A MORTAL RECOGNIZING SYSYTEM USING RESPIRATIVE SENSNING

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***Abstract*—Respiration rate signal is an essential signal in many applications such as patient and elderly people health monitoring. Respiration rate in humans is measured when a person is at rest and counting the number of breaths for one minute and by counting how many times the chest rises during the breathing. There are two known ways for the measurement of human respiration. One is the contact way and other is non-contact way. So in this paper we present an ultra wide band sensor (UWB) for the simultaneous measurement of chest respiratory rate and amplitude of a human being. It can detect the human respiration even at high temperatures. The proposed system is completely wireless. The obtained signal can detect the human beings beyond walls or any other obstacles.**

***Index Terms*—ultra wide band (UWB) radar, respiration rate, sensor, signals, wireless sensor.**

I. INTRODUCTION

Respiration signal is one of the most critical signals used to assess the human body functions and stability. Other than this respiratory signal is also used to monitor the sleep apnea of patients and sudden change in respiratory rate is marked as a the earlier detection of cardiac arrest. Furthermore, respiratory rate is used to detect various illnesses and help in to determining the effective treatment and care at correct time.

The researchers in this field have investigated mainly two different methods for this purpose. In the first method patient or subject has to be in physical contact with the measuring equipment. The operating methods of contact devises include the measurement of chest movements, respiration air flow, electrocardiogram signals, sounds, etc. As these method requires the direct contact between the patient and test equipment during the entire measurement period and sometimes they may be incompatible in many situations and may be during the entire measurement period. Moreover, most of the methods are affected by the environmental changes such as temperature and light interference.

To overcome above mentioned problems, a second method is found out to detect and monitor the respiratory rate. In this method a non-contact sensor is incorporated to detect the human respiratory and vital signals. Scientists have demonstrated the feasibility of using radar based sensing system in the respiratory rate detection. This respiratory rates can be also used in many applications such as in several security systems, in various rescue operations such as to find people buried under snow, in biomedical field, etc. In this paper we are discussing the feasibility of using ultra wide and sensor for the detection and measurement of human respiratory rate for rescue operations.

II. lITERATURE REVIEW

[1] In this paper, the respiratory rate is measured using the ultra wide band radar due to its large bandwidth. The proposed system in this paper uses wireless technology to capture the human respiratory signal. It uses four-segment linear wave form to model the respiration rate. It uses CZT algorithm for the purpose. [2] In this method, it presents a wireless signal to record the breathing profile of humans. For this non-contact method a passive wireless system is used. The passive system is incorporates an antenna and a resonator. It uses a thin-film piezoelectric-on-substrate (TPoS) resonator as the wireless sensor.

[3] Details in this paper proposes a contact free system using two pyro-electric infrared (PIR) sensors are used to detect the human respiratory rate. PIR sensor incorporated picks up the thoracic movements due to the breathing activity of a human being. It tells that the proposed system achieves an average accuracy rate of 90% in the respiratory rate measurements. [4] In this paper it tells about the working of UWB short range radar sensing. It tells about the basic importance of UWB signals that is penetration through a non-metallic material. The original signal is separated from the reflected signal using "background subtraction" algorithm.

[5] This paper tells an ultra wide band system-on-chip radar sensor realized in 90nm CMOS technology is used to detect the human respiratory rate. The pulse radars are operated by sending electromagnetic pulses and receiving the echoes reflected by the target. In this the proposed system is tested and monitored using three different subjects of three different ages. From the experiments conducted, it tells that the UWB sensor is capable of detecting the respiration activity associated with sub-centimeter chest movements. [6] Inside

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this another wireless technology is used to detect the respiratory rate. Here it uses two main technologies namely Wi-Vi and Vital Radio. Wi-Vi is used to track the human body movements and Vital Radio is used to track the human heart rate and breathing pattern. The proposed technology is embedded in a Wi-Fi device. It tracks the respiration rate of the target even through the walls. Using MIMO nulling, it remove the reflections from the wall.

