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Design of Electrical Device for Robust Detection and Diagnosis of Human Body Organs through Acupuncture Point

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Abstract

Humans are suffering from a lot of diseases, being diagnosed with various biomedical devices for treatment. Acupuncture treatment method on human body is performed with thin needles, which was dangerous and painful in the ancient time. Each organ in human body is linked with specific acupuncture points that report the disorder of the organ. Therefore, in this study, we designed a robust electrical device to trace function of the body organs through the acupuncture point. Our device diagnoses through electrical stimulation of specific acupuncture points and provides the information in the form of graphical view. The detected acupuncture points are presented on meridian lines of organs i.e. lungs, heart, small intestine and large intestine. After successful detection of acupuncture points, the device is switched to therapy mode by generating the electrical signals to normalize the function of human organ. The device is user friendly, reliable and voltage is properly controlled by specific electronic component.

Keywords: Electronic device; Electric-therapy; Acupuncture Point Locator.

Introduction

The recombination Human beings are always in search for the best and efficient technique for the treatment of diseases. Besides medical treatments, the unconventional techniques like Acupuncture, infrared heat and cupping are also employed. Among these, Acupuncture is very famous technique in traditional Chinese medicine to cure the diseases by puncturing on some acupuncture point of animal (Rat, horse, dog and human). Acupuncture treatment is very helpful and safe to control depression, chronic diseases, blood pressure and metabolism [1].

Acupuncture is one of best known of alternate therapies. It is a treatment method that invented more than 3,000 years ago in China. Most of the countries are practicing and believed to this technique other than china are Japan, Korea, European and Taiwan.

For many years, people have practiced needles or apply heat to cure the specific diseases. Recently, novel and advanced techniques have been emerged which are needleless, such as electrotherapy, bio-magnetic and laser therapy shown in figure 1. Laser therapy technique is the one of the latest techniques focused by researchers. The laser device performs its function by directing the high-intensity laser beams to specific points on human body. But this technique is invasive as it uses high-energy laser beams, and therefore may cause skin burning. Bio-magnetic techniques are also one of the well-known techniques for acupuncture treatment. These techniques are mostly used for stabilizing the blood pressure and for chronic pain due to restriction of blood [2]. The magnetic induced forces are generated by bio-magnetism device which is used to help increase the flow of bio-electricity. But this technique requires extensive setup to induce and control the magnetic forces. Besides this, the magnetic field can be distracted by metallic objects. On the other end, electrical devices are more robust, easily controllable and safer than those of the former two techniques (Figure 1).

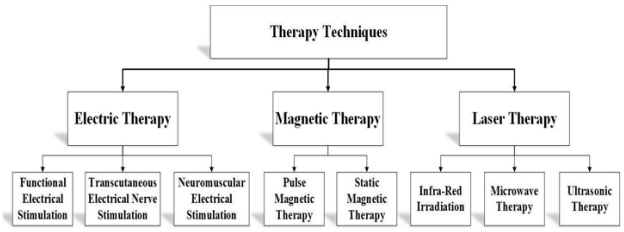

Figure: 1. Acupuncture Techniques used as a Therapy

Ancient Chinese confidently believed that a particular energy is moving in human body through the specific path which is called meridians. It is possible to apply the electric current to human body externally through stimulation which normalizes the function of the body organs. The energy can be transmitted to the human body during therapy from specific points which are called acupuncture points.

Acupuncture locating technique is used to analyze the condition of organs. Every organ has its own meridian line that contains acupuncture points. The points on meridian line exhibit lower electrical impedance and higher capacitance compared to that of surrounding skin. It has been reported that resistance of acupuncture point skin is lower than the normal skin [3]. Therefore, it is extremely feasible to use this device at low frequency because human skin resistance decreases by increasing the frequency. It has been reported in literature that 100 Hz is the optimum frequency value for checking the acupuncture point. However, we can apply 5-200Hz frequency through our device for locating the acupuncture point [4].

Electrical devices are used for locating these points by applying some electrical stimulus or signal for diagnosis. An acupuncture device regulates the function of organ and stabilizes the energy along meridian path called chi-energy. Therefore, a certain condition of organ can be assessed by observing the chi- energy in acupuncture points. Normally in literature, the frequency of 0 to 100 Hz is used for human body, that range falls well within the typical human body frequency range of 58 to 64 Hz. Moreover, the range of applied voltage to human body is 0 to 100 V with limit control current. But at the given voltage range there is greater possibility for getting

electrocuted [5]. Therefore, we make reliable devices operating under relatively low voltage. The ancient Chinese found 361 classical acupuncture points, and 14 general meridians. These points are linked with energy meridian of the nerves. Main organs of human are stomach, large intestine, small intestine, lung, heart, liver and so on [6].

