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Telemedicine Algorithm System using Pulse Data

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Abstract: We propose an algorithm that can remotely pulse to receive medical system support using a smartphone and an intelligent system that uses a ubiquitous technology and a system that judges real time health status by receiving a patient's pulse wave waveform from a remote place in real time. In real time we received the pulse waveform of the patient from a distance and realized the intelligent electronic needle which can easily judge the health condition of the patient in real time anytime and anywhere. In this study, we developed an electronic needle that automatically detects the finger tip area and automatically calculates the optimum needle in time by selecting the menu item on the fuzzy rule and web based mobile phone.

Key words: Medical system, intelligent system, ubiquitous, wave waveform, smartphone, automatically

INTRODUCTION

In this study, we propose an algorithm that can remotely pulse to receive medical system support using smartphone and a system and ubiquitous technology to judge real-time health status by receiving patient's pulse wave waveform from remote place in real time (Kakria *et al*., 2015). It is an intelligent medical diagnosis system that can easily select menu item by user's choice on mobile phone based on fuzzy rule and web, send remotely visualized image and pulse data to doctor and shoot tongue image with mobile phone camera and transmit it in real time.

In oriental medicine it is important to judge the MAC because it can observe the state of the pulse of the pulse and examine the health and disease situation of the person. Oriental medicine is studied remotely using pulse data by using IT technology and clinical algorithm system. However, the problem of the conventional pulse wave can not be known whether the pulse wave detecting sensor is located in the radial artery precisely. In order to solve such a problem an oriental medical practitioner does not judge only basic bio-signal data such as large and small, strong and weak, slow and fast when the patient's hand is grasped but with the large and small phenomenon of basic and quantitative pulse and the minute pulse waveform considering the difference of skin thickness and blood vessel thickness characteristic is analyzed. In this study we present an algorithm for analyzing the health status of a patient by analyzing the strength and weakness of the pulse as the difference between the second-order pulsatile pulse waveforms. Suddenly, a major change in the patient's pulse signifies that there is a disease and it tells you where the risk has occurred in any part of your body.

In oriental medicine, the measurement of blood flow in the human body is a very important indicator of how blood pressure measurement and blood substance transfer take place. Existing pulse waves do not take into account the gender, age and skin condition and therefore can not find accurate pulse wave measurement points. In order to solve these problems we use the intelligent fuzzy technique to make the optimal pulse considering the patient's body condition. In order to calculate the optimal time for the patient we used 27 rules to compensate for the problem, so that, more accurate judgment can be made taking into consideration patient's body condition and psychological condition. Each element of X*Y that corrects the saturation capacity is calculated using the purge correction coefficient.

When a person is injured by a certain tissue, the electrical resistance in that area is higher than the surrounding tissue. This is because the inherent electric current inherent in human beings has a characteristic that the electric current does not pass well because the electric resistance is high at the wound area. This is due to the less current flows in the cell. We performed patient's disease estimation simulation using oriental medicine knowledge where the pain can be felt on infected fingers. We implemented the hardware to judge patient's disease by using multi-pad electric stimulation (Langevin *et al*., 2015; Kiani *et al*., 2016; Pfab *et al*., 2018). The system

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is divided into 3 parts. The first consists of a sensor that senses the electrical conductivity of a part of the human body and a diagnosis of the human body and a sensing part that includes a reference signal generator that adjusts the intensity pattern of the electrical transmission signal according to the state of the patient. And a Digital Signal Processor Board (DSPB) which is a hardware part that measures and classifies signals through fuzzy awareness. Finally, the third part consists of analyzing software that displays the signals transmitted from the DSPB in real time on the screen and helps diagnosis and judgment according to the patient's condition and a computer device for realizing the analysis software. The DSPB for the implementation of the intelligent pulse wave judgment system proposed in this study is designed to cope with these various patterns for the experiment and also to be able to simultaneously detect the state where the minute signal potential of the body changes according to the sick part of the patient (Kasabov and Song, 2002; Karaboga and Kaya, 2018; Kaib *et al*., 2015).