[7] In this paper, UWB sensor is used to detect the respiration rate wirelessly. To improve the accuracy of calculation multipeak detection of pulse deposition method is used. It tells that Doppler radar technique has a disadvantage of inaccurate measurements of the respiratory amplitude. For this it uses a carrier less UWB-IR system which measures the pulse deposition in the time domain which is linearly related to chest movement. In this it uses a Thales UWB antennas are used as the transmitter and receiver of the UWB signals. In the conclusion it tells that the UWB sensor can be used for home based assessments of patients instead of the in-hospital assessments. [8] This method proposes a respiratory rate detection using IR-UWB radar sensor. The IR-UWB sensor radar uses a emits impulse signal with a very short duration and by analyzing the received reflected signal from people and environment, it can detect the number of peoples and distances. It proposes a new people counting algorithm of N persons from the radar's received signal and the finding of each distance for N persons as separate problems.

[9] These paper tells the antenna effects on respiratory rate monitoring using UWB radar sensor. The performance of three different types of antenna are studied in this paper. Broad spec UWB antenna, A-info JXTXLB-20180 double ridged horn antenna, a double layered Vivaldi antenna are the three different types of antenna. It employs Fast Fourier Transform to detect the human frequency rate. Antenna 1 showed the highest error than the antenna 2 and 3. [10] This paper addresses a research of the human respiratory detection behind a reinforced concrete wall using a UWB radar sensor. In this paper it uses a CW radar system based on Music algorithm. With the experiments conducted on various volunteers it finally summarized that the system proposed in this can detect and measure respiratory signal accurately through the reinforced concrete wall.

III. Methodology

The proposed methodology basically consist of two block diagrams i.e. two circuits. One circuit is based on the transmission part and second circuit is based on the receiving part. Fig. 1 shows the block diagram of the transceiver circuit and Fig. 2 shows block diagram of the receiving circuit.

The "A Mortal Recognizing System Using Reparative Sensing" works with the Atmega2560 microcontroller. It is basically an 8-bit microcontroller. All the components in the transceiver circuit is directly connected to the microcontroller. The Atmega2560 board is used because due to its large analog input, digital I/O capacity, and the pin outs are simple. The microcontroller can be programmed with the embedded-c language. The input power supply for the device will be provided using a 12V li-po (lithium-polymer) battery. The size and dimension of the battery will be 155 × 75 × 40mm. The li-po battery is chosen because of its small and compactable size. The battery can be easily recharged using a power adapter. The voltage and current from the battery is stepped down to suitable value using a buck converter and given to the microcontroller.

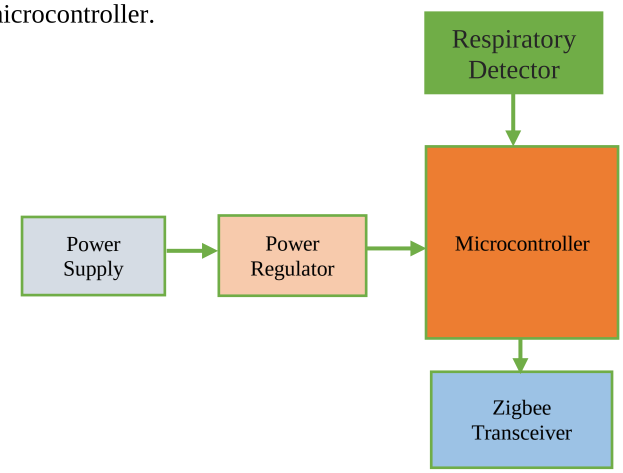

Fig 1. Block diagram of transceiver circuit.

The major part of the transceiver circuit is the respiratory detector. The respiratory detector used here is the Xethru X4M200 ultrawideband sensor. The sensor does not require any sperate power supply; the input from the microcontroller will supply a 5V to respiratory sensor. The sensor does the major part in the whole set-up. It senses the respiratory rate of the human beings along with the chest amplitude. This will produce the correct measurement data and it can detect the human respiration separately from other living beings. The state of the operation of the sensor can be determined using a RGB sensor mounted on it. Now the last and another important part of the transceiver circuit is the transceiver module which is an XBee Pro P24 module. It transmits the measured signal to the receiver circuit where it is received and analyzed.

The second circuit is the receiver circuit, it is an simple circuit as it only consist of three components, a zigbee receiver, a serial USB and a PC. The zigbee receiver is a receiver of XBee Pro P24. It receives the signal send by the transceiver circuit and sends it to the PC. Before sending the data to the PC, it is connected to a TTL logic to convert it into the form of serial USB. After that, from the serial USB, PC gets the transmitted data and the waves are analyzed, processed and recorded there.

