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Body Sensor Network

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Abstract- **In the modern day, life keeping track of the health status of the patient at home isn't easy. So our system puts forward a smart patient health tracking system that uses Sensors to track patient health and uses GSM technology to inform their concerned ones in case of any issues. Our system uses ECG, Pulse rate and temperature sensors to keep track of patient health. If the system detects any abrupt changes in patient health, then it automatically sends an alert message to the registered mobile number and it will display all sensor data on LCD. The system is developed for home use by patients that are not in a critical condition but need to be timely monitored by a doctor or family.**

Index Terms— Monitoring, Microcontroller, GSM, ECG, Pulse rate, Temperature sensor.

I.INTRODUCTION

Nowadays, we find old parents are staying at home alone. Since the nursing cost is very high these days it is very difficult to keep a nurse to constantly monitor and investigate their health as well. Moreover there is always a doubt regarding the monitoring process. Thus most of the people suffer from insecurity about their parent's health because they have to depend upon the notification provided by the manual process regarding the health condition of their parents. Thus it would be convenient if there is some process which would send real time health parameters regarding the health condition of the patients to their family members who are staying away without any manual intervention, along with some controlling instruments to facilitate the patients. Monitoring of patient constantly is difficult as doctors cannot monitor only one particular patient for total working hours. There can be many critical conditions such as the patient is located far away from hospital or an old patient who suffering is with heart disease and physical disorders. Continuous monitoring of such patients is also not possible. This module deals with solving the above problem. Module consist of ECG sensor, pulse rate sensor and temperature sensor which measures the electrical potential produced by the heart, heart rate and body temperature respectively and sends SMS through GSM module to the medical advisory for the preliminary precautions so that patient can be prevented from serious situation before reaching to the hospital. For display the measured values of ECG, heart beat and body temperature, LCD is used.

A. Scope

The project if implemented in future with IOT where all real time data can be stored and monitored in IOT server. Hence the system can connect with one hospital server where they can monitor all time about patient health condition and send the precaution. Also the system can connect with GPS module so that an alert SMS can be send with the location.

II. DESIGN METHODOLOGY

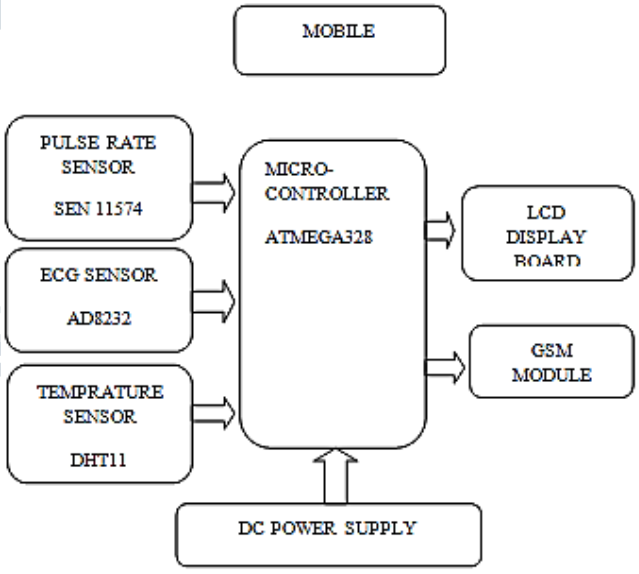

Fig. 1. Block Diagram

A. Working Principle

We propose a wireless healthcare monitoring system for both inpatients and outpatients. The main idea of the designed system is continuous monitoring of the patients over mobile phone using GSM wireless technologies. The model consists of microcontroller, ECG sensor, temperature sensor, heart beat sensor, GSM module and LCD display. In this system for outpatients monitoring, microcontroller collects the data from the sensors and used for analysis (compare with threshold values). We are collecting all sensor data and comparing with threshold value. If each

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sensor values are more than threshold values then the system will send message to predefined number using GSM module. All corresponding sensor data will display on LCD display which is connected with microcontroller as shown in Fig. 1.