MATERIALS AND METHODS

Oriental medicine electronic needle simulation: When electric stimulation was performed with a multi-electron needle a portion of the patient's hand reflex felt pain was sensed and a simulation was performed to judge organs corresponding to the reflexes as a patient's disease. It shows the results of remote electron probe in the internet based on the electronic needle point.

If the body's intrinsic current is reduced, the inflammation induces the pain to be damaged by a certain tissue and the area becomes higher in electrical resistance than the surrounding tissue. The inherent current that the human body originally possesses has a high electrical resistance at the wound site, so that, the current cannot penetrate well. The current flows less at the wound site and as a result, the absolute amount of current in the cell decreases and it leads to inflammation, resulting in pain, local fever, edema and redness. When you are injured by a muscle, the muscle contracts to protect you. When the muscle contracts, blood flow is reduced and the amount of oxygen is reduced and the amount of nutritional support is reduced as well. Also, nofeils are accumulated without being excreted. This is why the pain in the muscle occurs. The fact that these hypothesis are proved that acne, atopy and black spot are areas of high electrical resistance and become non-conductive that means, current does not flow and the oxygen supply is not received properly and the skin disorder collapses. It causes inflammation of the skin or dying of the skin tissue resulting in atopy or gum mushroom. In this study to solve this problem we developed an electronic needle that automatically detects the blood point for the patient's illness and automatically performs the self-needle as shown in Fig. 1.

