

Prior Detection of Cardiac Arrest and GSM Based Emergency Calling System

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ABSTRACT: In India, about 25 percent deaths occur in the age group of 25-69 years because of a cardiovascular disease. Many people among us lose their life because of heart attack. Heart attack is not easy to detect. After the occurrence of heart attack only, the patient can be monitored. To overcome and help our society from heart attack, we are developing such a system which helps to decrease the death rate and early detection of a heart attack. This heart attack detection system helps to inform if a person is about to have a heart attack by analyzing the number of beats per minute (BPM) and informs as soon as the heart beat level does not fall within the permissible limit. Thus this system can be used to save life of many people. This system uses two sections. One is transmitting section which is kept with patient and another one is receiver section which is connected to the GSM module. Controlling and monitoring functions to be done by Arduino with ATmega328 microcontroller and Zigbee is used for high level wireless data transmission from transmitter section to receiver section. Thus this equipment can used daily to indicate heart condition to detect heart attack earlier and also easily communicate with medical help centre by using GSM.

Keywords: Cardio-vascular disease, Arduino, Zigbee wireless transmission, Medical care with the help of GSM module.

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I. OBJECTIVE

To pre-detect Cardiac Arrest by using heart beat sensor with Arduino (ATmega328 microcontroller) and to implement the emergency calling system by using GSM Module, thus reduces the delay time between the onset of a heart attack and the call to the emergency services, this will greatly improve his or her chances of survival.

II. INTRODUCTION

The National Heart, Lung and Blood Institute States that “more than 3 million persons in the India have a heart attack and about half of them die in each year”. About one half of those who die do so within 1 hour of start of symptoms and before reaching the hospital. A heart attack happens to a person when the blood flow and oxygen supply to heart muscle is blocked, and it is mostly caused by the Coronary Artery Disease (CAD). CAD occurs when the arteries that supply blood to the heart muscle (coronary arteries) become hardened and narrowed. It often causes irregular heart beat or rhythm by blocking blood stream. The National Heart, Lung, and Blood Institute suggest that “everyone should know the warning signs of a heart attack and how to get emergency help”.

Life is precious. Many people among us lose their life because of heart attack by stack of symptoms and before reaching the hospital. This system is designed to used as detection unit and as the medium asking for medical help. By using GSM, emergency calling system calls for medical help at the moment of heart attack or before. This project aims to shorten the time between the moment of heart attack and the arrival of medical personal.

III. PROPOSED SYSTEM

Block diagram of the proposed system as shown in Fig.1. This system consists of low cost, energy efficient and reliable Zigbee technology for communication among the physical component, Arduino (ATmega328 microcontroller) which helps to perform the controlling functions and hence the effectiveness of the system is improved. This life saving system reduces the mortality rate of heart patients and it act as an effective heart care service to patients. Also this system uses GSM (Global System for Mobile Communication) module which helps to communication long distance as soon as possible. By do so, it is not only connecting one emergency number but also more than the three numbers. Also Parallax-Data Acquisition software and Arduino software are used for the purpose of simulation.

This works detects the heart attack based on the number of pulse. If the pulse rate other than the permissible range occurs, it is considered as the indication of heart attack. Addition to this detection of heart attack, this work intimates the occurrence of heart attack to the helpline in wireless GSM Module. In this work, a system to detect heart attack is designed and developed. A pulse sensor is used for sensing the heart beat signals. The microcontroller checks these signals and counts the pulses. If the pulses are greater or less than certain levels, the controller activates GSM module through the Zigbee wireless transmission and sends an alert message as well as call to mobile numbers already coded in a Arduino. The system performed accurate detection and intimation of messages to the different care takers of the patients.

