International Journal of Advanced Smart Convergence Vol.9 No.4 62-73 (2020)
http://dx.doi.org/10.7236/IJASC.2020.9.4.62

IJASC 20-4-8

Implementation of Intelligent Electronic Acupuncture Needles Based on Bluetooth

Chang Pyoung Han, You Sik Hong

Professor, Dept. of Smart Automobile Engineering, Sangji University, Wonju-si, Kangwon-do, Korea
Professor, School of Computer, Information and Communication Software Engineering, Sangji University, Wonju-si, Kangwon-do, Korea
Corresponding Author : yshong@sangji.ac.kr

Abstract

In this paper, we present electronic acupuncture needles we have developed using intelligence technology based on Bluetooth in order to allow anyone to simply receive customized remote diagnosis and treatment by clicking on the menu of the smartphone regardless of time and place. In order to determine the health condition and disease of patients, we have developed a software and a hardware of electronic acupuncture needles, operating on Bluetooth which transmits biometric data to oriental medical doctors using the functions of automatically determining pulse diagnosis, tongue diagnosis, and oxygen saturation; the functions are most commonly used in herbal treatment. In addition, using fuzzy logic and reasoning based on smartphones, we present in this paper an algorithm and the results of completion of hardware implementation for electronic acupuncture needles, appropriate for the body conditions of patients; the algorithm and the hardware implementation are for a treatment time duration by electronic acupuncture needles, an automatic determinations of pulse diagnosis, tongue diagnosis, and oxygen saturation, a function implementation for automatic display of acupuncture point, and a strength adjustment of electronic acupuncture needles. As a result of our simulation, we have shown that the treatment of patients, performed using an Electronic Acupuncture Needles based on intelligence, is more efficient compared to the treatment that was performed before.

Key Words*: ABS Brake, Yaw Mark, Traffic Accident Prevention, Skid Mark, Fuzzy Logic*

1. Introduction

Existing electronic Acupuncture needles were able to stimulate only one stimulation point of the patient's reflexes. For example, in order to treat the headache of patients there was a problem that ten points had to be stimulated on the reflexes of patients [1-2]. In this paper, we present the development of a Bluetooth-based intelligent electronic acupuncture needles in order to detect health condition of a patient and treat the patient using a smartphone. Also, in this paper we propose an electronic acupuncture needles we have developed that

Manuscript Received: September. 20, 2020 / Revised: September. 27, 2020 / Accepted: October. 4, 2020
Corresponding Author: chankih@cku.ac.kr
Tel: +82-33-649-7576
Professor, Department of Medical IT, Catholic Kwandong University, Gangneung, Korea

stimulate several acupuncture points in reflexes appropriate for patient conditions, using intelligent fuzzy techniques to adjust treatment time and intensity. If a human has a disease, the electrical resistance of the diseased cells becomes bigger than that of the normal cells around them. The reason is that the electric resistance is bigger in the location of the diseased cells and the location of the wounded cells than in the location of normal cells, so that the inherent electric current humans have inherently does not pass well through the diseased cells. Using these properties, we calculated the electrical resistance of the diseased cells by applying to the diseased cell locations, an intermittent electrical stimulation of pulse waves (DC voltages of 50 V to 200 V, currents of 500 uA to 1,500 uA, and frequency of 5 Hz to 5 khz). As a result, the effect of improving blood flow was obtained, which helped to transform the diseased cells into normal cells. We used ARM 32-bit Coretex: CPU (STM32F103ZET of STMicroelectonics Company) in order to implement the hardware of an intelligent electronic acupuncture needles that operates at a remote location.We included Flash Memory of 51 kB and SRAM of 64 kB, and used two UARTs (UART for Debug and UART for Bluetooth communication). It supports up to 112 IO ports, and is designed to be used as key I/F, LCD, and output port Enable. However, although oriental ways of medical treatment has many advantages compared to the western ways of medical treatment, there is a problem that the treatment effect is not scientifically proven. Therefore, in order to solve these problems, many scientists are working together to conduct a new research in order to remotely treat the patients by utilizing the advantages of the oriental ways of medical treatment and the western ways of medical treatment. In particular, the oriental medicine doctor must insert the needles into the patient's skin at specific points and hold them for a certain period of time; and how long the doctor should hold the needles is a matter of the doctor's own decision. Therefore, there is no objective data on how long the pricking time is the best one required to treat the patient most effectively [3]. In this paper, we present the results of our simulation for patients (living in areas where they have difficulties in receiving appropriate medical services) and soldiers (fighting on the battlefield), who transmit their biometric information such as tongue data and pulse data to a doctor of oriental medicine far away using mobile phones, and who receive results of diagnosis performed by the doctor [4-5]. In addition, we have implemented an intelligent system of electronic acupuncture needles that can receive and diagnose the pulse waves sent by patients far away in real time and that can make it easy for anyone to judge the results of diagnosis anytime and anywhere in real time [8-9]. In this paper we present an algorithm and the simulation results for an oriental medical doctor to treat a patient using the electronic acupuncture needles by comprehensively diagnosing disease, when the patient transmits to the doctor the basic biometric data such as pulse diagnosis and tongue diagnosis, using his or her smartphone. The paper is organized as follows. Section 2 describes the basic theory of diagnosis of oriental medicine. Section 3 discusses the results of the simulation for intelligent electronic acupuncture needles. Finally, Section 4 explains the simulation for the oriental medicine treatment system, and presents our conclusion.

