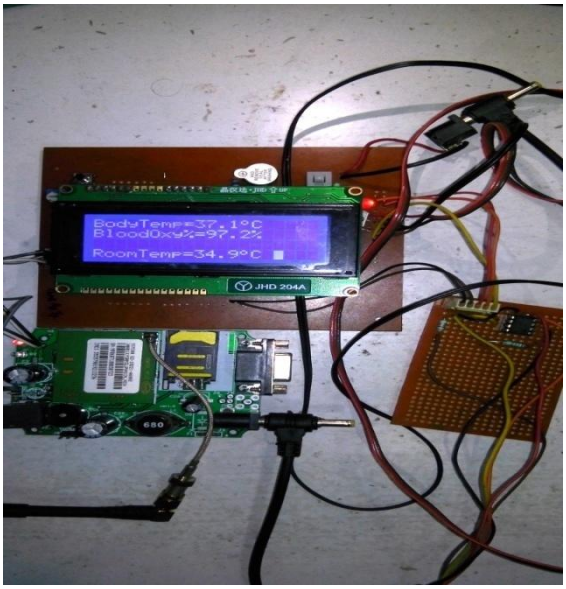

Fig.9 Final assembly of system

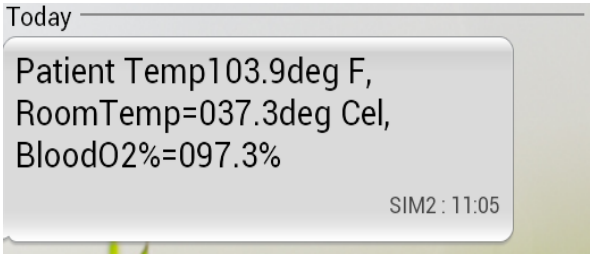

Fig.10 Message sent through GSM

VI. CONCLUSION

The proposed system fulfills the objective to measure the patient's oxygen percentage and body temperature in real timeIf any varied change takes place it is notified. The system is for home use by patients that are not in critical condition but need to be constant or periodically monitored by clinician or family. In any critical condition the SMS is send to the doctor or any family member so that we can easily save many lives by providing them quick services. If the threshold is crossed the message will be send to the numbers saved.

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