Gold, copper, silver, platinum are the useful metals for electronics due to their versatile properties. The electrodes and probes used in biomedical instruments are normally made of these metals. Among these, copper is not bio-compatible, as it reacts with human skin. Gold is a precious metal, therefore, it will make device more expensive. We choice silver for our device as probe among these metal because of its bio-compatibility, cheap and highly conductive nature [7].

Electro-acupuncture is best technique for therapy to stimulate the acupuncture points. It is a technique in which electrical pulses are applied to human body. A special current controlling circuit is designed for locating the acupuncture points and balances the chi-energy or meridian energy. Previously, many researchers carried out this work by using electronic component, but in this study, we tried a more robust technique by using microcontroller.

Methodology

A device is designed for detecting the existence of acupuncture points and for electrical therapy of human body. For checking the function of device; we select a specific acupuncture point on meridian of human organ. For detecting the existence of acupuncture points on lungs, large intestine, small intestine, and heart; meridian of the corresponding organs are better choice. The acupuncture points of these organs are discussed here.

Acupuncture Points

Every acupuncture point are linked with organ which shows the functional activity of the organ. Acupuncture points are classified into two types, active and inactive acu-point. Inactive points are less effective during diagnosis as compare to active point because of inactive are located at less sensitized (sensory nerve endings) position in human skin. By literature review, it is observed that active acu-point is more sensitive to external electric stimulus than inactive point.

Heart is organ that pumps blood to the whole body. After pumping, the blood moves in blood vessels, such as arteries, veins, and capillaries. There are 9 acupressure points in Heart meridian. Eight points out of nine points exists in arm. Main function of lung is to intake the oxygen from atmosphere as well as discharge the carbon dioxide. There are 11 acupuncture points of lung. The small intestine is a convoluted tube in human body that absorbs the nutrients. There are 19 acupressure points of small intestine. Large intestine has 20 acupressure points. The points of discussed organ which can be easily detected are given below in table 1.

Sr #	Organ	Acupuncture point
1	Heart	HT1, HT2, HT3, HT4, HT5, HT6, HT7, HT8, HT9
2	Lung	LU6, LU7, LU8, LU9, LU10, LU11
3	Small Intestine	SI1, SI2, SI3, SI4, SI5, SI6
4	Large Intestine	LI,1 LI2, LI3, LI4, LI5, LI6

Table 1: Acupuncture point, which can be easily detection by device

Device Description

After receiving the information about acupuncture points, acupuncturist may diagnose the function of organ by through these points by using this device. Device consists of two modes; the first mode (point locator mode) is used to find the acupuncture points, and the second mode (therapy mode) is based on stimulus applied to human for normalizing the function of organs. The independent circuits of both modes consist of ICs, resistors, capacitors, fuse, display board and microcontroller. Microcontroller is used to generate the frequency when therapy mode is active and also used for finding the value of frequency when acupuncture locator mode is active. Generating the frequency for therapy purpose and finding the frequency for acupuncture location are two opposite frequency modes of the device [8]. Device has two probes; one is used as a reference probe and other is used for finding the acupuncture point when device is used for acupuncture location purpose and same probe is used for applying electrical stimulus for therapy purpose. A good conducting metal is required for this purpose that is why silver probes are used in this device. Figure 2 shows I/O component function button, switches and variable resistor which are used as input components and display screen, LEDs and probes which are used as output component.

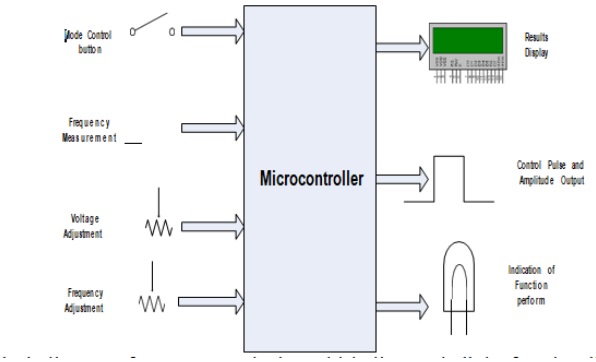

Figure: 2. Block Diagram of acupuncture device which discussed all the functionality of device

Flow chart demonstrates the steps that are used to operate the device shown in figure 3. First of all, select acupuncture point locator mode and then locate the acupuncture point. After locating the acupuncture point therapist should select the other mode electrical stimulus and give stimulus or therapy in the form of pulse to human with two other specific modes. These modes are intermediate and

continuous modes [9]. We can diagnose human by choosing any mode depend on condition and/or history of patient (Figure 3).

