# HUMAN HEALTH MONITORING USING ZIGBEE

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**Abstract**— Wireless sensor network is being a growing field in medical science. It has tremendous application in the areas of medical assistance. By Medical Statistics, many patients' lives are affected due to the neglection of a part that need immediate care. Many people live in abroad leaving their old parents' home. If the old parents get sick, it may get hard for them to contact doctor for their physical condition. For solving this problem, we need wireless based health monitoring system. In this designed system sensors and wireless technology is used with a help of a microcontroller module. Sensor will continuously monitor the health condition. If the vitals are abnormal then the system will alert the concerning person or the doctor via notification.

**Keywords— Zigbee, Health monitor, ECG sensor, Heartbeat sensor, Temperature sensor, Arduino.**

## 1. INTRODUCTION

This system used multiple sensors on a single system using wireless sensor technology. This system can measure real time activities of patient health without on-site medical assistance. Zigbee IEEE 802.15.4 standard is used for this system. The main advantage is mobility because it is portable and reduction of wiring and the low cost of wireless sensor communication system using Zigbee. With Zigbee we can use a vast number of devices under a common network. ZigBee technology uses a frequency band of 2.4 GHz, which is globally available. This can be very helpful for the military for using in the battlefield or training ground for checking health issues.

## 2. Reasons

The reason we chose this topic because now a days many people are finding interest in living abroad leaving their old parents behind. If the old people face any health issues suddenly, it is difficult for them to go to or consult a doctor immediately. Sometimes which could be life threatening. And again, on the battlefield or in the training ground of the military it is a difficult task the check for the health issues one by one, it is a pretty lengthy process to begin with. But using this wireless health monitoring system their health issues can be easily detected and for the old people it will be much easier to get in touch with the doctor with in a few moments after if they face any health issues.

## 3. Existing System

In the existing IOT based health monitoring system only the health condition is checked but there is no way to send the data to a doctor for taking care of the health issues properly. Even in the military the health is checked by a doctor in a manual process. Which take much more time to check and treat a patient. In the battlefield it is even much difficult task to check for the health issues of the patients. For this, the patients have to go to visit the doctor if they have any physiological abnormality. Which can be a pretty lengthy process to deal with.

## 4. Proposed System

In the proposed system of the health monitoring system using ZigBee, the health issues can be detected easily and also can be treated in a well manner. The health monitoring system will check the health condition of a patient. When the physiological parameters of the monitored patient is not normal the a notification message will be sent to the doctors device, in which the doctor can see the abnormal physiological parameters and treat the patient accordingly to the abnormality. This will make much easier to treat a patient even in the battlefield. Since ZigBee based wireless health monitoring system is less costly and portable, this device will be very affordable and much easier to carry around. Since ZigBee consumes very less power, the battery will a much longer life time than the other health monitoring system. It can be used for a long time in a war situation with a limited power supply available.

## 5. Description of Modules

### *a. Heartbeat sensor*

Heartbeat sensor give the digital output of a person's heartbeat when his/her finger is places in the sensory device. This output is measured in Beats per Minutes directly by Arduino. The heartbeat sensor use the principle of photo plethysmography to measure the heartrate of a human being. It measures the volume change of any organ, which causes change in light intensity through a vascular region. When the heart-rate is monitored the time and number of pulses are important. Since the blood flow of the body is controlled by the heart, the signal pulses are same as the number of heart-rate.