2. Theory of health diagnosis and Theory electron acupuncture needles

A normal healthy tongue is light red or pinkish in color, has a thin, light white, and moist coating on it. However, the color of the tongue changes depending on our health conditions. If a person's tongue is too red, the person's body is considered to have a lot of heat. If a person's tongue is too pale, the person's body is considered to be lacking energy. If a person's tongue is pale anemia is considered severe, and, if you have leukemia you can see that the tongue is usually pale [5]. In other cases, when a person has malnutrition, asthma, hypotension, hypothyroidism, blood circulation disorders, bleeding, etc., the person’s tongue will also turn pale in color. The reason why the tongue is red and dry is because of a pyrogenic infection, high fever, or severe pneumonia, or because of severe infection of acute epidemics.

High blood pressure and diabetes can also be the same cause. If a person's tongue is slightly red and has a

dark spot, it is a symptom of jaundice. When a person has gastrointestinal disorder such as stomach ulcers, the tongue will turn clean, moist, and brown. The tongue a person turns blue, when the person suffers from respiratory and circulatory problems or has an infection, an acute cholecystitis, a cholelithiasis, or a hepatocirrhosis . If a person's tongue turns black, it means that the health is at risk. So medical treatment for the person should be provided quickly [4-5]. Since the human tongue is a region where a lot of blood is distributed, the first signs of abnormality in health appear when the person is in poor health. When a person's lack of sleep or excessive work result in a lot of fatigue or stress, the lack of immunity leads to tongue-related disease such as tongue sore and stomatitis. In addition, if the color of the tongue appears abnormal (that is it too red, pale, or black, etc.), then we can tell the health of our body has deteriorated a lot, so we must undergo a close examination at the hospital. Pulse diagnosis refers to the process by which an oriental medical doctor examines the patient by the radial artery located on hands in order to determine the disease. The main principle of pulse diagnosis is a method to determine the function of the heart or the condition of the artery, and predict and judge the health condition of the patient's intestines; by checking the number of pulses, the rhythm of pulses, the strength of pulses, and the duration of pulses. In this paper, we propose an algorithm that can determine the disease of a patient and develop a device for electronic acupuncture needle treatment based on a smartphone, when a patient transmits health biometric data such as pulse data or tongue data to an oriental medicine doctor far away. When a patient used an existing electronic needle or hand acupuncture needle, he had to find the acupuncture points in reflexes connected to his disease by himself and choose the appropriate pricking strength and pricking time of needles in order to treat himself. To solve these uncomfortable problems, we aim to present in this paper a technology that allows a patient to send information about his own pulse and tongue to oriental medicine doctors far away using smartphone, and the technology that allows the doctors to provide 24-hour treatment by electronic acupuncture needles suitable for patient's physical and disease conditions.

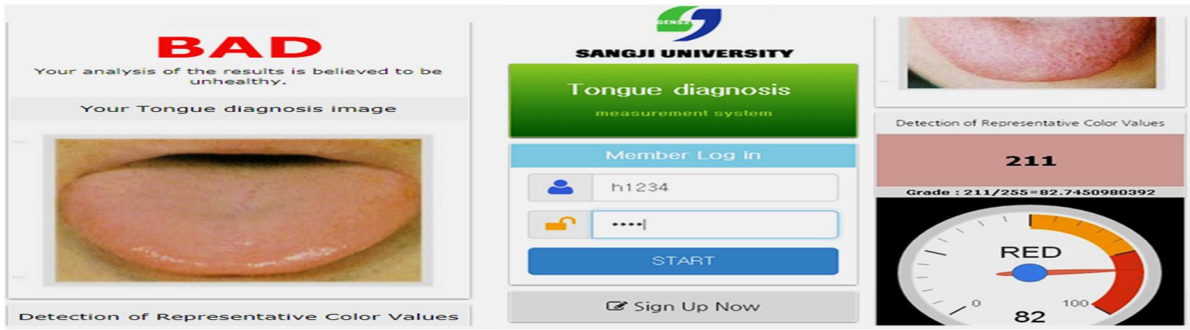

Figure 1. System for diagnosing the condition of patient's tongue based on mobile phone.

As shown in Figure 1, it shows the process of judging the patient's health status by transmitting the image of the patient's tongue to a remote oriental doctor through a smartphone.

