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Wireless Electronic Stethoscope

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***Abstract*—A stethoscope is a medical device for listening to the sound of heart and breathing in our body. The commonly used stethoscope is an acoustic stethoscope. The disadvantage of acoustic stethoscope is that the sound level is very low and this stethoscope is not very suitable to use in noisy environment as well as to detect internal sounds of babies as they are very low. However, acoustic stethoscope is commonly used because it is cheaper than electronic stethoscope. Electronic stethoscope electronically amplifies body sounds. As the sound signals aretransmittedelectronically, it can be wireless and can provide noise reduction. The primary aim of this paper is to develop and construct an electronic stethoscope using filters and based on wireless Bluetooth using Arduino Microcontroller that will make it easier to detect heart sound. In this paper we have discussed design and simulation of an electronic stethoscope which will not only provide us with a better signal but can also be wireless and interfaced with computers so that it can be further analyzed and stored for further uses.**

Keywords : Stethoscope, Arduino, Filter, Bluetooth

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. The chest piece has two sides, a diaphragm and a bell. The diaphragm creates high frequency sounds and bell creates low frequency sounds. The disadvantage of acoustic stethoscope is that the sound level is very low and this stethoscope is not very suitable to use in noisy environment as well as to detect internal sounds of babies as they are very low. However, acoustic stethoscope is commonly used because it cheaper than electronic stethoscope. The function of electronic stethoscope is similar to acoustic stethoscope. Electronic stethoscope electronically amplifies body sounds. In this device, sound waves from body are converted from analog to electrical signals and then amplified. As the sound signals are transmitted electronically, it can be wireless and can provide noise reduction. 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 an electronic stethoscope based on wireless Bluetooth that will make it easier to detect heart sound.In this paper we have explained the design and have simulated an electronic stethoscope which will not only provide us with a better signal but can also be wireless and interfaced with computers so that it can be further analyzed and stored for future uses.This paper covers software and hardware implementation.

A. Heart Sounds AndMurmur

The heart is a hollow muscular organ. it is divided into four chambers. The upper chambers are called atria and the lower chambers are called ventricles. The heart muscle squeezes blood from chamber to chamber. At each squeeze, the values open to let blood flow to the next chamber. Then the valves close to prevent blood from moving backward. In other worlds, The arrangement of one-way valves preventing back-flow, In this way the valves keep blood moving as efficiently as possible through the heart and out to the body. Under normal heart conditions, there are basically two heart sounds, S1 and S2, shown in Fig.1. 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.

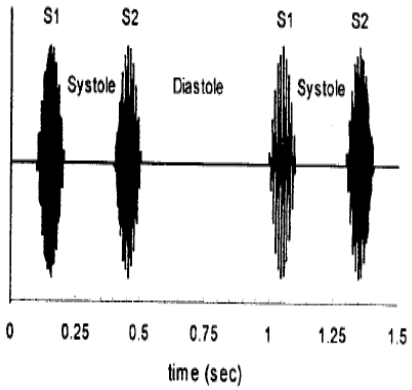

Fig1. Heart Sounds

II. PROCEDURE

B. Designing and Simulation

The first stage of the is to develop a model circuit for the stethoscope which is capable of catching the internal sounds of the body ,filtering out unwanted signals, amplify the

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required signal and give the conditioned signal for the output. And then implement this developed circuit virtually to verify its accuracy. The software implementation of the project is using National Instruments designed electrical circuit analysis software "Multisim". Multisim provides the user with a virtual breadboard with a varied number of components option to be used for easy designing of circuits. It equips the professionals with the tools to analyze circuit behavior. Using simulation for our project we can record a heart sound, analyze it and view the waveform on the oscilloscope though this software and verify the design. The Basic design consist of a preamplifier circuit, a bandpass filter to filter sound of frequency between 2 Hz to 100 Hz. Using Sallen Key filter model the filter was designed and implemented on the software for simulation. For designing the filter weused Op amp 741. The LM741 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709.The amplifiers offer many features:

a. Overload protection on the input and output
b. No latch-up when the common mode range is exceeded
c.Freedom from oscillations.

The sample circuit design is shown in fig 2.

