



# International Journal of Innovative Research in Computer and Communication Engineering

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## Design and Implementation of Digital Stethoscope with Disease Identification

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**ABSTRACT:** The Stethoscope is an acoustic medical device for listening to internal sounds in human body which is known, in medical terms, as auscultation. Heart sound auscultation is one of the most basic ways to assess the state of the cardiac function. Some researchers concluded that an abnormal heart-rate profile during exercise and recovery is a predictor of sudden death. Because the incidence of cardiovascular disease increased year by year, cardiovascular diseases relating to heart has become worldwide common and high prevalent disease. Stethoscope is a special device to hear heartbeat sound and monitor pulmonary disease. The most type of stethoscope used these days is the acoustic stethoscope. However, the problem with this acoustic stethoscope is the sound level very low. It is hard to analyze the heart sound and difficult to be diagnosed by a medical doctor. Therefore, this project was developed to monitor and display heartbeat sound using wireless digital stethoscope. The microphone is used as a sensor to capture the low sensitivity of heart sound signal and transmit the signal using RF Transmitter and RF Receiver where Microcontroller Arduino UNO is used as a platform to process the signal and set the result to the computer. Visual Basic was developed to monitor the real time electrocardiogram (ECG) waveform. The disease can be identified by the predefined data basis that are referred by the medical personnel. The result shows that this device able to transmit and receive ECG waveform wirelessly. The ECG signal can be recorded for further analysis by the medical personnel.

**KEYWORDS:** Wireless stethoscope, Arduino, RF transmitter, RF receiver, Disease Identification

### I. INTRODUCTION

The stethoscope comes from the Greek language for skope means chest and stethos means inspection. It is a very vital transducer for many medical practitioners and used for end user like doctors, nurses and physicians detect the abnormalities of the heart and lung such as sounds of heart, lung rhythm, and vibration of the intestines and blood flow (Geddes 2005). Diaphragm of head stethoscope is the metal end that is placed on the chest to listen to the lungs and heart sound with the tubing to tapered inner bores. This structure is able to provide a better sound transmission while listening is known as a vacuum tube. The most type of stethoscope used these days is the acoustic used these days is acoustic stethoscope (Mint & Dillard 2001). However, the problem with this acoustic stethoscope is the sound level is very low make it hard to analyze and diagnose the heart sound by a medical doctor. This is why several forms of digital electronic stethoscope have been developed to replace the conventional acoustic stethoscope. Basically, the purpose of digital stethoscope is to improve the sound resolution, allow variable amplification, minimize interference noise and simplify the output signal.

The digital stethoscope can enhance the auscultation problem of acoustic stethoscope which is easily affected by the movement and noise surrounding. Several techniques with the functions like stethoscope have been widely used such as SPO<sub>2</sub>, Sphygmomanometer and Electrocardiogram (ECG) (Francis E H Tay et al. 2009; Jokic et al. 2010).

#### A. EXISTING SYSTEM

Initial research was conducted to determine the types of heartbeats that are routinely measured during a visit by a doctor in hospital. This is a respiration rate of breathing that can give a total of heartbeats in heart rate per minute. One of the methods used to measure this heartbeat is by the auscultation methods. These methods provide information about a variety of internal body sounds originated from the heart, lungs, bowel and vascular disorders (Khan et al. 2012). A stethoscope is a medical device for listening to the sound of heart and breathing in our body. The commonly

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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<sup>[4]</sup> electronically amplifies body sounds. As the sound signals are transmitted electronically, it can be wireless and can provide noise reduction. The primary aim of the proposed system 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. The other works are based on the phonocardiography applications<sup>[3]</sup> which have been focusing on both the fundamental and abnormal heart sounds which also uses Bluetooth for wireless transmission.

## HEART AND MURMUR SOUND

The heart is a hollow muscular organ. It is divided into four chambers. The upper chambers are called atria and lower chambers are called ventricles. The heart muscle squeezes blood from chamber to chamber. At each squeeze the valves open to let blood flow to next chamber. Then the valves close to prevent blood from moving backward. In other words, 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 exists the heart to the body and lungs. Electrocardiogram are often used in many medical service centers and hospitals to diagnose and monitor a patient's health status by measuring their cardiac activity.