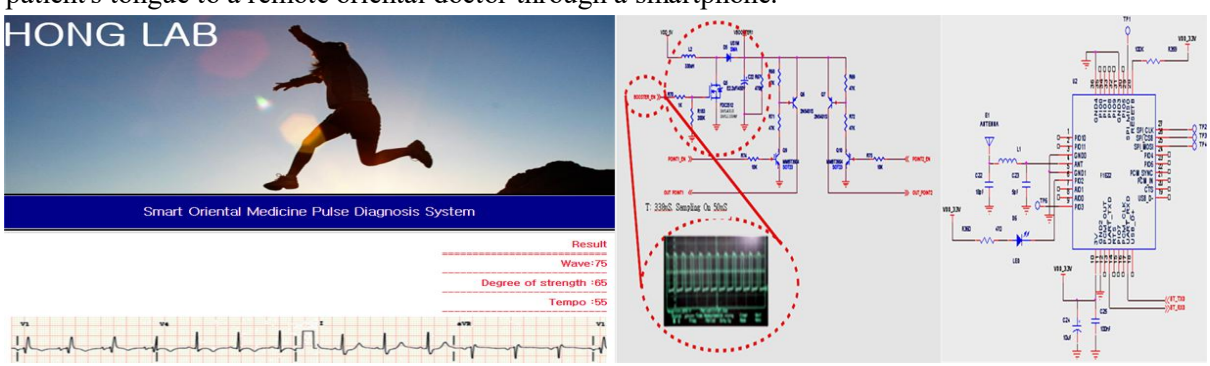

Figure 2. System for diagnosing the condition of patient's pulse based on mobile phone.

As shown in Figure 2, the result of the doctor's judgment based on a smartphone is shown to diagnose the patient's pulse state. In this paper, when performing electronic acupuncture, biometric data for pulse and tongue diagnosis that can diagnose a patient's disease are transmitted to the doctor. Disease diagnosis algorithm that can help determine the patient's health condition was proposed and a computer simulation was conducted. Moreover, we proposed a disease diagnosis algorithm that can judge a patient's health status and conducted a computer simulation.

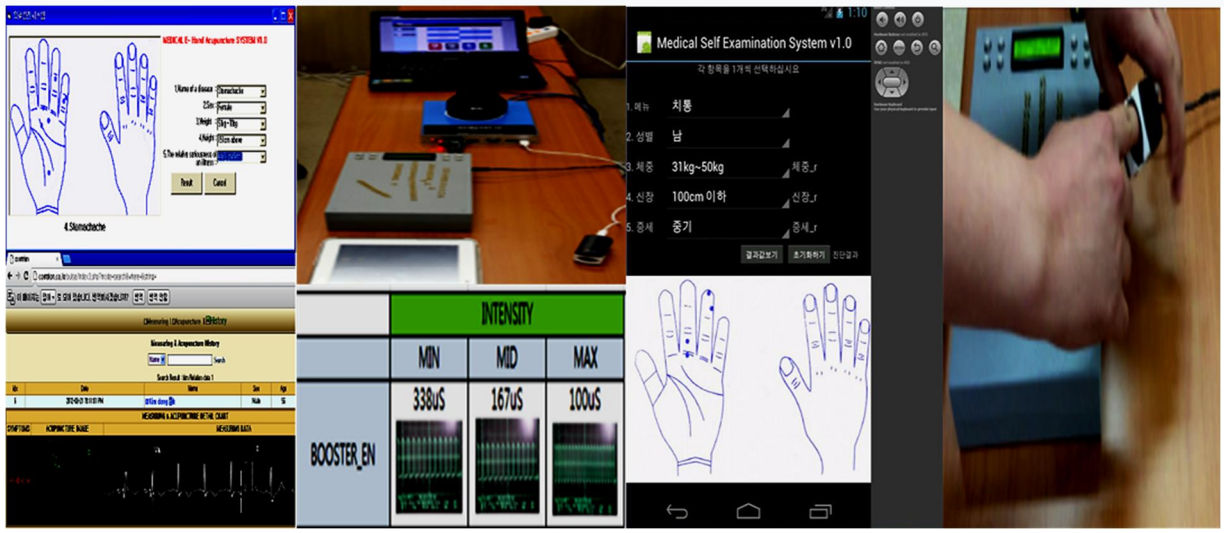

Figure 3. Simulation for finding the acupuncture points of electronic needles and for calculating the pricking time of acupuncture.

As shown in Figure 3, It use the patient pulse data automatically stored in the EMR chart in order to check the health status of the patient at a remote location; the figure shows the function of automatically marking the acupuncture points in reflexes according to the patient's disease, and the process of calculating the picking time in consideration of the patient's weight, height and type of disease.The algorithm for electronic acupuncture needles we used in this paper is as follows.

Rule: IF PA is t1 THEN C is B2 : (FBAD)
fact : PA is t1'
conclusion : C is t2' : (FCON)
PA : Condition of patient’s disease
CON : Judgement of inference result
FBad: Fuzzy number representing the uncertainty of conditions for determining patient health status, based on smartphone phone
FCON : Determining the pricking time of electronic acupuncture needles

RULE
IF Pulse rate = High And Numbe
Health Level by tongue diagnosis= Med And
BMI = High And
Health Level by pulse diagnosis = High And
Then

Needle time = Extend

We present in this paper the function of controlling the intensity and time of pricking a patient's skin with wireless electronic acupuncture needles, so that an oriental medical doctor can stimulate a remote patient with needles using wireless communication protocols such as Bluetooth and Wi-Fi, instead of applying an electronic needle directly to the patient for treatment.In other words, in the past oriental medical doctors used to apply, through the wire, the stimulation of the electronic acupuncture to the patient, by grasping the patient's disease and health condition, and by adjusting the intensity of the electronic acupuncture needles and pricking time the electronic acupuncture needles.

