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RESEARCH ARTICLE

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# WIRELESS DIGITAL STETHOSCOPE BASED ON ZIGBEE

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**ABSTRACT**
In this paper we have to design a digital stethoscope with the functions of wireless transmission. Zigbee is used to transmit data because of its range. Heart beat can be picking up by two methods, one by diaphragm and second by using microphone, we are using microphone in this project because of high sensitivity. Output gets from microphone than amplify with help of amplifier. These heart beats are processed and sent through zigbee module. Advantage of zigbee, its range and multiple doctors can do auscultation at different places. This data can also transfer to computer through serial port communication system where audio and video can be made available through LAN. Additional feature of this project is display. Heart beat can also be seeing through GLCD. Finally, heart beat are sensed, sent, monitored, displayed analysed with ease.
Keywords: Digital Stethoscope, wireless transition, filters, zigbee.


## I. INTRODUCTION

A stethoscope is a medical device for listening to the sound of heart and breathing in our body. By using the stethoscope the doctor can detect the problem of the heart and lung of the patient. There are two basic types of stethoscope. It is acoustic stethoscope and electronic stethoscope. Acoustic stethoscope is operating on the transmission of sound captured by the chest piece with two air tubing to the listener ears. Difference between acoustic and digital stethoscope shown in figure1.disadvantage of acoustic stethoscope is its amplification which is very low as compare to digital due to which sound level is very low [1]. On other hand in digital stethoscope signal is amplify so many times so it's more useful as compare to acoustic. In this type of stethoscope the sound wave get from heart beat are converts from analog to electrical signals and then amplifies. The signals from the device can be fed into a recording device or to a visual or an audio output device. In this paper we have explained our idea to construct a Digital stethoscope based on zigbee that will make it easier to detect heart sound. Design and simulation of stethoscope also explained in this research. Current stethoscope available in market based on Bluetooth which has very short range and has some drawbacks, but our idea is to design a digital stethoscope which has two modes, one is transmitter and second is receiver, data transition take place with help of Zigbee module.

Figure1. Difference between acoustic and digital stethoscope

## II. Related Work

The previous design group used a Bluetooth technique for data transmission. The device designed by centre for development of advance computing, Mohali. In which they has developed a wireless Digital Stethoscope The device works with a wired headset as well as with a Bluetooth enables wireless headset. The data from device can be displayed on mobile as well as stored on computer. Total cost of stethoscope is around 8000/- [2]. Ying-Wen Bai and Chao-Lin Lu developed a digital stethoscope for removing disturbances in the heart sounds using adaptive chebyshev IIR band pass filter of type 1[1]. Haibin Wang, Jian Chen and Yuliang Hu developed a heart sound monitoring and analysis system in which heart state can be monitored in home to find out whether the heart murmurs are innocent or pathological [3]. Ashish Harsola, Sushil Thale and M.S.Panse proposed PIC based stethoscope in which the heart sounds acquired are processed using Peripheral Interface controller (PIC) and recorded using serial EEPROM which can be heard and plotted as a graph called phonocardiogram (PCG) [5].

The paper is organized as follow section III deals with basic hear sound. Design and Simulation unit is explained in section IV.

## III. Basic Hear Sound

Sounds are produced in condition when heart muscles are stretched and blood flow from one chamber called atria and to another chamber called ventricles as shown in figure2.

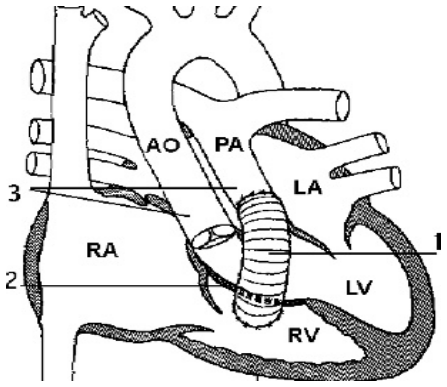


Figure2. Different chambers of heart

At each squeeze, the valve open and close to let blood flow to chamber. The valve close after that to prevent the blood flow backward. In normal heart condition, there are basically two types of sound produced by heart S1, S2 as shown in figure3. S1 sound corresponds to the near simultaneous closure of the mitral and tricuspid valves after blood has returned from the body and lungs. This is the start of systole. The S2 sound, indicating the end of systole and the beginning of diastole, is created by the closing of the aortic and pulmonic valves as blood exits the heart to the body and lungs.