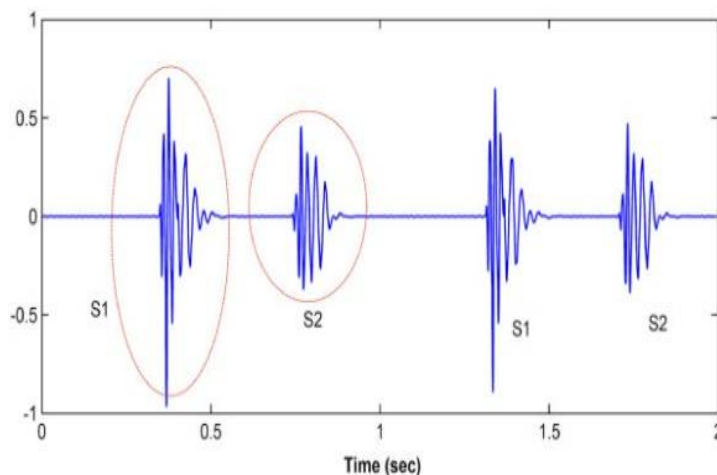


Fig1. Heart Sounds

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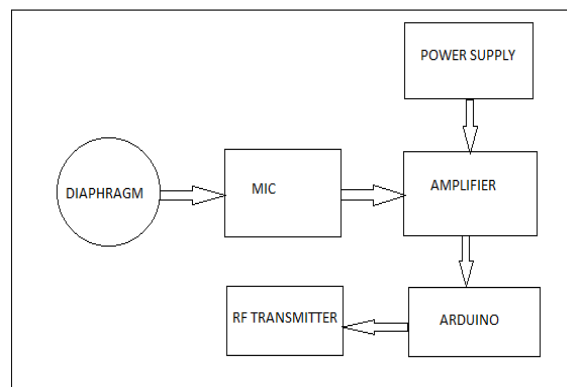
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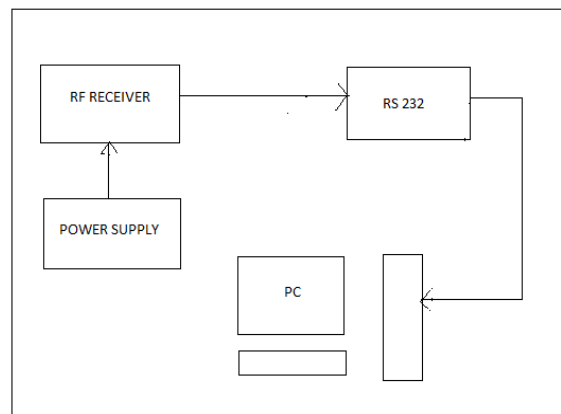
## B. PROPOSED SYSTEM

### II. BLOCK DIAGRAM

#### TRANSMITTER



#### RECEIVER



#### Diaphragm

The simplest and least effective method of sound detection is achieved by placing a microphone in the chest piece. This method suffers from ambient noise interference and has fallen out of favor.

#### Microphone

A **microphone** is a transducer that converts sound into electrical signal. Microphones are used in many applications such as telephones, hearing aids, live and recorded audio engineering, radio and television broadcasting, speech recognition, VoIP, and for non-acoustic purposes such as ultrasonic sensors or knock sensors

In our system, it is used to sense and record the pulse signal, that is received from the heart.



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## *Amplifier*

An operational amplifier is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually, a single-ended output. In this configuration, an op-amp produces an output potential that is typically hundreds of thousands of times larger than the potential difference between its input terminals.

## *Arduino*

**Arduino** is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default boot loader of the Arduino UNO is the optiboot boot loader. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals.

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor.

## *RF Transmitter*

An RF transmitter module is a small PCB sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a micro controller which will provide data to the module which can be transmitted.

## *RF Receiver*

An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: super- heterodyne receivers and super-regenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage

## *I. RS 232*

RS-232 is a standard for serial Communication transmission of data. It formally defines the signals connecting between a *DTE* (*data terminal equipment*) such as a computer terminal, and a *DCE* (*data circuit-terminating equipment* or *data communication equipment*), such as a modem. The RS-232 standard is commonly used in computerserial ports.

RS-232 devices may be classified as Data Terminal Equipment (DTE) or Data Circuit-terminating Equipment (DCE); this defines at each device which wires will be sending and receiving each signal. According to the standard, male connectors have DTE pin functions, and female connectors have DCE pin functions. Other devices may have any combination of connector gender and pin definitions. Many terminals were manufactured with female connectors but were sold with a cable with male connectors at each end; the terminal with its cable satisfied the recommendations in the standard.

## III. DESIGNING AND SIMULATION

The first stage of this 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 signal and give the conditioned signal for the output. Arduino is an open-source electronics prototyping platform based on flexible, simple microcontroller board. The development hardware is easy to use with software writing in the board. For this project by taking an input signal it

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controls a amplifier and the RF Transmitter. An important feature of the Arduino is that one can create a control program on the host PC download it to the Arduino and it will run automatically.

