

A STUDY ON PULSE RATE SYSTEM

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Abstract

In this paper, we devised a pulse rate detection system to provide basic clinical index of cold-hot diagnosis of oriental medicine. The system consists of pulse signal detection, respiration signal detection, electrocardiograph detection, A/D conversion and computer system parts. We define a pulse rate by a pulse count to the respiration period inspiration pulse rate by a pulse count to the inspiration period, and expiration pulse rate by a pulse count to the expiration period. The clinical experiments for normal person to evaluate the pulse rate detection system show the pulse/ respiration ratio of 4.30 ± 1.03 , the pulse/inspiration ratio of 1.60 ± 0.32 , the pulse/expiration ratio of 2.37 ± 0.75 .

I . Introduction

The development of diagnosis system for oriental medicine is consistently pursued among the oriental medicine doctors and biomedical engineers in Korea. The major parts of studies are clinical research using pulse detection and diagnosis system. The major concept of human physiology of oriental medicine is very different from occidental physiology. The physiology of oriental medicine is based on the oriental logic system(eum-yang five phase theory). Therefore, it is very difficult to take diagnostic information for oriental medicine from physiological data directly.

So, in a series of medicine related study, we developed a oriental medicine system for pulse rate decision which detects several physiological signals and oriental medicine information from them. This is the pulse rate detection system to determine pulse rate of patient. The pulse rate provides basic clinical index of cold-hot which is very important to determined the direction of clinical cure process in oriental medicine. Pulse rate detection system utilize biological signals

such as radial pulse wave, respiration, and ECG signal. We define pulse rate by a pulse count to the respiration period, inspiration pulse rate by a pulse count to the inspiration period, and expiration pulse rate by a pulse count to the expiration period. According to definition, we tried clinical experiment by using developed pulse rate system and verified its signification of oriental medicine.

II . Method

Pulse rate in the occidental physiology have been define pulse count per minute, but it did not match with the oriental medicine principle and has difficulties in clinics. In this study, we define pulse rate as following equations (1),(2),(3).

$$\text{Pulse rate} = \frac{\text{Pulse count}}{\text{respiration}} = \frac{1 \text{ respiration}}{1 \text{ pulse average period}} \quad (1)$$

$$\text{Expiration pulse rate} = \frac{\text{Pulse count}}{\text{expiration}} = \frac{1 \text{ expiration period}}{1 \text{ pulse average period}} \quad (2)$$

$$\text{Inspiration pulse rate} = \frac{\text{Pulse count}}{\text{expiration}} = \frac{1 \text{ inspiration period}}{1 \text{ pulse average period}} \quad (3)$$

The reason that the pulse rate are divided into basic pulse rate, expiration pulse rate, inspiration

pulse rate, are the stability of respiration is influence to the determination of pulse rate, so it need to examine the stability of each respiration period. The respiration period are consist with expiration, inspiration and holding period. Pulse rate detection system are consist of hardware system and software system as Fig.1.

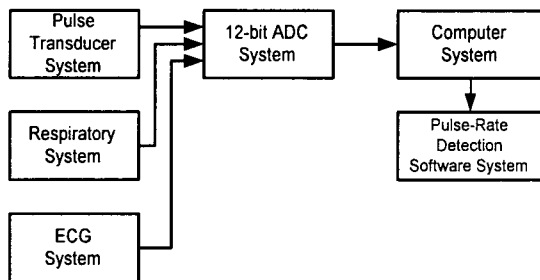


Fig.1. Pulse Rate Detection System Block Diagram.

Hardware system consist of pulse transducer part, respiratory part, ECG part, A/D converter and computer system. Pulse transducer system use semiconductor type pressure gauge, respiratory system adopted method of voltage detection when air flows of inspiration and expiration make temperature changing on thermister. ECG system consist of electrode, differential amplifier, signal and electrical isolation, and filter. A/D converter have 12-bit resolution and 16-channel input terminal.