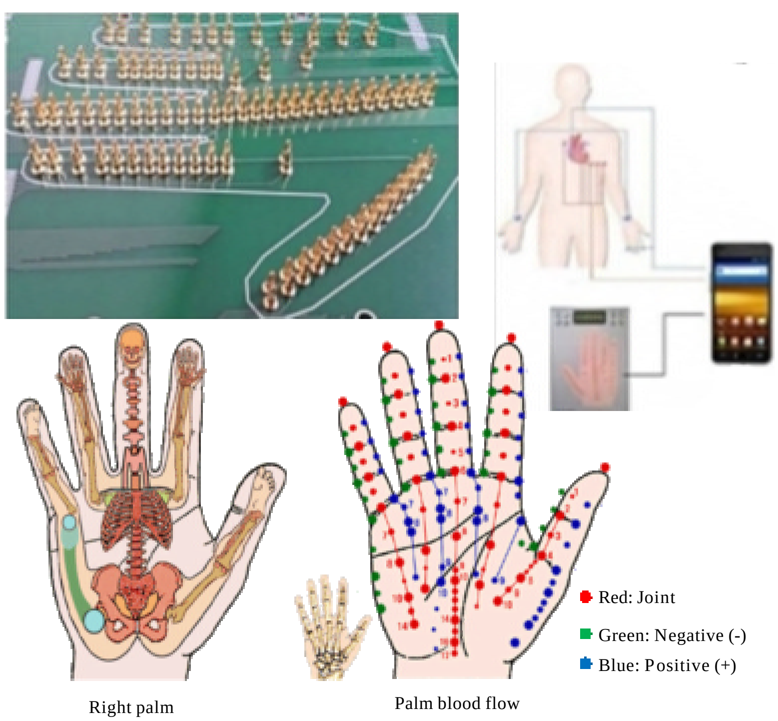

Fig. 1: Intelligent electronic needle appearance

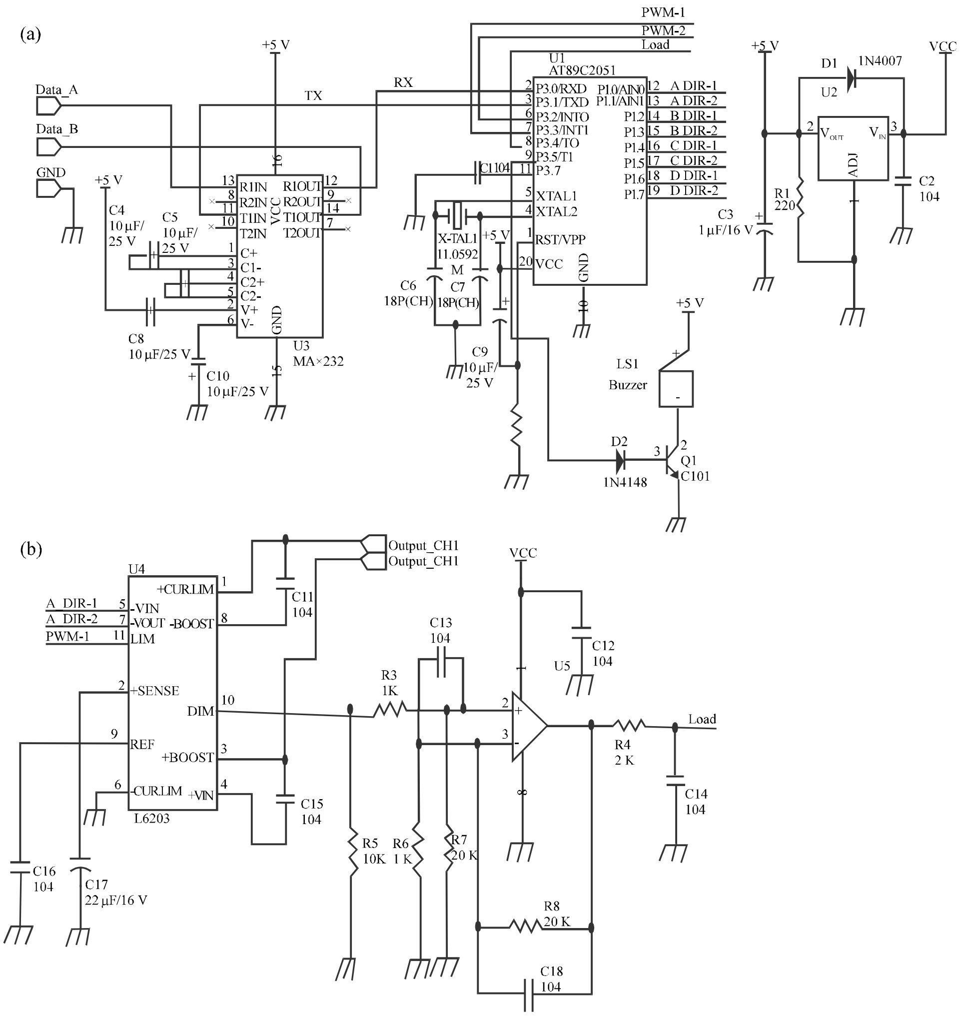

Fig. 2: a, b) Electron sediment simulation

RESULTS AND DISCUSSION

Disease inference algorithm: In Korea, more than 60% of the electronic needle has been developed by using the low frequency method and the electrical characteristic of the needle with positive electrodes for the instant stimulation is developed by about 40%. A low-frequency therapy device capable of treating the affected part of a human body. For this purpose 16-32 Hz frequencies are used and applied to a therapeutic electrode. In this case, we can not provide effective therapy because we use uncertain frequency which is supposed to be 15-30 Hz vaguely. In addition, since, it does not take into account the sex, age and condition of the patient. It also can not find the correct blood point and determine the time of the needle as well as the intensity of the self-healing. Therefore, a problem with weak skin, bruises or scratches arises for elderly people or children. In this study to solve this problem we used intelligent fuzzy technique to adjust the time and intensity of the needle for the patient's condition (Moya *et al*., 2015; Auyong *et al*., 2015).

Figure 2 illustrates the electron probe circuit using reflectors. The proposed intelligent electron probe is designed to reinforce the conventional electron probe and to select the structure of the waveform using the combination of master/slave output in the electronic needle controller. When an instruction of an arbitrary selected function is input to the control unit, the data signal is converted and an instruction for output corresponding to the data is executed in the electronic stick control unit. In this study we also considered the capacitance component of the patient to optimize skin

