휴대폰을 이용한 지능형 의료진단 시스템

Intelligence Medical Diagnosis System using Cellular Phone

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요 약 본 논문에서는 퍼지 규칙을 이용한 설진 진단 시스템을 개발하였다. 건강한 사람의 혀가 붉은 색이고 설태가 적다. 그러나 질병에 걸리면, 혀 색깔은 붉은색에서 흰색이나 파란색 혹은 검정색으로 변하게 된다. 그러므로 혀의색깔 및 설태를 분석하면 환자의 건강상태를 분석할 수 있다. 의료 진단 시스템은 자동으로 자신을 환자의 질병의 증상을 표시할 수 있으며 환자의 신체적 조건, 질병 조건, 연령 조건에 기초하여 최적의 침술 시간을 계산을 산출할 수있다. 컴퓨터 시뮬레이션 결과, 개발된 의료 진단 시스템을 사용하여 관리 전자 침술보다 기존의 방법보다 더 효과적인 것으로 입증되었다.

Abstract In this paper, we have developed a tongue diagnosis system using fuzzy rules. A healthy person's tongue is red in color and has less tongue coating. However, when a person suffers from a disease, the color of their tongue changes from red to white, blue, or black. Therefore, it can analyze patient's health if analyze color and coated tongue of tongue. Medical diagnosis system can automatically determines the symptoms of the disease of a patient and their and calculate the optimal acupuncture time on the basis of the patient's physical conditions, illness conditions, and age from any place and at any time. The computer simulation results have shown that electro-acupuncture administered by using the medical diagnosis system developed in this study is more effective than the conventional method.

Key Words : Medical diagnosis system, Fuzzy rules, Electronic acupuncture

I. Introduction

Currently, smart phones are being used for remote diagnosis. Inspection of the tongue is one of the most important methods of diagnosis in oriental medicine. However, traditional tongue diagnosis has its limitations, because of the absence of objective data. In order to overcome the limitations of traditional tongue

diagnosis, medical diagnostic systems such as tongue diagnosis systems, for observing the color of the tongue and tongue coating, and pulse diagnosis systems have been developed [1-3]. In this paper, we propose a medical diagnosis system that can determine the injection time for acupuncture on the basis of a patient's physical conditions, illness conditions, and age [4-7]. In order to realize a highly precise tongue diagnosis system, many researches have proposed the use of fuzzy rules and fuzzy logic control. By using fuzzy logic, the membership functions can be adjusted according to the optimum conditions, thereby enabling

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us to realize a highly effective diagnosis system [8-10]. In this study, a patient's disease is diagnosed on the basis of the characteristics of the patient's tongue. A healthy person's tongue is red in color and has less tongue coating. However, when a person suffers from a disease, the color of their tongue changes from red to white, blue, or black, and the tongue coating may thicken. The proposed system automatically displays information on the symptoms of the disease of a patient; further, it displays and calculates the optimal acupuncture time on the basis of a patient's physical conditions, illness conditions, and age from any place and at any time. Computer simulation results have shown that electro-acupuncture administered by using a tongue diagnosis system is more effective than conventional acupuncture. The proposed diagnosis system can be accessed through a smart phone. A person can use the smart phone to obtain a photograph of their tongue, and the smart phone can determine the person's health grade by analyzing the photograph. Further, if a patient wishes to receive treatment for a disease, they can choose one of the options from the self-diagnosis menu in the smart phone and receive oriental medical service at any time and location. In this paper, we focus on enabling the smart phone to automatically locate the nearest oriental medical doctor and arrange an appointment at a convenient time and place on the basis of a patient's physical conditions, illness conditions, and age. Further, we aim at enabling the smart phone to automatically find the suitable acupuncture spot by accessing EMR information using ubiquitous technology and administer a shot at any time and place. Despite the effectiveness of oriental medicine, there is less awareness about oriental medicine when compared to western medicine. In fact, oriental medicine is still inferior to western medicine in terms of worldwide market penetration. Practitioners of western medicine have not accepted oriental medicine as being effective and claim that the results of oriental medicine are not as impressive as the results obtained through visual diagnosis and treatment. In this study,

we simulated the oriental scientific movement that using the problem and intelligence of Western-Oriental Cooperative to solve these problems. The composition of this paper is as follows: section 2 discusses the western and oriental medicine techniquessection 3 discusses the development of an electronic needle for the practice of oriental medicine, section 4 reports the results of electronic needle simulation, and section 5 concludes this paper.

