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# Low Cost, Wireless Patient Monitoring System with Single Sensor using Arduino and GSM

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***Abstract:*** ***Prototype designed is intended to monitor the patient's condition continuously at a distant place and using a non invasive method to detect three parameters heart rate, body temperature and $SpO_2$. The project comprises of two parts hardware and software. The central and controlling unit of the system is Arduino. The hardware part contains a Liquid crystal Display (LCD), GSM module, Single sensor, Arduino. The sensor units are connected via common data line to ATMEL MEGA328P AU1722 Arduino. A SIM 800C GSM kit based network module, is used. GSM Bands has been used to send alert message. The system is implemented on general purpose printed circuit board (PCB).***
***Keywords: Arduino, Single sensor, GSM module, LCD, SMS***

## I. INTRODUCTION

The continuous improvement of technologies not only helps us transmit the vital physiological signs to the medical personnel but also simplifies the measurement and as a result raises the monitoring efficiency of patients. We presented the design and implementation of a Remote Patient Monitoring system based on wireless technology using a cellular phone, to send an SMS (Short Message Service) to the medical staff. The proposed System combines two commonly used technologies namely, Global System for Mobile (GSM).The system monitors patient's health status, oxygen saturation in blood, heart rate, and temperature. In case, the value for any of these parameters deviates from preset critical values/ranges, the arduino activates GSM module and send data in form of SMS to doctor or nursing staff. This system is used for measuring continuously the values of the patient's important physiological parameters such as body temperature, heart rate, $SpO_2$.

## II. DESIGN OF SYSTEM

This project describes the design of a simple, arduino based heart rate, body temperature and $SpO_2$ level measuring device with LCD output. All parameters of the subject is measured from the index finger using Single sensors and the data is processed using arduino, then averaged and displayed on a text based LCD. The device alarms when the heartbeat, the body temperature and $SpO_2$ level deviates the provided threshold value. This information i.e. the Heart Rate, the Body Temperature and $SpO_2$ level is then transmitted wirelessly to the doctor which in not in the vicinity of the patient through GSM module to doctor's mobile phone via SMS. The sensors measure the information and transmit it through GSM Modem on the same frequency as on which cell phones work.

Brief detail represents the scheme of implemented system

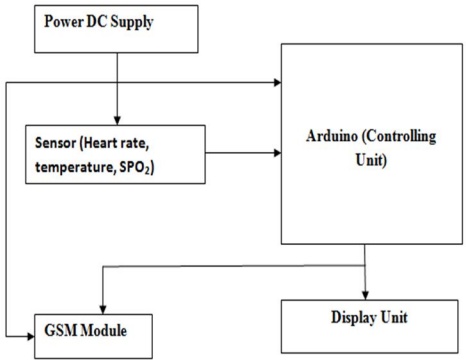



Figure 1.1: Block diagram of embedded system

### *A. Literature Survey*

Papers followed for the implementation of the project are tabulated in the Table-2.1

Table 2.1 Papers referred for Design of project

| S.No | Paper Title | Author | Sensor used | Technology Used |
|---|---|---|---|---|
| 1 | Intelligent Wireless Emergency Alert System for Patient Monitoring using AT89S52 Microcontroller | Yadav Satyendra Satyanarayan, Yadav Raghvendra Satyanarayan | Body temperature and pulse rate | AT89S52 Microcontroller and GSM |
| 2 | Microcontroller Based Wireless Temperature and Heart Beat Read-Out | Nisha Singh, Sr. Asst. Prof. Ravi Mishra | Body temperature and pulse rate | Microcontroller |
| 3 | Intelligent Wireless Patient Monitoring and Tracking System (Using Sensor Network and Wireless Communication) | Ch. Sandeep Kumar Subudhi, S.Sivanandam | Body temperature, BP and pulse rate | PIC16F877 Microcontroller and GSM |
| 4 | RFID-based Hospital Real-time Patient Management System | BelalChowdhury, Rajiv Khosla | N.A | Microcontroller and RFID |
| 5 | GSM BASED REMOTE PATIENT MONITORING SYSTEM | Mrs. M. V. Patil, Mrs. M. S. Cbavan, | Body temperature, BP and pulse rate | Microcontroller and GSM |
| 6 | IMPLEMENTATION OF PATIENT MONITORING SYSTEM USING GSM TECHNOLOGY | Manish M. Patil, Prof. Chaya S. Khandelwal | Body temperature and pulse rate | Microcontroller and GSM |

We have concluded from above research papers that a lot of work has been done in the field of patient monitoring systems. For wireless transmission they have used RFIDs, GSM, IOTs, but bulkiness and cost is the major problem in those systems. So, we have presented a system which is compact (single sensor used for three parameters), wireless (GSM) and cost effective.

