DEVELOPMENT OF WIRELESS MICROCONTROLLER BASED FUNCTIONAL ELECTRONIC STIMULATION DEVICE FOR DROP FOOT CORRECTION

ABSTRACT

Drop foot syndrome is a general term for difficulty lifting the front part of the foot from the ground which is a common problem that can lead to falls, trips and injuries in human life. It is usually a neuromuscular disorder that causes peroneal neuropathy between the neck and the fibula. In other words, drop foot problem is the loss of communication between the peroneal nerve and the central nervous system which enables the foot to make dorsiflexion. The patient cannot move his/her foot upward the ankle or toes. Foot drop correction is generally achieved by electric stimulation of the common peroneal nerve by sending a series of pulses at a given amplitude, duration and frequency. For this purpose, a wireless programmable microcontroller based, low-power, low-cost, battery operated, high performance and portable electronic stimulation device has been developed.

The stimulator has been designed to make correction on the foot drop syndrome, which is called wireless FES device. In the traditional FES systems, sensors are placed inside the shoe sole which are connected to a stimulator device using lead wires or cables. One of the biggest disadvantages of the cabled systems is the cable complexity, and also device giving discomfort to the patient during the walking, because of the cables around the shoe and the foot. The system designed by the author is wireless and was developed by removing these cables from the device and by using Radio Frequency (RF) transmitter/receiver pair to connect the sensors to the stimulator device. For this reason, the patients can use this device more comfortably and easier. In the design of the wireless FES device, a force sensitive sensor, programmable microcontroller, transmitter, receiver and electrodes are used. Stimulation amplitude, duty cycle, and frequency of the output waveform can easily be adjusted by using switches. Also design has been developed further by the addition of another second in-sole foot sensor underneath the metatarsal heads so that device enabled reliable sensing in addition to walking on straight surfaces during the stair climbing. The cost of the overall system is very low, because during the development process standard microcontroller development systems, standard electronic equipments and standard wireless components were used which are easily found in the market.

Keywords: Drop foot syndrome, foot drop, drop foot correction, wireless microcontroller based stimulation, peroneal nerve stimulation, FES device.