International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 5 | Issue 2 | ISSN : 2456-3307
DOI : https://doi.org/10.32628/CSEIT195230

Heartbeat Monitoring and Alert System Using GSM Technology

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ABSTRACT

Health related issues are utmost importance to man daily routine, and is essential to his existence and influence and thus he has sought for an improved system that would monitor the changes in health parameters irrespective of time and location and it provides the measures that will forestall abnormalities and cater for emergencies. This works in presents a system that is capable of providing an real time application in monitoring the heartbeat with improvements of an alarm and SMS alert. It is designed in such way that the heartbeat/pulse rate is sensed and measured by the sensor which sense the signals to the control unit for proper processing and determination of the heartbeat rate which is displayed on a LCD, it then proceeds to alert by an alarm and SMS send to the mobile phone of the medical expert or health personnel , if and only the threshold value of the heartbeat rate is maximally exceeded. This system proposes continuous, real time, remote, safe and accurate monitoring of the heartbeat rate.

Keywords : Pulse Sensor, Temperature Sensor, Heartbeat Rate

I. INTRODUCTION

Cardiovascular disease is one of the main cause of death in many countries and thus it accounts for the over 15million death world wide. In additional several million people are disabled by cardiovascular disease. One of the critical inference drawn from epidemiological data is that deployment of the resources for early detection of heart disease as higher potential of reducing fatality associated with cardiac disease than improved care hospitalization. New strategies are needed to reduce time and treatment for the patient on cardiac diseases. Monitoring of patients is one possible solution. And also, the trend towards the modern independent lifestyle of a person also increased in the demand for personalized non-hospital based care. Cardiovascular disease has shown that heart beat rate plays a major role in the risk of heart attack. There are many Heart disease such as heart attack, coronary heart disease, congestive heart failure, and congenital heart disease which leads cause to death for both men and women in many countries. Most commonly, heart disease are majorly harmful for the elderly person. They live with their own lifestyle and not willing to monitor them for 24 hours a day [1].

The heart beat and temperature of patients are measured by using sensors as analog data, which is converted into digital data by analog to digital

converter (ADC) which is suitable for wireless transmission using SMS messages through GSM modem. Micro controller device uses temporary storage for storing the data used for transmission [2]. For a patient who is already diagnosed with fatal heart disease, their heart rate condition has to be monitored continuously. This project is mainly focused on the design of the heartbeat monitor System that is able to monitor the heart beat rate condition of patient continuously. The signal processed using the microcontroller to find the heartbeat rate and it sends the alert message by SMS if any emergency to medical expert or patient's family members. The remote heartbeat monitor can be used in hospitals and also for patient who are in critical condition while travelling long distance where it continuously monitors the patient condition.

II. RELATED WORK

In the work "Heartbeat monitoring alert via SMS" [4], the heart beat rate is detected using photoplethysmograph (PPG) technique. The heartbeat signal is processed by PIC16F87 microcontroller to determine the heart beat rate per minute. Then, SMS alert is send to the mobile phone of medical experts or patient's family members, or their relatives via SMS. Thus, doctors can monitor and diagnose the patient condition continuously and could suggest earlier precaution for the patients themselves. This system will also alert the family members quickly to attend the patient. PPG is a low-cost optical technique which is used to detect blood volume changes in the micro vascular bed tissue. Most commonlly, it is used in non-invasively to make measurements in the skin surface. A PPG is obtained by pulse oximeter that illuminates the skin surface and measures the changes in light absorption. A PPG tools uses an emitter-receiver pair which is used to determine the blood flow. It consists of a matched infrared emitter and photodiode, which transmits the changes in infrared reflectance results in varying the blood flow. A heartbeat sensor circuit is adopted by PPG technique which is designed by MPLAB software. Making a monitoring system which is cost effective and flexible, and works as "A Low Cost Optical Sensor Based Heart Rate Monitoring System" [5], was conceived by researchers. It proposes the implementation of a single Microcontroller based heartbeat rate measuring device that integrates most the key features of the aforementioned devices and its models. The device is compact in size and energy efficient, and it is portable, capable of storing the data and well suited for communicating with an external remote device by connecting with bluetooth and cellular communication in case of a medical emergency. The device is based on a single Microcontroller chip which utilizes the changes in amount of reflection of light sensed by a photo transistor. The reflected light is sensed by photo transistor. Signal received by the photo transistor are considered to be very weak and perturbed by high frequency noise.

