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Heart and Lung Sounds Transmission and Analysis for Anesthetist Aid

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Abstract: The proposal of this project is to aid the anesthetist while carrying out auscultation. This proposed method uses an Oesophageal stethoscope to acquire the heart and lung sounds rather than going in for the normal stethoscope as the latter involves frequent placement of stethoscope on the chest of the patient during long surgical procedures. The acquired sound signals from the patient are then transmitted to a remote location with the help of a very simple FM transmitter and receiver. The signal thus received at the FM receiver is fed to the computer for further analysis and processing. The need for processing arises from the fact that both heart and lung sound has its useful information hidden in the same frequency range (i.e.) in 20 to 150Hz, so in order to separate them we go in for signal processing. The processing technique which will be used here will be wavelet transform.
Keywords— Oesophageal stethoscope, Auscultation, Transmitter and Receiver, wavelet transform.

I. Introduction

To carry out surgery the patient has to be under the sway of anesthesia as it rallies' round the patient's level of perception and pain thresholds to be taken beyond the sensory capabilities of the brain. This voids the pain sensation of the subject and thus assists the subject. The extent of the power of anesthesia on the patient depends on various factors like duration of surgical procedure, weight of the patient, gender, age and his/her nutritional habits. The vital signals of the patient are monitored continuously till the entire span of anesthesia. The anesthetist performs auscultation using a stethoscope to monitor the vital sounds (i.e.) heart and lung sounds; this will burden the anesthetist during long surgical procedures as he frequently places the stethoscope onto the chest of the subject. To mitigate the anesthetist from this encumber we go in for the proposed method [1].

II.General View

The signal is acquired by inserting the catheter into the subject's oesophagus. The heart and lung sound travels through the catheter and reaches the tip of the catheter which has to be interfaced with the transmitter of the telemetry. To achieve this connection between the catheter and the mic of the telemetry an acoustic coupler is used. The design of acoustic coupler is made in such a way that there is no loss of sound signal. The material used to make this acoustic coupler is Teflon as it yields lossless transfer [2][3].The proposed method uses telemetry to broadcast the acquired sound signals. Telemetry is a technology that allows data measurements to be made at a distance. The transmitter of the telemetry is a very simple f.m circuit which gives the required range and also noise free transmission. The sound can be received either in a mobile radio or in a simple radio circuit [4].

Catheter

The Oesophageal stethoscope is made up of PVC for its medical qualities. It is flexible so that it can be easily intubated into the oesophagus and can be manured easily for placing distal end near to the heart or near to the lungs. The PVC is highly insulated for electrical and sound properties Because of its sound insulating qualities; the sound waves travelling inside the stethoscope are not affected by the external sounds inside the oesophagus. Similarly the external sounds can only vibrate the diaphragm at the distal end, which in turn produces the sound waves inside the stethoscope. The PVC is not affected by temperature, which can vary in the range of 30OC to 40OC, so that there is no elongation or deformity to the stethoscope [3]

Fig 1 : Esophageal Stethoscope

Telemetry

Biotelemetry is a method of measuring biological parameters from a distance. It is in fact modification of existing methods of measuring physiological variables to a method of transmission of resulting data. The transmission of data from the point of generation to the point of reception can be done in various ways. The stethoscope is the simplest device which uses this principle of biotelemetry. The device amplifies acoustically the heartbeats and transmits their sound to the ears of a doctor through a hollow tube system [4].

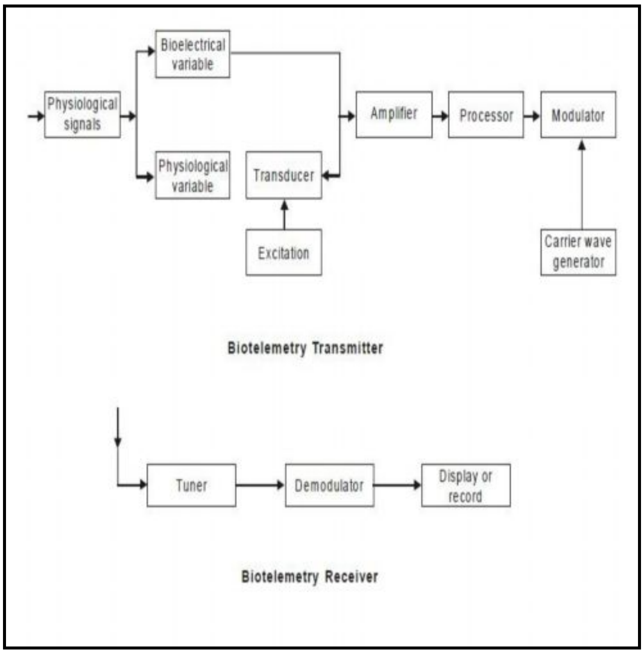


Fig 2: Bio Telemetry system

III. Circuit and Design

Transmitter

Transmitter is an electronic device which produces a carrier signal to hold the signal of interest and transmit it to a remote location with the help of an antenna. Here we go in for an fm transmitter as the design is simple and the range of transmission is more.