III. DESIGN IMPLEMENTATION

A. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 as shown in Fig. 2. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

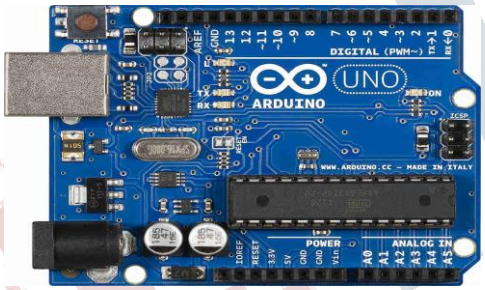

Fig. 2. Arduino

B. Pulse rate sensor (sen 11574)

A person's heartbeat is the sound of the valves in his/her heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

A. Principle of Heartbeat Sensor

The heartbeat sensor is based on the principle of photo phlethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decide by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.

There are two types of photophlethysmography:

Transmission: Light emitted from the light emitting device is transmitted through any vascular region of the body like earlobe and received by the detector.

Reflection: Light emitted from the light emitting device is reflected by the regions as shown Fig. 3.

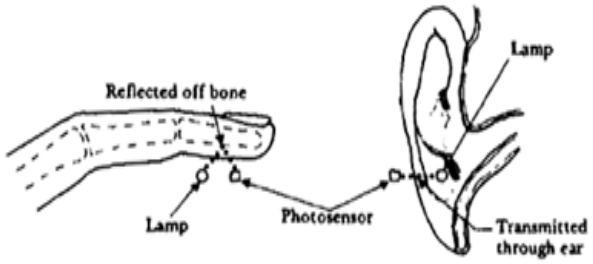

Fig. 3. Transmission and reflection via pulse rate sensor

Working of a Heartbeat Sensor

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate.

This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus the major requirement is to isolate that AC component as it is of prime importance.To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heat beat rate as shown in Fig 4.

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Fig. 4. Heart Rate Pulse Sensors

c) Interface with Arduino UNO Board

Connect the sensor's power supply pins to the arduino board supply pin as Red – 5V, Black – GND and Purple – A0 (analog input 0). This Analog input reading can be displayed in serial terminal of Arduino IDE or it can be drawn as pulse by using Processing IDE as shown in Fig. 5.

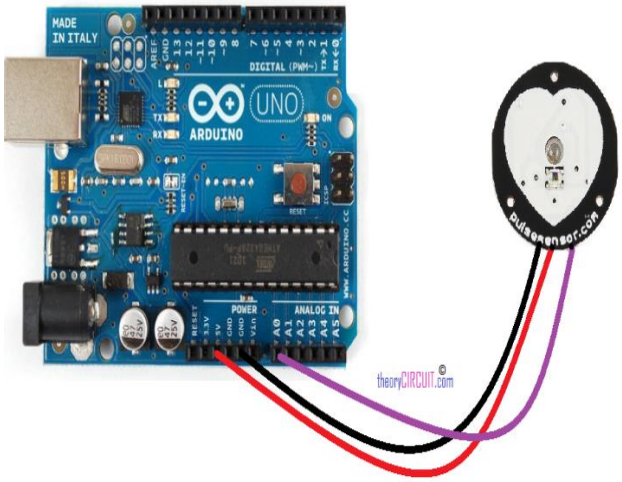

Fig. 5. Arduino Interface with Pulse Sensor (SEN 11574)

Temperature sensor (dht11)

DHT11 digital temperature sensor as shown in Fig. 6 and is a composite Sensor contains a calibrated digital signal output of the temperature. Application of a dedicated digital modules collection technology and the temperature sensing technology is to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement device, and connected with a high-performance 8-bit microcontroller.

