



JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Measurement of Heartbeat Sensor Using Arduino

¹Saumya Tripathi, ²Ankita Mishra, ³Gaurav Saxena, ⁴Shaheen Akhtar, ⁵Mr. Tushar (Chief Proctor)

Department of Electronics and communication, United College of Engineering and Research, Prayagraj, Uttar Pradesh, India

Abstract : In this paper, the heart beat monitoring system using GSM technology is discussed. The primary goal of this study is A heartbeat sensor is an electrical device that measures the rate of the heart. The heart rate may be measured in two ways: physically checking the pulse at the wrists or neck, or using a Heartbeat Sensor. Our plan is to create a Heart Rate Monitor System with an Arduino and a Heartbeat Sensor. You may learn about the Heartbeat Sensor concept, how it works, and how an Arduino-based Heart Rate can help you define your heartbeat quickly. This equipment will be able to detect heartbeats in people ranging in age from infants to the elderly. The device's inexpensive cost will aid in the provision of an adequate home base effective monitoring system.

Index Terms - Arduino UNO, Heartbeat Sensor, GSM, Heart Rate, Body temperature

I. INTRODUCTION

Monitoring heart rate is critical for sportsmen and patients since it determines the health of the heart. A heart rate monitor is a personal monitoring device that measures a person's heart rate in real time. There are several methods for measuring heart rate, the most exact of which is electrocardiography. The Heartbeat Sensor, on the other hand, is a more convenient technique to measure the heart rate. It comes in a variety of forms and sizes and provides an immediate method of measuring the heartbeat.

Wrist watches (smart watches), smart phones, and chest straps all have heartbeat sensors. The heartbeat is measured in beats per minute (bpm), which represents how many times the heart contracts or expands in a minute. Time or record their heart rate for future research. Early variants were comprised of a monitoring box and a series of electrode leads linked to the chest [7]. A healthy adult's resting heart rate is approximately 72 beats per minute (bpm), newborns' heart rates are around 120 bpm, and other children's heart rates are around 90 bpm. The heart rate steadily increases during activity and falls to resting levels afterward. The pace at which the pulse returns to normal is a measure of a person's fitness. Lower than normal heart rates are typically an indicator of bradycardia, whereas higher rates are an indication of tachycardia. The heart rate is readily measured by putting the subject's thumb over the artery pulsation and feeling, measuring, and counting the pulses over a 30-second period.

We created a heart rate monitor system with Arduino and a Heartbeat Sensor in this project. Heart rate can shift in response to variations in the demand of muscles to take oxygen and excrete carbon dioxide, such as during exercise or sleep. It also varies greatly across individuals depending on fitness, age, and

heredity. This implies that the heart must beat quicker in order to supply more oxygen-rich blood. A heart rate monitor is basically a device that captures a sample of heartbeats and computes the beats per minute so that the information may be used to track the status of the heart. A resting person's heart rate is around 70 beats per minute for adult men and 75 beats per minute for adult females.

II. COMPONENTS REQUIRED

i. Arduino UNO

The Arduino UNO is a microcontroller board based on the ATmega328. 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. Arduino board designs use a variety of microprocessors and controllers.

The boards are equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus on some models, which are also used for loadings programs from personal computers. The Microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. Arduino micro-controllers are pre-programmed with a boot loader that simplifies the uploading of programmes. The input voltage will be 7-12V and operating voltage is 5V. The Flash memory is 32kb of which 0.5kb used by boot loader. The length, width and weight are 68.6mm, 58.4mm and 25g [1].

ii. Heartbeat Sensor

An optical heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occur when the heart pumps blood. Pulse waves are detected by measuring the change in volume by using an optical sensor and LED. Heartbeat sensors are available in wrist watches, smart phones, chest straps etc. The heart beat is measured in beats per minute, which indicates the number of times the heart is contracting or expanding in a minute [12]. This is a plug and play type Sensor. The operating voltage is ranges +5V otherwise +3.3V and the current utilization is 4mA. Its diameter and thickness are 0.625 and 0.125. There are 3 pins in Heartbeat Sensor-

