

Review on Digital Stethoscope

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Abstract—the stethoscope is one of the basic diagnostic tools in the medical world. The heart sounds are generated by the beating heart and the resultant flow of blood through it. It can provide the information of patient's cardio respiratory system. The death due to heart diseases has become the second mortality after the stroke in the world. Heart sound stethoscope is primary stage to access. Stethoscope is an acoustic medical device for listening to internal sounds in human body. 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 every year, cardiovascular diseases relating to heart has become worldwide common and high prevalent disease. A digital stethoscope provides revolutionized way of auscultating the heart sounds.

Index Terms— auscultation, microcontroller, heart sounds, stethoscope.

I. INTRODUCTION

At present, with the improvement of domestic living standards, numbers of patients with heart disease are increasing rapidly. Stethoscope has been used since long time by healthcare professionals to listen the heart sounds for diagnostic purpose. Its major disadvantage is that the level of sound is very low it becomes difficult to listen it clearly, which is important for the diagnoses but cannot be clearly distinguished by doctors amplifiers. Recently, there have been a number of advances in auscultation technology, including the introduction of a number of electronic stethoscopes, portable Bluetooth visual electrical stethoscope, stethoscope based on Bluetooth and embedded digital stethoscope that uses the adaptive noise cancellation filter and the Type I Chebyshev IIR band pass filter to reduce the noise of the heart sound. Many of these stethoscopes rely on the use of a personal computer to filter record and replay the signal. During heart sound acquisition many external body noises such as ambient noise, as well as internal body noises such as heavy breathing, speech and etc, may be captured. These noises are mixed with heart sound.

II. SYSTEM DESCRIPTION

The proposed system consists of the following hardware components: 1) Microcontroller 2) Amplifier Circuit 3) Acoustic Sensor 4) Flash memory chip 5) LCD 6) software interface. These modules have been shown in figure below:

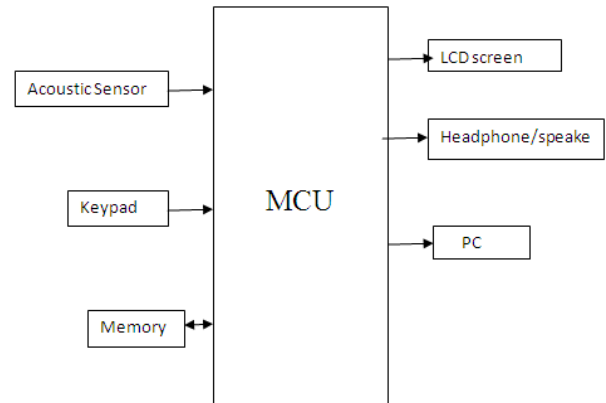


Fig 1: Basic Block diagram for digital stethoscope

Those researches are mainly concentrated on how to help the cardiologist. To diagnose human's disorders needs a long-term practice and experience. The above problems will be solved, even for ordinary people without medical knowledge can also improve the ability to identify heart murmur by auscultation. The digital stethoscope is possible to become a high performance-price-ratio home medical and health care instrument, and enter into numerous households. Heart sound can be heard using a stethoscope and recorded in phonocardiography. Phonocardiography is a method for graphical recording of sounds made by the heart and great vessels, namely, heart sound using a microphone that can detect low frequencies.

III. PRINCIPLE OF OPERATION

The stethoscope is composed of three major parts. The first part is the chest piece, tubes and headset. It consists of a shallow, bell-shaped piece and a clear, stiff diaphragm, which is connected to the metal earpieces by a flexible tube. The bell is used to pick up lower frequency sounds, and the diaphragm is used for higher frequency sounds. When the chest piece is placed on the skin, vibrations within in the body are amplified by either the bell or diaphragm. These acoustic pressure waves then travel up through the tubing to the earpieces and into the listener's ears. Digital stethoscopes offer new opportunities for computerized analysis of heart sounds. In cardiac auscultation, an examiner uses a stethoscope to listen to these sounds, which provide important information about the body condition. When the heart sounds are displayed graphically, the methodology is known as phonocardiography. As heart sounds are non-stationary signals, it is important to study both their temporal and frequency contents. Recently, with the rapid development of computer hardware and digital signal processing, heart sounds could be recorded and analyzed easily.

