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PC BASED UNIVERSAL ELECTROTHERAPY STATION

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Abstract

Electrotherapy is a method of treatment of patients by electrical means. This means that electrical forces are applied to the body bringing about physiological changes for therapeutic purposes. The concept of electrotherapy as therapeutic agent is not a recent innovation. The use of electricity for therapeutic purposes has grown in recent years and now includes a wide variety of apparatus, leading one perhaps to the false impression that the concept is novel. Electrotherapy employing low volt low frequency impulse currents has become an accepted practice by the physiologists. The biological reactions produced by low volt currents have resulted in the adoption of this therapy in the management of many diseases affecting muscles and nerves. The technique is used for treatment of paralysis with totally of partially degenerated muscles, for treatment of pain, muscular spasm and peripheral circulatory disturbances and several other applications.

Keywords: Electrotherapy, Universal Electrotherapy Station, Frequency, Microcontroller.

1. Objective

The aim of this project is to design and develop an indigenous, low cost Microcontroller based Micro-Ampere electrical stimulation system incorporating three therapeutic techniques namely IFC , TENS , GS.

1.1 Techniques

The techniques include use of probes and standard electrodes.

- Probes with moistened cotton swabs are held by the clinician on both sides of area so that current flows thru or along the painful region.

- Standard (TENS – type) electrodes with appropriate conductive gel are placed astride the target tissue.
- Techniques involving the use of “roller “cylinders are recommended when larger muscle groups are the targets.
- Stretching shorter muscle groups or compression of extended groups may be accomplished by recommended manual techniques with the electrodes.
- Targeting of motor points, acupuncture points and intratendinous structures determines the planned effects of stimulation, analgesia or relaxation.
- Electro massage techniques require the clinicians to place electrodes on their body as well as on the patients body. This is usually done by placing one electrode on the dorsum of the therapist and the other electrode on the patient away from the targeted massage area.

Parameters must be selected for individual patient. Treatment goals must be determined for proper parameter settings. These will include

- Time
- Wave Slope
- Intensity Levels
- Frequency
- Polarity

2. Universal Electrotherapy Station.

Design

2.1 functional block diagram

The Universal Electrotherapy Station has been designed with the latest microcontroller which is the latest invention in the electronics field. Microcontrollers are also called as single chip micro computers. They are designed in the single chip which typically includes microprocessor, Flash memory of 128 KB and several single lines to connect I/Os. They are primarily for functions such as controlling appliances. The functional block diagram of the Universal Electrotherapy Station has shown in the figure 1 . The equipment consists of microcontroller, which performs the functions of the CPU, menu structure. The output of Microcontroller has been given to the DAC, to convert the

output signal to analog signal. The flow chart is shown in figure 2 and figure 3 shows the entire circuit diagram in detail.

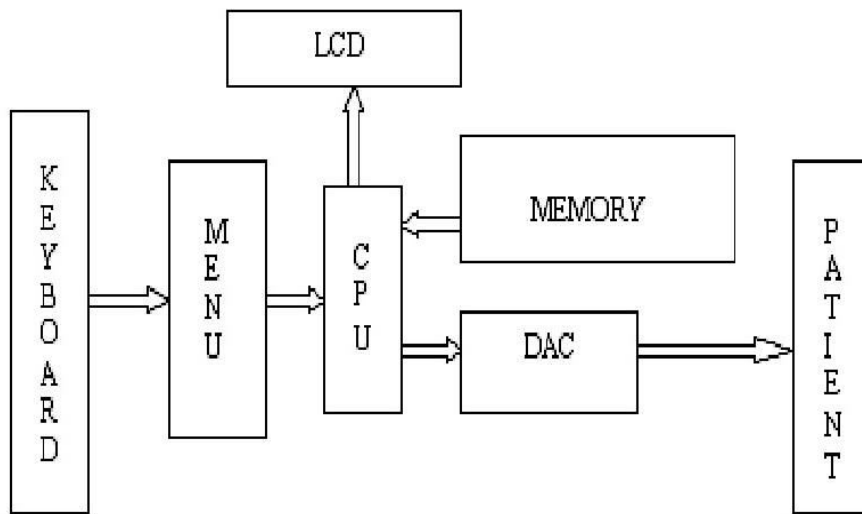


Fig.1: Block Diagram.