- Pin-1(GND) Black Color Wire: It is connected to the GND terminal of the system.
- Pin-2(VCC) Red Color Wire: It is connected to the supply voltage of the system.
- Pin-3(Signal) Purple Color Wire: It is connected to the pulsating o/p signal.

iii. Potentiometer

Potentiometers are very useful in changing the electrical parameters of a system. These potentiometers are commonly known as rotary potentiometer or just POT in short. It has 3 terminals;

- Voltage supply pin
- Signal output pin
- GND pin

with a sliding or rotating contact that forms an adjustable voltage divider. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. They work by having a resistive element inside. It has 15mm shaft length. The Sliding Noise is less than 47mV and the Rated Power is 0.5W. The total Rotation is 300° +/- 5°. A Potentiometer Knob can also be used along with the POT for aesthetic purposes. These three terminals device can be used to vary the resistance between 0 to 10k Ω by simply rotating the knobs [9].

iv. 16x2 LCD Display

The Liquid Crystal Library allows you to control LCD display that are compatible with the Hitachi HD44780 driver. The 16x2 LCD is named so because; it has 16 columns and 2 rows. There are a lot of combinations available but the most suitable and most used one is this. So, it will have 32 characters in total and each character will be made of 5x8 Pixel Dots. The minimum and maximum logic voltage is 4.5V and 5.5V. The typical LED backlight voltage drop is 4.2V and current is 120mA. The supply current provided to the LCD is 2mA. Its weight is 35gm.

Table 1: Pinout of LCD

Pin	Symbol	Function
1	Vss	Ground(0V)
2	Vdd	5V logic supply voltage
3	Vo	Contrast adjustment
4	RS	H/L register select signal
5	R/W	H/L read/write signal
6	E	H/L enable signal
7-14	DB0-DB7	H/L data bus for 4 or 8 bit
15	A(LED+)	Backlight anode
16	K(LED-)	Backlight cathode

CB
A

Printed Circuit Board is a laminated sandwich structure of conductive and insulating layers. PCBs mechanically support electronic components using conductive pads in the shape designed to accept the component's terminals, and also electrically connect them using traces, planes and the other features etched from one or more sheet layers of copper laminated onto or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB board to both electrically connect and mechanically fasten them to it. Printed Circuit Boards are used in nearly all electrical products and some in electronic products, such as passive switch boxes. The size of the PCB is 5x6cm and the thickness is 0.5mm-1mm [10]. PCBs can also be made manually in small quantities, with reduced benefits.

vi. Battery

An electric battery is a source of electric power consists of one or more electrochemical cells with external connections for powering electrical devices. Batteries have much lower

specific energy than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting electrical energy to mechanical work, compared to combustion engines [3]. The capacity of Alkaline is 550mAh, Carbon-Zinc is 400mAh, Lithium Primary is 1200mAh and NiMH is 175-300mAh. The operating temperature of 9V Battery is 0°C to 60°C. The length, width and height of 9V battery are 17.5mm, 26.5mm and 48.5mm.

vii. Connecting Wires

Connecting wires allows an electrical current to travel from one point on a circuit to another because electricity needs a medium through which it can move. Most of the connecting wires are made up of copper or aluminium. The Copper is cheap and have good conductivity. The length is 200mm and the weight is 30g, compatible with 2.54mm spacing heads, both the male and female wires are used [5].

viii. Battery Cap

A battery assembled cap, a cylindrical battery with the cap. The vent cap is attached to the battery cover by a hinge connection which allows for play between the vent cap and the battery cover and which allows for rotation of the vent cap. It assures safe secure use, reduces the potential of short circuits and prevents tampering with battery contacts.

ix. Soldering Wire and Soldering Iron

Solder is a fusible alloy used to join less fusible metals or wires. Solder wire comprised of different alloys or of pure tin. Each metal require a certain type of soldering wire to create strong bonds because the combinations of metals that comprise soldering wires melt at different temperatures. The iron is heated to temperatures above 600°F which then cools to create a strong electrical bond.

