Implementation of Interferential Therapy (IFT) Using Arduino Uno

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***Abstract*— Electrotherapy is drug free, non-invasive and non-addictive physiotherapy treatment. This treatment provides minimal risk and side effects and complications which are due to adverse drug. It also offers several advantages over old or conventional medical treatments for pain. A number of electrotherapy modalities were developed to offer the safest lifelong solutions. Interferential therapy (IFT) is one of the best electrotherapy modality. Working principle of IFT is based on the significant physiological effects of low frequency (< 250 Hz) electrical stimulation of nerves. IFT utilizes medium frequency stimulation to produce the strong physiological effects of low frequency electrical stimulation, in much deeper muscle and nerve tissues. Without the associated painful and unpleasant sensation of low frequency stimulation. Interferential signal used for stimulation is concentrated at the point of intersection between the electrodes. This concentration occurs deep in the tissues Thus, with Interferential Stimulators, current perfuse to greater depths and over a larger volume of tissue than other forms of electrical therapy. Thus, Interferential current penetrate into the skin without painful and unpleasant sensation allowing greater patient comfort during electrical stimulation.**

***Keywords*— IFT, IFC, Modulated Frequency Signal, Arduino Uno.**

I. INTRODUCTION

In electrotherapy generally low frequency with sufficient intensity is used for muscle stimulation. But the main problem associated with the application of low frequency current to patients is the very high skin impedance, because skin impedance $Z=1/2\prod FC$, here F is frequency. Using high frequency current will reduce the impedance and hence reduce the discomfort that is used by low frequency currents. Interferential current (IFC) uses medium frequency signal to reduce skin impedance and discomfort and produces low frequency stimulation effects in deeper tissues of the body..

II. WORKING PRINCIPLE

To create the interferential current signal, two carrier signal swith different frequencies are used for the interference. For example f1=4000Hz and f2=4100Hz. These two signals produce an interferentia lcurrent signal with amplitude modulated frequency of f=f2-f1as shown in fig 1. This is called Beat frequency. The interference takes place inside the body.Therefore carrier waves achieve greater depth of penetration ,due to their high frequencies that shortcircuit the skin capacitance, and produce interferential current while the resulting beat frequency signal causes the desired therapy [1].

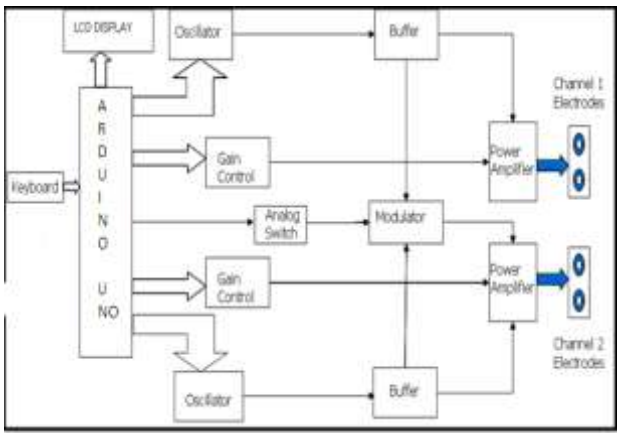

Fig.1 Block diagram of proposed work

Arduino Uno based IFT is as shown in fig. 3. With the help of 4 X 4 keyboard matrix different modes of operations of IFT is selected. This IFT is operated in two modes of operations

A. IFT using two electrodes (one channel)

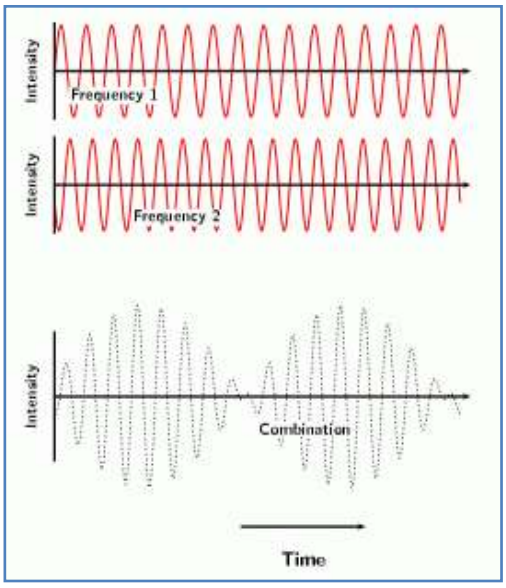

Fig.2. Amplitude modulated signal generated externally [5]

In this mode of operation Oscillator of channel1 generates 4KHz or 2KHz frequency signal. The selection of frequency is also done by Arduino Uno controller. Oscillator of channel2 generates either (4KHz + Beat frequency) or (2KHz + Beat frequency) depending on frequency selection. Beat frequency is also selected by Arduino Uno controller. Outputs of both

oscillators are fed to modulators. Modulator adds these two frequency signals with slightly out of phase (synchronization). Due to this modulator gives amplitude modulated wave with frequency equal to beat frequency. This AMF (amplitude modulated frequency) signal is amplified by output power amplifier. The gain of output power amplifier is also selected by controller with the help of gain control. output of power amplifier drives electrodes of channel 2. When these two electrodes are applied across affected painful area then medium frequency waves achieve greater depth of penetration, while the resulting beat frequency signal causes the desired therapy.