Fig 2. Block diagram of the receiving circuit.

IV. IMPLEMENTATION

The main components in the device are divided into two circuits as previously told. The description of the main components is as follows:

A. Atmega2560 Microcontroller

The Atmega2560 is a low power CMOS 8-bit microcontroller based on the RISC architecture. It consists of 32 general purpose registers which are directly connected to Arithmetic Logic Unit (ALU). It consist of the following futures: 256K bites of in system programmable Flash with read-while-write capabilities, 4K bytes of EEPROM, 54/86 general purpose I/O lines, 32 general purpose working registers, 4 USARTs, 2-wire serial interface, 10-bit ADC, a programmable watch dog timer, SPI port and interrupt system. The minimum response time for an interrupt in Atmega2560 is 5 clock cycles. Atmega2560 is supported with embedded C language. Fig.3 shows the pin configuration of Atmega2560.

B. X4M200 Ultrawideband sensor

The X4M200 can read vital signs data such as respiration rate and breathing pattern of people. It is able to sense human presence by detecting any motion such as a person walking, hand movements and even a person with no other movements than respiration. Its extreme sensitivity enables it to detect presence up to a distance of 5.0 meters. Fig.4 shows the image of the X4M200 sensor.

In the X4M200 sensor, it has multicolour RGB sensor which indicate the state of operation. If the operation is breathing the led will show blue colour, if the operation is movement tracking the led will show green colour and if there is no movement then the led will show red colour. At high frequency, the X4M200 sensor will operate within the 7.25 - 10.20 GHz band and at low frequency, X4M200 sensor will operate within the 6.0 - 8.5 GHz band. The noise map in the X4M200 sensor will flatten the tops of the landscape to detect very small movements. The X4M200 sensor is fitted with a USB micro type B connector type. There are 2 possible ways to power the sensor, through pins 1 and 2 on the 16-pin interface connector or via USB. The X4M200 can be connected to a host system in several ways, via USB or via the interface connector using the UART interface.

C. XBee Pro P24 Module

XBee Pro P24 module is used for long range communication. It has range of 1600 meters in line of sight or 90 meters in indoors or urban area. This XBee wireless device can be directly connected to the serial port (at 3.3V level) of your microcontroller. By using a logic level translator it can also be interfaced to 5V logic (TTL) devices having serial interface. It can support up to 12 direct sequence channels. Fig.5 shows the image of a XBee Pro P24 module.

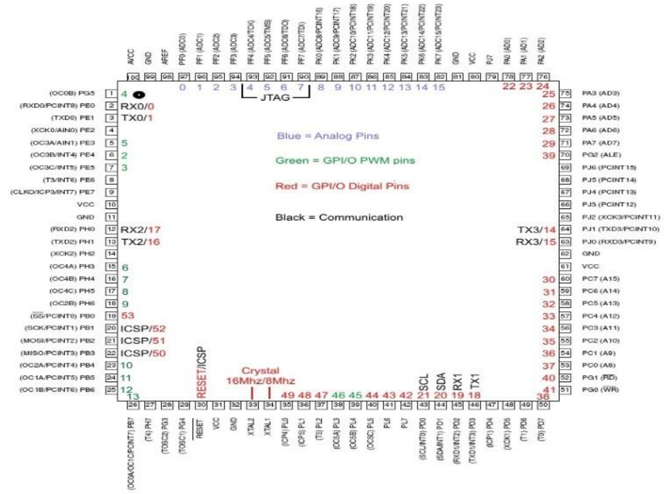

Fig3. Pin Configuration of Atmega2560.

D. 12V lithium-polymer (li-po) battery

A lithium polymer battery, or more correctly lithium-ion polymer battery, is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, like mobile devices and radio-controlled aircraft. These is the main purpose behind the choosing of li-po battery. For the device a 12V lithium-polymer battery is used. The main advantage of the these batteries is that it can be easily recharged using a power adapter and the life of the battery is also long lasting.

As we don't need a 12V power so the input to the microcontroller is controlled using a DC-DC buck converter which step downs the voltage to 9V.