A soldering iron is a hand tool used in soldering. Its supplies heat to melt solder so that it can flow into the joint between to work pieces. A soldering iron is composed of a heated metal tip and an insulated handle [4]. The bit size is given as 3.0mm Chisel. The temperature provided to them is 420°C and power and the power supply are 25Watts and 240V. The weight is 180g.

III. BLOCK DIAGRAM

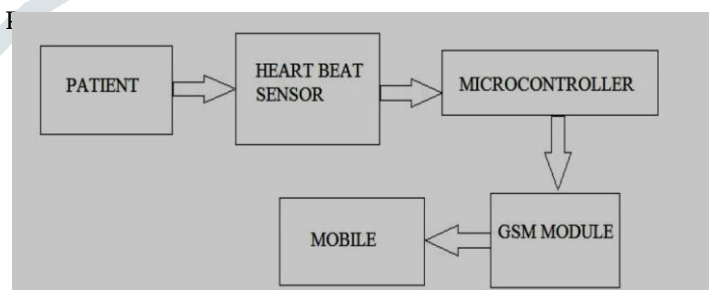


Figure1: Block Diagram of Heart beat Monitoring System

In this system, the sensor used is Heart beat Sensor; the control action is taken by the Arduino UNO and the communication control is taken by the GSM module. The pulse oximeter continuously senses the patient's Heart rate. In pulse oximeter, the photo detectors are placed next to each other. In the other method or we can say that in the reflective method when finger is placed, the light gets reflected back to the sensor. For every heart beat the volume of blood increased in the finger which results in increased reflection back to the

sensor. Figure1 shows the block diagram of the heart beat monitoring system.

Hence, the peak in the waveform of the received signal indicates the heart beat rate. The sensed heart rate is continuously compared with the threshold value which is provided in the microcontroller. When the continuously sensed heart rate falls below or above the given limit, the microcontroller sends an automated message to the patient's doctor or any other relatives using the standard GSM module which is interfaced to the controller unit. Also, the doctor can access the updated patient's record from the database using which the required treatments can be provided to the patient [17].

IV. WORKING PRINCIPLE

Photoplethysmography is the mechanism that drives the heartbeat sensor's operation. Changes in the intensity of light flowing through an organ are used to estimate changes in the amount of blood in that organ, according to this concept. The light source in the heartbeat sensor is often an IR LED, and the detector is any Photo Detector such as a photo diode, an LDR, or a photo transistor. We may organise these two components, a light source and a detector, in two ways: a transmissive sensor and a reflecting sensor. In a transmissive sensor, the light source and the detector are placed facing each other and a finger of the person must be placed in between the transmitter and receiver. Reflective sensor, on the other hand, has source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor [6].

1) Working of the Heartbeat Sensor

A simple heartbeat sensor consists of a sensor and a control unit. The sensor part of the heartbeat sensor consists of an IR LED and a Photo Diode placed in a clip. The control circuit consist of an Op-Amp IC and a few other components that help in connecting the signal to a Microcontroller. The working of the heartbeat sensor can be understood better if we take a look at its circuit diagram [12].

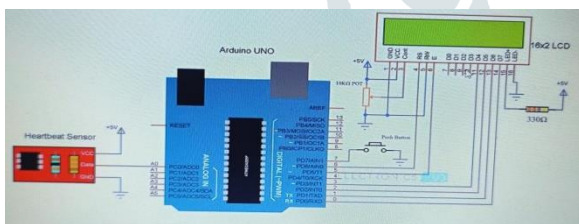


Figure 2: Circuit Diagram

The above circuit shows the finger type heartbeat, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary [2]. The output of the Photo Diode is given to the non-inverting input of the op-amp through a capacitor, which blocks the DC components of the signal. The first op-amp acts as a non-inverting amplifier with an amplification factor of 1001. The output of the first op-amp is given as one of the inputs to the second op-amp which acts as a comparator. The output of the second op-amp triggers a transistor, from which the signal is to the Microcontroller like Arduino. The op-amp used in this circuit is LM358. It has two op-amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to the transistor, will blink when the pulse is detected.