### *b. ECG sensor*

The full form of ECG is Electro cardiogram. This sensor records the interval of electric impulse of the heart muscle. ECG sensor monitor the electrical activity, which is created by heart muscle depolarization, by these electrical waves are created toward skin. ECG electrodes requires a layer of gel for maximize the conductivity between the wet electrodes and skin. By monitoring the waves, the rhythm of heart (beats per minute) can be easily estimated. The full ECG setup comprises at least four electrodes which are placed on the chest or at the four extremities according to standard nomenclature (RA = right arm; LA = left arm; RL = right leg; LL = left leg). Of course, variations of this setup exist in order to allow more flexible and less intrusive recordings, for example, by attaching the electrodes to the forearms and legs. ECG electrodes are typically wet sensors, requiring the use of a conductive gel to increase conductivity between skin and electrodes. Throughout the cardiac cycle, blood pressure throughout the body increases and decreases – even in the outer layers and small vessels of the skin. Peripheral blood flow can be measured using optical sensors attached to the fingertip, the ear lobe or other capillary tissue. The device has an LED that sends light into the tissue and records how much light is either absorbed or reflected to the photodiode (a light-sensitive sensor). PPG clips use dry sensors and can be attached much quicker compared to ECG setups, making the device relatively easy to use, and less bothersome for participants.

Recording heart rate data gives you access to the following parameters that can be interpreted with respect to a participant's arousal:

1. Heart Rate (HR). HR reflects the frequency of a complete heartbeat from its generation to the beginning of the next beat within a specific time window. It is typically expressed as bpm. HR can be extracted using ECG and PPG sensors

2. Inter-Beat Interval (IBI). The IBI is the time interval between individual beats of the heart, generally measured in units of milliseconds (ms). Typically, the RR-interval is used for the analysis.

3. Heart Rate Variability (HRV). HRV expresses the natural variation of IBI values from beat to beat. HRV is closely related to emotional arousal: HRV has been found to decrease under conditions of acute time pressure and emotional stress (meaning that the heartbeat is more consistent).

4. HRV has also been found to be significantly reduced in individuals reporting a greater frequency and duration of daily worry [2], as well as in patients suffering from post-traumatic stress disorder (PTSD) [3]. For IBI and HRV analysis, ECG sensors are recommended as they are more sensitive to certain signal characteristics which PPG sensors cannot pick up.

### *c. Temperature sensor (Switching Diode)*

A 1n4148 is a high-speed small signal switching diode, not a Zener. Any semiconductor diode inherently is a heat sensor, as its carrier mobility varies with temperature. We can use many semiconductors, transistor, IC, SCR, and more. But this circuit uses the diodes, D1-1N4148. Because it is easy to use, cheap, see all-time in store. in fact, when the diode is in forward biased. It has voltage across about 400mV to 500mV at current about 1mA. This voltage level depends on the current and the substance used to generate these diodes.

If you need to control two things at the same temperature. You should look at a Simple Differential temperature controller circuit diagram. It will turn on the relay switch when the both temperature sensor is different. Some people call that Balance temperature switch. In silicon diode, the voltage across it will reduce about 2mV in each one-degree Celsius temperature. We so can use it. Also, you can use a transistor, diode bridge and more. They are also silicon semiconductors.

### 5.1 OTHER MODULES

### *a. Zigbee transmitter module*

ZigBee is a IEEE 802.15.4 based specification for a suite of high level communication protocols used to create personal area networks with small, low-power digital radios. The technology defined by the ZigBee specification is intended

to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi.

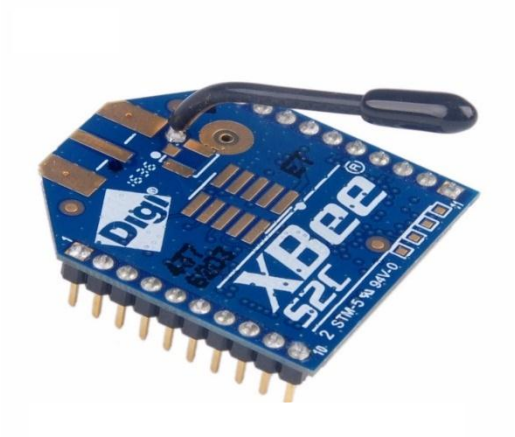


**FIG 1:** ZIGBEE MODULE

Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or input device. ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive. The information sent by the Zigbee Module is received wirelessly by the other Zigbee Module at the receiver section. ARDUINO will match the limit predefined in the code of the microcontroller. If a mismatch occurs, that is if the collected data is more than the limit defined than alert signals are issued. Alert signals are issued in the form of SMS on doctors mobile to alert him so that he can provide cure on time

***b.Arduino***

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.

