Low Cost Prototype of Pulse Measurement Devices

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Abstract: Traditional Chinese Medicine is a medical treatment that differs from western medicine. Pulse diagnosis is an important method to diagnose the health condition of patients. Pulse measurement instrument can help to quantify precisely the pulse signals and reduce the error of diagnosis. This study designs and fabricates a simple and low cost pulse measurement based on commercial laptop. The measurement result demonstrates that pulse signals are acquired correctly. [Jiann-Hwa Lue, Ting-Jou Ding, Yu-Sheng Su, Rong Seng Chang, Tai-Chuan Ko, Shuan-Yu Huang, Wen-Ming Cheng. **Low Cost Prototype of Pulse Measurement Devices.** *Life Sci J.* 2014; 11(6):317-319] (ISSN: 1097-8135). http://www.lifesciencesite.com. 42

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1. Introduction

In the middle of last century, Traditional Chinese Medicine (TCM), which differs from western medicine, has gradually attracted the world. The scientists have started to research on this new topic by theoretical, experimental and clinical testing studies. [1-4] In all work, pulse diagnosis, the remarkable feature in TCM, is the focused research project. Doctors of TCM diagnose and treat diseases according to patients' pulses. Moreover, pulse is taken to explain how diseases form. Pulse is a precise and useful sensor in the field of Traditional Chinese Medicine and it is able to avoid complicated checking procedure. Thence, scientists are interested in the studies of improving the pulse signals measurement

Currently, scientists and engineers measure the pulses by various sensors, such as ultrasonic wave, optical signal and piezoelectric methods. All kinds of them can be roughly divided into touch and non-touch measurement methods. The touch method uses an elastic material as sensor to sense the vascular pressure. [5] Contacting with skin directly to measure pulses is a simple and efficient method, but the sensor will also affect the pulse signals and change the shape of vascular wall. In contrast, the non-touch method can eliminate the distortion caused by the interference of external force. [6] Non-touching pulse diagnosis generally measures the vibration of skin to construct indirectly pulse signals. Because the measured signals are caused from skin vibration but not the vases, there is a deviation between the measured values and the real pulse signal. Furthermore, TCM doctors always apply a small press on skin to detect pulse difference. The non-touching sensing cannot achieve this function without applying pressure.

Conventionally, doctors feel the pulse signal simply by their fingers pressing on patients' skin around the wrist. In this way, perhaps different doctors will have different diagnosis which will possibly cause mistakable medical prescription. For this reason, quantification and qualitative analysis of pulse signals are an important topic for modern pulse signal measurement instruments. Moreover, in now and future medical system, there is a trend of home health care which can reduce the waste of medical resources. A simple, low cost, potable pulse diagnosis measurement system will encourage the development of Chinese medicine applying to home health care. This article reveals a very easy and inexpensive pulse diagnosis device which can combine with the existing audio in personal computers or notebooks for home care.

2. Experimental setup

The experiment setup of pulse diagnosis device is based on commercial laptop (Acer aspire 4763Z). The major signals acquisition device is composed of the build-in audio of laptop and a high sensitivity condenser microphone. This device is operated at Microsoft windows vista home premium and the

sound card is Realtek ALC888/1200. Table 1 shows the spec of condenser microphone.

Table 1 The spec of the high sensitivity condenser microphone.

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

Figure 1 shows the signal acquisition portion of the pulse measurement devices. The signals acquisition device consists of a condenser microphone, a plastic tube and an elastic band which is used to fix the device on the wrist.

(a) (b)

Figure 1 The signals acquisition components of the measurement devices. (a) is shown as whole device and (b) focuses on the zoom in picture of simple microphone.

Human body and heart have same function as pumps and they can drive blood flowing through the whole body by vases. When the blood flows through, the vascular walls have various oscillation frequency caused from pressure difference, vascular resistance and so no. Traditional Chinese Medicine calls those as vibration pulses. The signals acquisition device can detect those vibration signals and transfer to digital data. In the development of operations interface, LabVIEW (National Instrument) is used as a development platform. Figure 2 shows the developed human machine interface (HMI) in LabVIEW.

Figure 3 shows the measurement setup. The signal acquisition component connects to the laptop with audio cable fixed on the wrist by elastic band. The elastic band provides applicable stresses to simulate pressure applying from figures to human pulse diagnosis. In this framework, this device is used to proceed to measure 200 seconds continuous pulse signals.

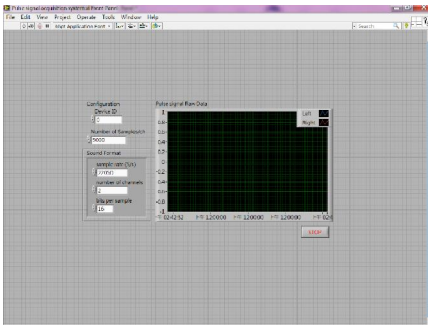

Figure 2 The developed human machine interface in LabVIEW. It can acquire data and show the graph of pulse vibrations at real-time.

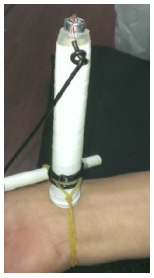

Figure 3. The measurement setup. The pulse sensor is fixed on the wrist and connects to the laptop.

3. Result and discussion

The measurement result is shown as figure 4. There is the 200 seconds continuous pulse signals measured by this simple and cheap pulse diagnosis measurement device. In the graph, the curve of pulse signals demonstrates that this pulse diagnosis device can easily measure the pulse signals by using simple apparatus. The curve also shows that the variation of pulse changes with time.

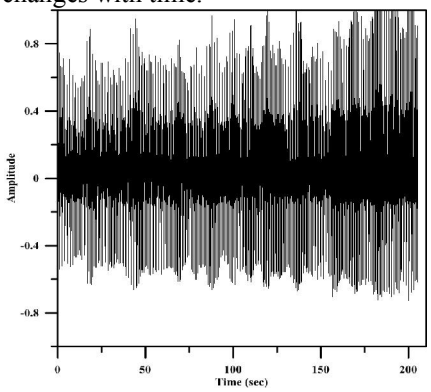

Figure 4. The measured pulse signals in 200 seconds.

Figure 5 shows the waveforms of pulse signals in the first four seconds period. Obviously, pulse amplitudes vary sharply and periodically with time

(note the change in the time scales). Furthermore, during each period, besides main pulse, there is still some other slight concussion which can easily be detected. It might possess more meanings for TCM diagnosis.

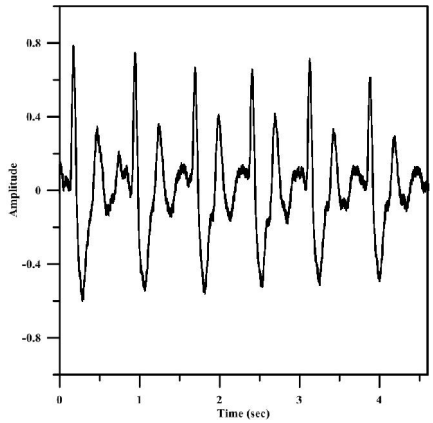

Figure 5. The pulse signals in the first 4 seconds.

4. Conclusion

The designed simple and low cost pulse diagnosis measurement device was fabricated and used to detect the real human's pulse. As a result, it shows that the pulse signals are measured successfully. The pulse signals changes with time according to the blood flowing condition of subject. This easy and inexpensive device provides another choice and promotes the development of home health care.

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