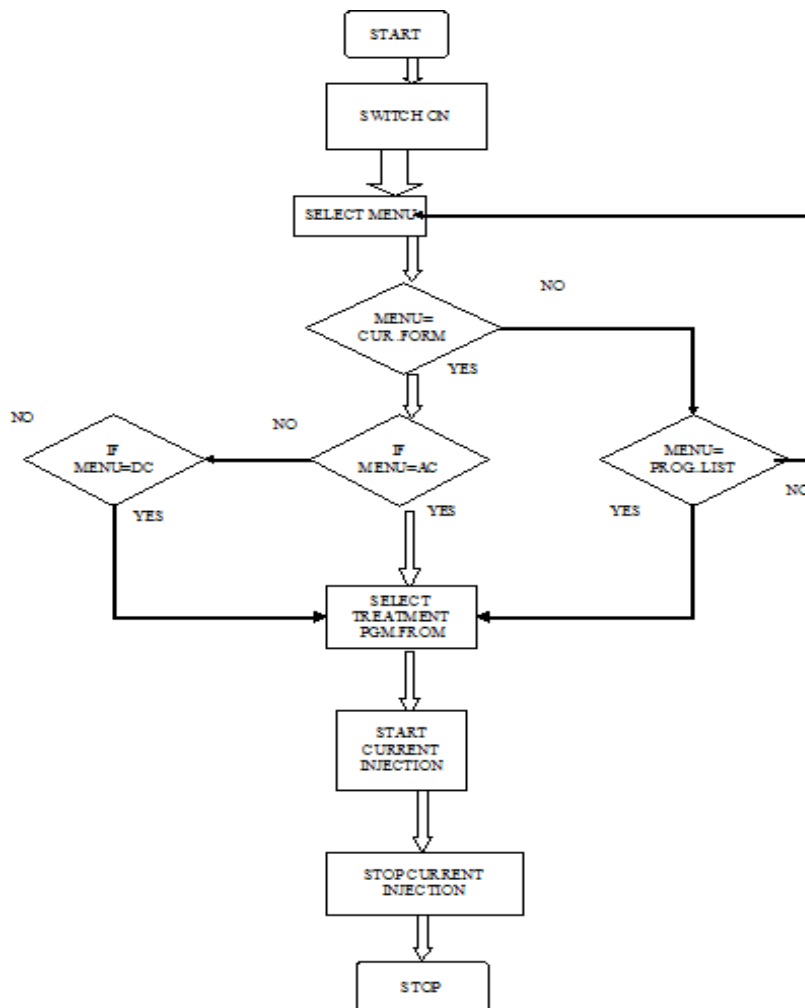


Fig.2: Flow Chart.

