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ZIGBEE AND GSM BASED PATIENT HEALTH MONITORING SYSTEM

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ABSTRACT

Care of critically ill patient, requires spontaneous & accurate decisions so that lifesaving therapy is properly applied. Statistics reveal that every minute a human is losing his life across the globe. In India, everyday many lives are affected by heart attacks and more importantly because the patients didn't get timely and proper help. This paper is based on monitoring of patients. We have thought of a reliable, energy efficient patient monitoring system. It is able to send parameters of patient in real time. It enables the doctors to monitor patient's health parameters (temp, heartbeat, ECG) in real time. Here these parameters of patient are measured continuously and wirelessly transmitted using Zigbee. In the current proposed system the patient health is continuously monitored and the acquired data is analyzed at a centralized ARDUINO. If a particular patient's health parameter falls below the threshold value, an automated SMS is sent to the pre-configured Doctor's mobile using a standard GSM module interfaced to the ARDUINO. Here, we are using Zigbee for wireless transmission. The Doctor can get a record of a particular patient's information by just accessing the database of the patient on his PC which is continuously updated through Zigbee receiver module.

KEYWORDS: Zigbee, ECG, ARDUINO, GSM module.

INTRODUCTION

Wireless sensor networks are used to structure home-care system in many researches. Wireless sensor networks application for physiological signals communication transmission has many technologies such as the Infrared, Bluetooth and ZigBee, etc. because the angle limit problem of the infrared transmission, and the infrared have not be used for Physiological signal transmission. Although Bluetooth is better than ZigBee for transmission rate, but ZigBee has lower power consumption. Hence, ZigBee is generally used for 24 hours monitor of communication transmission systems.

Compared to Bluetooth, ZigBee provides higher network flexibility and a larger number of nodes, and a better transmission range with low power consumption. Large number of nodes enables the expansion of such systems recently, ZigBee - based wireless networks were tested in various applications.

The proposed patient monitoring system would be beneficial for medical practitioners to do proper and better treatment; also it would be useful for health care providers to improve disease management.

The patient is monitored from ICU and the data transferred to the PC is wired. Recent work includes using Bluetooth technology coupled with the GSM technology to report signs to PDAs held by the patient or his doctor. Monitoring based on ultra wideband-based personal area networks. The work reported in discusses the implementation issues, and describes the overall system architecture of a Bluetooth sensor network for patient monitoring. The authors investigate the use of ZigBee and mobile phones in monitoring elderly patients with diabetes mellitus or heart diseases.

In the proposed system, patient's parameters such as ECG, Temperature and Heart Beat will be continuously transmitted and monitored through wireless technology Zigbee .This system is convenient and efficient in nature and

has no influence on patients' daily life, so it increases interaction between patient and doctor which made surveillance has real instantaneity. And it ultimately prevents heart disease and avoids unexpected tragedy practically.

A ZigBee node is connected to every patient monitor system that consumes very low power and is extremely small in size. These are specifically designed for low power consumption, with minimal circuit components intended for small packet, long distance range applications and typically consist of a low power processor with minimal resources and interface capabilities. They also have a conservative transceiver that is capable of transmitting 8 bytes of data at a time and has a moderate transmitting range of about 130 m. Therefore, WPANs seem to be a perfect fit for remote patient monitoring.

To improve the accuracy and to increase the efficiency of the above processes a real time patient health monitoring system based on Wireless Sensor Network