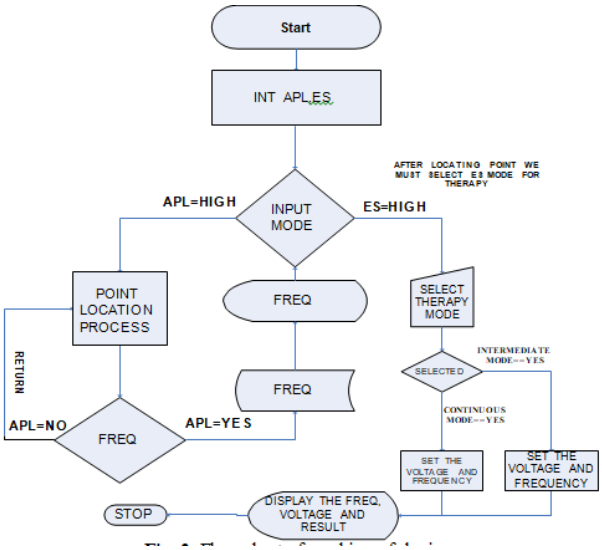

Figure 3: Flow chart of working device

Different experiments can be performed on this acupuncture device.

Select the Specific Acupuncture Point

This device is designed for detecting the existence of acupuncture point in human body. First of all, select the specific organ that is to be examined. Each organ has its own meridian or channel. Acupuncturist can use any point on meridian for testing or locating the point. The point on meridian of the targeted organ is selected. In this study, the acupuncture point HT9 from heart, LU9 from lung meridian, LI1 from large intestine meridian and SI1 from small intestine were selected.

Select the Acupuncture locator Mode by Switching

For detecting the acupuncture point, there is some difference of resistance between normal skin and acupuncture points skin. It is very interesting that measurement of acupuncture point is almost like resistance measurement in electronics. The resistance is large at normal skin as compared to acupuncture points. For detecting the acupuncture point we use two probes, i.e. given reference probe and point locating probe. The reference probe is held by patient's hand, and the other pointer locating probe is used for locating the patient's acu- points. After potential difference across reference probe of device and point locating probe, some acquired results show that bio-electricity (chi energy) moves from organ to acu-points along meridian lines, this happens because our organs is linked with acupuncture points [10].

Select the Electrical Therapy Mode by Switching

After detection of acupuncture point, electric therapy should be applied in the form of pulse which causes the flow of meridian energy and clear the meridian line for proper flow of chi energy. Therapist should select the electric therapy mode for diagnosis. A square wave is generated according to requirement by microcontroller modulated frequency and voltage through potentiometer. Frequency can be varied by changing frequency adjustment potentiometer and voltage can also be increase or decrease on the basis of requirement by potentiometer [11]. For diagnosis device has two therapy modes. One is intermittent and the other is continuous mode.

Results

As discussed earlier, the value of resistance at acupuncture point skin is less than normal skin. Similarly, the value of electrical capacitance is more at acupuncture point skin than that on normal skin. For this, we have electrical modeling, R2 show the resistance of circuit, C1 and R2 show the capacitance and resistance of acupuncture point respectively shown in figure 4. On the basis of this circuit, we have performed several experiments and compiled the obtained result.

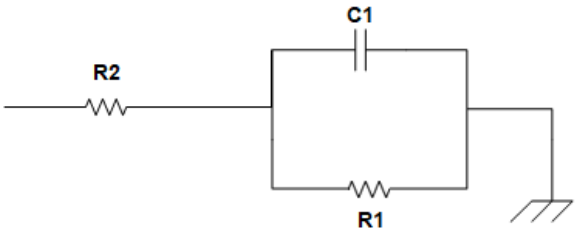

Figure 4: Electrical modeling of human acupuncture point

Location of acupuncture point of heart (HT9), Lung (LU11), small intestine (SI1) and large intestine (LI1) on hand, bottom of the figures show the real time results in the form of frequency. The value which is more than 60Hz shows the surface of acupuncture point on human skin as discuss earlier, the resistance of acupuncture point is round about 20 to 50% less than normal skin. Other values shown in graph are at the places of normal skin surface which are less than 60 Hz. Frequency is high due to low resistance at acupuncture point. The frequency at normal surface of skin is low due to high resistance; alternatively, due to high resistance less voltage are produced. Another factor which increases the frequency of acupuncture skin is the temperature, it is mention that the temperature at the skin of acupuncture point is high (0.5 Celsius) than normal skin surface.