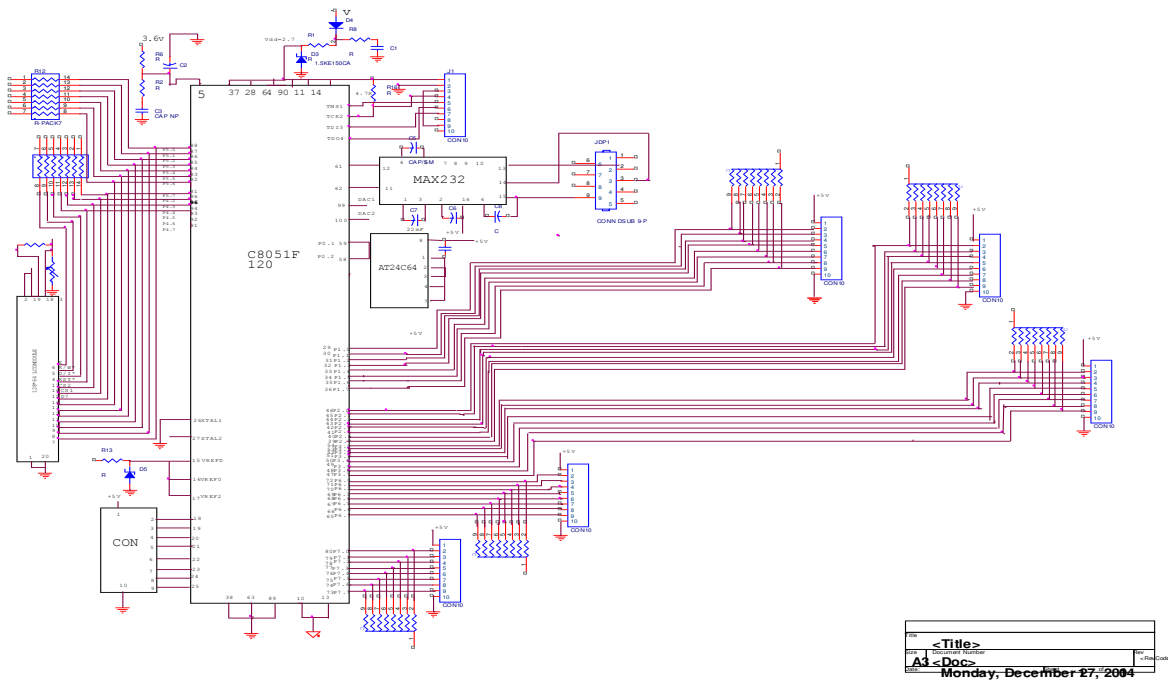


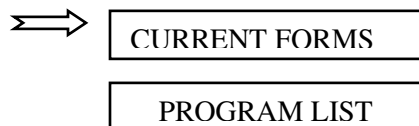
Fig.3: Main Circuit Diagram

2.2 Software

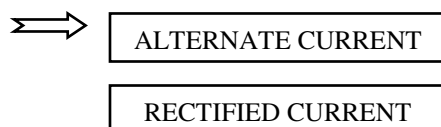
The software program has been developed to suit the requirement of electrotherapy waveforms. The program has been written in assembly language .The software is embedded in the microcontroller through a microcontroller programming kit.

2.3 Testing Procedure

The input power supply is given to the Kit . The LCD will show at the beginning “UNIVERSAL ELECTRO THERAPY STATION”. When the menu key is pressed the display will show the following menu to choose, which the first level menu is. The cursor will rest on “CURRENT FORMS “by default



To increment and decrement the menus, use “UP” and “DOWN” keys respectively. Locate the cursor in the “CURRENT FORMS“ AND PRESS “SEL” KEY. The second level menu will be displayed as shown below . To select the current forms use the “UP “and “DOWN” key and press “SEL” key.



After the selection of the current forms, the display will show the third menu as shown below.”SEL” the type of program like technical details like frequency, current etc. and then press “ST/SP”key. As soon as the “ST/SP” key has been pressed, the current, frequency for the selected program will be the output at the electrodes.



Selecting “RECTIFIED CURRENT “ in the menu following will be displayed.Select the program by pressing “INC/DEC” key and the press “ ST/SP” key.In the first menu “PROGRAM LIST “ has been selected which will list all the programs .In this type of menu , the person can select the required treatment as per the procedure explained above. The menu of the “ PROGRAM LIST ” has been listed.

3. Programs and Parameters

3.1 Medium Frequency Alternating Currents

Whereas direct and rectified currents are particularly active near the surface and at the same time put a great strain on the skin due to the special characteristics of rectified current, the medium frequency alternating currents have greater depth efficiency and put considerably less strain on the skin. The high frequency of the current 4000 Hz means that the skin is less resistant and the deeper tissues can be stimulated more easily. Moreover, the medium, frequency current is an alternating current with no positive or negative pole and the same chemical processes occur under all the electrodes.

A nerve fibre can only react several times within a second. If through an electrically induced stimulation, such a nerve fibre is stimulated more often say 800 times per second, a sort of “Weariness” will soon manifest itself. The refractory period will get longer and not every pulse will be able to cause a discharge. This type of weariness of

the nerve fibre does not occur at frequencies less than 250 Hz. Therefore stimulation current under 250 Hz can be met by a synchron pulse discharge for hours an end. Now in order to be able to take advantage of the in-depth effect of the medium frequency current and yet at the same time produce effective nerve stimulation at a frequency which the body can tolerate, use is made of a two – channel approach. This technique consists of applying two current circuits which cross in the body. With classic interferential current Channel – 1 for instance would have a frequency of 4000 Hz, whereas current channel – 2 would have frequency of 4100 Hz. In the area of the body where CH -1 and CH-2 cross a frequency modulation of 100 Hz is achieved. In this way a good in-depth effect is combined with appreciable nerve stimulation.

Within this interferential therapy several refinements have been developed. On your appliance you will find three four pole programs. Each of these programs represents an advance in a specific field of classic interference therapy. Below you will find a description of each of the application possibilities of the vector techniques for each vector field. With the two poles interference technique the interference of the two current takes place within the instruments. One then applies amplitude modulated current to the body. The two-pole technique has similar characteristics to the four-pole technique but gives a smaller treatment area, and produces an increased surface stimulation thus putting a greater strain on the skin. The two pole technique will never offer you the possibility of achieving effects which can be obtained with the vector programs.

3.2 Low Frequency Current

All rectified current forms have rectified amplitudes, which means its effects are dependent on polarity; namely, there is a positive and negative pole. You must therefore ensure before each treatment, that you have chosen the correct place to apply the electrodes as well as the correct polarity. The wrong polarity could produce a diminished result or even a negative reaction to the treatment.