MATERIALS AND METHODS

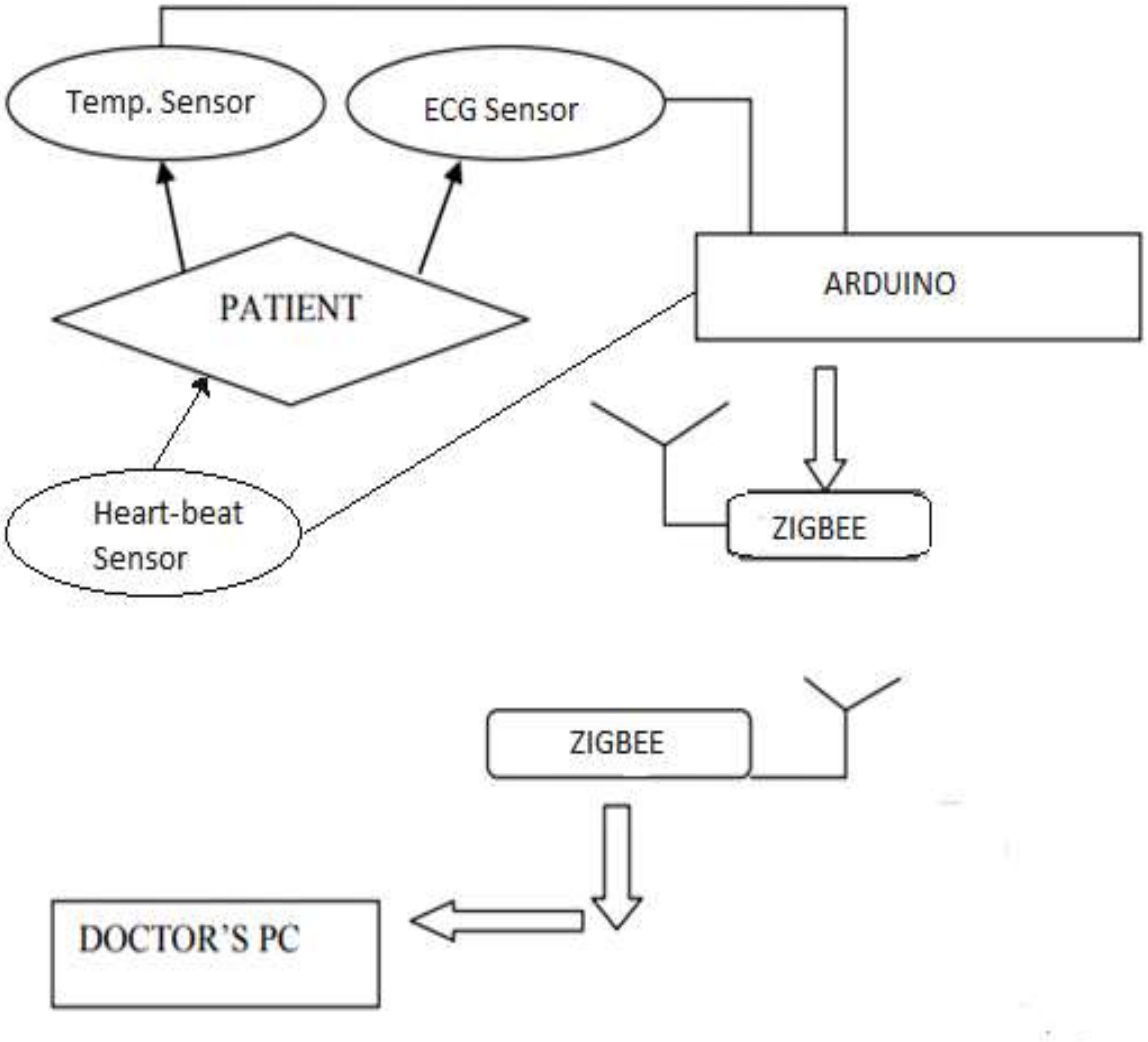

Fig 1:Block diagram of Zigbee based Patient health monitoring system

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Description of Modules

Sensors

ECG Sensor

ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical events of a heart. The ECG is the electrical manifestation of the contractile activity of the heart, and can be recorded fairly easily with surface electrodes on the limbs or chest.

The rhythm of the heart in terms of beats per minute (BPM) may be easily estimated by counting the readily identifiable waves.

The amplifier takes the input from 3 electrodes which are connected to the patient. In a conventional 12 lead ECG, ten electrodes are placed on the patient's limbs and on the surface of the chest. The overall magnitude of the heart's electrical potential is then measured from twelve different angles ("leads") and is recorded over a period of time (usually 10 seconds).

In this way, the overall magnitude and direction of the heart's electrical depolarization is captured at each moment throughout the cardiac cycle.

The graph of voltage versus time produced by this non-invasive medical procedure is referred to as an electrocardiogram (abbreviated ECG or EKG).

Heart Beat Sensor

Heart beat sensor is designed to give digital output of heart beat when a finger is placed inside it. This digital output can be connected to ARDUINO directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger each pulse.ICLM358 is used for this sensor. Its dual low power operational amplifier consists of a super bright red LED and light detector.