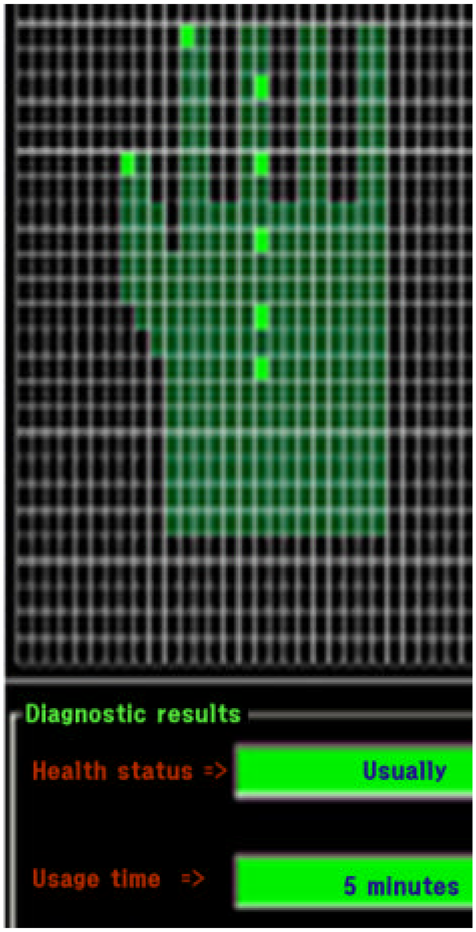

Fig. 3: Temperature and humidity sensor monitoring system (Experimental result using Korean Software)

impedance resistance measurement. Also, in order to calculate the optimal electronic needle-sticking time by applying intermittent electrical stimulation of 50-200 V of DC, 500-1.500 uA of current and 5 Hz-5 kHz to the main pad and fingers the magnitude of the peak voltage and the phase according to the given frequency were measured.

Figure 3 shows a multi-electron needle function for detecting and automatically treating the acupuncture points is completed by using an electronic needle for electrically detecting a specific part of a human body. The web based display of acupuncture points and the function of automatically calculating the needle stick time was performed. Figure 1 shows the simulation of a real-time intelligent electronic needle system that can adjust the time and intensity of the needle to suit the user's condition using the real-time bio-signal information (Sandhu *et al*., 2016).

Figure 3 shows the electronic mechanism that can accurately measure the signal intensity according to the electrical conductivity of the pulse wave and the skin that occurs in the patient, focusing on the fact that the conductivity of the skin varies according to the affected part of the patient. Using fuzzy rules, accurate measurements can be made by applying different body shape, skin impedance, vascular compliance and algorithm according to body situation. In addition a database is constructed based on the body signal information according to the patient's condition and a device for storing and determining the data in a memory through a signal processing algorithm is built in a Digital Signal Processor (DSP). Figure 3 shows how to send and receive remote information through the following process:

- Measures of biometric information using health care sensor equipment (pulse sensor, blood pressure/blood glucose sensor, electrocardiogram sensor, infrared temperature sensor)
- Hmote 2420 processes the measured information in H-Andro 210
- H-Andro 210 transmits information to android platform through wireless network (Bluetooth)

It is based on the MSP240CPU and CC2420 RF chip as the Telos platform and a hardware was developed for it to implement the electronic needle USN (Ubiquitous Sensor Network) with capable of remote diagnosis. Figure 4 illustrates the fuzzy rule-based, intelligent electron probe simulation results. If the patient wishes to determine the time of electronic needle stitching in a state of being caught in a cold, the conventional electronic needle is subjectively determined by the oriental doctor. In order to optimize the personalized electronic acupuncture treatment for the patient, the fuzzy inference rule in the MATLAB 2009 tool base is used. In this study, there are 4 fuzzy input membership functions and 1 membership function. First, the first fuzzy input membership function was classified into 3 types, high, normal and low. The second fuzzy input membership function is classified into 3 cases when the patient's symptoms are terminal, symptomatic and initial. In the third fuzzy input membership function when the electronic needle stimulus is applied, the electronic needle strength is different depending on the skin thickness, the dry skin and the wet skin. Therefore, in order to optimize it we categorized into in the case of high, normal and weak electric conductivity. The fourth fuzzy input membership function classifies the patient's age as elderly, adult and