However, the advantage of using the wireless electronic acupuncture needles we present in this paper is that the oriental medicine doctor can control the pricking strength of needles from far away; that is, the oriental medicine doctor at the remote location can apply the weaker strength of the electronic needles, if the patient is overreacting to the stimulation of electronic acupuncture needles. And the oriental medicine doctor at the remote location can apply the stronger strength of the electronic acupuncture needles, if the patient does not respond to the electronic acupuncture needles. Since the wireless system of electronic acupuncture needles we have developed based on such a Bluetooth can receive pricking information through wireless communication, analyze the received information, and treat patients using a wireless electronic acupuncture needles, the system is the result of our latest research with improved functions from the existing wired system of electronic needles.

We have implemented largely in two parts our electronic acupuncture device that operates based on Bluetooth; the main board and the sub-board (the electronic acupuncture pad). We used the DC 5V adapter and lithium polymer battery (3.7 V) as the input power source, and included a circuit for battery charge (U3). We used MCP73831 of Microchips for the charging IC. We use Fast Charge Constant-Current Mode in order to charge lithium polymer batteries by applying Typ. 505 mA charging current. The state of "charging" or the state of "charge completed" is indicated by an LED. We used Step-up Converter, TPS61240 IC (U3) in order to apply 5 V as a power source of LCD. When we use a battery power, we can stably supply 5V to the LCD. We designed the equipment so that 5V voltage is generated when the PWR_ON signal is controlled by the CPU after the initial power ON key is pressed.In addition, we developed a device to remotly control the pricking time and pricking strength of the electronic acupuncture needles by using the Bluetooth function.We configured the operating keys of the electronic acupuncture needles with buttons for the Power/start, Set, Auto, Manual, Intensity, Interval, Time, and Sound. We have designed our equipment to operate by pressing the "Power/Start" button when we want to turn on the initial power the device, and pressing the "Start" button when we want to operate the electronic acupuncture needles after setting the function.

We have designed the equipment to operate in each mode, when we want to use electronic acupuncture needles after setting the AutoKey to one of seven prescription modes. We used the Manual key of electronic acupuncture needles when we want to generate each port corresponding to the acupuncture blood point, and we designed the equipment to support up to 10 ports. The intensity of the electronic acupuncture needles, operating based on Bluetooth, has three types: Max, Mid, and Min; we have designed each intensity to be controlled by the "sampling on" timing of the BOOSTER_EN signal. We set an Interval to control the period of electronic needle stimulation using Bluetooth of wireless communication based on smartphone as a mobile device. We used F1E22 module and chip antenna, and designed UART communication between F1E22 module and CPU. We used ARM 32-bit Coretex CPU (STMicroelectrics STM32F103ZET) for the control system of electronic acupuncture needles, and included Flash Memory of 6 4kB and SRAM of 512KB, and used two of Debug and Bluetooth communications as UARTs. It supports up to 112 IO ports, and is designed to be used as key I/F, LCD, and output port Enable. We designed the output part of electronic needle system to operate according to the control signal by sending the operation signal of the needle to the sub board.We applied the operating signal to the electronic acupuncture needles in order to generate an electrical stimulus to

treat patients.That is, we have designed the system to send output to each of acupuncture blood point through the pin of the electronic needle.We designed the pad of electronic needles with sizes to be used for adults or the children. We used the pad for adults or the children by replacing the main body of pads. In particular, we have designed the equipment to stimulate the corresponding acupuncture needle point by automatically recognizing whether it is a pad for the adults or a pad for the children. We have constructed the basic circuit consists of two parts; a part of voltage boosting and a part of the output port, for the circuit to accumulate energy of the electronic acupuncture needles. This circuit was designed so that it can have 80 output ports for the maximum of 10 ports can generate output values simultaneously. The circuit is composed of a condenser (C) and a coil (L), where the electromagnetic phenomenon occurs in circuit that can accumulate the energy by charging and discharging with the current flow (I). The current increases linearly through the coil. The operating principle of the boost converter constituting the circuit is as follows. That is, when the switching element is in the ON state, the current flows through the switching circuit for the current to charges the inductor. In addition, the current of output capacitor does not play a role of flowing in the reverse direction of the diode. When the switching element constituting the circuit changes into an OFF state, a current charged in the inductor is discharged, so that the current can perform an operation of generating a voltage larger than the input voltage. In addition, the output capacitor of the circuit plays a role of absorbing high-frequency components. In addition, each point corresponding to the reflexes or acupuncture points of each part of the human body is distributed on the palm of human the hands. Therefore, we designed and fabricated the pads of electronic acupuncture needles in order to allow multiple contact points on the user's hand is used to perform the treatment by electronic acupuncture needles.In addition, by executing the treatment command transmitted from the main board of the device, we applied the electric stimulation simultaneously to a number of reflexes or acupuncture points corresponding to each relevant part of the patient's body. In other words, as an electrical stimulation we intermittently applied a voltage signal of 5V to 30V in magnitude and 0.1 ms to 10 ms in time period.