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The majority of these researchers mainly emphasize on the characteristic extraction by frequency-analysis method. Others concern on how to extract the heart rate from a weeping infant through the heart sound signals, and improve signal-to-noise ratio by adaptive filtering way.

IV. TYPES OF STETHOSCOPES

The stethoscope is most often used to listen to heart sounds and breathing. There are two basic types of stethoscopes for respiration system diagnostics of the human body.

a) Acoustic Stethoscope

Acoustic stethoscopes are familiar to most people. Acoustic stethoscopes maintain their popularity and trust among doctors due to their longstanding use in the medical profession. Although it is taking digital stethoscopes time to catch up, they are rapidly gaining in popularity. However, acoustic stethoscopes are the most commonly used.

b) Electronic Stethoscope

Electronic stethoscopes function in a similar way as acoustic stethoscopes, but the sound is converted to electrical signals which can then be amplified and processed for optimal listening. Because the sounds are transmitted electronically, an electronic stethoscope can be a wireless device, can be a recording device, and can provide noise reduction, signal enhancement, and both visual and audio output.

V. ADVANTAGES /DISADVANTAGES

1. In Digital stethoscope Amplifiers are used which amplifies the low level signal.
2. Data can be stored for further analysis and consultation.
3. Heart signal is displayed on the LCD screen.
4. In digital stethoscope battery replacement can be tedious.
5. They are expensive.
6. They suffer from interference when other electronic instruments like cell phones are around.

VI. CONCLUSION

The electronic stethoscope increases the level of the sound by amplifying it. It converts the analog sounds made by the body into digital signals, which can then be amplified and processed. The simplest form of this type of stethoscope is a microphone placed against the body. This stethoscope can produce excellent sound quality and has recording, playback, and Bluetooth capability. It offers a new home care medical device, a useful doctor's diagnosis assistant, and a new training assistant for young doctors and students.

REFERENCES

1. Shin, J.Y.; Lim, S.W.; Kim, Y.C.; Kim, S.J.; Cha, E.J.; Lee, T.S. "Portable digital esophageal stethoscope system". Annual International Conference of the IEEE. Publication Year: 2010, Page(s):1844-1847.
2. Haibin Wang; Jian Chen; Yuliang Hu; Zhongwei Jiang; Choi Samjin, "Heart Sound Measurement and Analysis System with Digital Stethoscope" Biomedical Engineering and Informatics, 2009. Publication Year: 2009, Page(s): 1 – 5.
3. Jatupaiboon, N.; Pan-ngum, S.; Israsena, P. "Electronic stethoscope prototype with adaptive noise cancellation", Knowledge Engineering, 2010 8th International Conference on ICT .Publication Year: 2010, Page(s): 32 – 36.

4. Udawatta, L.; Abeykoon, A.H.S.; Prasanga, D.K.; Prasad, S.; Perera, W.; Perera, K. "Knowledge on heart patients through stethoscopic cardiac murmur identification for E-healthcare". Knowledge Engineering, 2010 8th International Conference on ICT. Publication Year: 2010, Page(s): 58 – 63.
5. Jia-Ren Chang Chien; Cheng-Chi Tai. "The implementation of a Bluetooth-based wireless phonocardio-diagnosis system", Networking, Sensing and Control, 2004 IEEE International Conference. Volume: 1 Publication Year: 2004, Page(s): 170 - 173 Vol.1
6. Samuel E. Schmidt; Egon Toft; Claus Holst-Hansen; Johannes J. Struijk "Noise and the detection of coronary artery disease with an electronic stethoscope" 2010 5th Cairo International Biomedical Engineering Conference Cairo, Egypt, December 16-18, 2010 page 54-56.
7. Christian McMechan and Poman So "Design and Implementation of a Low Cost Electronic Stethoscope" IEEE714-718.
8. Ying-Wen Bai and Chao-Lin Lu, "The embedded digital stethoscope uses the adaptive noise cancellation filter and the type I Chebyshev IIR bandpass filter to reduce the noise of the heart sound," Proceedings of 7th International Workshop on Enterprise networking and Computing in Healthcare Industry, 23-25 June 2005, pp. 278-281.

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