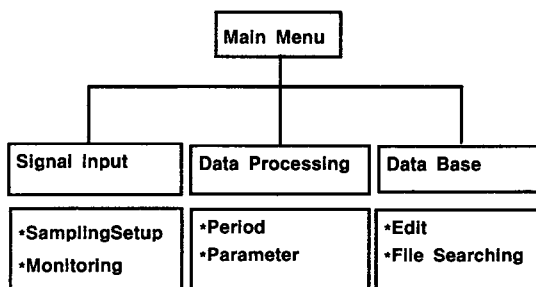


Fig.2 Menu of Software System

Software system are made with pull-down menu as Fig.2.

Monitor procedure is include in input-signal part, it can monitoring signal and setting

sampling rate, file name and data acquisition condition. In monitor process, the signal are inputted in the sequence with radial pulse, respiration and ECG signal and display on CRT.

At the same time stored in memory. When pressing switch S, stop a monitoring process, and stored file in main memory is transfer to auxiliary memory and then return to main menu.

III. Result and Discussion

At experiment, we detected radial pulse, respiration, ECG signal from 38 persons who has pathologically normal condition to evaluate the pulse detect system and defined pulse rate. In among subjects, mens population is 10, women is 28, and average age is 44.3. Pulse signal is detected from chon-gu point with radius artery, respiration is detected from nasal cavity, and ECG signal is detected from cordial point.

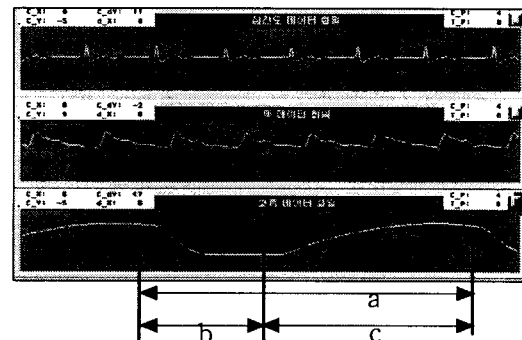


Fig3. Output Data of the Pulse Rate Detector System.

Signal detection result is shown in Fig 3. expiration period. In Figure 3, 'a' shows one respiration period, 'c' is expiration period, and 'b' is inspiration period. The first window is shown to ECG signal, second window is shown to pulse signal, third window is shown to respiration signal.

Respiration signal consist of inspiration period and expiration period. In Fig 3, 'a' shows one respiration period, 'c' is expiration period, and 'b' is inspiration period.

Table 1 is shown results of experiment, using defined pulse rate. normal pulse rate(wan mack)

is 4.3, and less than 4.3 is slow pulse rate(seo-mack), more than that is fast pulse rate(soo-mack).

Table 1. Pulse/Respiration Ratio, Pulse/Inspiration Ratio and Pulse/Expiration Ratio.

		Pulse/Respiration Ratio	Pulse/Inspiration Ratio	Pulse/Expiration Ratio
Total		4.30±1.03	1.60±0.32	2.37±0.75
Range (Min~MAX)	Male	3.32~5.06	1.09~2.05	1.53~3.24
	Female	2.64~7.23	1.06~2.40	1.26~4.57
	Total	2.64~7.23	1.06~2.40	1.26~4.57
Male		4.15±0.61	1.62±0.28	2.20±0.59
Female		4.35±1.14	1.59±0.34	0.43±0.77

IV. Conclusion

We have been implemented pulse rate detecto system and evaluate pulse rate. We had conclusion as below:

- 1) Pulse rate detection systems are effective dete three kinds of biological signals.
- 2) The pulse/respiration ratio of 4.30 ± 1.0 minimum pulse rate of 2.64, maximum pulse ra of 7.23
- 3) The pulse/inspiration ratio of 1.60 ± 0.3 minimum inspiration pulse rate of 1.06, maximu inspiration pulse rate of 7.23
- 4) The pulse/expiration ratio of 2.37 ± 0.7 minimum expiration pulse rate of 1.26, maximu expiration pulse rate of 4.57

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