II. Oriental Tongue Diagnosis System

The tongue diagnosis system developed in this study can display the health grade of a patient from the photographs of their tongue, as shown in Figure 1.

그림 1. 전자 혀 차트 시스템
Fig. 1. Electronic tongue chart system

In this paper, we attempt to develop an intelligent algorithm to determine the appropriate time for administering an acupuncture shot on the basis of a patient's physical condition. Doctor's decision, the tree technique is comprised of research to solicit comprehensible interpretation. The tree technique has been developed by statisticians and is also used as a machine learning method.

The shape of the tree corresponds to the doctor's decision-making process, which can be expressed by the following rule: if A, then B, else C. To produce this

decided rule of doctor's tree structure, we should select that how to divide the variety by which one among the explanation variable of number of p in each phase. The objective is to develop a rule-generation algorithm to find the optimum parameters on the basis of the level of the tree. In order to realize the scientific temper of Oriental Electro acupuncture rule is intended to provide the best. In this study, the optimal time for administering electro-acupuncture is determined by using a set of fuzzy rules that are based on a patient's physical condition, as shown in Table 1.

Especially, note that the safety information is divided into three grades (safe, normal, dangerous) so as not to exceed the limit.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \varepsilon \tag{1}$$

Y : With automatic breaking power regulation

X_1 : Influencing subjection variable1

X_2 : Influencing subjection variable2

X_3 : Influencing subjection variable3

X_{10} : Influencingsubjectionvariable10

The neural network being used in this thesis is as follows

① turn offsets, weight to the initial stage

② Present input, target pattern to the neural network

③ Seek for errors and delta output of nerve cells and polarize by concealment

ej = tj - aj .

δj = aj (1 - aj) ej

④ By electronically waved delta concealed nerve cells seek for errors and delta and polarize

ej = Σ wjk δk

δj = aj (1 - aj)ej

⑤ By the delta rule regulate the connection weight

W(new)ij = W(old)ij + αδiaj + βΔwij(old)

bias(new)ij = bias(old)ij + αδ. 1 + βΔbiasij(old)

⑥ Repeat steps 1-5 by all factors

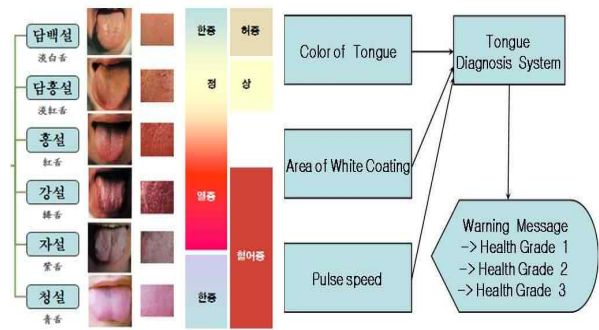⑦ Repeat step 4 until the whole neural network has been studied

그림 2. 환자 의료 단계 시스템
Fig. 2. Patient's health grade system

Figure 2 shows the algorithm, which is used to calculate the optimal time for administering an acupuncture shot.

