An Automatic Patient Monitoring System Using GSM and ZIGBEE

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Abstract: The heartbeat is monitored with the pulse rate of the body. The high-intensity light sensor detects the expansion and contraction of the heart with the help of the nerves. That beam will transmit the signal to the receiver and the minute change in the pulse is noticed as the heartbeat. The main processes involved in this type of control system are to monitor the patient's health status. ZigBee is a wireless connection network that is used to connect different devices at a frequency of 2.4GHz. For medical applications also this ZigBee is widely used. The ZigBee can communicate with the devices of about 1km. The other network is a GSM network. This can be operated from any distance to any point of control. The communication is done with the help of local network support. This can get communicated to any part of the world in which the network of the local system is applicable. Here the author is using for the hospital communication for monitoring the patient.

Keywords: EEG, Heart rate, Microcontroller, GSM, ZigBee

INTRODUCTION

The human heart is a muscular organ that provides continuous blood circulation through the cardiac cycle and is one of the most vital organs in the human body. The heart is divided into four main chambers: the two upper chambers are called the left and right atria and two lower chambers are called the right and left ventricles. The lateral section is shown in figure 1.
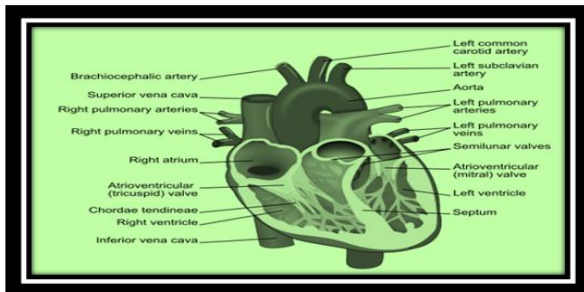

Figure 1: Lateral Section of Human Heart

There is a thick wall of muscle separating the right side and the left side of the heart called the septum. Normally with each beat, the right ventricle pumps the same amount of blood into the lungs that the left ventricle pumps out into the body. Physicians commonly refer to the right atrium and right ventricle together as the rightheart and to the left atrium and ventricle as the left heart.

Heart rate is the number of heartbeats per unit of time, typically expressed as beats per minute (bpm). Heart rate can vary as the body's need to absorb oxygen and excrete carbon dioxide changes, such as during exercise or sleep.

The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individuals, such as athletes, who are interested in monitoring their heart rate to gain maximum efficiency from their training. The R wave to R wave interval (RR interval) is the inverse of the heart rate.[1]–[4]

Heart rate is measured by finding the pulse of the body. This pulse rate can be measured at any point on the body where the artery's pulsation is transmitted to the surface by pressuring it with the index and middle fingers; often it is compressed against an underlying structure like bone. The thumb should not be used for

measuring another person's heart rate, as its strong pulse may interfere with discriminating the site of pulsation.
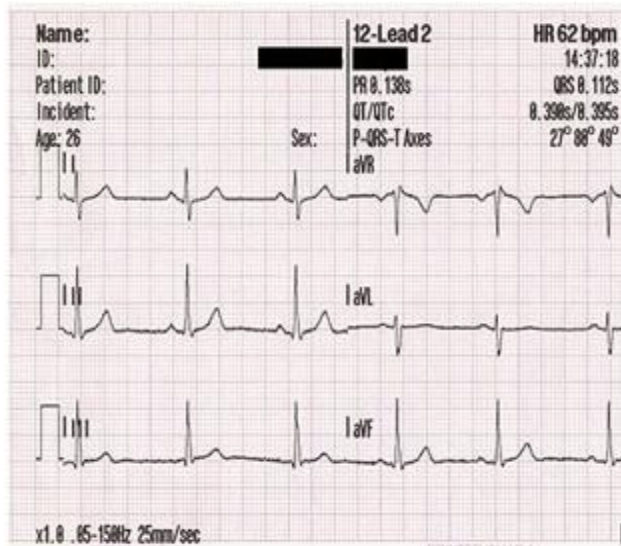

Figure 2: ECG of a Male

The ECG works mostly by detecting and amplifying the tiny electrical changes on the skin that are caused when the heart muscle "depolarizes" during each heartbeat. The ECG of a male is shown in figure 2. At rest, each heart muscle cell has a charge across its outer wall, or cell membrane reducing this charge towards zero is called depolarization, which activates the mechanisms in the cell that cause it to contract. During each heartbeat, a healthy heart will have an orderly progression of a wave of depolarization that is triggered by the cells in the sinoatrial node, spreads out through the atrium, and passes through "intrinsic conduction pathways" and then spreads all over the ventricles.[5], [6]

METHODOLOGY

The flat form for this paper is based on Embedded System**.** An Embedded system is a special-purpose system in which the computer is completely encapsulated by the device it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to

specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, so the cost savings may be multiplied by millions of items.