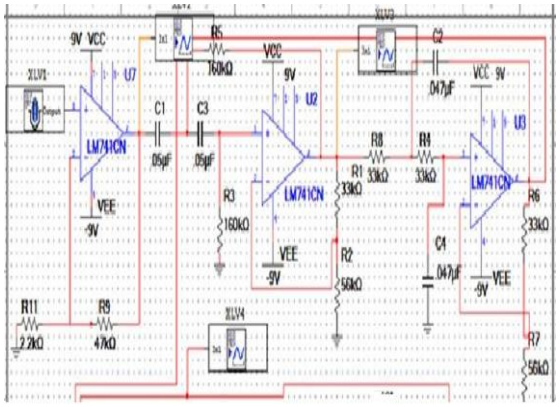

Fig2. Developed Circuit on Multisim

C. *Implementation on hardware*

Once the successful simulation of the developed circuit is done and expected results are achieved then the second stage comes i.e. development of a prototype by realization of the virtual circuit on hardware via breadboard and active and passive components. After the development of the prototype, the output of it is verified usingoscilloscope.

D. *Interfacing the developed prototype with transmitter*

After the successful implementation on hardware is achieved, the final stage comes -interfacing the prototype with a Bluetooth transmitter so that it can be made wireless.This is done with the help of Arduino Microcontroller and a Bluetooth module. The Arduino board is shown in figure 3.

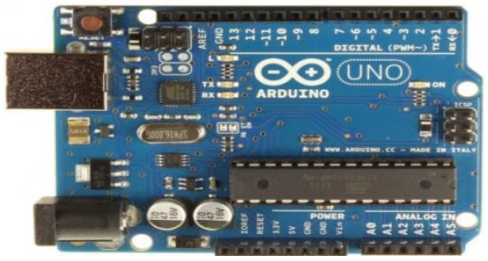

Fig 3- Arduino UNO

The arduino board is powered by a 9V DC power adapter and the output signal from the developed prototype is sent to the input pin of the arduino module . This arduino module is interfaced with Bluetooth transmitter HC-05 shown in figure 5.

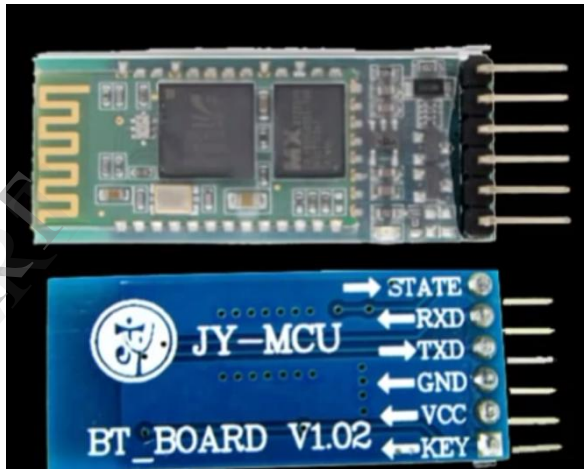

Fig4- HC-05 Module

III. RESULT

The results of simulation on softwareachieved were satisfactory as shown in following figures