One will act as amplifier and another will be used as a comparator. LED needs to be super bright as the light must pass through finger and detected at other end. When heart pumps a pulse of blood through blood vessels, finger becomes slightly more opaque so less light reaches the detector. With each heart pulse, the detector signal varies which is converted to electrical pulse. The Heart Beat Sensor provides a simple way to study the heart's function.

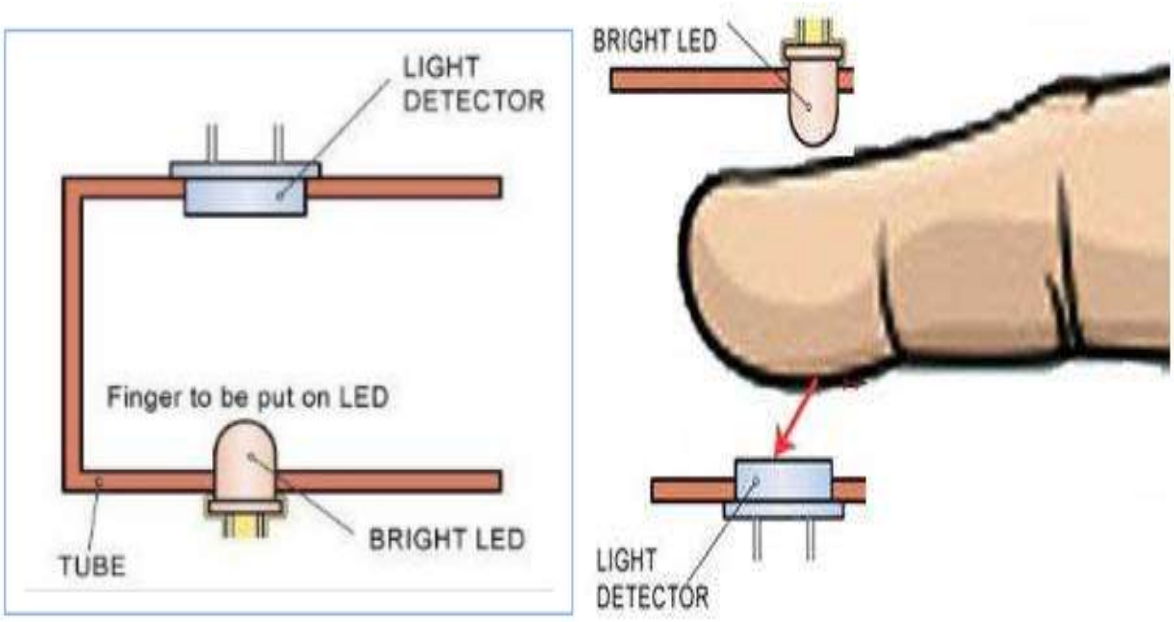

Fig 2:Heart beat sensor

The LED and LDR are mounted in a spring loaded device that can be clipped into the fingertip. The light emitted by the LED is diffusely scattered through the fingertip tissue. An LDR or photo sensor positioned on the surface of the skin on the opposite side can measure light transmitted through it.

Light is absorbed well in blood and weakly absorbed in tissue. Any changes in blood volume will be registered since increasing (or decreasing) volume will cause more or less absorption. Assuming the subject does not move the level of absorption of the tissue and non-pulsating fluids remains same.

Temperature Sensor- Switching Diode

The 1N4148 is a standard silicon switching diode. It is one of the most popular and long-lived switching diodes because of its dependable specifications and low cost. Its name follows the JEDEC nomenclature. The 1N4148 is useful in switching applications up to about 100 MHz with a reverse-recovery time of no more than 4 ns. The 1N4148 comes in a DO-35 glass package for through-hole mounting. This is useful for breadboarding of circuits. A surface mount device, 1N4148WS, is available in a plastic SOD package. A change in the temperature above or below the threshold causes the diode to change states causing LEDs to glow.

As the most common mass-produced switching diode, the 1N4148 replaced the older 1N914. They differ mainly in their leakage current specification at 25°C: 25 nA @ -20V vs. 5 µA @ -75V with maximum leakage for both at 150°C to be 50 µA @ -20V.

Other modules

Zigbee

Fig 3:Zigbee

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.

Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipments 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 micro-controller. 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.

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 4:ARDUINO

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.

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.