An embedded system is a special-purpose computer system designed to perform a dedicated function. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. The embedded system comprises both hardware and software.
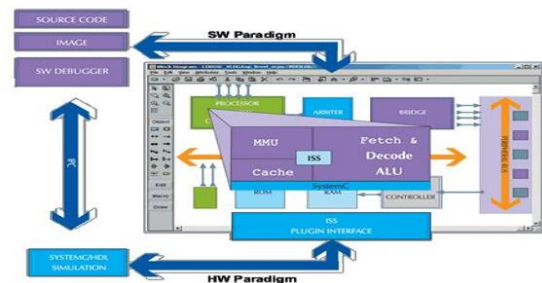

Figure 3: Embedded System Design

An embedded system is fast-growing technology in various fields like industrial automation, home appliances, automobiles, aeronautics etc. Embedded technology is implemented to perform a specified task and the programming is done using assembly language programming or embedded C. Ours being a developing country the power consumption is increasing on large scale to meet the growing need of the people. Power generation is widely based on the non-renewable sources and these sources being depleting some means have to be found for power saving as shown in figure 3.

Mainly the block diagram of the project consists of a microcontroller, sensors, GSM modem, ZigBee module, power supply and Liquid Crystal Display. In case of emergency and dangerous situations, someone has to alert the doctor immediately. For this, the author is using a ZigBee based network for the doctor to patient communication in the hospital and

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even to communicate and indicate the status of the patient through SMS. [7]–[10]

This way of communication is actually done with ZigBee network topology and with the GSM network. Each patient will be given this module and with the help of this module the patient health condition is monitored and if there is any change in the condition of the health then it immediately sends that changed data through ZigBee to the local system where the main module is connected to the computer to maintain the status of the patient. The same information is transfer as a message to GSM to the corresponding or the relevant person. The transmitter section is shown in figure 4 and the receiver section is shown in figure 5.
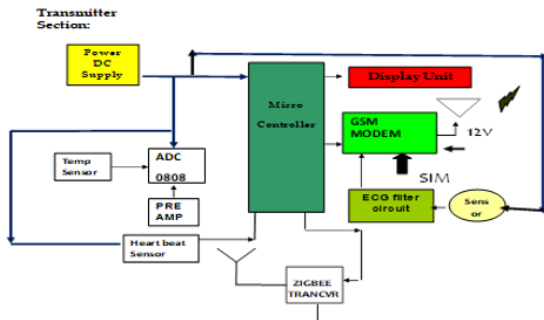

Figure 4: Transmitter Section

In this, the author checks the patient's health condition by monitoring the heartbeat. The heartbeat is monitored with the pulse rate of the body. The high-intensity light sensor senses the expansion and contraction of the heart with the help of the nerves. That beam will transmit the signal to the receiver and the minute change in the pulse is noticed as the heartbeat. If there is any change in the pulses then it is noticed as the change in the heart and then the controller will get a disturbed pulse count which indicates the fault or malfunction of the heart. The controller is fixed for a no. of pulses initially.

If there is any change in any of the pulse count then it considers as a malfunction of the heart and then it transmits the pulse count with the patients' ID to the

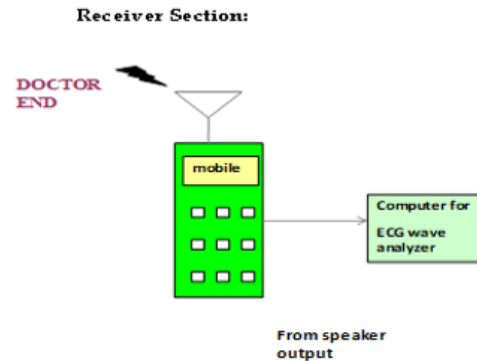doctor in the hospital and at the same to it sends SMS to a fixed number in the microcontroller.

Figure 5: Receiver Section

This is a convenient process to monitor the patients' health conditions form any of the distance. Since the authoris using both the networks like ZigBee and GSM this makes the user communications for the internal system and as well to the longer distances.[11], [12]

RESULTS AND CONCLUSION

The author presented the design and implementation of an automatic 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) and ZigBee technology. This indeed is an easy, practical, inexpensive and yet very effective way of transmitting vital information to the healthcare staff and healthcare providers. The system monitors patient's health status, such as ECG, heart rate, and temperature. In case, the value for any of these parameters exceeds preset critical values, the position parameters, from the attached GPS module, are transmitted to pre-defined phone number in form of SMS using a GSM module.

All the information obtained from the human body from sensors and ECG filter circuit is then transmitted to the microcontroller system as digital values. The values obtained from like ECG, heart rate and the temperature are also displayed on to the

attached LCD in alphanumerical form. In conclusion, the author considers how this system can be further improved in the future, maybe by adding a new type of sensors as well as using new approaches for the security and triggering the alarm.

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