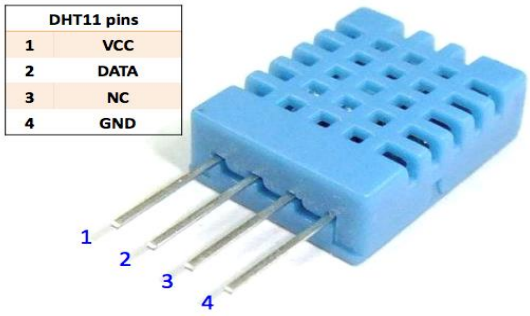

Fig. 6. Temperature Sensor (DHT11)

a) Interface with Arduino UNO board

Connect the ground and the VCC of the DHT11 temperature sensor to the ground and 5v of theArduino.Then connect the data pin of the DHT11 sensor to the pin 2 of the Arduino as shown Fig. 7.

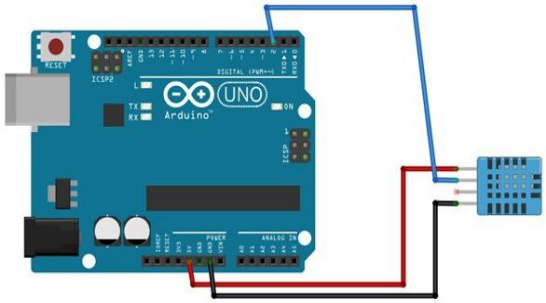

Fig. 7. Arduino Interface with Temperature Sensor (DHT11)

D. ECG sensor(ad8232)

The AD8232 is as shown in Fig. 8 which is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

Fig. 8. ECG sensor (AD8232)

a) Interface with Arduino UNO Board

Connect the GND pin and 3.3v of AD8232 ECG sensor to the GND and 3.3v of Arduino Board
Connect the output pin to the A1 pin of Arduino board
Connect LO- and LO+ pins to the 11 and 10 pins of Arduino board respectively as shown in Fig. 9.

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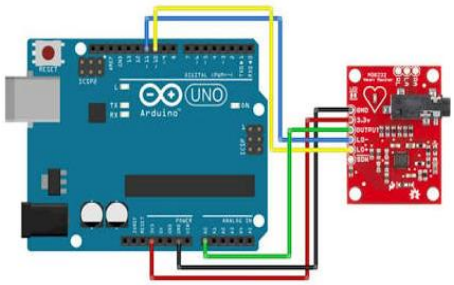

Fig. 9. ECG sensor (AD8232) interface with Arduino Board

b) Interval section ecg

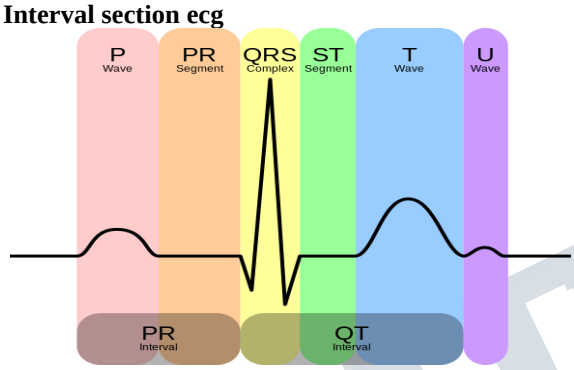

Fig. 10. Interval Section of ECG

PR Interval

The PR interval is the initial wave generated by an electrical impulse traveling from the right atrium to the left as shown in Fig. 10. The right atrium is the first chamber to see an electrical impulse. This electrical impulse causes the chambers to "depolarize". This forces it to contract and drain deoxygenated blood from both the Superior and Inferior vena cava into the right ventricle. As the electrical impulse travels across the top of the heart it then triggers the left atrium to contract. The left atrium is responsible for receiving newly oxygenated blood from the lungs into the left ventricle via the left and right pulmonary veins.

QT Interval

The QT Interval is where things get really interesting. The QRS is a complex process that generates the signature "beep" in cardiac monitors. During QRS both ventricles begin to pump. The right ventricle begins to pump deoxygenated blood into the lungs through the left and right pulmonary arteries. The left ventricle is also beginning to pump freshly oxygenated blood through the aorta and into the rest of the body. After the initial contraction comes the ST segment. The ST segment is fairly quiet electrically as it is the time where the ventricles waiting to be "re-polarized". Finally the T wave becomes present to actively "re-polarize", or relax the ventricles. This relaxation phase resets the ventricles to be filled again by the atriums.