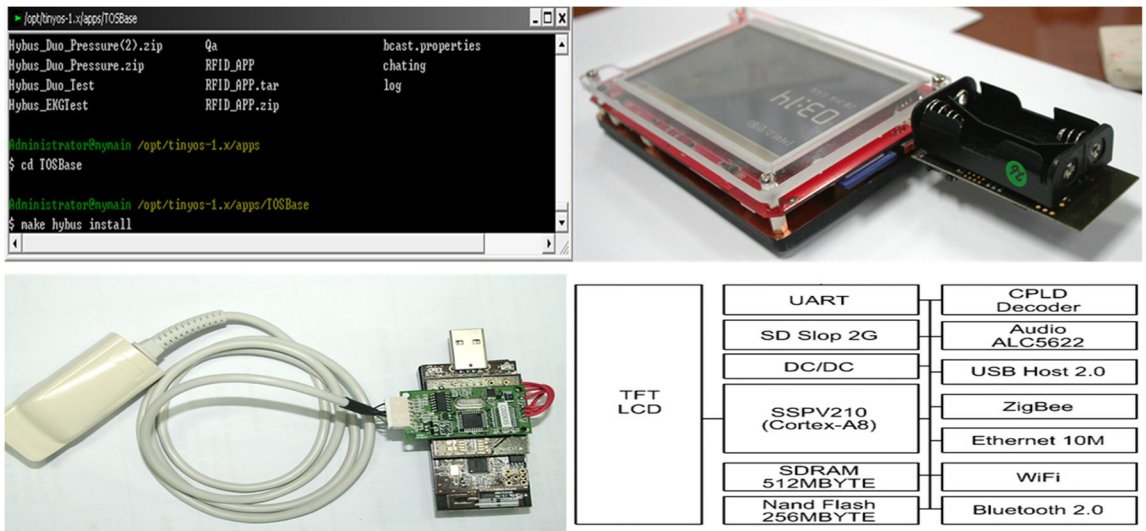

Figure 4. Simulation for the oxygen saturation kit

In addition, we present in this paper the equipment we have designed in order to further identify the health status of patients, using pulse diagnosis, tongue diagnosis, biometric data, and oxygen saturation sensors In Figure 4, we explain the basic structure of the kit for measuring oxygen saturation in H-AndroSV210, with a Pulse Oximeter sensor installed.

4. Simulation

We conducted simulations for software and hardware of electronic acupuncture through Mobile Phones, in order to extend or shorten the pricking time by automatically determining, based on fuzzy rules, the strong or weak state of pricking by electronic needles to treat patients. Even for the patients with the same disease, if the patients show the mean pulse rate is “High”, age is “High(for old age)“, and BMI (obesity index) is “High (healthy condition)”, as an input condition for biometric input data, and if the electrocardiography (ECG) is “Med (normal condition)”, and the average blood pressure is “Med (normal condition)” ; then we used intelligent fuzzy rules in order to determine the pricking time is 25 minutes. If two or more conditions of patient are “High (dangerous condition)”, for example, the electrocardiogram is “HIGH (dangerous condition)” and the average blood pressure is “HIGH (dangerous condition)”, then the patients may have seizures during the pricking time; in order to cope with this unwanted situation we have proposed an algorithm and simulation that can extend or shorten the pricking time to suit the patient's physical condition using a fuzzy algorithm. There are many types of signals that the human body produces. We generally use sensor pads in order to measure the strength of the blood pressure signal generated by the heart. However, in oriental medicine, we measure the aorta radialis of the wrist using several types of sensors. We can generally express fuzzy rules in the IF-THEN format. Fuzzy interference means a series of processes that infer new relationships or facts from a given rule, and we used Max-min reasoning. However, the conclusions of the fuzzy generation rules represent more than one different belief value. In these cases we use the belief value combination function to recalculate the belief value of the conclusion. For example, if the probability that a patient had a disease of hypertension is 0.3, then the probability of being normal without hypertension is 0.7. However, according to the fuzzy measure in this ambiguous situation, the probability of having a hypertension disease is 'possibility' 0.3 does not mean that we can determine the probability of normal (that is without hypertension) is 0.7. The probability that a person is normal, without hypertensive disease, may be 0.5 or 0.9. This is because there can be many variables such as the patient's physical condition, the patient's health condition, and the presence or absence of other diseases.

Table 1. Correction data for patients based on association rules

Input data	
Variable 1	Age20, 20-29, 30-39, 40-49, 50-59, 60
Variable 2	Gender (Male, Female)
Variable 3	Samp:,Low, Med, High
Variable 4	Namp:,Low, Med, High
Variable 5	Ramp:Low, Med, High
Variable 6	Ntime:Low, Med, High
Variable 7	Stime:Low, Med, High
Variable 8	Rtime:Low, Med, High
Variable 9	BMI :Low, Med, High
Variable 10	Blood:Low, Med, High

As shown in table 1, in order to improve the health judgment even with the same heart rate waveform, the process of providing the optimal health status judgment value considering 10 related rules is described. The ten component analysis conditions that for important for health judgment are as follows. As explained above,

the important factors that determine health are the patient's age status, gender status, wrist restraint status, three conditions for skin prediction, and obesity status.

