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# DESIGN OF BIO-POTENTIAL DATA ACQUISITION SYSTEM FOR THE PHYSICALLY CHALLENGED

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**ABSTRACT**

The discovery of bio potentials in human body, influenced to invent numerous Bio Medical equipments. Many such equipments where modeled and implemented for treatment & curing various malfunctions of the organs. One such bio medical equipment is Functional Electric Muscle Stimulator (FES). This FES is mostly used for persons who are affected by stroke and spinal cord injury. Medical Personnel and Bio-medical Engineers around the world developed various Stimulators, where the stimulating currents are Faradic or surge or Galvanic types. Continuous Exposure of these types of current causes skin burns, increases static field etc. To overcome these disadvantages, the FES here produces a Biphasic Stimulating current which cures the defect at cell level itself. LabVIEW incorporated in FES to generate Biphasic electric current and stimulate the paralyzed muscles. The LabVIEW software is programmed for various operating frequencies ranging from 20 Hz to 100 Hz and also for various pulse width ranges 100 µS to 500 µS. A Pair of Carbonized EMG electrode is used to give transcutaneous electric current and stimulate the paralyzed Muscles. While another set of EMG Electrodes are used to pick up the EMG signals, at a time interval of 5 minutes after stimulation, which are in the frequency range of 20 Hz. The EMG signal produced from the Muscles is actually the potentional difference between the recording Electrodes. Many Manufacturers develop their own recording software. Here Bio –Feedback signal (EMG) is recorded in PC using, a standard software, LabVIEW. The Picked-up EMG signals from the muscles are fed in to one of the channels the DAQ devices. The DAQ device, DAQmx 9233, removes the artifact from the Biofeedback signal and sends it to the PC for analyzing the EMG signals with the help of LabVIEW software, to find the cure percent of paralyzed muscles.

## INTRODUCTION

Now-a-days, physicians diagnostics rely on electronic instrument for monitoring, logging and providing result. The Bio-instruments is focused on acquisition, processing and analysis of bio signals for medical purpose and real time monitoring of the patients (Holonce, *et al*., 2015; Arumugam, 1997). In biomedical engineering, the biomedical signals such as EMG, ECG, EEG are very important for real time monitoring (Raman, *et al*., 2010).

The functional electrical stimulation (FES) is a form of orthotic/therapeutic treatment that applies transcutaneous current to initiate contractions in muscles, and is commonly used for the persons who are affected by spinal-cord injuries (SCIs) or stroke (Lau, *et al*., 2007; Holonce, *et al*., 2015). This FES is used to helps to lower and upper boundary mobility and to improve respiratory function. And also help to avoid inferior complications such as spasticity and pressure ulcers. This FES is a controlled electrical stimulus is applied to motor units/nerves to educe a muscle contraction in an endeavor to restore the functional movements of a paralyzed musculoskeletal system. Many of the FES stimulators have been developed with the help of either microcontroller or microprocessor. For this, it will improve upper and lower limb functions following stroke or SCI. FES are

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commonly work with pre-programmed stimulation patterns lookup table which are already stored. A single sensor united with a control algorithm either the reading scale stimulation parameters out of a lookup table or triggers pre-programmed stimulation sequences. (Cheng, *et al*., 2004; Bergveld, 1980; Katz, 1996) proposed various design of multiple-purpose portable functional electrical stimulator.

LabVIEW expanded as Laboratory Virtual Instrumentation Engineering Work bench. LabVIEW is fundamental graphical development environment software which is used to signal acquiring and analysis to diagnosis (Selva and Gavaskar, 2015; Khandpur, 1987; Cromwell and Weibell, 1980; Web star, 1999).

## TRADITIONAL METHODS

FES using a transformer circuit

Traditionally, an analogue electronics has been used for designing of FES circuit using oscillator for generating pulses. The output waveforms which are include of frequency, amplitude and pulse width are to be regulated. To produce the required output voltage a step-up transformer has been used to step up. Fig. 1 shows the circuit of the muscular stimulator.