2) Circuit Design of the Heartbeat Sensor with Arduino

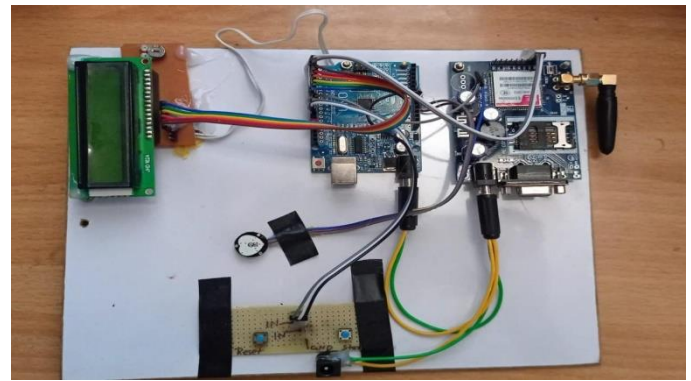


Figure 3: Heartbeat Monitoring system using GSM

The circuit design of Arduino based Heart rate monitor system using heartbeat sensor is very simple. First, in order to display the heartbeat readings in bpm, we have to connect a 16x2 LCD Display to the Arduino UNO. The 4 data pins of the LCD Module (D4, D5, D6 and D7) are connected to pins 1, 1, 1 and 1 of the Arduino UNO. Also, a 10kΩ potentiometer is connected to pin 3 of the LCD (Contrast adjust pin). The RS and E (Pins 3 and 5) of the LCD are connected to pins 1 and 1 of the Arduino UNO. Next, connect the output of the Heartbeat Sensor Module to the Analogue Input Pin (Pin1) of Arduino.

3) Working of the Circuit

Upload the code to Arduino UNO and Power on the system. The Arduino asks us to place our finger in the sensor and press the switch. Place any finger in the sensor clip and push the switch. Based on the data from the sensor, Arduino calculates the heart rate and displays the heartbeat in bpm. While the sensor is collecting the data, sit down and relax and do not shake the wire as it might result in faulty values. After the result is displayed on the LCD, if you want to perform the another test [11], just push the reset button on the Arduino and start the procedure once again.

V. FUTURE SCOPE

Further improvements can be applied to this project to enhance its performance:

- Monitoring device that could be used to detect the heartbeat anomalies of physically challenged individuals without hands.
- Also a graphical LCD can be used to display a graph of the change of heart rate over time.
- A serial output can be incorporated into the device so that the heart rate can be sent to a Personal computer for further online or offline analysis.
- It could be integrated with mobile technology for e-health cloud transmission to health care providers.
- It could help the doctors by expanding our project through gathering the data (heartbeat readings) of the patients and assisting the concerned doctors/caretakers with foreseeing the irregularity in not so distant future.

VI. RESULT

The Heartbeat and Body Temperature Monitoring using Arduino will detect the Heart beat using the pulse sensor and body temperature using LM-35 sensor. Sensor will show the readings in BPM (Beats per Minute) on the LCD connected to it. The body Temperature will be displayed on serial monitor

along with the BPM readings. This system measures the heartbeat of the person and the measured data is send to a mobile as SMS through GSM module. Using this, we can create an analytical data sheet by measuring the heart rate of the various patients.