We succeeded to obtain the results in form of a graph while slowly moving point locating probe along the surface of acupuncture point. The value more than 60 Hz in the graph depicts the surface of heart (HT9) acupuncture point, which was pointed for finding the fixed position. The values in graph more than one point just because localizing the point, locator probe is moving around specific acupuncture point. Result is given in figure 5 for heart acupuncture point (HT9).

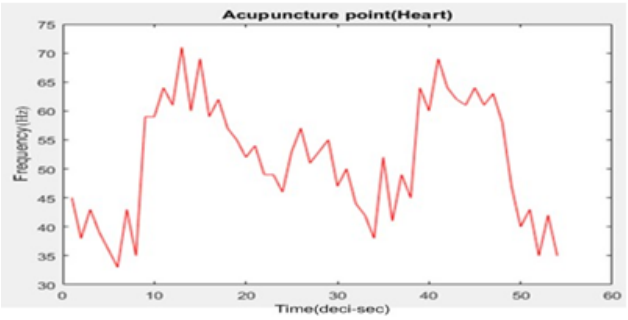

Figure 5: Acupuncture point detection (Heart)

As heart acupuncture point when we put point locating probe near the surface of lung (LU11) and move the locating probe near the acupuncture point for localizing then we get the results shown in the graph. The value more than 65Hz in the graph shows the surface of lung (LU11) acupuncture point in figure 6. The increment of 5Hz shows that it is more active acupoint as compare to HT9 or skin point of this sensor is much softy as discussed in introduction.

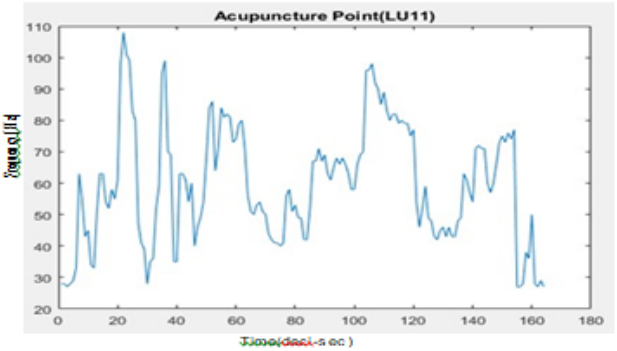

Figure 6: Acupuncture point detection (Lung)

After locating the acupuncture point of heart and lung, when we put point locating probe near the surface of large intestine (LI1) and small intestine (SI1) acupuncture point as we move in heart and lung organ for localizing acupuncture points. Then we also get some result shows in figure 7 and figure 8.

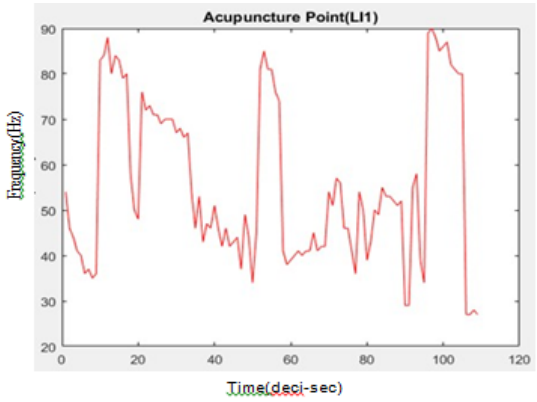

Figure 7: Acupuncture point detection (Large intestine)

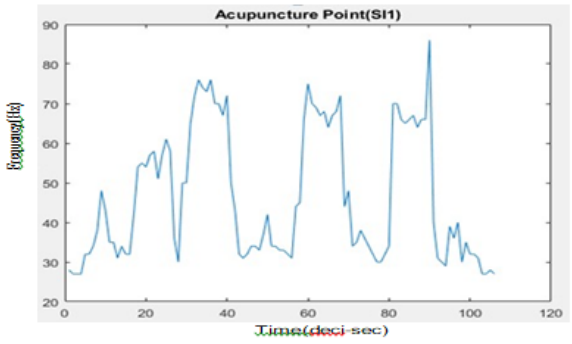

Figure 8: Acupuncture point detection (small intestine)

The second mode of this device is electrical therapy; the obtained results are given below for electrical stimulus. Figure 9 and 10 shows the results of intermittent and continuous signal. These signals are generated by microcontroller. Then after, a circuit is designed which work to increase the voltage for therapy up to 8 to 12 volts. Figure 9 show the result of intermittent signal and figure 10 show the result of continuous signal.