## PROPOSED METHOD OF FES USING LABVIEW

In this paper uses PC with LabVIEW software to control the amount of stimulating pulses to the muscles. The entire circuitry is energized by alkaline battery (12 V). The signals from the PC is converted to Analog by DAC, amplified, and converted to current output by V/I converter. This output current is fed to the muscles by surface electrodes. Another pair of surface electrodes senses the EMG signal produced by the muscles in response to external electric stimulation. This EMG signal consists of various noises due to motion of muscles. So these raw EMG signals are conditioned and send to the PC for analysis using LABVIEW Software. The block diagram is shown in Fig. 2.

After that we select the ordered coefficient from 1 to N to get N coefficient. the formulae of watermark embedding are as follows. The main objective of this paper is to design and implement a low cost LabVIEW based Functional Electric Muscle Stimulator for rehabilitation of patients suffering from paralysis and finding the cure percent of the paralytic patient. For the stimulation of skeletal muscles Electric pulses are needed for different frequency ranges depending on the complexity of the patients (extension, contraction, and orienting to some degrees). Flexible designs and programming for this complexity is possible by LabVIEW software.

### LabVIEW

The (Babu, *et al*., 2016; Jacobson and John, 1979) proposed real time patient monitoring system using LabVIEW which is used to continuous monitoring of a patient and helps the doctors to make diagnosis.

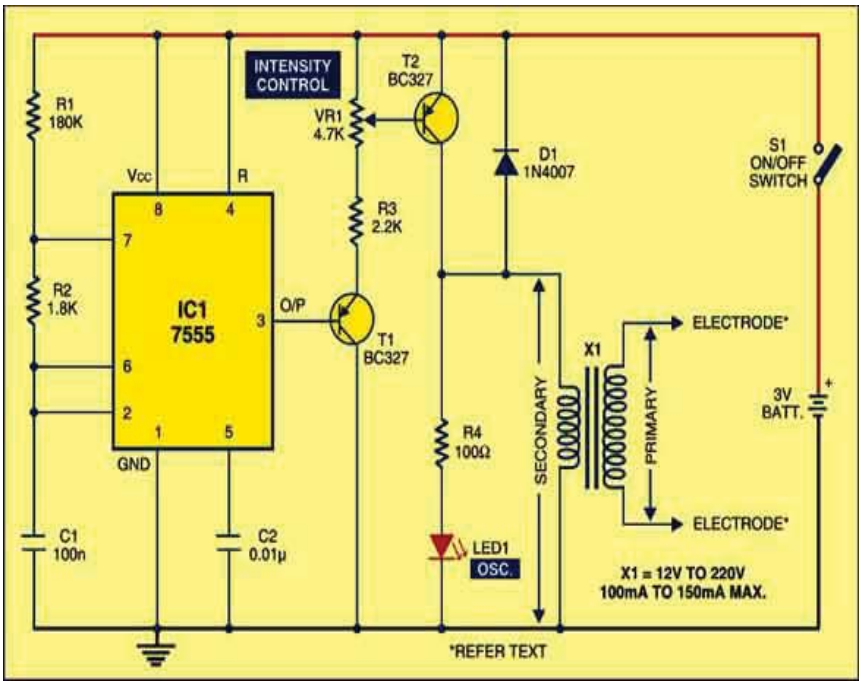


**Fig.1** Typical FES circuit.

In this paper, the main purpose of LabVIEW programming is virtual automating of the usage of measuring equipment and any processing of system. In this paper uses USB 9162 card in the output side where one can get the signals from EMG electrode. The signal is analysed through LabVIEW and the generated signal is given to DAQ card USB 6009. The current output from V-I converter is send to surface electrodes to stimulate the muscles. (Fig. 3) shows LabView panel and (Fig. 4) shows LabVIEW generated pulses (Fig. 3 and 4).

### I/O Card

The NI USB-9162 is a 4-channel dynamic sign securing module for making high-exactness estimations from IEPE sensors. It can be delivers 102 dB of element range and incorporates IEPE signal molding for accelerometers and amplifiers. The 4 USB-9233 information channels all the while gain at rates from 2 kHz to 50 kHz. (Fig. 5) shows a NI IO card with its 4 simple info channels.

### DAQ Card

Fig. 6 shows NI USB-6009 which supplies connection to 8 analog input (8-AI) channels, two analog output (2-AO) channels, 12 digital input/output (12-DIO) channels, and a 32-bit counter with a Full-Speed Universal Serial Bus (USB) interface.

