International Journal of Advanced Smart Convergence Vol.3 No.2 10-13 (2014)
DOI 10.7236/IJASC2014.3.2.3

IJASC 14-2-3

Development of Electronic Acupuncture using Intelligence Technology

YouSik Hong[1], Seongsoo Cho[2*], Bhanu Shrestha[2], Young Roak Kim[3]

[1]*Department of Computer Scienve Professor, Sangji University, 660 Woosan-dong, Wonju-si, Kangwon-don, 220-702, Korea*
yshong@ sangil.ac.kr

[2]*Department of Electronic Engineering, Kwangwoon University, 20 Kwangwoon–ro, Nowon-gu, Seoul, 139-701, Korea*
{css, bnu}@ kw.ac.kr

[3]*Department of LINC, Dongguk University, #710, 82-1 Pil-dong 2-ga, Jung-gu, Seoul 100-272, Korea*
yrkim@dongguk.edu

Abstract

In oriental medicine, the pulse beats are important signals that may let us know the conditions of one's health and disease. In other words, doctors of oriental medicine can simply analyze pulse waves anywhere and anytime to treat patients without using high-priced medical appliances. However, they are largely subjective in interpreting the pulse rates and hence their reliability is far from being perfect. The current paper aims to solve this problem by using fuzzy inference rules in judging patients' health status and to develop a software kit of intelligent electronic needles.

Keywords: *fuzzy rules, acupuncture, pulsewave, expert system*

1. Introduction

Oriental doctors have considered pulse rates as important data in diagnosis. But the existing blood pressure pulse analyzer has some problem. It is difficult to standardize the pulse exactly because thickness of their blood vessels is different even if the thickness of two person's forearm is equal. And it is uncertain whether the blood pressure pulse analyzing sensor is located precisely on the radial artery. The analogue type blood pressure pulse analyzer has problems with quantification the blood pressure pulse.[1-4] Therefore there is no set of data that is considered reliable enough to judge the accuracy of blood pressure pulse rates. In order to gain an accurate diagnosis, oriental doctors consider the patient's pulse by the basic biological signals such as checking the pulse's size, strength, and speed, and also the basic and quantitative analysis of the pulse. And the doctor should consider physical characteristics, such as the thickness of the skin and blood vessels, in order to reach an accurate conclusion.[4-6] But the method of existing diagnosis has problem which cannot diagnose the old and the infirm exactly because it does not take into consideration the condition of patient's gender, age, skin. Most of the conventional electronic acupuncture systems are made

Manuscript received: Sept. 15, 2014 / revised: Oct. 10, 2014
Corresponding Author: css@kw.ac.kr
Tel: +81-2-940-8101, Fax: +81-2-940-8101
Dept. of Electronic Engineering, Kwangwoon University, Korea.

by using low frequency and the rest are made by using momentary electro-stimulation. They can't treat the patients effectively because it uses uncertain and vague frequency. In this paper, we proposed the algorithm that diagnoses patient optimally considering patient's condition using intelligent fuzzy technique to solve those problems [5-11]. We analyzed the fine distinction considering thickness of skin and blood vessels and pulse, weather big or small, strong or weak and fast or slow.

2. Acupuncture system using intelligence

In order to solve the associated problems, we used the intelligent fuzzy rules algorithm for pulse diagnosis as follows:

e=R-Y
Ce=e2-e1
Where Y: optimum pulse feeling judgment
R: Criteria Input
e: Error
Ce: Error Displacement
e2: Current Error

In this paper, in order to solve this kind of problem, it uses compositional inference while using the fuzzy rule. Fuzzy compositional rule of inference is applied to come up with a calibrating constant in order to derive an accurate result (considering the patient's physical condition) in analyzing the blood pressure pulse. In existing method, an oriental doctor infers one pulse wave out of 28 pulse wave and diagnoses the patient. It is difficult to know whether pulse detection sensor is located in the radial artery exactly or not by using existing pulse checker. And in the case of different body type and the thickness of a forearm, it is difficult to take pulse exactly. It is also difficult to standardize the pulse with analog pulse checker. For example, even if the thickness of two person's forearm is equal, it is difficult to standardize pulse exactly because thickness of their blood vessels is different.