These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits.

The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the micro-controllers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes supports C, C++, Java Programming languages.

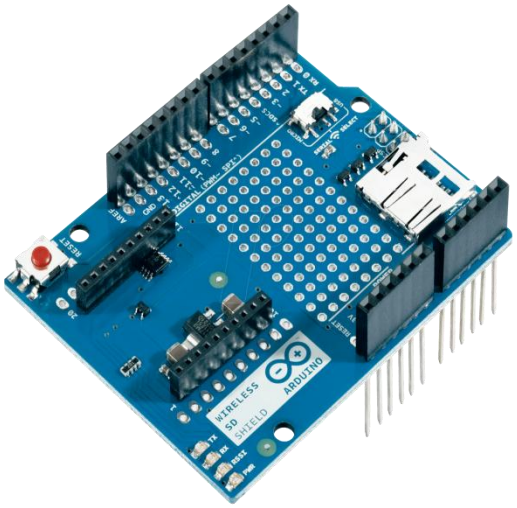


**FIG 2:** ARDUINO MODULE

## 6. Methodology

In this health monitoring system, the ECG sensor, Heartrate sensor and the temperature sensor will be connected to the patient's body. The Arduino will be connected to the sensors and the ZigBee sender Module. The physiological parameters of the patient will be transmitted by the ZigBee module the ZigBee receiver module. The receiver module will be connected to the computer device of the patient. Which will check the current physiological parameters of the patient with some pre-defined physiological parameters. If the difference seems abnormal then an notification message will be sent to the doctor device for some further attention to the patient. The patient can consult the doctor online in voice or video calling system.

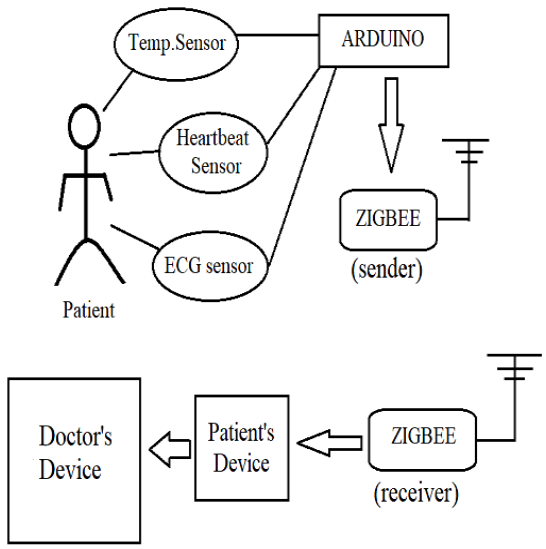


**FIG:3** Proposed architecture of the ZigBee health Monitoring system

## 7. SOFTWARE DESCRIPTION

In this health monitoring system, we are going to use different kinds of software to interface with all the hardware connected in circuit.

i) To program Arduino, we are going to use software Arduino software of version 1.6.8. This software makes easy to interface with Arduino by coding and uploading that codes into the Arduino board.

ii) To program Zigbee, X-CTU software can be used because this will allow to transmission of data over some range. For increasing the range of ZigBee we can use various topologies.

iii) Goldwave software allows us to see different waveforms of sound that is generated by heart to measure heart rate. By using this software, we can edit, amplify the waveform according to our need.

## 8. Future Scope

By further enhancement of this health monitoring system a mobile doctor application can be developed, which can prescribe the medicines to the patients by monitoring the health symptoms of the monitored patient. This system can also be used to predict the diseases by monitoring the health symptoms for a certain time of the patient. Which can help to prevent many deadly diseases before it causes any problem to the patient. Which can save many lives.

## 9. Conclusions

In this paper, we have presented a prototype model of human health monitoring system using ZigBee. This prototype model consists of sensor modules, Arduino and ZigBee modules.

A mobile health monitoring system can be very helpful the old parents and also for the soldiers in the military operations. The developed health monitoring system is provide low power consumption, easy to operate, portability, high performance and a cost effective system to the patient welfare.