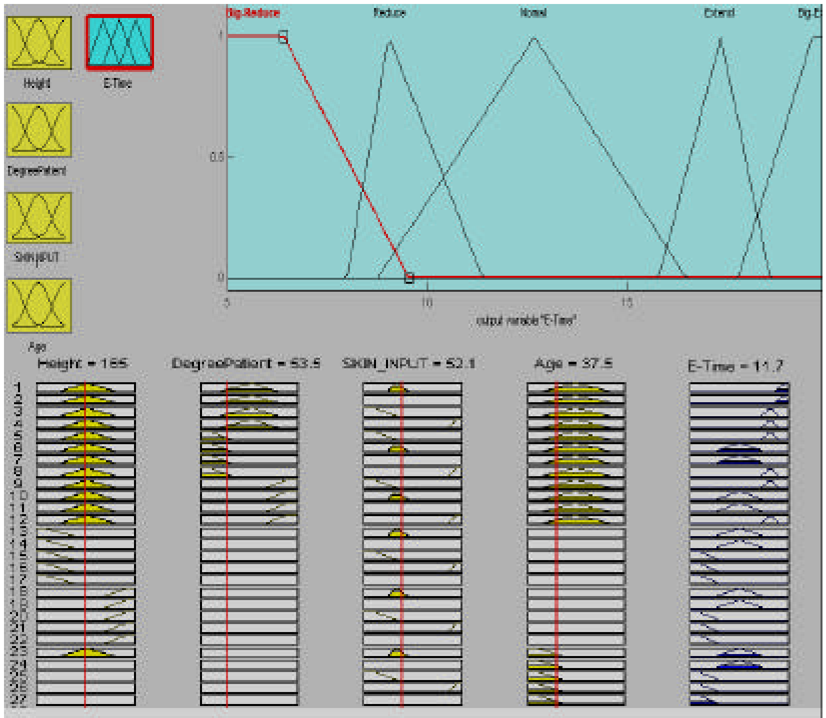

Fig. 4: Electronic penetration simulation using fuzzy rule

younger. Finally, the fuzzy output function integrates the 4 fuzzy input functions and describes a fuzzy inference system that prolongs the optimal electron dipstick and the needle time in this study we propose a combination of the belief value combining function to calculate the belief value in order to make accurate inference when the same quality of the pulse data conclusion becomes 2 or more different inference values as shown in Eq. 1:

$$\beta_c = \beta_\infty mb\left(\beta_c, \beta_c^{old}\right) = \max\left(\beta_{\downarrow c}, \beta_{\downarrow c}{}^{\uparrow old}\right) \quad (1)$$

β_c^{old} is the belief value which has already cocluded through the inference path and β_c is the belief value for another conclusion reached through the other inference path. Fuzzy rules are usually expressed in IF-THEN format and fuzzy inference is a series of processes that derive new relationships or facts from a given rule. The fuzzy creation rule shows the conclusion with 2 or more different belief values. In this case, the function used to recalculate the belief value of the conclusion. There are a number of variables such as the patient's physical condition, the patient's health condition and the presence or absence of other diseases. We used the electrical needle with optimum needle simulation considering the patient's body condition with some variables such as sex, weight and height using intelligence and it can be performed anytime, anywhere. The merit of this oriental medicine technology against the conventional method where the electronic acupressure point is determined using electronic acupressure intensity and the autonomous acupuncture time is adjustment of suitable patient's condition and body condition with the optimal blood pressure and intensity using the intelligent fuzzy rule.

CONCLUSION

In this study we proposed a method to remotely diagnose a doctor by sending remotely patient's pulse data and diagnostic data to the patients living in areas where medical services are difficult to receive or soldiers fighting in war. We implemented a software that can diagnose a soldier's disease system using soldier's pulse who have difficulty in medical treatment on the battlefield. The fuzzy rule was used to implement the electronic needle to infer the exact patient's illness. The fuzzy logic and fuzzy inference rules were used to calculate the optimal time for the patient to match the patient's body condition. The advantage of the electronic needle with built in multiple pad is that the body condition of the patient can be grasped and treated at the same time. In addition we simulated electronic needle implementation and software with embedded electronic sensing pad and related AMP using small signal drive circuit and DSP technique.

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