B. IFT using 4 electrodes (two channels).

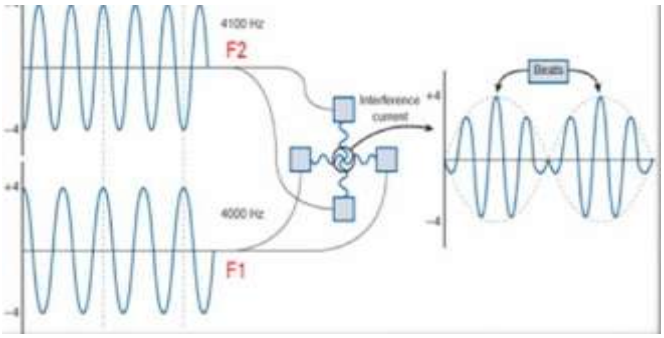

Fig.3.Interference Effect When Electrodes are arranged cross diagonally [3]

In this mode of operation Oscillator of channel-1 generates 4KHz or 2KHz frequency signal. The selection of frequency is also done by Arduino Uno controller. Oscillator of channel-2 generates either (4KHz + Beat frequency) or (2KHz + Beat frequency) depending on frequency selection. Output of both oscillators are fed to corresponding buffers and then to respective power amplifiers. Gain of power amplifier is controlled by Arduino Uno controller. Thus amplified frequency signals 4KHz or 2KHz & (4KHz + Beat frequency) or (2KHz + Beat frequency) will appear across channel - 1 electrodes & channel - 2 electrodes respectively. When four electrodes are applied to the body, the optimum interference effect occurs when they are arranged cross diagonally. Maximum nerve excitation occurs endogenously in the region of the tissue where the currents from the two circuits cross. Around the geometric center between the four electrodes, the total current is the sum of from each pair of electrodes. Interferential Therapy delivers a continuous stimulation deep into the affected tissue

III. RESULTS

I) When we select mode 1 of operation i.e. IFT using two electrodes (one channel) then two frequency signals with frequencies F1(4000Hz) and F2(4000Hz+ beat frequency) are generated by oscillators. By using modulator amplitude modulated frequency signal is generated. This amplitude modulated wave is further amplified by output power amplifier. The resulting modulated signal causes the desired therapy

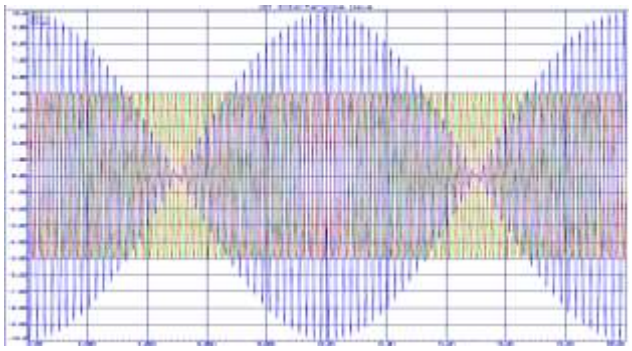

Fig.4 one channel Generation of AM interference wave

II) When we select mode 2 of operation i.e. IFT using four electrodes (two channel) then two frequency signals f1(4000Hz) and f2(4000Hz+beat frequency) are further transferred through unity gain buffer amplifiers to power amplifiers. Power amplifier amplifies these two signals. These amplified signals are applied to electrodes. These four electrodes are further applied to affected area of patient cross diagonally. According to the body resistance of patient applied frequency signal penetrate the body and stimulate muscles, due this patient get the desired therapy.

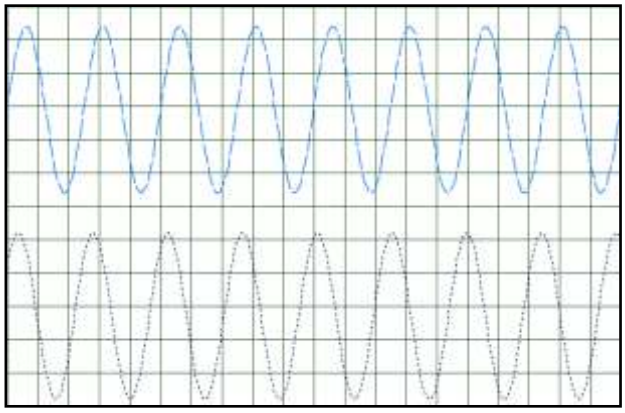

Fig. 5 IFT using 4 Electrodes (Two Channels)

IV. APPLICATIONS OF PRAPOSED WORK

a. **Pain relief** - Electrical stimulation for pain reliefhas widespread clinical use. IFT uses 90-130Hzfrequencies to stimulate the pain gate mechanism& thereby mask the pain symptoms.
b. **Increase local blood flow** - IFT causes muscle contraction which brings about a local metabolic and thus vascular change.
c. **Reduction of Oedema**- IFT has been claimed to be effective as a treatment to promote the reabsorption of oedema in the tissues.
d. **Other clinical applications** - IFT is almost used to treat almost any conditions where inflammation isa problem. Ex.-sports injuries, arthritic conditions, bruising and swellings, back pain, osteo arthritis, muscular pain etc.

V. CONCLUSION

Thus it is believed that IFT permeates the tissues more effectively and, with less unwanted stimulation of cutaneous nerves, is more comfortable than transcutaneous electrical stimulation (TENS). Interferential stimulation has been investigated as a technique to reduce pain, improve range of motion (ROM), or promote local healing following various tissue injuries. There are no standardized protocols for the use of interferential therapy; the therapy may vary according to the frequency of stimulation, the pulse duration, treatment time, and electrode-placement technique.

The clinical application of IFT therapy is based on response threshold and the physiological behavior of stimulated tissues. Since IFT acts primarily on the excitable tissues like nerves and muscles, the strongest effects are likely to be those produced by such stimulation, i.e. pain relief and muscle contraction. The other effects like drainage of fluid and reduction in muscle spasm are secondary consequences of the primary effects..

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