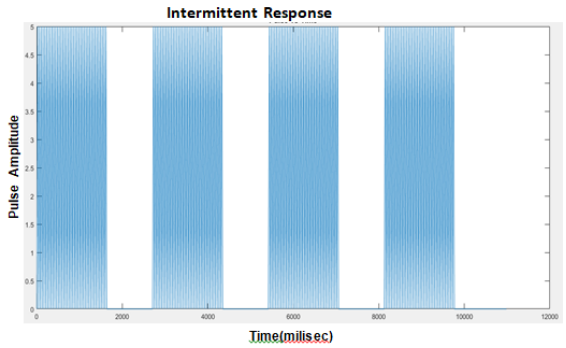

Figure 9: Intermittent signal for Therapy

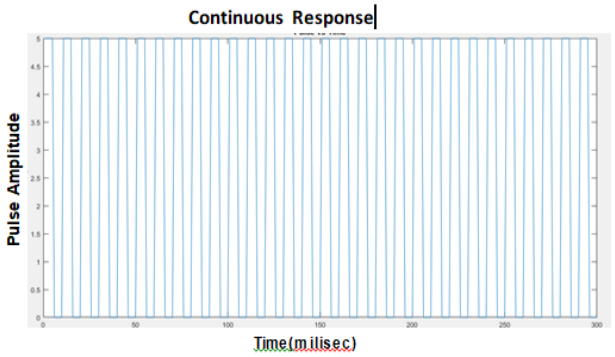

Figure 10: Continuous signal for Therapy

Bottom figure shows us the result of continuous pulse signal, displays the frequency and voltage at specific point that was applied to human body as a therapy. But we cannot get voltage and frequency of intermittent response on software for some reasons because voltage and frequency of intermittent is not constant as in continuous response. Simulations have been performed on Proteus software shown in figure 11.

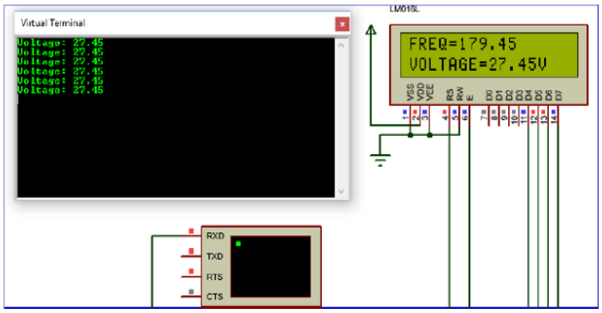

Figure 11: Continuous signal result on specific software

Discussion

The analysis of this work shows the efficacy of modern day treatment in bio-medical sciences. This work focused on the use of an acupuncture point surface for therapy. The value which shows the surface of acupuncture point on human skin resistance is about 20% to 50% less than normal skin. Acupuncture point skin can easily be traced by measuring the skin resistance of whole body. It was being reported in literature that human can tolerate 0 to 100 V with minimal current. But for safety purpose, this device operates in the range of 8 to 12 volt with minimal current.

Conclusion

Device is designed for biomedical purpose and it performs two operations. During the first operation, it successfully locates the position of acupuncture points, and it stimulates by applying electrical signal to acupuncture point to normalize the function of the specific organ. Each organ of human is linked with specific points; these points are acupuncture points and resistance of acupuncture points are less than normal skin resistance. After locating the points, a specific type of electrical stimulus is necessary for therapy that balances the meridian energy and removes blockage of chi energy flow (Vital energy). Locating of acupuncture point and applying the stimulus is performed by a microcontroller. The proposed device is highly compatible for the persons except pregnant women and children. As electrical stimulation is applied on human body so for this purpose a well-trained acupuncturist is required for handling the usage of this device to perform therapy. This device is user friendly and easy to use as compare to traditional acupuncture techniques.

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