The oscillator which is used here in this design is colpitts oscillator. The distinguishing feature of the Colpitts circuit is that the feedback signal is taken from a voltage divider made by two capacitors in series. One of the advantages of this circuit is its simplicity; it needs only a single inductor. The frequency is generally determined by the inductor and the two capacitors. The frequency of oscillation is determined by the equation The transmitter circuit shown above is designed with the help of Colpitts oscillator. In the circuit L has 6 turns and has a diameter of 5.5mm and has a length of 4.5mm. Based on the formula for an air cored inductor, Where, L = inductance in uH r = radius of coil in inches l = length of coil in millimetres (mm) n = number of turns on coil.

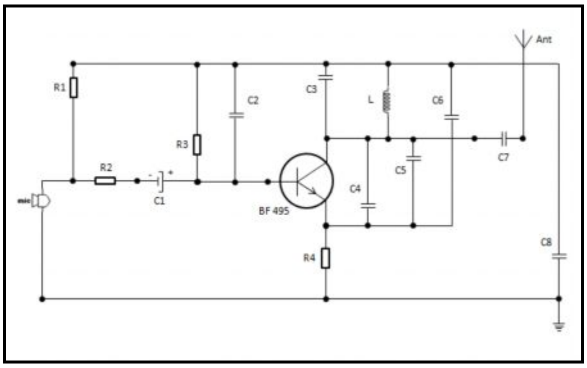
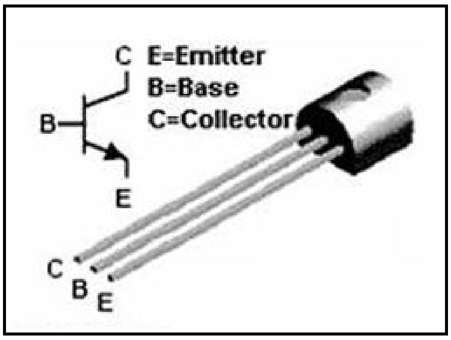


Fig 3 : Transmitter circuit

Using the above values, the inductance of L can be calculated. A diameter of 5.5mm = 0.22 inches, the radius is half this value or 0.11 inch, the length is 4.5mm and number of turns, n = 6. This gives L a value of: **L = 62 [(4(0.11)2) / (36(0.11) + 1.6(4.5))] = 0.156 µH** Q amplifies the input signal via C1 from the condenser microphone. Q acts as an oscillator and the signal coming off C2 is fed onto the base of Q. Q also acts as mixer. L/C3 is a so called 'tank' circuit it generates carrier wave. L is a variable inductor coil to be able to tune it a little bit, and the range of L is approximately 20meter. The antenna can be as simple as 21cm copper wire. The transistors which are used here is an NPN transistor.



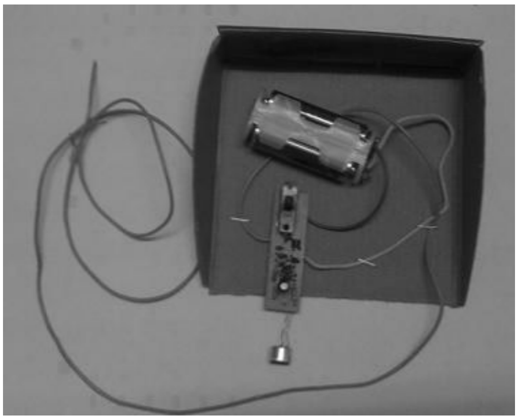


Fig 4: FM Transmitter

Receiver

In radio communications, a radio receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. The antenna intercepts radio waves (electromagnetic waves) and converts them to tiny alternating currents which are applied to the receiver, and the receiver extracts the desired information. The receiver uses electronic filters to separate the wanted radio frequency signal from all other signals, an electronic amplifier to increase the power of the signal for further processing, and finally recovers the desired information through demodulation. A radio receiver may be a separate piece of electronic equipment, or an electronic circuit within another device. The receiver used here is of the frequency range 88-108MHz. The signal is obtained at 100.8MHz.