## III. METHODOLOGY

The design and development of this project are divided into two main parts which are hardware and software. In the hardware part, the design of the circuit was constructed and the prototype of the project was built. While in the software development, the whole complete prototype was operated via programming codes in the C IDE and Arduino Desktop IDE.

### *A. Hardware Architecture*

*1)* *Arduino* is the main board; microcontroller on it which is ATmega328 is used as the main controller to manage the circuit accordingly

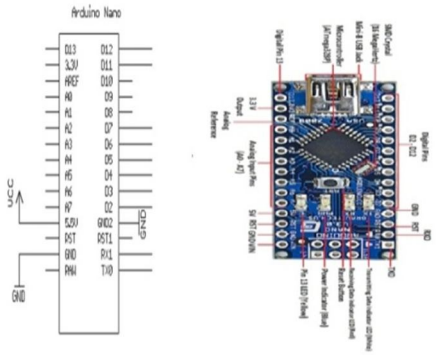
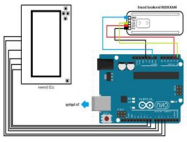



Figure 3.1: Arduino Nano board

*2)* *Single Sensor MAX30100:* In this project we have used a single sensor MAX30100 for measuring three parameters. The MAX30100 is an integrated body temperature, $SpO_2$ and heart-rate monitor sensor solution


Fig 3.2 Single Sensor MAX30100



| Sensor MAX30100 Module | ArduinoNano |
|---|---|
| VIN | 5V |
| GND | GND |
| SCL | A5 |
| SDA | A4 |
| INT | D2 |

Fig 3.3 Interfacing arduino with Sensor MAX30100

The above figure 3.3 shows the pin to pin interfacing of arduino with MAX30100 sensor.

3) *GSM Module,* GSM SIM800C type is selected to carry the task in communication part. SIM800C is a quad-band GSM/GPRS module that works on frequencies GSM850 MHz, EGSM 900MHz, DCS1800MHz and PCS1900 MHz
4) *Interfacing Arduino with GSM:* Communication between Arduino and GSM module is serial. So we are supposed to use serial pins of Arduino (Rx and Tx). Connect the Tx pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to Tx pin of Arduino**.** GSM Tx –>Arduino Rx **and** GSM Rx –>ArduinoTx**.** Now connect the ground pin of arduino to groundpin of GSM module.

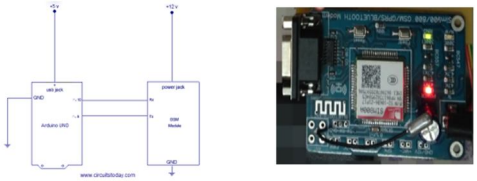


Figure3.4: GSM Module interfacing with arduino

*B. Circuit Diagram*

Circuit diagram shows the connection and interfacing of Arduino Nano board with Single sensor, GSM module, LCD display screen.

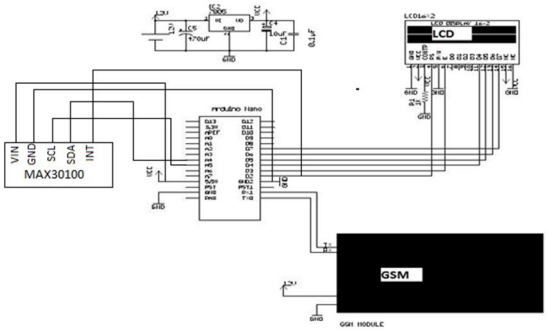



Figure 3.5: circuit diagram

In the circuit the signal starts from the sensor which continuously monitors the three parameters and send signals to the arduino through sensor pins VIN, GND, SCL, SDA, INT of sensor to VCC, GND, A5, A4 and INT pins of arduino and then monitored data is processed in arduino and sent to the LCD display through pins D2, D3, D4, D5, D6, D7 of the arduino in the form of numbers and if these parameter limits are crossed then a signal is sent to GSM module through pins Tx/Rx of arduino to the Rx/Tx pins of GSM module and ultimately a text message is sent to the doctor of the disturbed parameters of the patient.

*C. Software Development*

The software of the project is based on the flow chart in figure 3.6.

