A simple electronic stethoscope for recording and playback of heart sounds

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UNDERGRADUATE TEACHING of cardiovascular physiology often involves lectures on heart sounds. To complement these lectures, online resources are commonly used. The audio files of heart sounds are available as free downloads on the internet from websites of stethoscope manufacturers such as Thinklabs (http://www.thinklabsmedical.com/sound-library.html) and Littmann (http://solutions.3mindia.co.in/wps/portal/3M/en_IN/Littmann/stethoscope/education/heart-lung-sounds/). The auscultation assistant website of the University of California-Los Angeles (http://www.wilkes.med.ucla.edu/inex.htm) is also an excellent resource for abnormal heart and lung sounds. Heart sounds can also be demonstrated during practical sessions (1). It is, however, interesting for students to see the recording and playback of heart sounds during lecture. Described below is a simple electronic stethoscope that can be used for performing such recordings. It is a modified version of the stethoscope microphone described in a YouTube video available at http://www.youtube.com/watch?v=iqjxOapIKbE. This electronic stethoscope will be useful for departments that do not have phonocardiographs, electronic stethoscopes, echocardiography, or ready internet access.

MATERIALS AND METHODS

Materials required. The following materials are required to create the electronic stethoscope (Fig. 1):

1. An ordinary stethoscope.
2. Medical grade tubing.
3. A condenser microphone with a 3.5-mm stereo plug.
4. A laptop (Microsoft XP/Mac OS or later) with Thinklabs phonocardiography software.

Construction. Remove the stem of the stethoscope chest piece (Microtone, India) from the tubing. Attach a medical grade tube of 5 cm length and 6-mm inner diameter to the stem of the chest piece. Insert a condenser microphone on the other end of the tube. This end may have to be heated to facilitate the proper fixing of the microphone. The microphone is then connected to a 3.5-mm stereo plug. Computer microphones already connected to a stereo plug can also be used. The electronic stethoscope is now ready for use.

Recording of sounds. The diaphragm of the electronic stethoscope is placed over the mitral area, and the stereo plug of the electronic stethoscope is connected to the microphone input of a laptop installed with Thinklabs phonocardiography software. Sounds are recorded using this software. The software can be freely downloaded from the Thinklabs electronic stethoscope website (http://www.thinklabsmedical.com/software-download.html).

It is safer to use a laptop disconnected from the main power supply (floating) and running on battery. More details about the safety precautions can be accessed here: http://www.thinklabsmedical.com/safety/. During recording, the sound waves can be seen on the waveform track of the software (Fig. 2). The microphone input volume may be adjusted to clearly visualize the waveform.

After being recorded, the sounds can be played back. Recorded sounds are better heard with headphones. Sounds can be amplified after the selection of an area of interest. Additional functions, such as filtering of the heart sounds, display of the frequency spectrum of the heart sounds, and changing the tempo of the recorded sounds, can also be performed. The software also provides an option to label the heart sounds (Fig. 2). The recorded sounds can be saved in the software format for easy access or can be exported to .wav or .mp3 sound formats. The following link provides more details regarding the use of the phonocardiography software: http://www.thinklabsmedical.com/support-and-manuals/26-electronic-stethoscope/support/74-stethoscope-software-user-manual.html.

Fig. 1. A: stethoscope chest piece. B: medical grade tube. C: condenser microphone of the computer microphone. D: condenser microphone. E: stereo plug.

Electronic stethoscope after assembling the parts

Items required for making the electronic stethoscope
This electronic stethoscope can also be used for recording Korotkoff sounds (Fig. 3). For this, the diaphragm of the stethoscope is kept over the brachial artery while the blood pressure cuff is inflated and deflated.

The making of the electronic stethoscope and the recording of heart sounds and Korotkoff sounds can be seen as a YouTube video at the following link: http://youtu.be/T5UytMyPeSM.

**RESULTS**

*Use of the electronic stethoscope.* Recording and playback of heart sounds with the above electronic stethoscope was demonstrated to 60 undergraduate medical students during a lecture on heart sounds. The recording of Korotkoff sounds and heart sounds was also demonstrated in a laboratory session for students undergoing the M.Tech clinical engineering course. In both cases, the students were keenly interested in the recordings.

The making of this stethoscope was also given as an assignment to M.Tech clinical engineering students, who were able to construct this quite easily.

**DISCUSSION**

This electronic stethoscope is simple to construct. It is versatile in that it can be used to record heart sounds and Korotkoff sounds as well as other sounds such as lung sounds and sounds from the joints. This electronic stethoscope is useful for familiarizing the students with the nature of Korotkoff sounds before practical sessions on the recording of blood pressure.

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**DISCLOSURES**

No conflicts of interest, financial or otherwise, are declared by the author(s).

**AUTHOR CONTRIBUTIONS**

Author contributions: A.B. conception and design of research; A.B. performed experiments; A.B. analyzed data; A.B. interpreted results of experiments; A.B. prepared figures; A.B. drafted manuscript; A.B. edited and revised manuscript; A.B. approved final version of manuscript.

**REFERENCES**

Fig. 3. Korotkoff sounds recorded using the electronic stethoscope and Thinklabs phonocardiography software.