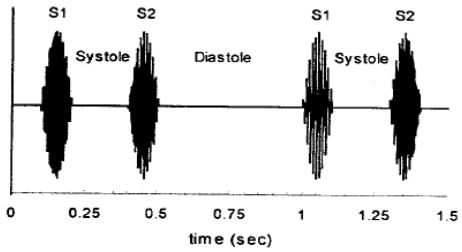


Figure3. Heart Sound

## IV. Designing and Simulation

System design consists of two parts that is transmitter and receiver. In transmitter part**, a** model circuit for the stethoscope is to be design which used to catch the internal sounds of the body, filter out unwanted signals, amplify the required signal and give the conditioned signal for the output. Output is transmitted with help of zigbee module as shown in figure 4.

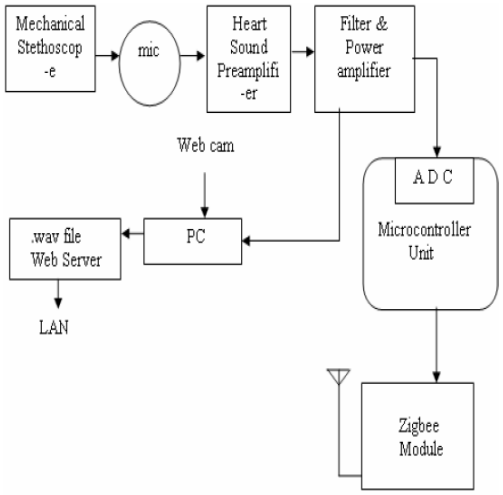


Figure4. Transmitter

There are many types of sensor available in market to convert heart sound to electrical signal. Microphone and diaphragm are mainly two methods. We are using microphone in this project because it converts the analog signal which coming from heart and convert into digital signal. Output of microphone is fed to pre processing section which is consisting of primary amplification, filter circuit and second amplification circuit. Primary amplification circuit is used to rid the noise from DC components and it amplifies the low level signal. Operation amplifier LM741 is used in pre amplification process. Total gain required 20 which is calculated by feedback resistor. Than output of pre amplifier is fed to active low pass filter with $F_c$ = 100HZ and 1000HZ and total gain of 1.6. Output get from filter is further processed by power amplification.

$$f = \frac{1}{2\pi RC}$$

LM386 is used for this process. Gain can vary by varying input given to amplifier through pot. Fig5shows signal processing circuit. The output of signal processing Circuit is converted into digital form by ADC. Analog to digital converter is interface with AT89s52 microcontroller. In this project XBee S2, Blue EDC-288588 module is used. Output signal is also provide to computer as data storage purpose.

