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ON A NEW DIGITAL ELECTROTHERAPY EQUIPMENT WITH MICROCONTROLLERS AND COMPLEX PROGRAMMABLE LOGIC DEVICE

Abstract:

Nowadays innovation such as applications of electronic devices and information technologies are commonly seen as one of the most important trends in sustainable development of health. Recently, Electrotherapy Equipment typed Transcutaneous Electrical Nerve Stimulation (TENS) and Electrical Muscle Stimulation (EMS) are widely used for treatment of general acute and chronic pain syndromes. This equipment uses electrical stimulation of the peripheral nervous system to override pain messages or evoke muscle contractions and requires electrical stimulation with high accuracy. Traditionally, the electronic devices, then the IC, and most recently low power Complex Programmable logic (CPLDs) together with Information Technology (IT) have been used in designing and manufacturing of medical equipment. To improve the treatment's capabilities, effects, planning and performance, a new Digital Electrotherapy Equipment has been designed using advanced system capabilities and re-programmability, programmable logic devices (PLDs), especially low power Complex Programmable logic (CPLDs), low-power, high-performance Microcontroller, based on neurophysiology and medical treatment knowledge. This new device has Switching Power Supply, Interface, Microcontroller, Pulse Amplitude, Pulse type modifier, Power Amplifier, Instrument Errors, and CPLD and Microcontroller Interface parts. The new type of the Electrotherapy Equipment also has an automatic self-test routine to detect functional errors during operations and display on a LCD. This equipment was tested several times at Center of Electrical Department, Faculty of Electronics-Telecommunications, Hanoi University of Technology (HUT) and has been used widely in several hospitals in Vietnam for treatment of thousands of patients.

Applying the new technology allows more complex capabilities, improves the functionality, ergonomics, and lowers the production costs of the equipment. This digital electrotherapy equipment is easy to upgrade by software. The new equipment can generate 11 methods in treatment, 18 different treatment currents and 21 different waveforms which can be used to treat acute sprains and strains, arthritis, low back pain, osteoarthritis, shingles, spinal cord disorders, sports injuries and tendonitis. All of created waveforms have a high accuracy and stability satisfied EU standards. The tests and treatment results show that treatment's capabilities, effects, planning and performance of the new type of the Electrotherapy Equipment are remarkably improved compared to the traditional ones. This method of design can also be used for many other medical devices.

Keywords:

Complex Programmable Logic Device, Digital Electrotherapy Equipment, Microcontrollers, Medical Devices

JEL Classification: I12, L86, O30