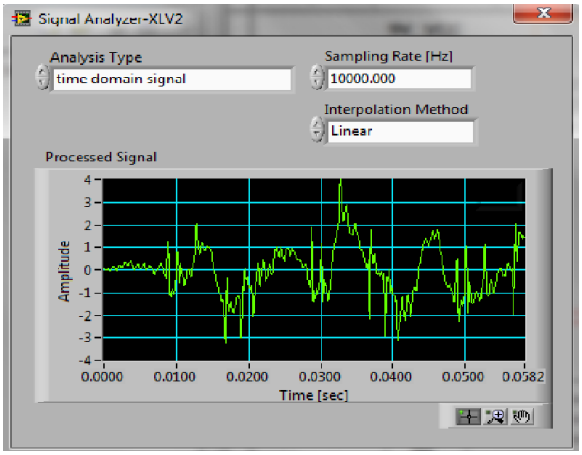

Fig5- Input Signal from Microphone

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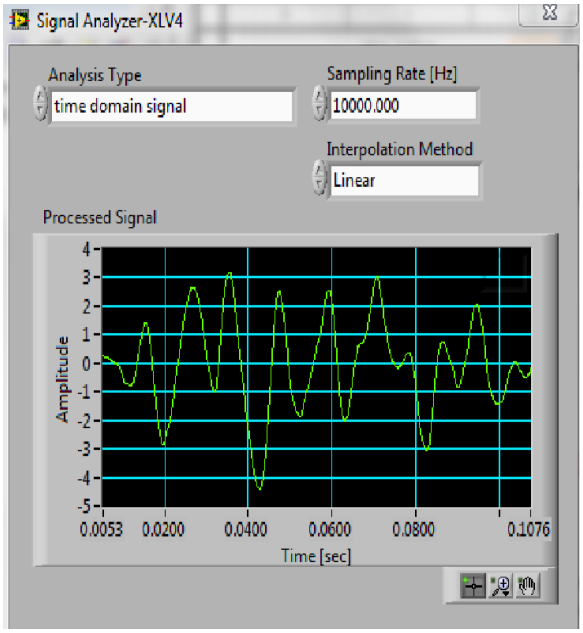

Fig6- Output Waveform

The interfacing of arduinomodule with HC-05 Module is done as following -
a. 5V and GND pin of both module are connected together.

b. RXD pin of HC-05 is connected with TXD pin of arduino.

c. TXD pin is connected with RXD pin of arduino module.

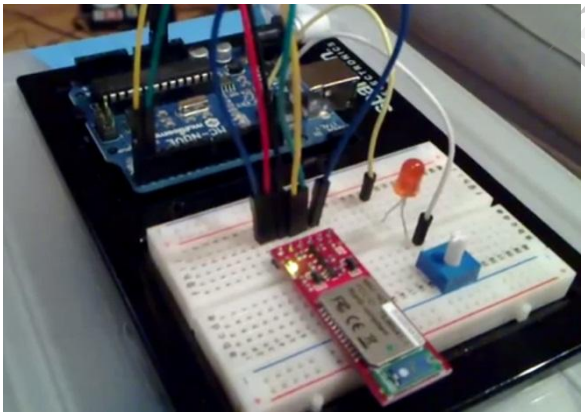

Fig7- Interfacing Arduino with HC-05

At present the work is going on interfacing the stethoscope with arduinoboard and once it is done the whole prototype will be ready and will be very cheap to the models available in market at present and more efficient as it is using arduino module.

IV. CONCLUSION

Nearly all medical personnel actively involved in the treatment and diagnosis of patients use stethoscopes on a daily basis. Stethoscopes are used for pulse measuring, blood pressure monitoring, and diagnosis of cardiovascular, respiratory, and digestive diseases. The majority of stethoscopes currently on the market are acoustic devices that use purely passive mechanical parts to isolate and focus sound generated by the body. Though these methods have been used for years, the simplicity of such devices is overshadowed by poor sound quality, discomfort, and high cost. These devices are also difficult to interface with modern technologies such as computers to record and analyze body sounds. Therefore efficientelectronic stethoscopes need to be designed that are comparable in cost, has better acoustic response, and can interface with modern technologies better than the current acoustic stethoscope. Electronic stethoscopes have been used for the last couple of decades, although it is only recently that they have gained any acceptance in everyday medical practice. This is because historical electronic stethoscopes were typically bulky and non-portable, requiring large separate cases to house the electronics. Because of this, electronic stethoscopes were only used in research and advanced diagnostic settings. Recent advances in microelectronics have led to smaller, more portable devices, and a subsequent rise in electronic stethoscope usage in everyday medicine. This project is oureffort towards designing such an electronic stethoscope which not only interfaces with computers and other display devices easily but is also cost effective and easy to use. we have used the simplest of components known so that the designing of this stethoscope can be universal and have simulated it through multisim software which is rather simple software to work on. So considering the widespread use of stethoscopes for diagnostic purposes we hope the stethoscope we have designed to be a success keeping in mind its advantages over the acoustic and other bulky stethoscopes now being used. The various advantages which this stethoscope has over others are:

a. This provides for better noise cancellation so a better signal is obtained.

b. It is very easy to be implemented both in terms of software and hardware.

c. It is rather compact and portable.

d. It is very cost effective.

e. A heart beat can be recorded and analyzed later on.

f. This provides for the viewing and storing of the waveform which is not possible in an acoustic stethoscope.

g. Real time monitoring can be done using LabVIEW.

V. ACKNOWLEDGEMENT

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