

## **A COST-EFFECTIVE, MODIFIED ELECTRONIC STETHOSCOPE FOR IMPROVED AUSCULTATION AND TO FACILITATE TEACHING**

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Detection of heart sounds by placing the ear of the clinician directly on the chest of the patient, was developed to the modern day stethoscope coined by the Greek words "stethos" (chest) and "skopein" (to look at). It would be rewarding for the clinical teacher to describe different heart sounds, murmurs and other abnormalities while performing the auscultation him/herself. Our objective was to develop an electronic stethoscope with improved functions which can facilitate group teaching/learning and monitoring of heart rate during anesthesia.

A modified integrated circuit power amplifier with an amplification factor of 200 was used to amplify the sound in the new modification. High sensitive condenser microphone which is sensitive for 20 Hz to 16000 Hz was used to receive sound waves. Earphones or a speaker were used to listen to the auscultatory sounds. A modified amplifier circuit was used to filter the environmental noise. The head of a conventional acoustic stethoscope was used for the head part of the electronic stethoscope. A rubber esophageal probe with a sensitive condenser microphone replaced the head part when used for anesthetic monitoring and a connector was used for easy interchange. The electrical signals are transmitted through a low noise coaxial cable to the amplifier circuit. As heartbeat emits a sound wave between 10 to 150 Hz and can reach a maximum energy at 10-40 Hz., the detection of high frequency sounds was minimized in order to reduce the environmental noise. Two controls were used for the filtration of the output frequency and sensitivity sound volume.

The electronic stethoscope and Littman stethoscope were used to measure the blood pressure of the 30 veterinary students, and the heart rate, rhythm, amplitude and murmurs of 15 dogs in order to validate the electronic stethoscope. The heart sounds of 28 cardiac patients were auscultated by a consultant cardiologist. There was no difference between the results of both stethoscopes for the heart rate, rhythm and in the detection of murmurs, and in the blood pressure values. The electronic stethoscope gave a significantly better amplitude of sound.

The electronic stethoscope can be used to listen to low amplitude heart sounds which are not audible with normal stethoscope, and in group auscultation. The high sensitive esophageal probe can be used for easy anesthetic monitoring. This stethoscope can be made with minimal cost of Rs. 2000/= when compared to a modern electronic stethoscope that can range from US\$ 250-600. Disadvantages are the bulkiness and the amplification of unwanted environmental noises with increasing frequency.