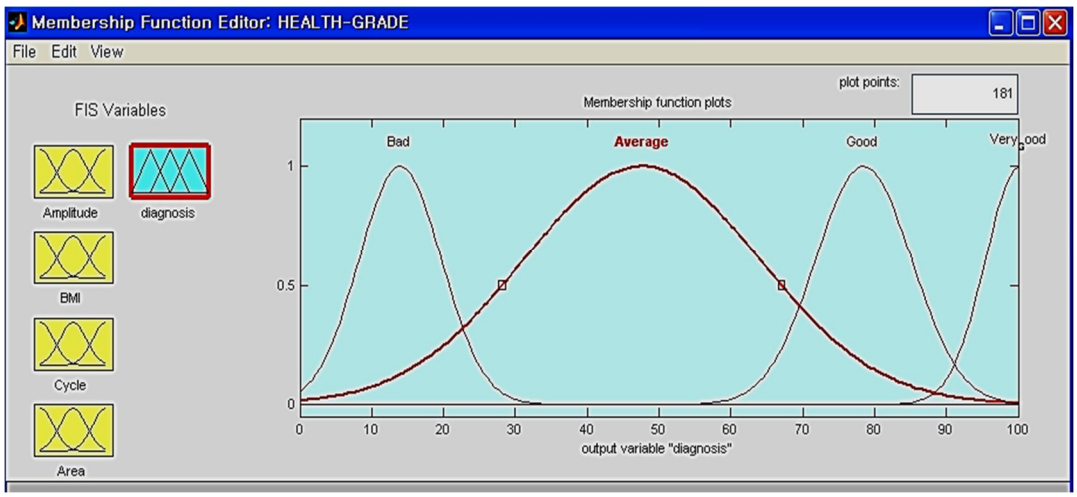

Figure 5. Simulation for electron acupuncture needles using MATLAB

As shown in Figure 5, It proposed and simulated the algorithm of the fuzzy rules in order to determine the pricking time of the electronic acupuncture needles according to the patient's disease and patient's health conditions. Therefore, in Figure 5, we proposed and simulated a fuzzy rule algorithm to determine the puncture time of the electronic needle according to the patient's disease and the patient's health status. In other words, in this paper, According to the health and physical conditions, we propose and simulate the strength and magnetic needle time algorithm of the electronic needle.

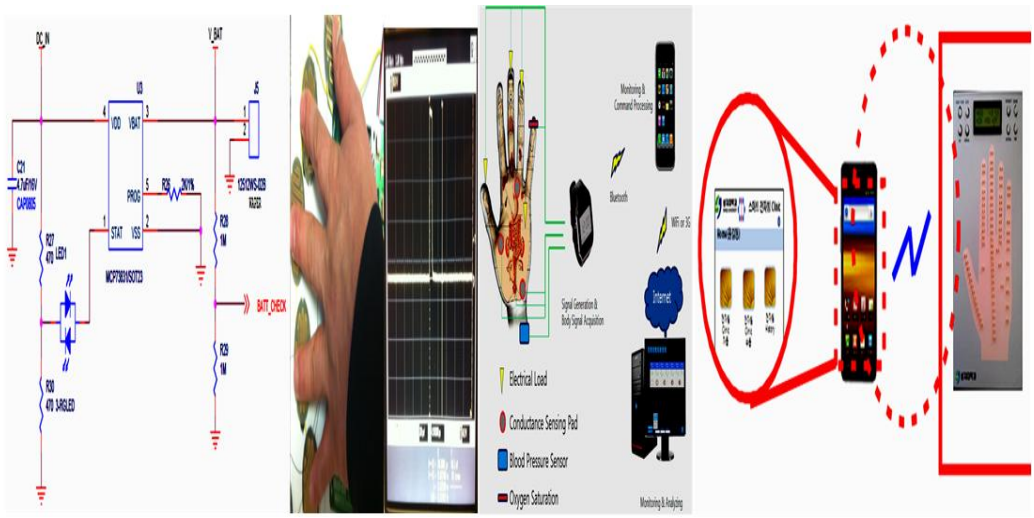

Figure 6. Screen for executing electronic acupuncture needles.