Thus it is that continuous galvanic currents will diminish the threshold of stimulation of the nerve tissue through the negative pole, whereas the positive pole will enhance this threshold. If you wish to stimulate the muscle tissue, then the negative pole is the active electrode. To relieve the pain the effective electrode is the positive one. To increase circulation, the negative pole is the most effective. With diadynamic currents and with Ultra Reiz it has been demonstrated that the best results can be obtained with the negative pole. In these cases the positive pole can be referred to as the indifferent electrode as with this electrode the effects are considerably less severe. Owing to the

galvanic effects and the possibility of etching you should ensure that when using direct on rectified currents a layer of material is used between the electrode and the tissue which is thick enough and moist enough to avoid this problem.

3.3 Rectified Currents

The rectified currents characterize themselves by the etching effects which can occur. This needs to be carefully considered during the treatment. The therapist needs to be present with the patient at all times. Preceding the treatment the information with regard to medicine use and sensitivity of the patient need to be checked thoroughly. This has to be checked because a diminished or disturbed sensitivity under the influence of medicines and/or disorders can lead to a wrong interpretation of the current intensity by the patient. In order to minimize the etching effect of the rectified currents you have to apply an optimal combination of time (as little as possible), intensity (as low as possible).

3.4 Galvanic Continuous Current

This direct current is applied in partial or total submersion baths, but can also be applied direct to the skin through electrodes using viscous substance in between the two. The important use of this form of current is the iontophoresis application where galvanic current is used to introduce charged ionized particles through the skin into the body. One disadvantage of this type of current however, is the etching that occurs under the electrodes.

3.5 Interrupted Galvanic Current, Rectangular Pulse

This current can be used diagnostically and therapeutically in the case of damage to the peripheral nerves. In a diagnosis for example, you can determine if a nerve can be stimulated directly and what is the rheobase and chronaxie value of the muscle with the aid of an I/t curve. As therapy you can stimulate totally denervated muscles in order to prevent atrophy and to preserve contractility. The current has also been used in certain cases for pain relief and circulation stimulation.

3.6 Interrupted Galvanic Current, Triangular Pulse

Interrupted galvanic triangular pulse current can be used both diagnostically and therapeutically, particularly in the case of excitability disorders. Diagnostically you use this type of current for the I/t curve. By using the 300 ms value you can determine the accommodation quotient; this will give you an indication as to the condition of the muscle or

the nerve. Also from the shape of the curve you can determine whether you are dealing with a complete or only a partial denervation.

Therapeutically the triangular pulse is used to obtain a contraction of the denervated muscle tissue, without causing the healthy musculature surrounding the affected muscle to contract. The gradually increasing pulse type means that the healthy muscles can accommodate to the stimulation. Smooth muscle tissue can also be stimulated with the triangular pulse which means that it can also be used in the case of bladder or intestinal function disorders. In the case of bladder function disorders you use pulse width of 250 ms, and off time – 1 sec, with intestinal function disorders a pulse width of 150 ms, and off time 2 sec.

3.7 Ultra Reiz Current

Rectangular type current with 2 ms pulse width and a 5 ms off time. These parameters cannot be adjusted. The Ultra Reiz current has a powerful pain relief effect which is experienced by the patient especially during the first few hours after treatment. This effect, called the Ersteffect becomes more prolonged after repeated treatments, as long as the patient is treated daily and on a regular basis. The beneficial effects of this current on the circulation are partially due to the variable contractions, but also due to a reduction in the activity of the orthosympaticus. The influence on the vegetative nervous system can be increased by preceding a local treatment with a vertebral one.

According to Ultra Reiz the treatment time per electrode application is always 15 mins and the dosage is up to tolerance level. If patient adaptation occurs, the output current should be increased.

3.8 Faradic Current

The faradic current consists of a continuous or surged. The surged duration and OFF time can be variable. The use of the faradic current is indicated in cases where a patient needs to be rehabilitated after a general or partial denervation, or where a patient is suffering from an incapacity to move without there being a clear organic cause. This incapacity to make random contractions with specific muscles can occur after an operation or a trauma.

3.9 Diadynamic Current

MF - Single phase sinusoidal current with a base frequency of 50 Hz. This type of current is experienced as a strong vibration, easily capable of inducing contractions. DF-Double phase sinusoidal current with a basic frequency of 100 Hz. The patient experiences this as a light vibration which is usually considered more agreeable than the other dynamic currents. DF is therefore very often used as an introductory current.

