1. INTRODUCTION

Motor paralyses following spinal cord injury (SCI) inevitably eliminates upright standing and bipedal walking. As a result, SCI leads to extreme muscle atrophy, fiber type transformation towards fast-fatigable fibers and lower bone mineral density. This musculoskeletal degeneration can be attributed largely to the dramatic reduction of muscular activity and mechanical stress in the paralyzed limbs, which is due primarily to the motor paralysis following SCI. Furthermore, long-term immobilization of the paralyzed limb may bring about vascular

DOI: 10.4018/ijbre.2011010103
effects such as reduction in vessel diameter and changes in muscle blood flow and vascular compliance (Kawashima, Suzuki, Nakazawa, & Ohta, 2009).

Because chronic inactivity and hypocirculation of the paralyzed area are especially crucial factors in cardiovascular-related complications such as pressure sores and deep venous thrombosis, enhancement of the metabolism and circulation in the paralyzed area is particularly important in preventing these problems.

In addition to the mentioned disuse syndrome, spasticity is also a major source of disability in SCI patients. Lack of mobilization and prolonged spasticity may result in a reduction of joint range of motion (ROM) and lead to joint contracture. Because severe spasticity is accompanied by pain, most SCI patients need to take antispastic medication, which has strong side-effects of dizziness and drowsiness. There is a strong need to regularly treat and exercise joints of neurologically impaired patients effectively to reduce contracture and/or spasticity (Kawashima, Suzuki, Nakazawa, & Ohta, 2009).

Improvement of joint mobility and muscle flexibility and curing spasticity are regarded as the main objectives of rehabilitation after SCI. It is well recognized that muscle stretching and passive joint motion are effective and simple ways to cure the above-mentioned problems and a daily regimen is necessary to achieve the desired effects. However, in fact, many patients cannot maintain these activities after leaving the hospital because of the time and effort involved. Manual stretching and passive motion can be very laborious for patients and caregivers. As a consequence, daily care for the paralyzed area is frequently abandoned after being applied for only a short time after discharge from the hospital (Kawashima, Suzuki, Nakazawa, & Ohta, 2009).

Although some previous researchers have tried to develop a rehabilitation device to assist in passive joint motion, no device has satisfied the requirements for daily home use by patients, such as ease of use and low cost. We are here developing a rehabilitation device in order to prevent disuse syndrome and secondary diseases following SCI. Our developed device has a very simple structure, which uses 3 DC motors to provide movement in the hip, knee and ankle joints and can be attached to the patients’ bed at ease.

2. BLOCK DIAGRAM

The designed block diagram of the device is shown. Complete patient safety and other parameters have been considered in the proposed design

A. Explanation

The device uses PIC 16F877A microcontroller. It is connected to a 230V- 50Hz power supply during which the battery charges. The device doesn’t get switched ON until the main power supply is OFF, thereby providing complete patient- circuit isolation.

Three different DC- motors (Figure 1) are used to provide the desired movements. One motor (knee flexion-extension) is controlled by a gear box so as to adjust the torque required. Control Panel and display are provided for the easier adjustments of the parameters (Oblak, Cikajlo, & Matjacic, 2010; Kalsi, 2008; Bali, 2006).

3. MECHANICAL SETUP

The complete mechanical set-up (Figure 2) is made using Mild Steel. Three mechanical movements using three motors are used for hip, knee and ankle joint of the lower limbs. The motor used for knee movement is provided with a gear box for torque adjustment. The motors used are two 45W-4A motor for hip and knee and 25W-2A motor for ankle movement.

A. Constructional Details

The developed device is a rectangular shaped device that can be attached to the lower part of the patients cot. The device is made up of mild steel rod, mild steel bar and mild steel...
Related Content

Towards the Sixth Kondratieff Cycle of Nano Revolution
[www.irma-international.org/article/towards-the-sixth-kondratieff-cycle-of-nano-revolution/104148/](www.irma-international.org/article/towards-the-sixth-kondratieff-cycle-of-nano-revolution/104148/)

Citrate Stabilized Silver Nanoparticles: Study of Crystallography and Surface Properties
[www.irma-international.org/article/citrate-stabilized-silver-nanoparticles/99583/](www.irma-international.org/article/citrate-stabilized-silver-nanoparticles/99583/)

Routing Physarum with Electrical Flow/Current
[www.irma-international.org/article/routing-physarum-electrical-flow-current/66397/](www.irma-international.org/article/routing-physarum-electrical-flow-current/66397/)

Nano-Based Food and Substantial Equivalence: A Category-Mistake
[www.irma-international.org/article/nano-based-food-substantial-equivalence/52088/](www.irma-international.org/article/nano-based-food-substantial-equivalence/52088/)
Advances in the Reduction of the Costs Inherent to Fossil Fuels’ Biodesulfurization towards Its Potential Industrial Application
www.irma-international.org/chapter/advances-in-the-reduction-of-the-costs-inherent-to-fossil-fuels-biodesulfurization-towards-its-potential-industrial-application/139168/