

Simple Two-Channel Sound Detectors Applying to Pulse Measurement

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Abstract: Traditional Chinese Medicine (TCM) is an interesting issue in the last two decades. In TCM, pulse diagnosis is a remarkable tool that differs from western medicine. Nowadays, various pulse measurement instruments have been developed to use in clinical medicine. This study reveals that simple and low cost two-channel sound detectors can easily be applied to the pulse diagnosis successfully. This device can promote the development of TCM and reduce the cost.

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1. Introduction

Traditional Chinese Medicine (TCM) is a very interesting topic nowadays. The theory of TCM is still a mystery for modern science; people indeed like to look for the answers by various ways. The scientists collaborate with TCM doctors to study this new topic by theoretical, experimental and clinical testing studies. [1-5] Pulse diagnosis, the remarkable feature in TCM, is the key project. Traditionally, doctors diagnose diseases and explain how diseases form according to pulses. Pulse is a precise and useful tool in Traditional Chinese Medicine. Therefore, a precise, corrective and stable pulse signals measurement instrument is very important for TCM.

At present, scientists and engineers develop various sensors for pulse measurement, such as ultrasonic wave, optical and piezoelectric sensors and so on. All kinds of them can be roughly divided into two types: touch type and non-touch type. The touch type usually uses an elastic material as sensor to detect the vascular pressure. [6] Contacting with skin directly to measure pulses is a simple and efficient method. However, direct measurement might affect the pulse signals and change the shape of vascular wall. The non-touch methods can eliminate the distortion from interference that makes form pressure. [7-8] Non-touching type generally measures the vibration of skin to construct indirectly pulse signals. The indirect measurement only can detect the vibrations of skin, but not the real vibrations of vases. Furthermore, doctors always feel the pulse by

applying a small press on wrist skin to detect different types of pulse. The non-touching method has a great limitation in practice.

This study reveals simple and low cost two-channels sound detectors can easily be applied to the pulse diagnosis. This device has advantages that all components are commercial goods not specially made and can be fabricated easily. Furthermore, combining with internet techniques, this device can be used to remote home health care applications.

2. Experimental setup

The experiment setup is composed of two parts: pulse signal detector and data receiving and storage device. The pulse signal detector constructs of commercial sound card (Realtek ALC888) which supports stereo microphone. Two high sensitivity condenser microphones are connected to the sound card as receivers. The specifications of condenser microphones are shown in table 1. A commercial notebook (Acer aspire 4763Z) is used as the data receiving and storage device.

Table 1 The spec of the high sensitivity condenser microphone.

Response frequency	30Hz~15000Hz
Resistance	2.2K ohm
Sensitivity	-58dB±3dB
Output power	30mW

In the composition of detectors, two high sensitivity condenser microphones are attached to plastic tubes respectively. The plastic tubes can enhance pulse signals. The elastic bands attached to the tube opening can provide appropriate stresses when sensors are fixed on the wrist. Figure 1 shows the pulse signal detector. All the components in our experimental setup are inexpensive commercial commodities.

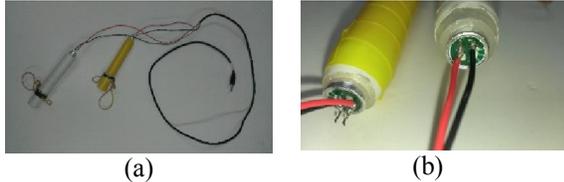


Figure 1 The pulse signal detectors. (a) The panorama of detector. (b) The zoom-in configuration.

LabVIEW (National Instrument) is used to develop the control program which can acquire, transfer, and store up signals in a notebook. By this program, the vibration signals of pulse can be shown in digital data on the screen. In Traditional Chinese Medicine's theory, pulse is a very useful tool to diagnosis. The pulse form from heart pushes blood to flow through vases and makes completely cycles. The blood flowing in vases produces various vibrations of vascular walls because of pressure difference, vascular resistance and so on.



Figure 2. The actual measurement setup. Both two detectors are attached on the wrist.