CP-Sinusoidal current, alternating between single phase MF and double phase DF. The rhythm is 1 sec at 50 Hz and 1 sec at 100 Hz, the transition being abrupt. CP is the most aggressive of the diadynamic currents and it is, therefore well suited for patients who are difficult to stimulate. Resorption is good. For this reason CP is one of the most appropriate currents for treatment of Oedema. LP-Rectified sinusoidal current, alternating between single and double phase. The rhythm is 6s at 50 Hz and 6s at 100 Hz with a gradual change over from one to other. The frequency is at 50 Hz. LP is less aggressive than CP and is often used for neuralgias but also to treat patient who cannot tolerate CP.

3.10 Russian Stimulation

The optimum carrier wave frequency for muscle stimulation is 2500 Hz. Contractions, caused by a frequency of 2500 Hz are more powerful than those caused by frequency of 4000 Hz. Therefore Russian stimulation is often used for muscle stimulation. Russian stimulation is well suited for a number of applications. For example rehabilitation can be obtained by means of this currents with patients whose mobility is affected. It is also possible to keep the muscle condition at an optimum during a period of immobilization so as to prevent atrophy. This can be done without the harmful effects of a faradic surge current. Russian stimulation can also be used to strengthen either healthy or afflicted musculature.

A powerful contraction is allowed to take place during stimulation, but make sure the stimulation doesn't become painful. We advice you to use a mild dose in the case of a muscle lesion.

3.11 Tens Currents

TENS (Transcutaneous Electrical Nerve Stimulation) is a form of low frequency electrotherapy. This biphasic current was originally employed to evaluate the suitability of patients for a surgically implanted nerve stimulator. Fortunately it was soon discovered that in most cases pain could also be reduced by superficial treatment thus rendering surgery unnecessary. Many people now treat their pain using portable TENS units instead of medicine. TENS is frequently used because of its broad range of adjustments, its patient – friendly character and the wide variety of conditions for which it is indicated.

3.12 Tens Continuous

This is the most commonly used TENS current and with it you can selectivity achieve the effects. If you want to stimulate the thick fibres then select a pulse duration of less than 70 Micro sec. and a pulse frequency of at least 50 Hz, this form of TENS is also called 'Conventional TENS'. If however your aim is the promotion of endorphin

production then you should use a low pulse frequency settings, 1 to 5 Hz, and a pulse duration of atleast 100 Micro sec, this is often called 'low frequency TENS', 'Brief intense TENS' combines a rather longer pulse time (150-250 Micro sec.) with a high constant frequency (60-100Hz) and high pulse intensity (Highest dose tolerable).

3.13 Tens Burst

This form of TENS has specifically been developed to treat chronic pain; for many patients with chronic pain it appeared to be quite painful to generate muscle contractions with the aid of continuous TENS. In general, the internal frequency is high with bursts of TENS, but the current is delivered as trains of pulses in which both the duration and frequency of each individual pulse can be separately adjusted. In addition you can regulate the number of trains produced per second.

4. Preprograms

1. TENSION HEADACHE, 4 - POLE APPLICATION

Base - 100 Hz
Treatment Time - 12 minutes

Two electrodes are applied on the most lateral part of the left and right trapezius muscle and two other electrodes are applied on the most cranial part of the same muscle, or a little to the side of it. Ensure when applying these electrodes that the CH - 1 and CH - 2 are applied cross - wire opposite each other. The motor stimulation threshold must be exceeded.

2. TENSION HEADACHE, 2 - POLE APPLICATION

2 poles modulated
Freq - 2 KHz
Base - 10 Hz
Treatment Time - 15 minutes

Apply two small electrodes on the most cranial part of the trapezius muscle. This is the place where the occipitalis comes to the surface through the muscle. By stimulating the A- fibers selectively, which can be done with this type of current, the patients pain can be alleviated. Contractions may take place to improve blood flow, but they should not cause any pain.

3. ARTHRITIC SHOULDER, 4 - POLE APPLICATION

Base	- 100 Hz
Sweep	- 50 Hz (Trapezoidal)
Treatment Time	- 12 minutes

Apply two electrodes of current CH - 1 ventral and dorsal on the shoulder. One of the two other electrodes is applied laterally on the upper arm and the other on the shoulder in the middle of the acromion. Contractions may take place, but the treatment should not be painful. Look for the best electrode placing by means of option rotation the electrode and let the current flow.

4. ARTHRITIC SHOULDER, 2 - POLE APPLICATION.

Base	- 100 Hz
Sweep	- 50 Hz (Rectangular)
Treatment Time	- 12 minutes

Apply one electrode on the most painful area, apply the other if possible in such a way that the current passes through the whole joint. By using medium frequency current the deeper tissues can be reached.