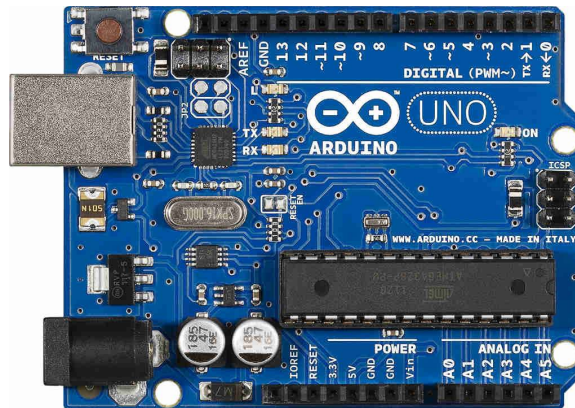


Fig2. Arduino UNO

Referring to figure4, this project used Arduino Uno as a microcontroller to receive data and then transfer it through RF Transmitter for wireless communications. The arduino board is powered by a 5V DC power supply and the output from the amplifier is sent to the input pin of the arduino module. This arduino module is interfaced with RF transmitter. The signal is modulated and transmitter wirelessly through RF transmitter. The signal is received by the RF receiver and demodulated. The signal is stored in PC and the disease can be identified by the predefined data bases.

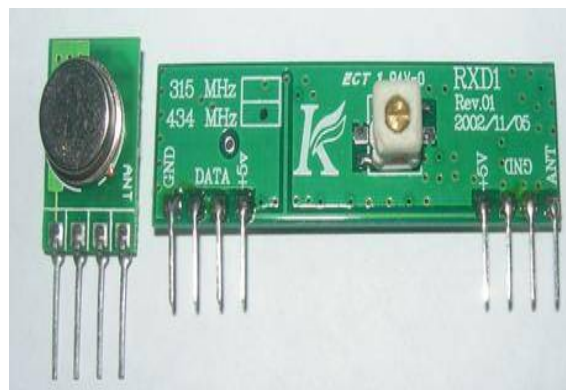


Fig.3 RF Transmitter and RF Receiver

## IV. SOFTWARE METHOD

Software that is needed to control this wireless stethoscope system can be monitored and analyzed the heartbeats by the doctors or physician. The system that is used for this method is capturing the input signal in voltage that is from microphone and then being read by the software programming system to convert from analog signal to digital signal for final result in the development of wireless stethoscope.

### *Embedded c*

Embedded C Programming is the soul of the processor functioning inside each and every embedded system we come across in our daily life, such as mobile phone, washing machine, and digital camera. Embedded C language is most frequently used to program the microcontroller.

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## Visual Basic

Visual Basic was designed to accommodate a steep learning curve. Programmers can create both simple and complex GUI applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions for those components, and writing additional lines of code for more functionality. Since VB defines default attributes and actions for the components, a programmer can develop a simple program without writing much code.

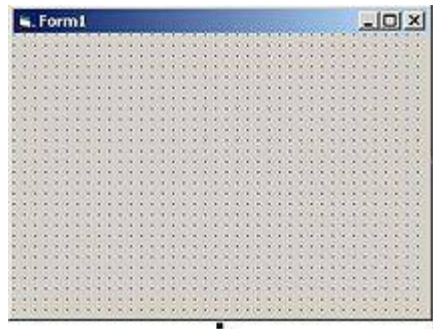


Fig4. An empty form in Visual Basic

## V. RESULT

The results of simulation on software achieved were satisfactory as shown in following figures.

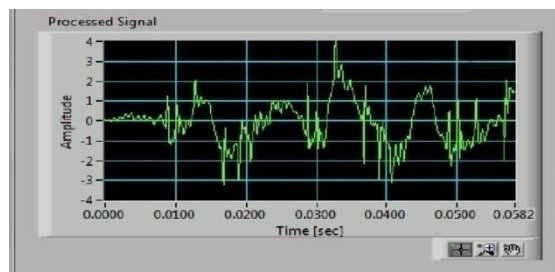


Fig 5. Input Signal from Microphone

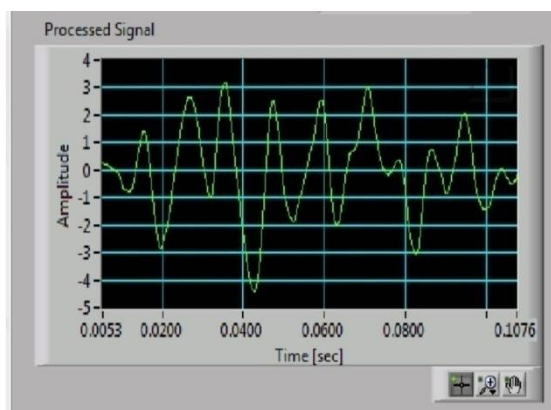


Fig6. Output Waveform





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## VI. 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. This project is our effort towards designing of 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 components known so that the designing of this stethoscope can be universal and have simulated it through embedded c 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.

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## BIOGRAPHY

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