3. E-Acupuncture pad with built-in multi-active

A multi-pad with built-active electronic acupuncture is depending on a patient's current body status. Based on this information, the patient meets the voltage and current self-oscillation. The frequency with the ability to automatically advanced procedure is called electronic acupuncture. In order to perform these functions simultaneously with the sensing of electronic acupuncture, one is required to possess the ability to perform surgery, derive accurate analysis from fuzzy logic and process statistical data. Electrical resistance of the body including long-term resistance, internal resistance and the surface can be divided into exposed skin. Resistance of the body can be considered only based on the consideration of the impedance of the AC voltage since the DC voltage is based on the pure resistive component. The skin, blood and muscles are electrical conductors and these are resistive and capacitive components in term of voltage and current. These components are separated by impedance and its size, the electrical conduction path, the contact voltage, the contact area, and energizing time. The voltage and current is applied differently depending on the frequency that many occur. In the experiment, according to AC current that can safely can safely flow around 16mA (60Hz) for a man and 10.5mA (60Hz) for women and the human body can withstand DC current is approximately 74mA for a man and 50mA for woman. But it also, including a person's body size and weight may appear slightly different, depending on the requirements. In this paper, the voltage between 15V ~ 50V AC voltage to the change of 5Hz ~ 1.2Khz and current 500uA ~ 1500uA given in the current experiments were carried out.

We proposed the system that diagnoses a patient optimally considering the patient's condition using intelligent fuzzy technique. We analyzed the fine distinction considering thickness of skin and blood vessels and pulse, weather big or small, strong or weak and fast or slow. The patients by their body, illness and age

are classified and calculated the exact time of electronic acupuncture suitable for the patient's physical condition using fuzzy logic and inference. We designed the system to respond to the various patterns and to sense the situation in which potential difference is changed according to the patient's painful part simultaneously. It contains the function that a patient can search the exact point of electronic acupuncture and check on optimal strength and time of electronic acupuncture considering the patient's body conditions. The patients can be treated with optimally, and acupuncture time can be shortened and strength of acupuncture can be moderated considering their condition. This system is useful for remote medical examination and treatment.

The traditional method in oriental medicine mainly depended on doctors' subjective judgments in deciding on the spots, strength and time for acupuncture.

RULE
IF Bmi = High And
Spo2/ vascular age= High And
Pulse wave speed = Med And
Then
Health grade = CNF 70
This CNF 70 means: Strong (Excess syndrome) wave:

The RULE given above means a degree of confidence which is 70%. If, without the use of fuzzy rules of the existing methods do not display the degree of confidence in these patients is likely to be classified as health grade is always 100% is assumed. In this paper, BMI (body mass index; weight (kg) / key (m2)) and Spo2/ vascular age and Pulse wave speed. If the patient confidence in the BMI = Low degree of confidence to the conclusion that I want that 80 degree is $0.8 \times 0.7 = 0.56$. Exhaustion of the disease, the patient's vascular age, pulse wave speed, and other physical conditions by the pulse strength and quickness are not the same, so the exact reasoning is very difficult to occur. Fuzzy IF-THEN rules typically can be represented in the form of fuzzy reasoning (fuzzy inference). The max-min inference was used for a new relationships from a given rule or set of processes that are going to infer.

Input: x is A 'AND y is B'
R1: IF x is A1 AND y is B1, THEN z is C1
OR R2: IF x is A2 AND y is B2, THEN z is C2
....
OR Rn: IF x is An AND y is Bn, THEN z is Cn

Decision : z is C (represents the combined function).