5. FROZEN SHOULDER, 4 – POLE APPLICATION

Step 1	- V-90
Base	- 100 Hz
Treatment Time	- 2 minutes
Step 2	- V-45
Base	- 100 Hz
Treatment Time	- 10 minutes

Apply two electrodes from CH – 1, ventral and dorsal on the shoulder; one of the two other electrodes is applied laterally on the upper arm and the other on the shoulder in the middle of the acromion. Contractions may take place, though the treatment should not be painful. The vector – 45 fields has been chosen here because its detonising and circulation stimulation effect is considerable. The patient experiences this particular current as pleasant and will, therefore, be more willing to submit to the treatment and the contractions.

6. OEDEMA, V-90 4 – POLE APPLICATION

Base	-	50 Hz
Sweep	-	50 Hz (Rectangular)
Treatment Time	-	10 minutes

Apply the electrodes around or on the oedema. Increase the intensity until the patient feels a powerful vibration. It is preferable to treat daily. By making use of the vector – 90 field a 100% modulation depth is achieved over the whole area, which results in a maximum stimulation of that area.

7. LUMBAGO, 4 – POLE APPLICATION

Step – 1

Vector	-	90
Base	-	150 Hz
Treatment Time	-	2 minutes

Step – 2

Vector	-	45
Base	-	143 Hz
Treatment Time	-	12 minutes

Apply the electrodes beside the vertebrae in such a way that the currents cross each other. The treatment should not cause any pain. Contractions of the back muscles may take place rhythmically. The automatically rotating vector field has a considerable detonising effect and also stimulates the circulations. The current can be easily endured by the patient and the sensation is often compared to massage.

8. TORN MUSCLE, 4 – POLE APPLICATION

Vector	-	45
Base	-	100 Hz
Treatment Time	-	12 minutes

The electrodes are applied cross-wire so that the lesion lies in between the electrodes. A light, rhythmic contraction is permitted, though in the acute stage especially, care should be exercised.

9. TORN MUSCLE, 2 – POLE APPLICATION

Base	-	100 Hz
Sweep	-	50 Hz (Rectangular)
Treatment Time	-	7 minutes

Apply the electrodes on the muscle wall across the line of the tissue. A light rhythmic contraction is permitted, though in the acute stage especially, care should be exercised. By making use of the two-pole premodulated current, the afferent and efferent nerve tissues of the muscle are stimulated.

10. ATONIC BLADDER, 4 – POLE APPLICATION

Base	-	1 Hz
Sweep	-	99 Hz (Trapezoidal)
Treatment Time	-	10 minutes

Apply two electrodes about 100 sq.cm. on the buttock just lateral to the S1 joint. The two other electrodes (50 sq.cm.) are fixed on either side just above the symphysis. This 2 current circuit should cross each other in the body. Increase the intensity to just above level of sensitivity.

11. MYALGIA, 4 POLE APPLICATIONS

Vector	-	45
Base	-	100 Hz
Treatment Time	-	8 minutes

Apply the electrodes in such a way that the whole muscle group, and possibly the antagonists among the smaller up muscle groups lie in between the electrodes. Connect the current cross-wire. Adjust the dosage so that as a minimum there is a visible contraction and as a maximum, to tolerance level. The best result is achieved when the patient feels a definite contraction while still experiencing the current as a pleasant sensation.

12. MYALGIA, 2 POLE APPLICATION

Two-pole premodulated		
Base	-	100 Hz
Treatment Time	-	10 minutes

Two electrodes are placed on the muscle wall. Adjust the dosage so that as a minimum there is a visible contraction and as a maximum, to tolerance level. The best result is achieved when the patient feels a definite contraction while still experiencing the current as a pleasant sensation.

13. HIP OSTEOARTHRITIS, 4 POLE APPLICATIONS

Vector	- 90
Base	- 50 Hz
Sweep	- 50 Hz (Triangular)
Treatment Time	- 15 minutes

Apply one electrode from CH – 1 ventral on the upper leg; place the other on the buttock. Of current CH – 2, you place one electrode dorsal of the trochanter major and the other in the groin. Increase the dosage to tolerance level. Contractions may take place. By treating with the 4 pole vector 90 there is a modulation depth of 100% everywhere between the electrodes so that the whole area is stimulated effectively.

14. EPICONDYLITIS 4 – POLE APPLICATION

Vector	- 45
Base	- 80 Hz
Sweep	- 40Hz (Trapezoidal)
Treatment Time	- 10 minutes

Apply one electrode close to the lateral epicondylus and the other electrode on the processus styloideus radii. The electrodes of CH – 2 are placed on the medial epicondylus and the caput ulnae. Determine the correct locality and let the current have its effect at that place.