E. GSM MODULE

GSM is a mobile communication modem as shown in Fig. 11. It is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

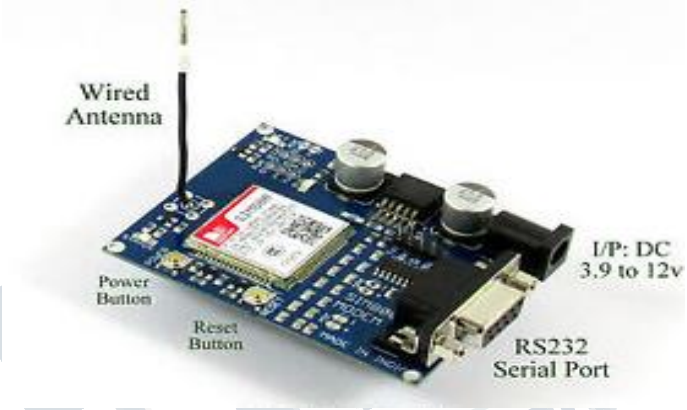

Fig. 11. GSM Module

a) GSM Interface with Aurdino

This part of instructable explains GSM module interfacing to arduino as shown in Fig. 12. Nowadays GSM is used in all the projects for wireless data transmission or alerting or messaging system.

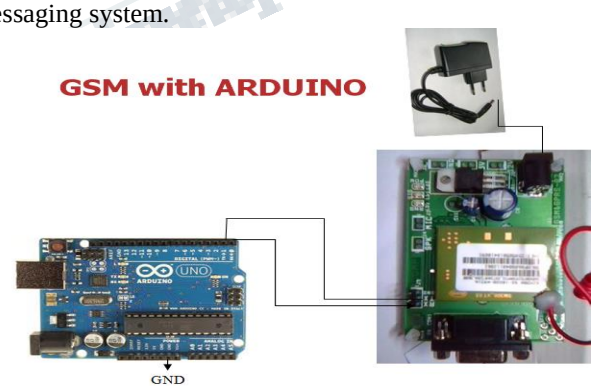

Fig. 12. GSM Interface with Aurdino

1) GSM Module is powered using 12Volts DC adapter.
2) Arduino is powered using USB cable / Adapter.
3) 2nd pin of Arduino is connected to TX pin in GSM module.
4) 3rd Pin of Arduino is connected to RX pin of GSM Module.
5) Arduino GND is connected to GSM GND.

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F. LCD BOARD

LCD (Liquid Crystal Display) screen is an electronic display module as shown in Fig. 13 and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

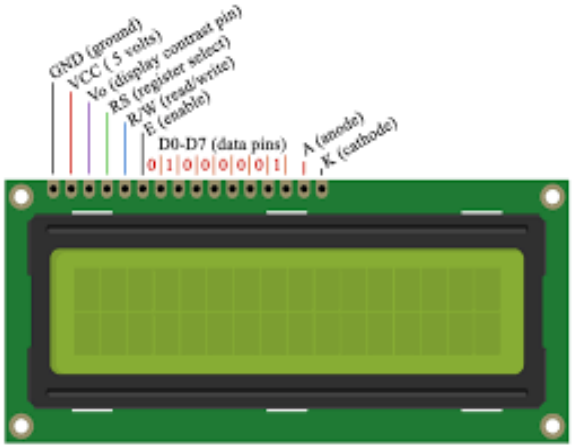

Fig. 13. lcd board

a) Interface of LCD Board with Arduino

Point to point connection between LCD display and Arduino are as shown in the Fig 14:
LCD RS pin to digital pin 12
LCD Enable pin to digital pin 11
LCD D4 pin to digital pin 5
LCD D5 pin to digital pin 4
LCD D6 pin to digital pin 3
LCD D7 pin to digital pin 2