The values 0.8-1.0, 0.5-0.7, and 0.1-0.4 indicate a state of serious illness, medium health, and poor health, respectively. In Figure 3, the determination of the optimal acupuncture time on the basis of the patient's physical conditions is shown. Each of the connecting lines corresponds to a float number that indicates a patient's physical conditions. For example, patients of height and weight less than 150 cm and 45 kg, respectively, are denoted by float numbers 0.1--0.3, patients of height 151-170 cm and weight 46-70 kg are denoted by float numbers 0.4-0.7, and patients of height 171-200 cm and weight 71-130 kg are denoted by float numbers 0.8-1.0. Right at the end, the optimal time acupuncture has been shown.
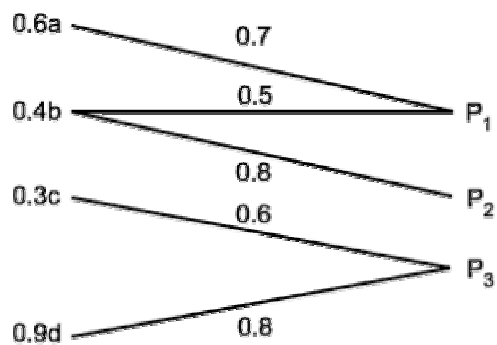

그림 3. 퍼지규칙을 이용한 환자 신체조건
Fig.3. Patient physical conditions using fuzzy rules

Ⅲ. Fuzzy Rules

In order to calculate the optimal time for administering acupuncture, a patient's physical condition must be taken into consideration; in this study, we have used 27 set of rules to calculate the optimal time. Figure 4 shows the fuzzy rules used to calculate the patient conversion factor on the basis of a patient's weight, height, and age conditions.

Height conditions and age condition

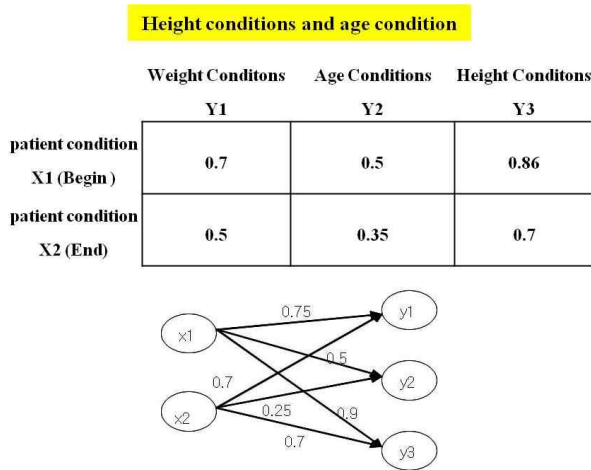|	Weight Conditons	Age Conditions	Height Conditons
	Y1	Y2	Y3
patient condition X1 (Begin)	0.7	0.5	0.86
patient condition X2 (End)	0.5	0.35	0.7

그림 4. 퍼지규칙을 이용한 신체 변환요소
Fig. 4. Body condition conversion factor using fuzzy rules.

표 1. 퍼지규칙을 이용한 상이한 다른 환자 조건
Table 1. Determination of patient conditions using fuzzy rules.

GRADE		Strength	Depth	Time
Weight Conditions	Y1H	High	Medium	Long
	Y2YM	High	Medium	Medium
	Y3S	Medium	Small	Short
Age Conditions	Y2H	High	Medium	Short
	Y2M	Medium	Medium	Medium
	Yy2L	Low	Small	Short
Height Conditions	Y3H	High	Medium	Long
	Y2M	Medium	Medium	Medium
	Y1L	Low	Small	Medium

In Table 1, in order to calculate the optimal time to acupuncture, patients with medical conditions have been described to calibrate the fuzzy rules as followings.

As Shown in Figure 5 shows to optimal acupuncture time using fuzzy logic as following.

(RULE 1) IF DPSV IS PB
　　　　　　AND USPC IS NS
　　　　　THEN OPRG IS PB
(RULE 2) IF DPSV IS PB
　　　　　　AND USPC IS NM
　　　　　THEN OPRG IS PM
(RULE 3) IF DPSV IS PS
　　　　　　AND USPC IS NS
　　　　　THEN OPRG IS PS

In above routine, the constrained condition is as follows.