This signal is processed in Microcontroller, which eliminates undesired noise in the human body. The signal level must be raised to a satisfactory level so that the spikes coming from the transistor every time the heart beats can be distinguished by the Microcontroller. After the noise being properly recognized, the signal is send into the Microcontroller where the data processing is done which converts the analog signal to digital signal. This device is developed with significant operational conformity with its commercial counterparts. The device is designed in such a way that it can be automatically responded during medical emergencies via Bluetooth and cellular communication. It can store huge amount of data and can also be made portable.

In the word titled as "Microcontroller Based Heart Beat Monitoring and Alerting System" [6]. It explains how a single-chip microcontroller is used to analyze

the heart beat rate of a person in real-time. In addition, it allows doctors to get the heart beat and location of the patient by GSM every twenty four hours. It can also be used in controlling the patient's health issues or athletic person health cares over a long period. The system reads stores and analyses the heartbeat repetitively in real-time. Both the hardware and software design are made in a single-chip microcontroller-based system, hence the size is minimized. The hardware design is based on an embedded system implementation using the PIC16F877 (a 40 bit) microcontroller from microchip.This system consist of Microcontroller (PIC16F877A), heart beat sensor, GSM modem, GPS receiver.

In order measure the Heartbeat rate, the input are taken from the finger of a person. Heart beat sensor will generate digital pulse corresponding to each beat. This pulse is counted by interfacing heart beat sensor to microcontroller to pin no. 15(TICKL) and programming the microcontroller in counter mode. After counting of pulse for one minute, value of heart beat will be displayed on LCD and if value is beyond the normal range then the patient location will be automatically messaged to doctor or health attendant using GSM.

III. WORKING PRINCIPLE

a) TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-9Vand 15-0-15) level. If the secondary has less turns in the coil then the primary, the secondary coil's voltage will decrease and the current or AMPS will increase or decreased depend upon the wire gauge. This is called a STEP-DOWN transformer. The secondary potential transformer will be connected to the rectifier.

b) BRIDGE RECTIFIER

1. When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input is given to the circuit which is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.
2. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. The positive potential at point A will be forward bias D3 and reverse bias D4.
3. The negative potential at point B will be forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow the current to pass through them; D4 and D2 are reverse biased and will block current flow.
4. The path for current flow is from point B through D1, up through Load, through D3, through the secondary of the transformer back to point B.
5. One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through Load, through D2,through the secondary of transformer, and back to point A. across D2 and D4. The current will always flows through Load in the same direction. In flowing through this Load the current will develops a voltage corresponding to that. The current flows through the load in both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier
6. One of the major advantage of a bridge rectifier is a conventional full-wave rectifier is with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional half-wave circuit.
7. This bridge rectifier always drops 1.4Volt of the input voltage because of the diode. We are using

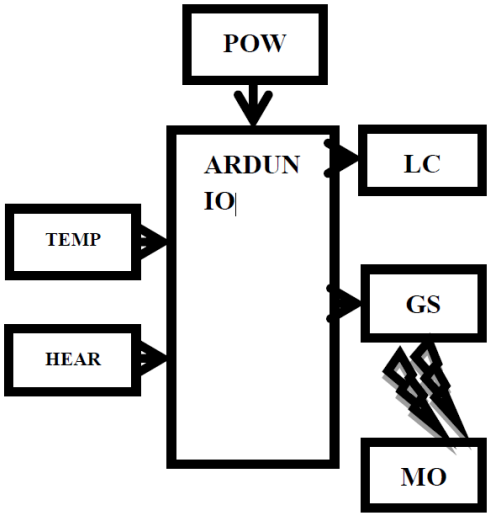
1N4007 PN junction diode, its cut off region is 0.7Volt.

8. So any two diodes are always conducting, total drop voltage is 1.4 volt.

PROPOSED SYSTEM

This work focuses on the heartbeat monitoring and alert system that automatically monitor the heart beat rate condition of patient. The system determines the heart beat rate per minute and then sends short message service (SMS) alert to the mobile phone of medical experts or patients family members, or their relatives via SMS. It helps the doctors to monitor and diagnose the patients condition continuously and could suggest earlier precaution for the patients future condition. This will also alert the family members immediately know about the patient condition.