Block Diagram

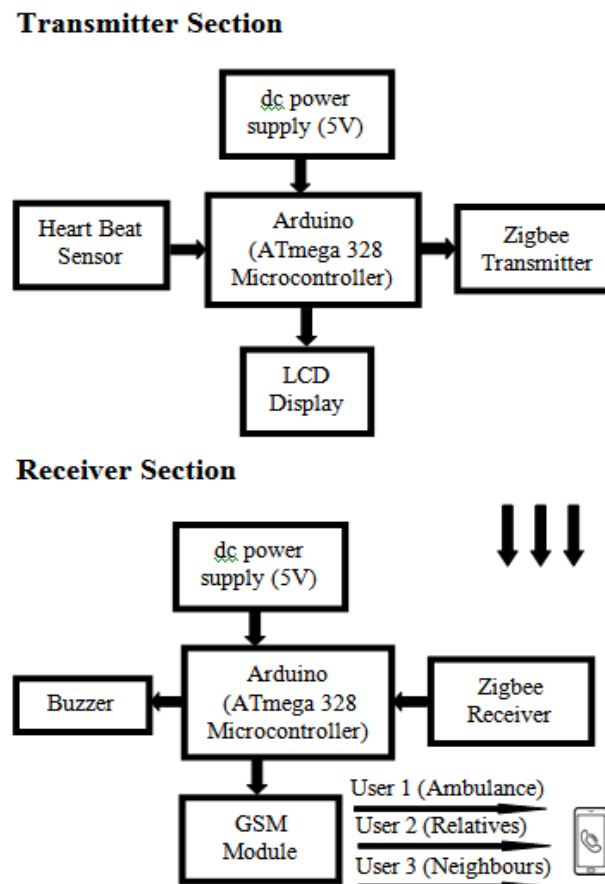


Fig.1 Block diagram of the proposed system

3.1 Heart Beat Sensor

Heartbeat is sensed by using high intensity type IR sensors. With each heartbeat, a surge of blood is forced through the vascular system, expanding the capillaries in the finger, and changing the amount of light returning to the photo detector. Very small changes in reflectivity or in transmittance caused by the varying the blood content of the human tissue are almost invisible. Valid pulse measurement therefore requires expensive preprocessing the raw signal. A suitable operational amplifier is needed to amplify the heartbeat signal, due to its very low amplitude compared to the surrounding noise. A super bright LED is suggested in the circuit as it can also perform well as light sensor.

3.2 Arduino

The Arduino is a microcontroller board based on the ATmega328. It has 14 digital input/ output pins (of which 6 can be used as a PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, and 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 an AC-to-DC adapter or battery to get started. The detailed features of an Arduino are given in table1.

Description	Type/Range
Microcontroller	ATmega328
Operating voltage	5V
Input Voltage (recommended)	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O pins	14 (of which 6 provide PWM output)
Analog input pins	6
DC current per I/O pin	40mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 1: Features of Arduino

3.3 Zigbee

Zigbee is a low cost, low power, wireless mesh network standard. The low cost allow the technology to be widely developed in wireless control and monitoring applications. Low power usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. Zigbee is a specification for a suite of high level communication protocol based on an IEEE 802.15.4 standard for personal area networks. Zigbee has a defined rate of 250 Kbits/s best suited for periodic or irregular data or a single signal transmission from a sensor or input device. Zigbee based traffic management system have also been implemented. Zigbee chip vendors, typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. The Zigbee network layer natively supports both star and tree typical networks, and generic mesh networks.

3.4 GSM

Global System for Mobile Communication (GSM) is a digital mobile telephony system. It is intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. GSM uses several cryptographic algorithms for security. SIM cards (Subscriber Identity Module) holding home network access configurations.

3.5 LCD

In this system, a 16x2 LCD display will be for displaying the value of heart rate. There are 16 pins in whole LCD. The maximum voltage used on LCD is +5V. The four MSB of the port is used data lines of LCD connected with pins 10-14 and the three first LSB is used as control lines of LCD connected with pins 4-6.

IV. EXPERIMENTAL RESULTS

Software implementation was performed by using C code for ATmega328 and then the appropriate performance was obtained.

The transmitted heart beat rate was displayed in Parallax Data Acquisition Excel spreadsheet. PLX-DAQ provides easy spreadsheet analysis of data collected in the field which is shown in Fig.2.

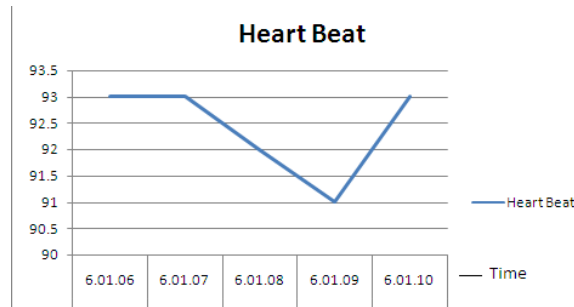


Fig.2 Result of measuring heart beat rate

Through the Zigbee module, heart beat rate was received which is displayed in Arduino Serial Monitor as shown in Fig.3.