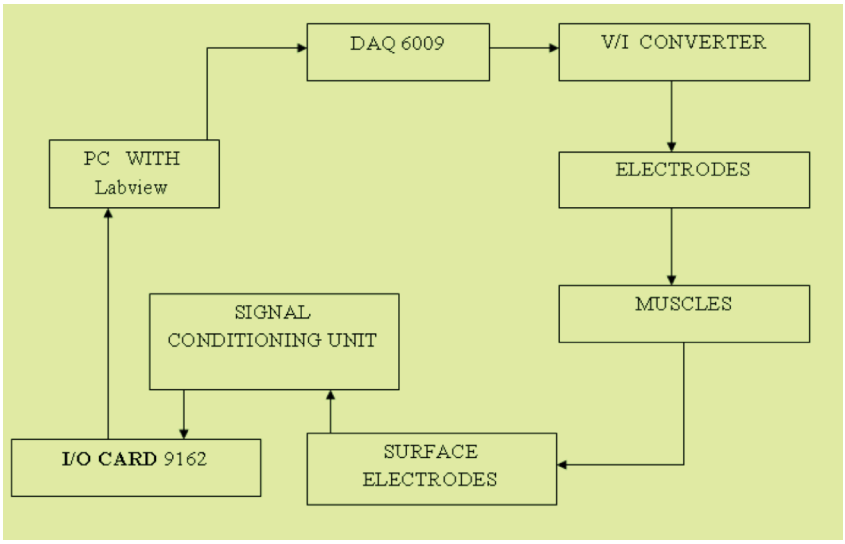


**Fig.2** Block diagram.

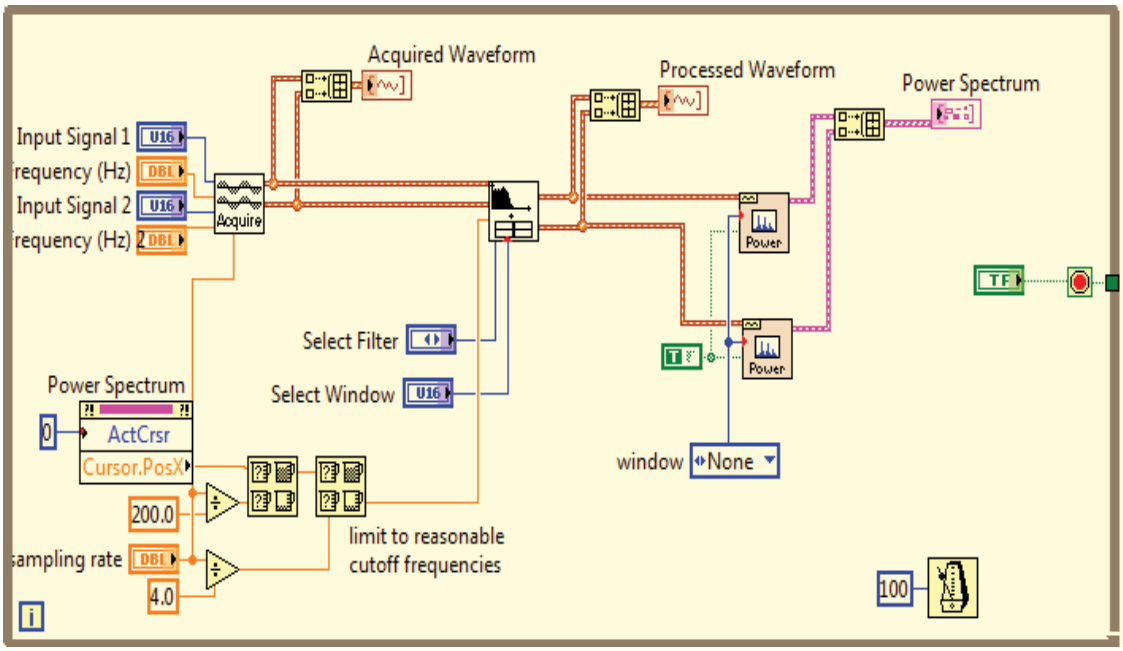


**Fig.3** Lab VIEW panel.

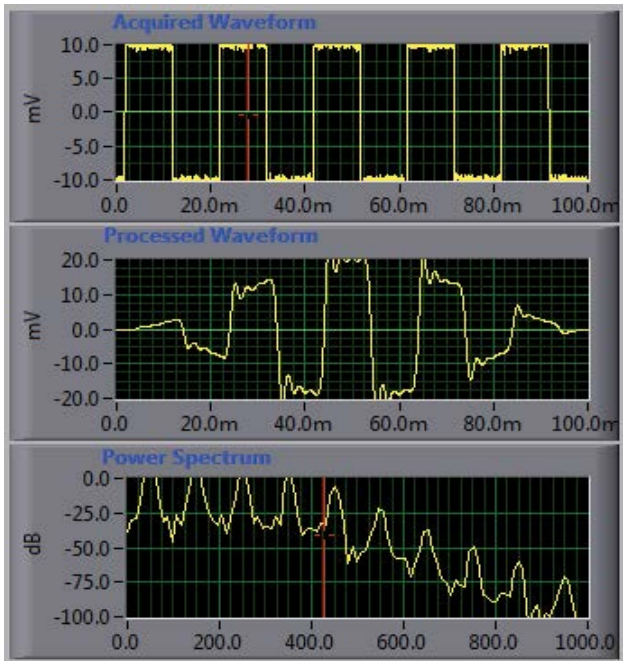


**Fig.4** Lab VIEW generated pulses.


**Fig.5** NI USB 9162 I/O card.


**Fig.6** NI USB-6009 DAQ.

## EMG SIGNAL RECORDING UNIT

This recording unit comprises of surface electrodes to acquire raw signals from the stimulated region, instrumentation amplifier, signal conditioning unit which is the combination of low pass filters and integrators, DAQ, and a PC with LABVIEW software7.1.The integrator unit is to combine the signals from various electrodes. The low pass filter removes the noises such as motion artifacts and fluctuations in the input, usually notch filters are used. The DAQ card stores the data before send to PC.

The signal Obtained is recorded and analyzed for further variations to be given in the input. Important parameters required for quantitative analysis are peak rate, zero crossing rate, negative wave duration, wave rise time like that of time domain parameters. Fig. 7 shows the signal recording unit.