15. EPICONDYLITIS 2 – POLE APPLICATION

Base	- 80 Hz
Sweep	- 40 Hz (Trapezoidal)
Treatment Time	- 10 minutes

Place one electrode on the epicondylus lateralis / medialis humerus and the other electrode on the length of the muscle. By this positioning of the electrodes the whole extend and the flex musculatures in stimulated. If you find this unsuitable for a certain patient, you can place a second electrode beside the epicondylus.

16. WEAK ABDOMINAL MUSCULATURE, 4 – POLE APPLICATION

Vector	-	45
Base	-	50 Hz
Treatment Time	-	15 minutes

Apply all four electrodes on the muscles of the wall of the abdomen, ensuring that the two channel electrodes placed cross-wire. Increase the intensity until a clear rhythmic contraction of the abdominal muscles is achieved. It is preferable to treat daily. By making use of a relatively low frequency the tonic activity of the abdominal muscles is enhanced.

17. CHRONIC CONSTIPATION, 4 – POLE APPLICATION

Base	-	20 Hz
Sweep	-	20 Hz (Trapezoidal)
Treatment Time	-	30 minutes

Apply two electrodes on wall of the abdomen one on the colon descendens and one on the colon ascendens. The other electrodes are placed on either side of the back, over the cristae iliacae. The length of the treatment is necessary for a good result.

18. HAEMATOMA, 4 – POLE APPLICATION

Step - 1		
Vector	-	90
Base	-	50 Hz
Sweep	-	50 Hz (Rectangular)
Treatment Time	-	5 minutes
Step - 2		
Vector	-	45
Base	-	50 Hz
Treatment Time	-	10 minutes

Apply four electrodes around the haematoma, taking care that the two current circuits cross each other. The current is increased until a definite rhythmic contraction becomes visible. This increases the speed at which blood and waste products are resorbed.

19. HAEMATOMA, 2 – POLE APPLICATION

Base	-	100 Hz
Treatment Time	-	10 minutes

Secure the electrodes on either side of the haematoma, if possible against the muscle wall of the underlying musculature. Increase the intensity gradually until a definite rhythmic contraction becomes visible. This increases the speed at which blood and waste products are resorbed.

20. HAEMARTHROSIS, 4–POLE APPLICATION

Vector	-	90
Base	-	80 Hz
Sweep	-	40 Hz (Rectangular)
Treatment Time	-	12 minutes

Apply the whole joint between the electrodes, taking care to attach channel 1 and 2 cross-wire. By making use of the vector-90 field, all the tissue is stimulated with a modulation depth of 100%.

21. HAEMARTHROSIS, 2 – POLE APPLICATION

Base	-	80 Hz
Sweep	-	40 Hz (Rectangular)
Treatment Time	-	12 minutes

Apply the electrodes on either side of the joint so that the current passes through transversely. Increase the dosage to tolerance level.

22. CELLULITIS 4 POLE APPLICATION

Vector	-	45
Base	-	50 Hz
Treatment Time	-	15 minutes

Place 4 electrodes on the area to be treated, preferably in such a way that the big underlying muscles are stimulated. The dosage should be sufficiently high to produce clear, rhythmical contractions. As treatment proceeds the intensity can be increased further.

23. RHEUMATOID ARTHRITIS, 4 – POLE APPLICATION

Vector	- 90
Base	- 100 Hz
Sweep	- 50 Hz (Trapezoidal)
Treatment Time	- 10 minutes

For the purposes of this treatment the electrodes should be widely spaced around the joint thus ensuring that the largest possible area is stimulated. Use of the vector 90 ensures that the entire area enclosed by electrodes is treated with an interference current and 100% depth of modulation. The intensity is increased until the patient feels a powerful vibration but certainly not far enough to cause pain.

24. SHORTENED MUSCLES 2 POLE APPLICATION

Base	- 100 Hz
Treatment Time	- 6 minutes

Place two electrodes proximally and distally to the belly shortened muscle. Ensuring that the muscle remains quiescent bring it almost to the point of contraction. Next increase the intensity until a clear contraction is produced and then ask the patient to stretch the muscle by tensioning antagonists. You assist this movement by manual intervention. With each subsequent series of pulses you maintain your attempts to extend the muscle a little further. If the sensation of stretching starts to overpower the sensation caused by the current then you should further increase the intensity.