S.No.	Person's Age(Years)	Heart Rate(Beats/min)
1	21	67
2	23	70
3	20	73
4	22	71
5	21	69

Table 2: Record of Heart beat rate

VII. CONCLUSION

Instead, a pulse sensor, which can be thought of as an infrared sensor with a reaction to changes in light intensity, was employed. The primary goal of constructing this project with the aid of the Arduino Open Source platform is to promptly notify Medical Emergency and the patient's emergency contacts about the patient's health state. We are working on a prototype of this application that will use continuous parameter monitoring to identify and predict heart attacks and issue an alarm. When the body temperature and heart rate surpass or fall below the chosen threshold levels, the buzzer will sound. This goal is achieved by monitoring the heart rate and body temperature. It is useful in situations when continuous monitoring is being recorded under critical conditions [13]. Furthermore, because of its mobility, it is a highly useful equipment that patients may carry with them, eliminating the need for them to stay in hospitals because the Heart Rate Monitor is applicable practically everywhere. Along with the Heart Rate Monitor, we created an Android application that allows physicians and patients to connect with one another, captures data from the heart monitor through Bluetooth, and provides the doctor access to these information.

REFERENCES

- [1] Souvik Das "The Development of a microcontroller Based Low Cost Heart Rate Counter for Health Care Systems" International Journal of Engineering Trends and Technology-Volume4Issue2-2013.
- [2] Ch.Sandeep Kumar Subudhi, 'Intelligent Wireless Patient Monitoring and Tracking System'-2014
- [3] Bhagya Lakshmi.J.M1 Hariharan.R2 Udaya Sri.C3 Nandhini Devi.P4 Sowmiya.N "Heart Beat Detector using Infrared Pulse Sensor" IJSRD-International Journal for Scientific Research & Development Vol. 3, Issue 09,2015.
- [4] Embedded Lab " Arduino measures heart beat rate from fingertip"
- [5] Joyce Smith, Rachel Roberts, Vital Signs for Nurses: An Introduction to Clinical Observations, WILEY-BLACKWELL, June2011
- [6] NamrataNawka, Anil Kumar Maguliri, Dharendra Sharma, PreetiSaluja "SESGARH: A Scalable Extensible Smart-Phone based Mobile Gateway and Application for Remote Health Monitoring" 978-1-4577-1328-6/11
- [7] SudipanSaha, SaustomBhaumik, "SMS Based Wireless Global Range Automation and Security System" IEMCON,2011
- [8] Arduino UNO datasheet www.arduino
- [9] Nitika "Multimesseging system using GSM modem" IJAEST VoN.no. 11 Issue no. 1 157-161
- [10] Deepak Krishnan M Unnikrishnan, VineethRadhakrishnan, Denny C Jacob, Akhil K.S. Amrita VishwaVidhyapeetham University, Amritapuri, Clappana "Wireless gadget for Home Bound Patients" 15th Oct 2011IEEE
- [11] Heartbeat Monitoring Using IOT, Sayan Banerjee, Souptik Paul, Rohan Sharma, Abhishek Brahman, IEEE Access, January 2019
- [12] HarshvardhanB.Patil, Prof. V.M. Umale, "Arduino Based Wireless Biomedical Parameter Monitoring System Using Zigbee", International Journal of Engineering Trends and Technology- Volume 28 Number 7- October 2015
- [13] https://www.electronicshub.org/heartbeat-sensor-using-arduino-heart-rate-monitor/#Applications_of_Heartrate
- [14] KarandeepMalhi, Subhash Chandra Mukhopadhyaya-"A Zigbee-Based Wearble Physiological Parameters Monitoring System" IEEE Vol.12 no.3 March 2012
- [15] Sahani Books of IEEE using GSM, www.heartbeatsensorwithGSM, May 2011
- [16] P. VenketRao, V.Akhila, Y.Vasvi, K.Naisse, :An IOT based patient health monitoring system using Arduino Uno", International Journal of Research in Information Technology (IJRIT), Vol. 1, Issue 1, 2017
- [17] <https://irejournals.com>
- [18] <https://microcontrollerslabandtechnolabcreation.com>