As shown in Figure 6, the operating principle of the wireless electronic needle is based on Bluetooth, and explains the process in which anyone can easily receive remote medical treatment. In this step, we describe the software and the hardware for Bluetooth-based wireless electronic needles, so that the patient's health status can be objectified by transmitting the patient's biometric data, such as pulse data and tongue data, to the doctor of oriental medicine far away.

```
function ajaxcall4(myurl){
$.ajax({
type : "POST" //"POST", "GET"
, async : true //true, false
, url: myurl
, dataType : "html" // type of data to be received
, cache : false //true, false
, int len, v, v2, v3;

     : key = KEY_AUTO; break;
     : key = KEY_PIN; break;
    : key = KEY_SET; break;
    : key = KEY_SET_LONG; break;
    : key = KEY_INTENSITY; break;
     : key = KEY_INTERVAL; break;
     : key = KEY_SOUND; break;
    : key = KEY_TIME; break;
   : key = KEY_ACTIVE; break;
   : key = KEY_POWER; break;
    : key = KEY_POWER_LONG; break;


key;
data : "" //Parameter to be sent to the server
"a=b&c=d" You can Directly enter the data as a character string
, contentType: "application/x-www-form-urlencoded; charset=UTF-8"
, error : function(request, status, error)
{ //process when the communication error occurs
alert("code : " + request.status + "\r\nmessage : " + request.reponseText+ "\r\n Oh my! Internet connection is cut off.");
, success : function(response, status, request)
{ //process when the communication is successful
$('#scr4body').html(response); //place where the contents will enter
, beforeSend: function() { //process when the communication begins
$('#ajax_indicator').show().fadeIn('fast');
, complete: function() { //process when the communication is completed
$('#ajax_indicator').fadeOut();
function ajaxcall5(myurl){
$.ajax({
type : "POST" //"POST", "GET"
, async : true //true, false
, url: myurl
, dataType : "html" //datatype to be received
, cache : false //true, false
   /*** select disease menu for electronic needles ***/
   switch( Screen )
   case S_AUTO :
   LCD_WriteString(0,0," *AUTO ");
   switch( Mode )
   {
   case M_HEADACHE : LCD_WriteString(1,0," 1.HEADACHE "); break;
   case M_COLD : LCD_WriteString(1,0," 2.COLD "); break;
   case M_STOMACH : LCD_WriteString(1,0," 3.STOMACHACHE "); break;
   case M_TOOTHACHE : LCD_WriteString(1,0," 4.TOOTHACHE "); break;
   case M_HEART : LCD_WriteString(1,0," 5.HEART "); break;
   case M_BLOOD : LCD_WriteString(1,0," 6.BLOOD "); break;
   case M_DIABETIC : LCD_WriteString(1,0," 7.DIABETIC "); break;
```

```
   /*** Receiving command from remote site *******/

   _INPUT_KEY: Make a input transmission packet.
   MyRxProcess: 'Receive while 1 if kbhit()=0 then Return
   'If there are no received bytes, it ends. RxByte = getch()
   'From the reception buffer, one byte is read If RxByte=MY_STX Then
   'If the received byte is STX ,RxCount=GetStr(RxBuf, 9, 10, 0, MY_ETX)
   'Start reading the packet.. If RxCount<>0 Then
   'If there is a received byte 'if RxBuf(0)<>MyAddress then return
   case S_INTERVAL : Settings[Mode].Interval = Interval; break;
   case S_INTENSITY : Settings[Mode].Intensity = Intensity; break;
   case S_TIME : Settings[Mode].Time = Time; break;
   default :
   main()
{
if (choice == 1)
{
while( 1 ) {
msgp = &sndbuf;
printf("\nEnter the key_value = ");
scanf("%d", &key_value);

// Filtering part. The first filtering data shown above. Remove ionce.

// Edong_avg(50, OriginalWave_filter,0); // Original 1 //Edong_avg(50, OriginalWave_filter,0); //

Original 2 filtering

buffer[i] = c

if(c == SERIAL_START_BYTE)
                                if(buffer[20] == 0 && buffer[21] == 0 && buffer[22] == 0) {
                 if(status_opened == 0) {
                  status_opened = 1;
                  printf("The sensor of pulse oxymeter is opened. \n");
                if(buffer[24] != 0x04) {
                  status_signal = 0;
                  status_opened = 0;
                  printf("Your pulse rate is %x beats per minute. ", buffer[20]);
                 printf("Your blood oxygen saturation level is 2%. \n", buffer[22]);
                  pulse_pkt = 0;
                  duo_pkt = 1;
                  status_signal = status_opened = 0;
                  printf("[Packet notification] Blood pressure module \n");
                }
                if(buffer[18] == 0) {
                if(status_duo == 0) {
                status_duo = 1;
                printf("Not connected, or the blood pressure module \n");
                printf("has not received the value.\n");
                printf(" 1. Measurement data must exist in the module.\n");
                printf(" 2. After measurement, the module must be reset and the Hmote2420 must also be reset. \n\n");
                if(buffer[18] != 0) {
                status_duo = 0;
printf("At(%x,%x ;time, min ) on( %x,%x ;Month, Date)",buffer[18],buffer[19],buffer[20],buffer[21]);
if(buffer[23] > 9)
printf("Systolic blood pressure of %x%xmmHg/", buffer[22],buffer[23]);
```

```
else
printf("Systolic blood pressure of %x%xmmHg/", buffer[22],buffer[23]);
if(buffer[25] > 9)
printf("Diastolic blood pressure of %x%xmmHg/", buffer[24],buffer[25]);
else
printf("Diastolic blood pressure of %x%xmmHg/", buffer[24],buffer[25]);
if(buffer[27] > 9)
printf("Your pulse rate is %x%x beats per minute is detected.\n", buffer[26],buffer[27]);
else
printf("Your pulse rate of %x0%x beats per minute is detected.\n", buffer[26],buffer[27]);
   Action = 0;
   TimerInterval = 0;
   char *mode_str[8] = { "", "HEAD ", "COLD ", "STOMACH ", "TOOTH ", "HEART ", "BLOOD ", "DIABETES" };
   char *intensity_str[4] = { "", "MAX" , "MID" , "MIN" };
  char *interval_str[5] = { "", "CON" , "S-1" , "S-2" , "S-3" };
 POINT_T PinMap[81] = { { NULL, 0 },
{GPIO_Pin_7 }, { GPIOE, GPIO_Pin_8 }, { GPIOG, GPIO_Pin_0 }, { GPIOE, GPIO_Pin_9 },
```

4. Conclusion

In this paper we present an algorithm and present the results of our simulation performance, that allows the oriental medical doctor to conduct Bluetooth-based electronic acupuncture needles to treat the patient, by analyzing the disease condition of the patient with the oxygen saturation function, when he receives through smartphone the patient's basic biometric data such as pulse data and tongue data.