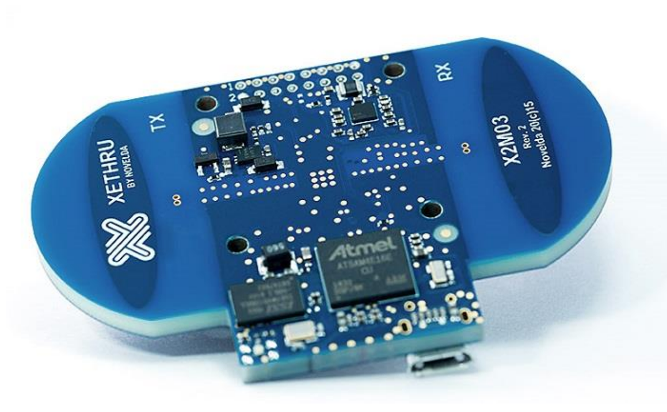

Fig4. X4M200 respiratory sensor module.

Fig.5 XBee Pro P24 Module

E. Graphical User Interface

The graphical user interface (GUI), is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators. Using the GUI, we can produce a simple sinusoidal type wave form which show the respiration signals to analyze the respiration rate. The sinusoidal wave form is simple, so that we can detail the features of the respiration signal in a given period, such as the difference between the rate of the respiration and expiration. By this we can track the presence of a human in a particular place. Fig.6 shows a corresponding wave generated using GUI.

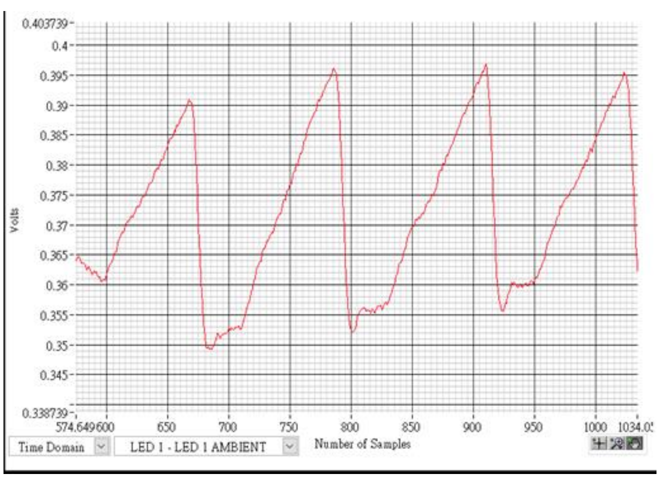

Fig. 6 Wave form generated using GUI

I. RESULT AND DISCUSSION

The use of ultrawideband (UWB) sensor make the measurement of human respiration make easy due to its non-contact way of measurement. For the measurement of human respiration, here we will use a Xethru X4M200 ultra-wideband sensor. The main advantage of using these sensor is that it can measure human respiration along with the amplitude accurately.

The sensor will produce RF ways which will also measure respiration rate and is prone to the heat. The main goal is to measure the respiration rate in high temperature. Most of the UWB sensors are affected by the changes in atmospheric conditions and temperature. Therefore we have gone for the RF transmission which measures the human respiration even in high temperatures. The obtained results will be tested with different peoples and it will compared with another results taken. Based upon the comparison of results the people finding ability will be improved if needed.

V. CONCLUSION

The process of measuring the human respiration rate should always be simple, comfortable and reliable. The ultrawideband (UWB) sensors in these area make these features in a right manner. They can measure the human respiration rate without physical contact. In this paper measurement of human respiration rate at high temperature is investigated and studied. The measurement will be robust and continuous for a long period by the mentioned sensor. The results of different peoples will be taken and evaluated.And the suitable method will be chosen. The proposed work can be used in the area of rescue operations. Although the UWB sensors are used in rescue operations such as to find the people buried under snow. But most of the sensors are affected by changes in the temperature. In this paper we are designing a contact free sensor which measures the respiration rate even in high temperatures. The main aim is to design a respiratory sensor that will measure the respiration rate during a fire rescue operation. So that the rescue workers can detect any survivors using respiration without getting harm. In future, the proposed system can be embedded in robots and drones so that the rescue operations can be done where the humans can't. It can also be modified with IoT so the information about the operations can be transferred to a long distance.

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