Oriental doctors should not only judge the basic biological signals such as checking the pulse's size, strength, and speed, but should also consider the basic and quantitative analysis of the pulse in order to gain an accurate diagnosis. Also, the doctor should consider physical characteristics, such as the thickness of the skin and blood vessels, in order to reach an accurate conclusion. Therefore, measurement of the blood flow rate is a vital indicator in understanding the blood pressure rate and how the substances in the blood are transported. The method of exiting diagnosis has problem which cannot diagnose the old and the infirm exactly because it does not take into consideration the condition of patient's gender, age, skin. To solve this problem, we analyzed the fine distinction considering thickness of skin and blood vessels and pulse, weather big or small, strong or weak and fast or slow.

4. Conclusion

The fuzzy algorithm is applied in this work to analyze such a problems and draw an inference from objective data in view of pretreatment and applied the electrical characteristics of pain parts which respond

to acupuncture device which considering intelligence pulse wave system using fuzzy rules. In this paper, the electronic acupuncture with a built in multi-pad is proposed. It has advantages to find out the patient's physical conditions and treat the patient with acupuncture simultaneously. To implement this system, the sensing pad, AMP, the small signal drive circuit and the DSP system are used. Built-in fuzzy technique is proposed for the analysis and control algorithm. In the traditional medical system, pulse rhythm is considered to be important and is observed carefully for checking health and disease diagnosis. The fuzzy logic and fuzzy inference rule is utilized to estimate the proper treatment duration for each patient. Physical condition, related disease, and age effects are studied for electronic acupuncture. The simulation results show the proposed method is more efficient than the prior one.

References

[1] Haider, A.W.; Larson, M.G.; Franklin, S.S.; Levy, D. "Systolic Pressure, Diastolic Blood Pressure, and Pulse Pressure as Predictors of Risk for Congestive Heart Failure in the Framingham Heart Study", Ann. Inter. Medi., 138, 10-17,(2006)

[2] Shaltis, P.A., Reisner, A.T, Asada, H.H. Cuffless Blood Pressure Monitoring Using Hydrostatic Pressure Changes. IEEE Trans. Biomed. Eng., 55, 1775-1777, (2008)

[3] Y. J. Lee, J. Lee, H. J. Lee, H. H. Yoo, E. J. Choi, J. Y. Kim, "Study on the characteristics of blood vessel pulse area using ultrasonic," Korea Institute of Oriental Medicine researches, 13(3) , pp.111 –119, (2007)

[4] Y.S. Hong, H.K. Kim, B.K. Kim, "Electronic Acupuncture system with built-in Multi-pad using intelligence", Proc. Of The 2012 Advanced Information Technology and Sensor Application, pp.162, (2012)

[5] Hong You Sik and Park Chong Kug, Proc. of the sixth international fuzzy system association, IFSA, pp.461-464, (1995)

[6] Garg, M. L., Ahson, S. I., and Gupta, D. V., "A Fuzzy Petri-nets for Knowledge Represent- action and Reasoning," Information Processing Letters, 39, pp165-171, (1992)

[7] Y.S.Hong, H.K.Kim, B.K.Kim, Implementation of Adaptive Electronic Acupuncture System using Intelligent Diagnosis System, Internation Journal of Control and Automation, Vol.5, No.3, pp.141-l52, (2012)

[8] Leung, K. S., and Lam, W., "Fuzzy Concepts in Expert Systems," IEEE Computer, Sep., pp.43-56, 1988.[10] Looney, G. C., and Alfize, A. A., "Logical Controls via Boolean Rule Matrix Transfor- mation," IEEE Trans. on SMC, Vol. 17, No. 6, Nov./Dec., pp1077-1082, 1987.

[9] Yong Jin Kim, "A meridian system study on Mawangtew medical books and Whang Di Nei Qing," The Journal of Oriental Medical Classics, vol. 9, pp. 51-86, 1995.

[10] Hyun Won Kim, "Meridian system and Bong-Han Theory's Sanal," 2005.

[11] Kwnag Sup Soh, "Meridian point and meridian system in the Bong-Han Theory," 2003.