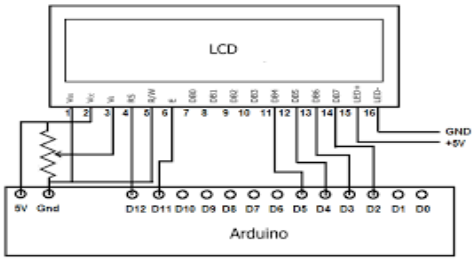

Fig. 14. Interface of LCD Board with Arduino

IV. FLOW CHART

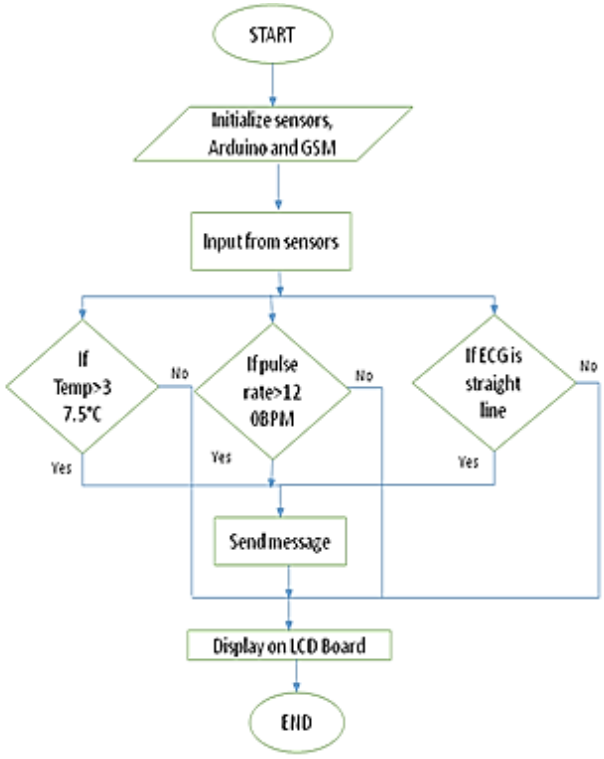

Fig. 15. Flow chart

V. RESULTS OBTAINED

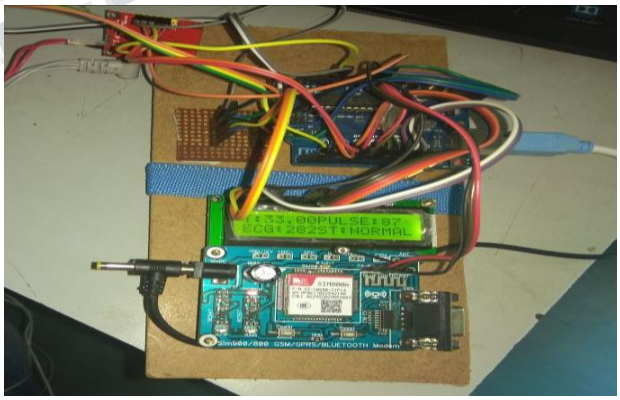

Fig. 16. Outlook of system hardware

Interfacing Pulse Rate Sensor,ECG sensor and temperature sensor with Arduino UNO Board.
Displaying the values of ECG data, Pulse Rate and temperature of a patient in LCD board as well as in computer as shown in Fig. 16.

VI. CONCLUSION AND FUTURE SCOPE

The concept of attending and serving patient from a remoteplace will find a household application. Old people and sickpeople will see a secured life. Family members will also getlot of breathing time. The extent of control can be extendedoverseas as well, where one can control the devices fromthousands and thousands of kilometers apart. The main reasonwhy this project is unique from others is because it providesreal time data to the controller as well as allows the controllerto control those parameters. The pre-existing transmission system is not real time system but this project can be implemented in real time system via SMS and the real time medical data can be safely and surely stored into encrypted electronic storage. This system can also be implemented in ambulance and home application. The project if implemented in future with IOT where all real time data can be stored and monitor in IOT server. Hence the system can connect with one hospital server where they can monitor all time about patient health condition and send the precaution. Also the system can connect with GPS module so that an alert SMS can be send with the location.

VII. ACKNOWLEDGEMENT

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