In addition, we proposed a simulation to operate a medical system in which patients living in remote areas having a hard time to receive medical diagnosis, patients of farming and fishing villages far away from hospitals, and patients climbing the mountain can use their smartphones to send basic biometric data (such as pulse data and tongue data) to oriental medical doctors in remote areas, while the doctors can diagnose the patients' disease and treat them. In particular, even if patients have the same disease, the biometric data varies depending on their physical condition. So it is difficult for oriental medicine doctors to accurately deduce and grasp the final disease for treatment. This is because the patient's pulse patterns vary depending on conditions such as gender, age, and emotion. To solve these problems, we used belief values based on fuzzy logic and statistical probability values. We have made and simulated a software and a hardware for an Bluetooth-based intelligent electronic needles so that a doctor can accurately deduce and treat the patient's disease; that is, if a patient simply clicks on the smartphone environment menu for 24 hours a day in order to send his or her biometric data to a doctor at the hospital far away, the doctor can accurately deduce and treat the patient's disease. In addition, in this paper we proposed an algorithm that can control the strength of an electronic acupuncture needles at a remote location, and presented the results of the electronic needles hardware completed, with the Bluetooth-based fuzzy logic and reasoning by supplementing to the system of existing electronic needles such functions as the electronic acupuncture treatment time and pricking time suitable for the patient's physical condition, methods for pulse and tongue diagnosis, automatic determination of oxygen saturation level, and automatic display of acupuncture points.

References

[1] Han Gu Lee, "A study on meridian system using electrical characteristics," Korea Institute of Oriental Medicine, 1996.

[2] J. Lee, Y. J. Lee, H. J. Lee, E. J. Choi, J. Y. Kim, "Designing a stabilized process of pulse analyzing method using sigma 6," Korea Institute of Oriental Medicine researches, pp 85– 92, 2006.

[3] Y. G. Lee, "***Diagnostic atlas 2 analyzing pulse,***" Chungdam books, pp 11-14, 2003
[4]You-Sik Hong, "Smart Tongue Electronic Chart System,"Journal of the Institute of Webcasting, Internet and Telecommunication",Vol.12,No.2,pp.243-249,2012,
[5]https://www.momq.co.kr/board/board.html?code=2020nemomq_board1&page=6&type=v&board_cate=6&num1=9999085&num2=00000&number=71&lock=N.
[6] J K Kim, " The Development of Digital Tongue Diagnosis System,"Kyung Hee University, Bachelor Thesis, 2005
[7] U.H. Yong, U.S. Yun, & C.S. Nam "A study on mobile phone using behavior by age group," Journal of Ergonomic Socity of Korea Vol.23, No.2, pp.105-120, 2004.
DOI: http://dx.doi.org/10.5143/JESK.2004.23.2.105
[8] Hong You Sik, "Web-based smart electronic acupuncture system," The journal of the Institute of Webcasting, Internet and Telecommunication, v.13 no.4, pp.209 - 214, 2013
[9] J. Haddadnia, K. Faez, and M. Ahmadi, "A Fuzzy Hybrid Learning Algorithm for Radial Basis Function Neural Network with Application in Human Face Re cognition," Pattern Recognition, Vol. 36, No. 5, 2003
[10] A. Kandal, L. Li, and Z. Cao, "Fuzzy Inference and Its Application to Control Systems, "Fuzzy Sets and Sytems, Vol. 48, No. 1, pp. 99-111, 1992.
[11] Kim, gwanghwan, "A study on medical records and standardized format," Korea Institute of Venture Technology Conference, pp.507-508,2010
[12] Dong H. Shin, Seol B. Bae, Woon K. "Way-Point Tracking of AUV using Fuzzy PD Controller ," Korea Institute of Information Technology Vol.11, Issue 5, 2013
[13] You Sik, Hong "Web-based smart electronic acupuncture system," The journal of the Institute of Webcasting, Internet and Telecommunication, Vol.13 No.4, pp.209 - 214, 2013
[14] You-Sik, Hong,"Smart Tongue Electronic Chart System," Journal of the Institute of Webcasting,
Internet and Telecommunication, ,Vol.12,No. pp.243-249,2012
[15]C.J. Bernardos, M. Gramaglia, L. M. Contreras, M. Calderon, and I. Soto, "Network-based Localized IP mobility Management: Proxy Mobile IPv6 and Current Trends in Standardization," Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (Special issue: Advances in Wireless Mobile and Sensor Technologies), vol. 1, no. 2/3, pp. 16-35,2010
DOI: https://doi.org/10.22667/JOWUA.2010.09.31.016
[16]W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy efficient communication protocol for wirelesssensor networks,"Proceedings of the 33rd Annual Hawaii International Conference on System Sciences,2000,
DOI: https://doi.org/10.1109/HICSS.2000.926982
[17]R. Patel, S. Pariyani, and V. Ukani, "Energy and Throughput Analysis of Hierarchical Routing Protocol (LEACH) for Wireless Sensor Networks," International Journal of Computer Applications, vol. 20, no. 4, pp. 32-36,2011
DOI: https://doi.org/10.5120/2420-3247