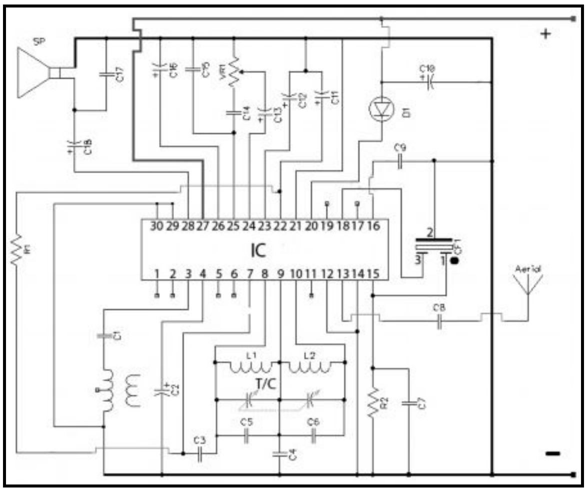


Fig 5: Receiver Circuit

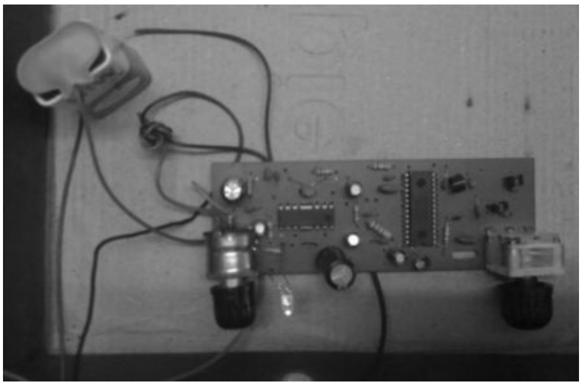


Fig 6 : FM Receiver

CXA1619BS is the IC which is used in this receiver circuit. This IC has several features like low current consumption, high gain amplification etc… therefore it is well suited here.

IV. Analysis of Signal

The Auscultation of the heart sound is a most common method to obtain all the useful information to detect various diseases of cardiovascular system. However one of the main problems of this signal analysis is interference of different sound. These sounds may be external or internal. The external sound is avoided by using sound proof room or other method etc. but internal sound like lung sound, vessel sound and muscle contraction sound is unavoidable during the recording of this sound signal. Wavelet is a most successful method for denoising this sound signal. Here a wavelet based denoising method for separation of lung sound from heart sound is proposed. In the wavelet transform (WT) based filter it has been shown that the multire solution representation of the lung sound signal in the WT domain combined with soft-thresholding can separate the input signal (lung sound) from the nonstationary one (heart sound)[5].

Wavelet Transform

A wavelet allows one to do multi-resolution analysis, which helps to achieve both time and frequency localization. Wavelet algorithms process data at different scales or resolutions. The wavelet basis's translation and companding capability enables the wavelet to possess flexible and variable time frequency windows that narrow down at high frequencies and broaden at low frequencies, making it available to focalize on any detail of the analytical object and perfectly suitable to analyze unstable heart sound signals [6]. Nowadays, wavelet analysis has successful applications in bio-medical engineering, intelligent signal processing, image processing, voice and image coding, speech recognition and synthesis, multi-scale edge detection and reconstruction, fractal and digital television, and other fields. In this paper I propose to take four types of heart sound signal which are: normal heart sound, aortic insufficiency, atrial septal defect and patent ductus arteriosus. In these sounds I propose to add the four lung sound as a noise and check the effect of lung sound before and after the denoising process.

V. Results & Discussion

The sound broadcasted by the transmitter was received on a remote receiver. The receiver was then connected on to a CRO and a sound of low amplitude was fed to the microphone and the corresponding waveform was observed in the monitor. the sound was received by the receiver at 100.8MHz. the required range of transmission (i.e.) 20m was obtained. The sound was attained without any noise. The signal received is then interfaced to a computer for further processing and analysis. The signal is a mixture of heart and lung sound. Both the heart and lung sounds has its useful information hidden in the same frequency range (i.e.) in 20 to 150Hz, so in order to separate them we have to adapt a good signal processing technique. The proposed method which will be used here is wavelet transform. The type of wavelet transform used here will be discrete wavelet transform as the signal needs to be broken in finite time samples before processing.

VI. References

1. Oesophageal Electronic Stethoscope- A.N.Nithyaa, Subhashree Rajan, D.Sujitha. 2010 International Conference on Nanotechnology and Biosensors IPCBEE vol.2 (2011) © (2011) IACSIT Press, Singapore
2. Design of wireless electronic stethoscope based on zigbee- Department of E&TC Vidya Pratishthan's CoE, Baramati, Maharashtra, India, International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.1, January 2012
3. Oesophageal Stethoscope and vital signs monitor system – James D. Uphold, Robert L. Pfohl, 1992.
4. Development of Wireless Bio-telemetry System Using FM Stereo Method For Exercising Rehabilitation Patients - Youngsik Kim, Jong Man Cho Department of Biomedical Engineering, Inje University, Kimhae, Korea, 2001.
5. Separation of Lung Sound from PCG Signals Using Wavelet Transform - Abhishek Misal, G. R. Sinha, augusts 2012
6. Application of Wavelet Transform and its [7] Acoustic Response of Oesophageal Stethoscopes,Apple, H. P. Ph.D.; Dauchot, P. J. M.D. Case Western, September 1980 - Volume 53 - Issue 3 - ppg S365

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