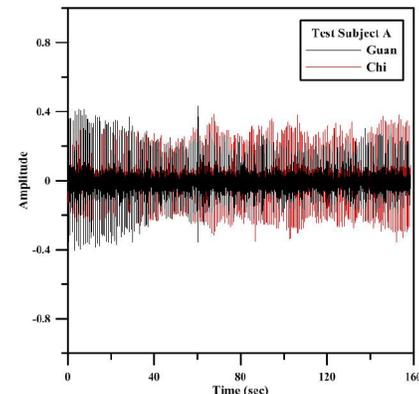
Figure 2 is the actual measurement frameworks. Both two channels sound detectors are fixed on the wrist by elastic bands respectively. Those two detectors are put in around the Guan and Chi positions to measure pulse. In the experiment, the pulse detector measures two test subjects and simultaneously records their pulse data for about 160 seconds in real time.



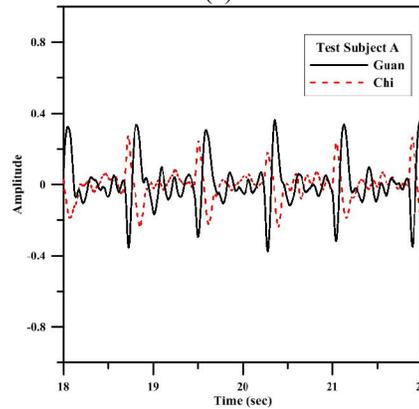
Figure 3. The measurement setup. The pulse sensor is fixed on the wrist and connects to the laptop.

3. Result and discussion

The measurement results of two test subjects are shown in figure 3 and figure 4 respectively. Figure 3(a) shows the two continuous pulse signals, Guan and Chi pulses of test subject A. The data in period of 18-22 seconds shows in the graph of figure 3(b). The data shows that different measurement position has various signals. For test subject A, two signals differ in amplitude, shape and phase. Those two signals have a shift in phase.



(a)



(b)

Figure 3. The measured pulse signals of test subject A. (a) Complete pulse signals of two channels. (b) The pulse data in period of 18-22 seconds.

Figure 4(a) shows the pulse signals measured from subject B at Guan and Chi positions respectively. Figure 4(b) shows the data measured in the period of 18-22 seconds. In the graph of figure 4(b), the phases of Guan and Chi pulses nearly match to each other. The results of two test subjects have significant difference in phase, frequencies and shapes. The pulse signals reflect the health status of individuals. TCM doctors can diagnose according to those pulse signals. As a result, this simple two-channel sound detector can be applied to pulse diagnosis successfully.

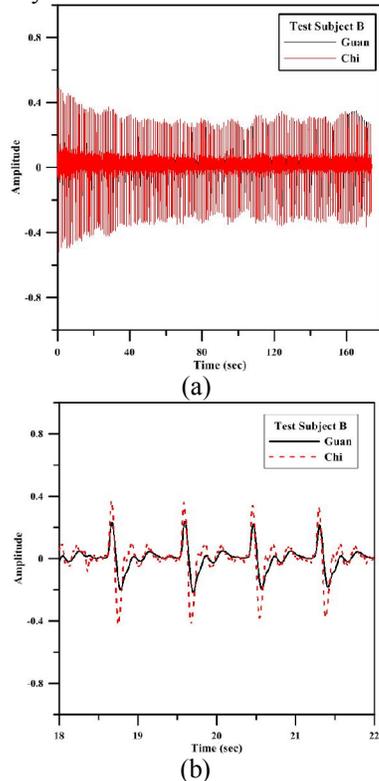


Figure 4. The measured pulse signals of test subject B. (a) Complete pulse signals of two channels. (b) The pulse data of Guan and Chi positions in period of 18-22 seconds.

4. Conclusion

In this study, a simple framework and low cost two-channel sound detector has been applied successfully to the Traditional Chinese Medicine pulse diagnosis measurement. This device has been used to measure the pulse signals of two test subjects. The result shows that pulse signals will change with the health conditions of individuals. This device is able to provide a better choice for home health care because of simple, cheap, portable, and readily available characteristics. In the future, people can use this device to monitor their health by use of the relative programs at website in internet.

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