25. SHOULDER – ARM SYNDROME – 4 POLE APPLICATION

Base	- 1 Hz
Sweep	- 99 Hz (Triangular)
Treatment Time	- 15 minutes

Apply the electrode from CH – 1 ventral and dorsal on the shoulder, one of the two other electrodes is applied laterally on the upper arm and the other on the shoulder in the middle of the acromion.

26. SHOULDER – ARM SYNDROME – 2 POLE APPLICATION

- Base - 80 Hz
- Sweep - 20 Hz (Trapezoidal)
- Treatment Time - 15 minutes

Electrode placement same as in previous program.

27. OSTEOARTHRITIS OF THE KNEE JOINT – 4 POLE

Step - 1

- Base - 100 Hz
- Treatment Time - 7 minutes

Step – 2

- Base - 80 Hz
- Sweep - 20 Hz (Rectangular)
- Treatment Time - 8 minutes

Apply the four electrode around the problem knee and ensure that the CH – 1 and CH – 2 electrodes are crosswise.

Increase the intensity to tolerance level. Contractions may take place.

28. ACUTE CASE, 4 POLE APPLICATIONS

- Base - 1 Hz
- Sweep - 99 Hz (Triangular)
- Treatment Time - 15 minutes

Apply the four electrodes, place where to treat. Ensure the CH - 1 and CH – 2 are cross-wire. Increase the intensity to tolerance level. Contractions may take place.

29. SPRAIN – 4 POLE APPLICATIONS

- Freq - 2000 Hz
- Base - 120 Hz
- Treatment Time - 15 minutes

Apply the electrodes in the affected area cross-wire. Increase the intensity to the tolerance level. Contractions may take place. After the treatment make strapping in the area and treatment should be given three to four days.

30. BACK PAIN

Ultra reiz.

Treatment time - 15 min

Apply the electrodes in the pain area. Increase the intensity the current must give tingling , vibration sensation.

5. Results and Discussions

The testing and performance of the equipment was carried out by connecting the equipment with digital storage Oscilloscope and various current forms are given and output waveforms are measured several times and recorded .

Waveforms

For discussion, four waveforms were generated for the performance testing, they are listed below.

In alternating current,

- IFT classic

B In Rectified current,

- ULTRA – REIZ
- DIADYNAMIC – MF
- GALVANIC – TRIANGULAR

5.1 Alternating Current

IFT Classic is an alternating current form which provides alternating polarity, i.e., changes from positive to negative and vice versa, many times per second, too rapidly to offer any polar effects. When the alternating phases are smooth and equal in energy levels, they are often referred to as sine wave; this form of current is generally applied to neuromuscular components with no reaction of degeneration to provide relaxation to muscles in spasm or to exercise weak, strophic or debilitated musculature. It is a comfortable waveform, easily controlled and modified as needed with no chemical characteristics at the electrode surfaces.

5.2 Rectified Current

Ultra-Reiz, dia dynamic MF, and Galvanic triangular waveforms come under the direct or galvanic current techniques. Direct currents represent a constant electron flow from the negative electrode to the positive with no oscillations or alterations. Polarity remains constant, as predetermined by the clinician. Continuous direct current is used primarily for iontophoresis. Interrupted direct or pulsed galvanic currents are preferred modality for stimulation of neuromuscular components with RD, since the body loses the ability to respond to alternating current in the

presence of RD. We have generated these waveforms and these are compared with the standard results and are found to be in line with the requirements. The electrical parameters of the output waveforms are well within the safety limits. The various output waveforms have been checked for their consistency and found to be accurate for all times. Preliminary tests are conducted under the supervision of a physiotherapist for the actual field trials using carbon mixed rubber surface electrodes and the results are satisfactory. Different types of electrodes can be used for various sites

6. Hardware Performance

This equipment has been designed and developed for three modes of electrotherapy namely TENS, IFC and GALVANIC, these outputs are generated and are well within the physiological permitted limits, upon treatment the applied output waveform with associated current ratings are highly reproducible.

As the microcontroller is used in this equipment and this performs digital signal processing, the output waveforms are accurate and these will not vary due to continuous usage of this equipment.

7. Trial Test Results

Three trials were done on the following waveforms

1. IFT Classic
2. Dia Dynamic MF and
3. Ultra-Reiz

The results are found to be within 0.1% accuracy, any deviation could be detected and controlled through using software.

8. Conclusion

The PC based Universal Electrotherapy Station has been designed and developed using the microcontroller C8051F120. The performance and functional requirements of the microcontroller based universal electrotherapy station has been verified and tested as designed. Various program menu are selected, the outputs of the equipment are found satisfactory and are within the limits.

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