Block Diagram:



The heart rate monitor include a microprocessor which is continuously monitoring the ECG and calculating the heart rate, and other parameters. Modern heartbeat rate monitoring usually comprise two elements: a chest strap transmitter and a wrist receiver or mobile phone

EXISTING SYSTEM

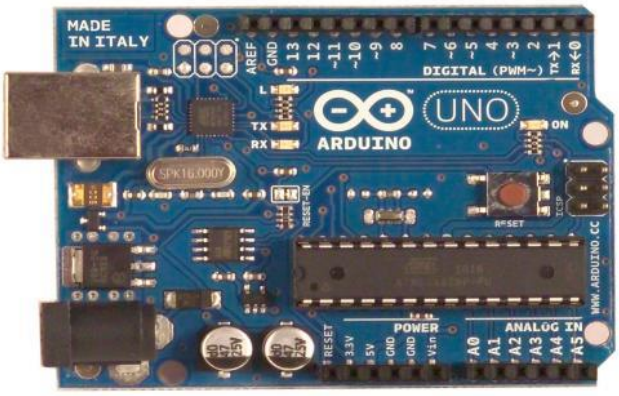
In old versions of the heartbeat system, when a heartbeat is detected the receiver uses to determine the current heart rate by transmitting a radio signal. The signal which are generated can be a simple radio pulse or a unique coded signal which are generatedfrom the chest strap (such as Bluetooth or other low-power radio link)and the latter prevents user's receiver by using signals from other nearby transmitters (known as cross-talk interference).

IV. HARDWARE REQUIREMENTS

1. ARDUINO
2. TEMPERATURE SENSOR
3. HEARTBEAT SENSOR
4. 16X2 LCD
5. GSM/GPRS Module

1) ARDUINO

The Arduino is a microcontroller board which is based on the ATmega328. It consists of 14 digital Input/output pins where 6 can be used as PWM outputs and as 6 analog inputs.It as a 16 MHz crystal oscillator, a USB connection, has a power jack, and an ICSP header, and also has a reset button. It contains everything that are needed to Support the microcontroller and it is simply connected it to a computer by a USB cable or power with a AC-to-DC adapter or battery to get started. The Arduino devices differs from all preceding boards where it does not use the FTDI USB-to-serial driver chip. The Uno and version 1.0will be the reference versions of Arduino in moving forward for updated version. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform and it comparison with previous versions.



2) TEMPERATURE SENSOR :

FEATURES :

a) Calibrated directly in ° Celsius (Centigrade)
b) Linear + 10.0 mV/°C scale factor
c) 0.5°C accuracy guarantee able (at +25°C)
d) Rated for full –55° to +150°C range
e) Suitable for remote applications
f) Low cost due to wafer-level trimming
g) Operates from 4 to 30 volts
h) Less than 60 μA current drain
i) Low self-heating, 0.08°C in still air
j) Nonlinearity only ±1⁄4°C typical
k) Low impedance output, 0.1 W for 1 mA load

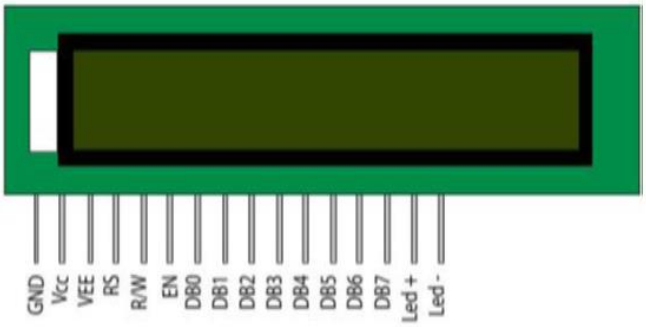
3) HEARTBEAT SENSOR

a) A Heartbeat sensor is a monitoring device that allows the users to measure his or her heartbeat rate in a real time or record the heartbeat rate for later study. It provides a simple way of studying the heart function.
b) This sensor monitors the flow of blood through the finger and is designed to give digital output of the heartbeat when a finger is placed on it.
c) When the sensor is working, the beat LED flashes in unison with each heartbeat.
d) This digital output can be connected to the microcontroller directly to measure the Beats per Minute (BPM) rate. It is measured by the principle of light modulation by blood flow through finger at each pulse.

4) 16X2 LCD

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. PIN DIAGRAM.

PIN DIAGRAM



PIN DISCRIPTION

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

GSM/GPRS Module

The SIM300 is a Tri-band GSM solution with a compact plug-in module. Featuring an industry-standard interface, the SIM300 delivers GSM/GPRS 900MHz to1900MHz performance for sending voice, SMS, Data, and Fax in a small form factor and consuming low power consumption. The leading features of SIM300 make it ideal for virtually unlimited applications, such as WLL applications (Fixed Cellular Terminal) and handheld devices.

V. METHODS AND MATERIAL

In this project, Heartbeat Monitoring and Alert System using GSM Technology uses the pulse sensor to detect the heartbeat of the person. The pulse sensor mainly consists of the IR transistor which always sends the signal to sender to receiver. While the pulse sensor placed on a person hand the signal transmitting from senders to the receiver gets stopped and check the speed of the blood circulating in the person hand and it sense the heartbeat rate of the person heart. It displays the sensed heartbeat rate per minute. If the heartbeat rate of the person detected is founded to be lower or upper than the normal heartbeat rate (60 bpm – 120 bpm) by using the GSM module the text message is send to medical expert and to the family members as an alert message that the person is in the critical condition.