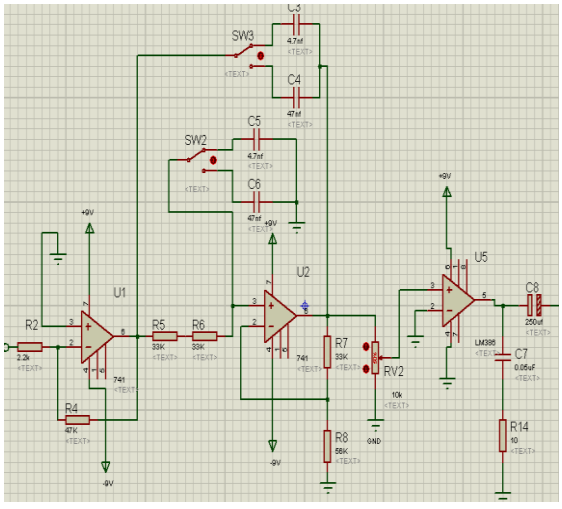


Figure5. Signal Processing Circuit

Receiver part is consisting of zigbee module, microcontroller, digital to analog converter and amplifier as shown in figure6. Zigbee receiver is used to receive the signal and transmits to microcontroller. Than this signal is digital form and convert it into analog with help of DAC. Data can also transfer to computer with help of serial data communication.

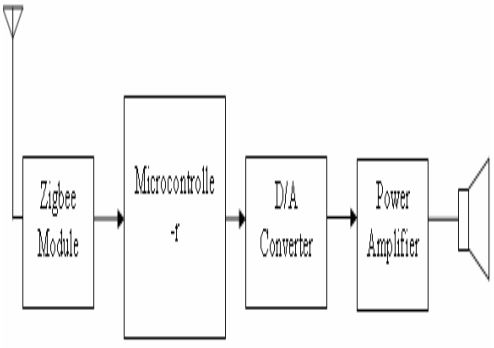


Figure6. Receiver

Now, simulation is done with help of proteus 7.6. Signal is checked by oscilloscope. Complete circuit is simulated for heart sound, murmur and different types of lung sounds audio as input for both filters with cut of frequency 100 Hz and 1000 Hz as shown n figure 7.

## V. Features

Heart and lungs sound are amplified so that in noisy area we get proper clear audibility. Filter is used to reduce the noise. Amplifier is used to control the gain and cut of frequency is controlled by filter design. Heart sound can be stored in computer with help of serial communication. With help of Zigbee, wireless auscultation is possible. The patient can be monitored by multiple doctors at a same time at long distance.

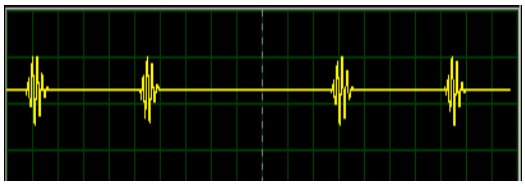

Figure7. (A). Heart sound as input

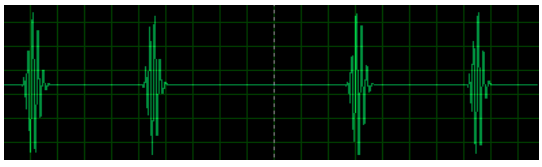

Figure7. (B). Output of amplifier

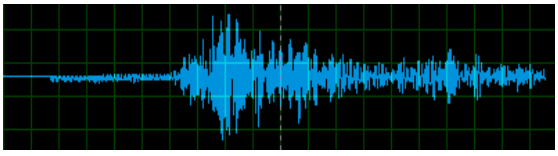

Figure7. (C). Output when filter with cut off 100Hz

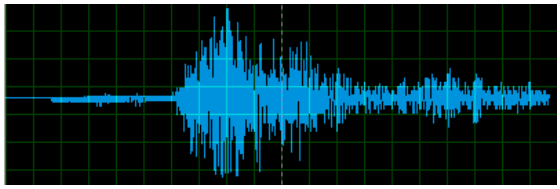

Figure7. (D). Output when filter with cut off 1000Hz

## VI. Conclusion

Digital stethoscope is designed by using embedded system. Data get from stethoscope can also store in PC by using serial data communication for further analysis and consultation. Pre amplifier is used to amplify the signal of gain 20. Designed filter is giving proper output until cut off frequency and showing attenuation above that frequency. Frequency selection can be possible by low pass filter formula. Potentiometer is connected at input With help of proteus, signal processing is simulated. In future, zigbee PRO can be use for data transmission and doctor can handle number of patient with help of wireless diagnose at same time.

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