To program Zigbee, we are going to use X-CTU software which allows to transmission of data over some range. To increase the range of Zigbee we can connect zigbee in mesh, star etc loop.

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.

Arduino Software (Version 1.6.8)

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.
The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and

automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consists of two functions that are compiled and linked with a program stub main ( ) into an executable cyclic executive program:

The open-source Arduino environment makes it easy to write code and upload it to the i/o board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software.

The serial port of the arduino which is to be open and programs are uploaded by means of the arduino software. Therefore this software is very much of ease for user to handle the arduino programming, also the board can be set by means of selecting different board in the software which is used by the user while programming.

X-CTU Software

The software is easy to use and allows the customers to test the radio modems in the actual environment with just a computer and the items included with the radio modems.
X-CTU operates strictly for Windows Platforms.

GoldWave Software

In the Goldwave software, Sounds are displayed graphically as a waveform and the level of detail can be changed by zooming in or out. The waveform can be reshaped directly with the mouse when zoomed in.

RESULTS AND DISCUSSION

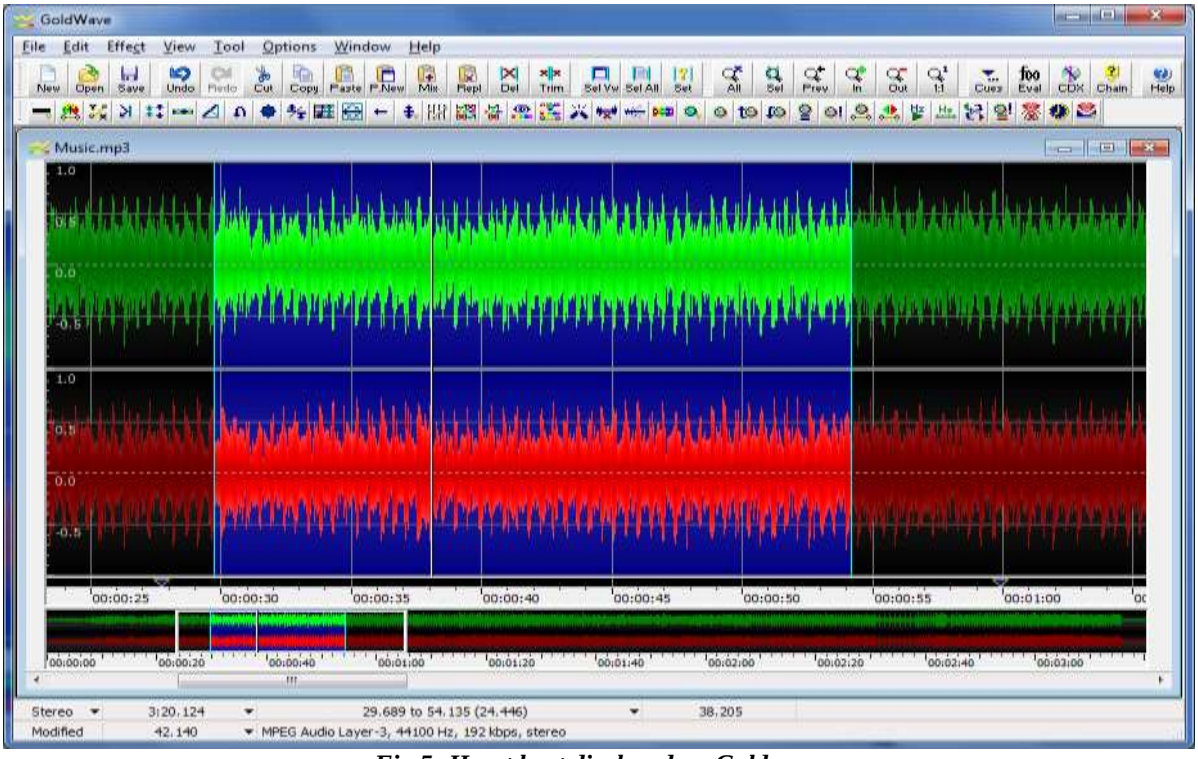

Fig 5: Heart beat displayed on Goldwave

CONCLUSION

Thus, it can be concluded that this project will help in monitoring the patients centrally over a large scale. This could be a great leap in biomedical sciences. With just mere monitoring, we would be able to save a lot of lives without much effort.

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