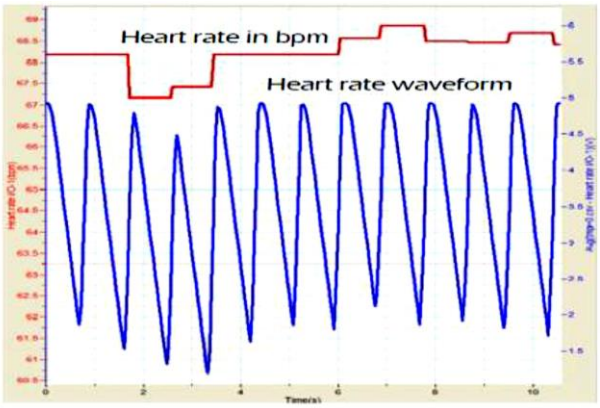
OPERATION:

The sensor consists of a LED and a LDR light detector. The LED has super bright red colour light which is used to produces the maximum light to be spread in the finger and detected by LDR. Now, when the heartbeat pumps a pulse of blood passes through the blood vessels and the finger becomes slightly more opaque where only less light reaches the LDR. With each heartbeat pulse are detected the signal gets varies.

The variation of the pulses gets converted into electrical pulse. The signal gets amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is indicated by a

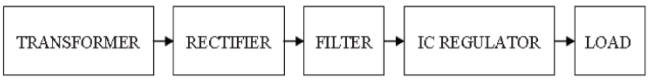
LED light which gets automatically blinks on each heart beat.

Unlike an electrocardiograph (EKG) which monitors the electrical signal of the heart, the Heartbeat Rate sensor measures heartbeat by monitoring the change in infrared transmittance through blood vessels for every seconds while heart gets pumps. As the heart forces blood pass through the blood vessels, the amount of blood changed with time will be the corresponding changes in the variation of light intensities. By plotting the heart beat signal, the heart rate can be determined.



POWER SUPPLY :

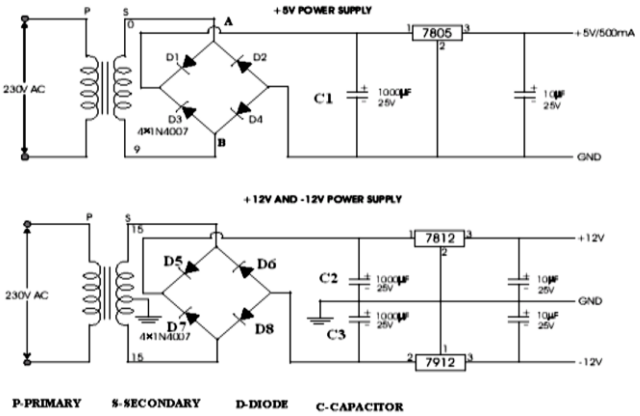
BLOCK DIAGRAM :



The ac voltage will be typically 220V rms, is connected to a transformer, which steps the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage which is initially filtered by a simple capacitor filter in order to produce a dc voltage. This results the dc voltage usually have some ripple or ac voltage variation in it.

A regulator circuit removes the ripples and also remains in the same dc value even if the input dc voltage gets varies. This voltage regulation is usually obtained by using one of the popular voltage regulator IC units.

SCHEMATIC DIAGRAM



VI. CONCLUSION AND FUTURE WORK

In this project, we have developed a device which is used to sense the heartbeat rate and the temperature of the normal person using heartbeat/pulse sensor and temperature sensor.This device checks the heartbeat rate and if there is any emergency that the person heart beat is lesser or more than the normal rate(60 BPm – 100 BPm) then it automatically sends an alert message to the medical expert or family members that the patient is in critical condition through SMS by GSM module. It also sense the body temperature of the patient and through the sensor it also checks the patient or normal human health by sensing natural physical state of the human body. This technique can be helpful for coma patient and it can be used remote area access and patients who takes home treatment. In future, it can be implemented in various field of health system and additional module can be added to it.

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Cite this article as :

Karthik R., Ruban Paul Issac D., Saravanan S., Vijay V. , "Heartbeat Monitoring and Alert System Using GSM Technology ", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 5 Issue 2, pp. 80-87, March-April 2019.
Available at doi :
https://doi.org/10.32628/CSEIT195230
Journal URL : http://ijsrcseit.com/CSEIT195230