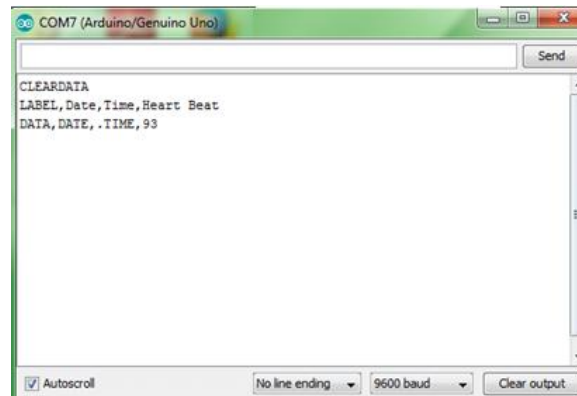


Fig.3 Result of received heart beat rate

Hardware implementation was performed by using appropriate circuit connection and desired output was obtained which is shown below.

Due to normal heart beat rate (i.e 60 to 90 Beats Per Minute), “Normal” was displayed in the LCD module as shown in Fig.4. Also transmitter section does not give the signal to the receiver section. Hence the buzzer was not activated and also the message was not send by GSM module.



Fig.4 Normal condition of heart beat rate

Due to abnormal condition (i.e Less than 60 BPM or greater than 90 BPM), it alerts buzzer and also the message is to be sent by the GSM module to the emergency numbers which was already programmed in the controller as shown in Fig.5 and Fig.6.



Fig.5 Abnormal condition of heart beat rate

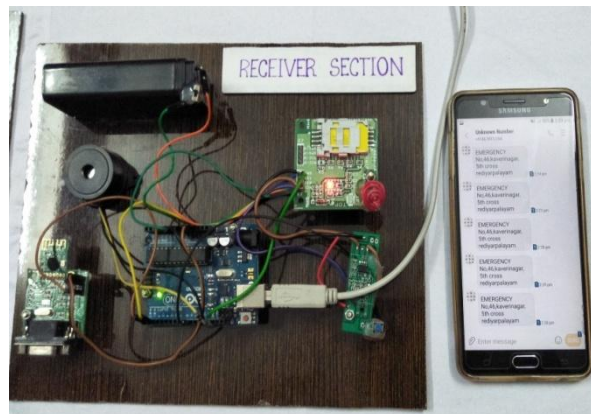


Fig.6 Sending SMS during abnormal condition

The physical view of the developed system is shown in Fig.7.

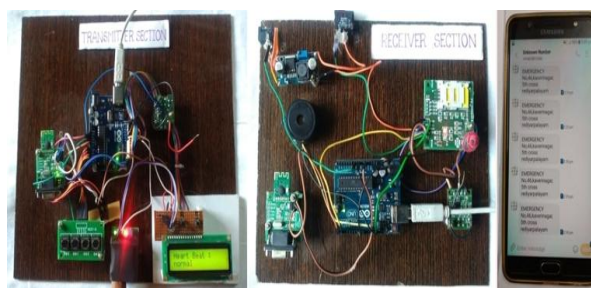


Fig.7 Heart attack detector system

V. CONCLUSION

With the fast development of the industrialization and urbanization process in the world and hence with the increase of busyness of people it has become difficult to monitor the health conditions of a heart patient continuously. To avoid unexpected health problems and obtain higher accuracy in diagnosis of the health conditions of a patient, efficient and comprehensive data collecting, monitoring and play an important role to improve the health care system and make it more reliable and effective. Thus the device is designed for the continuous monitoring of the patient's heart rate. The function of this device is based on the heart beat which can be sensed by heart beat sensor from the finger tip. Microcontroller in this device takes the input from sensor and calculates the heart rate, Heart Attack is detected. Also microcontroller takes the responsibility to call the emergency numbers through GSM. This device has some advantages such as low cost, low power consumption and eliminates delay in receiving medical treatment. Hence it is used in domestic places, primary health care centre for heart patients.

VI. FUTURE WORK

There is always chance to improve any system as research and development is an endless process. Research claims that fuelled by rapid rise in home networking, Zigbee would provide revolutionizing statistics in the upcoming years which would entirely change the wireless world.

This project can be further improved by including ECG Blood pressure, Pulse oximeter, Galvanic-Skin Resistance. Also we can reduce the size of the system, so that it can be wearable and easy to carry.

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