### Recording Electrode

The bioelectric events before they can be put into the amplifier for subsequent record or display have to be picked up from the surface of the body. This is done by using of electrodes. Electrodes make transfer from ionic conduction in the tissue to the electronic conduction which is used for measurements. Two types of electrodes are in practice, one is surface electrodes- pickup potential difference from tissue surface and other one is needle electrode-potential difference arising inside the live tissue. Fig. 8 shows surface electrode.

## RESULTS AND DISCUSSION

The stimulator gives out constant current output of

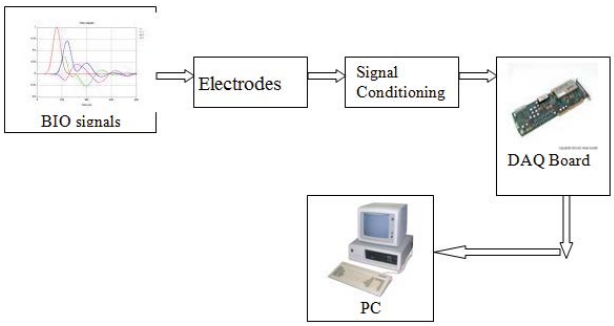


**Fig.7** Signal recording unit.

**Fig.8** Surface electrodes.

amplitude 200mA.From previous discussions it is decided to use bi-phasic pulse for stimulation. In this paper, various frequencies and pulse width ranges are used for biphasic pulse output. The frequency is varied from 20 Hz, 40 Hz, 80 Hz, 100 Hz, whereas the pulse width ranges from 100 μS, 200 μS, 300 μS, 400 μS.

## CONCLUSION

In this paper various frequency and pulse width ranges are selected using Rotary switches. FES also incorporates a toggle switch, which on one side gives biphasic pulse output while on other side it displays the selected frequency and pulse width ranges.

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