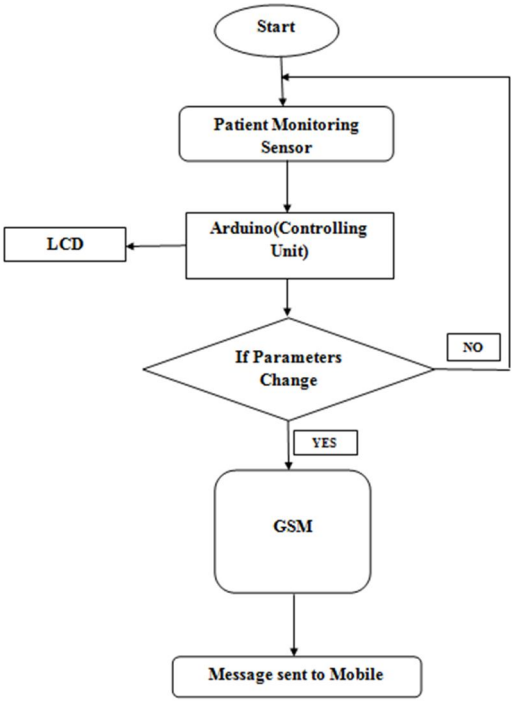



Figure 3.6 Flow chart of complete system

**START**
SENSOR READ PARAMETERS
**ARDUINO** PROCESS DATA
**IF** PARAMETERS EXCEED LIMITS
**GSM** ACTIVATED
SEND **SMS** TO DOCTOR
**ELSE**
CHECK FOR CHANGE IN
PARAMETERS AGAIN

Figure 3.7 Pseudo code for the Project based on the flow chart

## IV. RESULT

A test was conducted to demonstrate and check the working of system. The test was conducted by placing the index finger over the sensor and the following observations were noted.

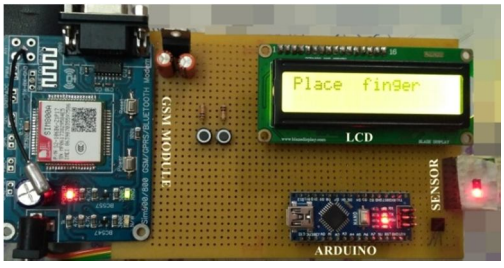



Fig 4.1 System ready to detect the parameters

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When finger is placed over the sensor it start sensing the three parameters and display them over LCD. As soon as any one parameter change the GSM is activated and a message is sent to the registered mobile number.

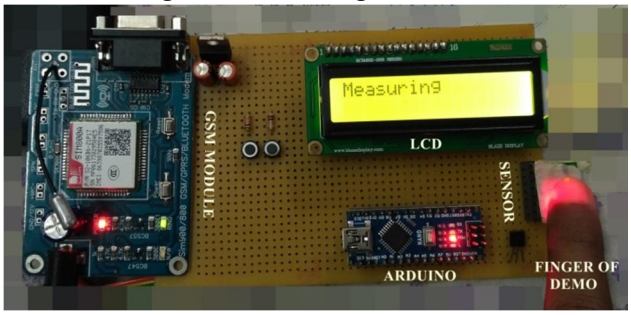


Fig 4.2 Finger placed over sensor

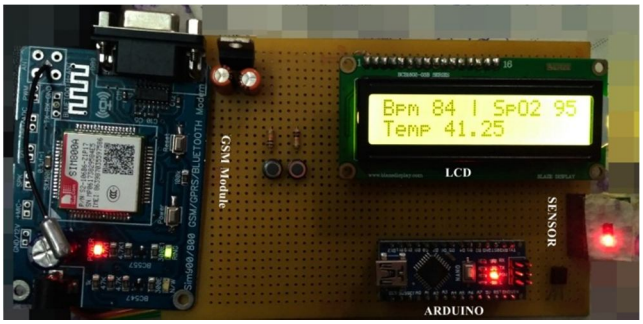


Fig 4.3 Patients information displayed over LCD

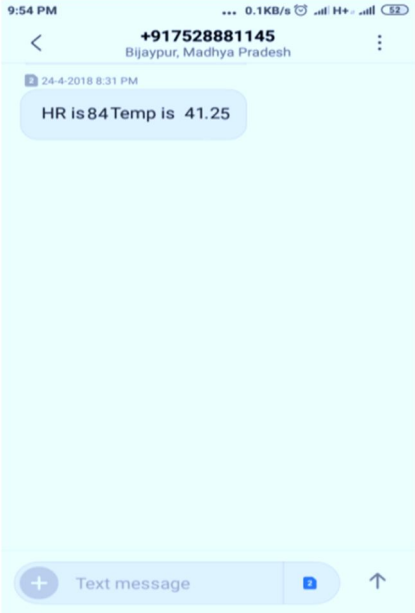


Fig 4.4 SMS alert to doctor

## V. CONCLUSIONS

The prototype built monitors the patient physiological parameters i.e. heart rate, oxygen saturation level and temperature easily and thus increases the efficiency of patient data monitoring. By using this system, we are able to successfully transmit the data i.e. three parameters Temperature, oxygen saturation level and Heart rate from Transmitter side (Patient) to the Receiver side (Doctor or Nursing Station) to a considerable distance and display on the LCD. Hence making presented system a good contender to presently available systems at a comparably low cost and compact in size.

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