DPSV: Patient condition error (E)
USPC: Degree of patient's disease
Skin: Error change amount (CE)
OPRG: Optimal acupuncture time

To consider fuzzy control rule and patient's physical condition, it produces the most Optimal acupuncture time output (OPRG).

(Rule 1)
$[0.3/4, 0.5/5, 1/6] | \wedge [0.7/-3, 0.6/-2, 0.8/-1, 0.4/0, 0.1/1]$
$\wedge [0.3/4, 0.5/5, 1/6]$
$= 0.3 \wedge 0.7 \wedge [0.3/4, 0.5/5, 1/6]$
$= [0.3/4, 0.5/5, 1/6]$

(Rule 2)
$[0.3/4, 0.5/5, 1/6] | \wedge [0.3/-6, 0.2/-5, 0.8/-4, 0.5/-3, 0.4/-2, 0.2/-1]$
$\wedge [0.1/2, 0.5/3, 1.0/4], 0.5/5, 0.2/6]$
$= 0.3 \wedge 0.5 \wedge [0.1/2, 0.5/3, 1.0/4, 0.5/5, 0.2/6]$
$= 0.1/2, 0.3/3, 0.3/5, 0.3/5, 0.2/6$

(Rule 3)
$[0.3/1, 0.9/2, 0.7/3, 0.3/4] | \wedge [0.7/-3, 0.6/-2, 0.8/-1, 0.4/0, 0.1/1] | \wedge [0.3/1, 0.9/2, 0.7/3, 0.3/4]$

= 0.3, 07^[0.3/1, 0.9/2, 0.7/3, 0.3/4]

= 0.3/1, 0.3/2, 0.3/3, 0.3/4

As you know, de fuzzification U value of the optimal level is 3.5 has been calculated. Therefore, Optimal acupuncture time output which considering patient's physical condition, it produces the most Optimal acupuncture time output (OPRG) as following.

Defuzzification method:

$$U = \frac{\sum (\text{Big set that have membership value of function} \times \text{Its value of function})}{\text{Value of membership function}}$$

U=[0.3/1, 0.1/2, 0.3/3, 0.3/4, 0.3/5, 0.2/6]

{0.3 *[1+3+4+5] }+0.1*[2] +0.2*[6]} / (0.3 * 4) + (0.1*1) + (0.2*1) = 3.5
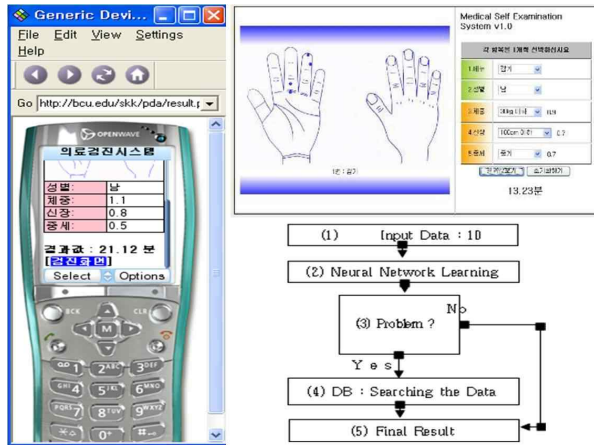

그림 5. 전자침 자침 계산
Fig. 5. Calculation of electro-acupuncture time.

IV. Conclusions

In this study, we developed an effective medical diagnostic system using fuzzy logic. The system uses a fuzzy algorithm to determine the optimal acupuncture time on the basis of a patient's physical conditions, illness conditions, and age. The proposed medical diagnosis system can be integrated with a smart phone. In this study, we have focused on enabling the system to automatically locate the nearest oriental medical doctor and arrange an appointment at a convenient time and place on the basis of a patient's physical

conditions, illness conditions, and age. We have also aimed at enabling the smart phone to automatically find the suitable acupuncture spot by accessing EMR information using ubiquitous technology and administer a shot at any time and place. The optimal time for administering electro-acupuncture is also determined by using a set of fuzzy rules that take into account a patient's physical conditions, illness conditions, and age.

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