LEG REHABILITATION AND MOBILITY AID FOR PARALYSIS PATIENTS

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Abstract:
This project involved designing and manufacturing a cost efficient device that will retrain the leg muscles of paralysis patients. This project group developed a more economic design for to retrain their muscles and feeling of walking in their legs at a lower cost than what is on the market today. The group was able to make the device adjustable and comfortable for the patient to use easily. The group also made the device move in a precise way to simulate the human gait walking motion.

Regarding classical rehabilitation techniques, there is insufficient evidence to state that a particular approach is more effective in promoting gait recovery than other. Combination of different rehabilitation strategies seems to be more effective than over-ground gait training alone. Robotic devices need further research to from the analysis of these approaches we can draw the following conclusions. Show their suitability for walking training and their effects on over-ground gait. The use of FES combined with different walking retraining strategies has shown to result in improvements in hemiplegic gait. Reports on non-invasive BCIs for stroke recovery are limited to the rehabilitation of upper limbs; however, some works suggest that there might be a common mechanism which influences upper and lower limb recovery simultaneously, independently of the limb chosen for the rehabilitation therapy. Functional near infrared spectroscopy (fNIRS) enables researchers to detect signals from specific regions of the cortex during performance of motor activities for the development of future BCIs.

Introduction:
According to the United States Census Bureau, as of 2002, 18.1 percent of Americans had a disability and 11.5 percent of those disabilities were severe. These severe injuries can be accredited to a multitude of causes. Paralysis, the loss of motor function of a limb or limbs, can be attributed to some of these causes such as stroke, brain trauma, and spinal cord injury. Roughly one of every one hundred Americans has experienced a stroke. The likelihood of having a stroke doubles by the decade once reaching the age of 55. With the baby boomer era growing older, the amount of strokes in the United States will be on the rise and will therefore require more accessible rehabilitation techniques.
A stroke can cause a variety of different forms of paralysis such as hemi paresis, paraplegia, quadriplegia, and tetraplegia. These types of paralysis are caused by damage to the spinal cord and nervous system. Hemi paresis is the loss of motor functions in one side of the body. Paraplegics lose the use of their legs but have complete control over their arm functions. Quadriplegic and tetraplegia refer to a patient that has lost the use of all four limbs. A patientís rehabilitation regimen depends mainly on the severity of their disability. These exercises range from walking on a treadmill to the bending of their fingers. Sometimes however the paralysis is so severe that the patient cannot support their own body weight or lift the weight of their limbs. Rehabilitation devices are responsible for an increase in the overall recovery of the patientís mobility in their affectedlimbs [6]. They are able to support the patientís weight and assist in their limb movement with minimal interaction from the therapist. An example of this would be the rehabilitation device that is being worked on at the Rehabilitation Institute of Chicago (RIC). This device is helping paralyzed patients regain their ability to walk.

Objective:
This project involved designing and manufacturing a cost efficient Device that will retain the leg muscles of paralysis patients. This project group developed a more economic design for paralysis patients to retrain their muscles and feeling of walking in their legs at a lower cost then whatís on the market today. The group was able to make the device adjustable and comfortable for the patient to use easily. The group also made the device move in a precise way to simulate the human gait walking motion.

Problem definition:
Now-a-days we saw a large need in both the United States and China for a device that would be able to be sold to hospitals and patients that would allow for the treatment of the paralyzed. This need was drawn from the increasing number of patients that were developing paralysis like conditions and the few resources available to help rehabilitate them. The mission was to design and manufacture a cost efficient robotic device that would retrain the leg muscles for these patients and the patient should feel walking like a normal person. This problem definition emphasizes that the device must be cost efficient.

With a lack of monetary funds available in hospitals today the need for a cheaper alternative to rehabilitation is greatly needed. Along with cost, the project group came up with two other important specifications that their design should follow. As mentioned before the group thought it was important that the device be comfortable to use. In the following sections you will see how the project group incorporated ideas so that their device would allow for the patients to feel comfortable while using the device.

Motivation:
Past research done on robotic rehabilitation is quite extensive. Even though today this field of study is making huge strides, its subject matter is still in the beginning stages of development. The main motivation is to provide different kinds of paralysis, related projects, and current treatments. Also, research was conducted on the different types of information that will be needed for our project design to be put into realization. This information includes motion analysis on the joints as well as the technology that will be used in our design to move these joints.
Methodology:

The following section will explain our methods for completing our project. Our project's success will be contingent upon the accomplishment of the following individual objectives:

- Design a device to move in a precise human walking motion.
- Device must be adjustable to provide comfort to different sized patients.

**Arduino UNO:**

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller.

**Motors:**

Motors are used in this project so as to provide the movement of the mechanical setup, helping the patient to walk autonomously. Due to the motion of the motor it gives physiotherapy to different joints of the leg such as foot, knee and hip region. Here we are using three geared motors for three joints of the leg, one motor at hip region is capable of producing 10 kg of torque and other two motors are capable of producing 3 kg torque. Each motor runs at 10 rpm at 12 volts.

**Driver Circuit:**

Any hardware for its working would require the use of driver circuit for its proper functioning. In this project, driver circuit has been used to drive the motors. We are using relay driver circuit in order to drive the motors. It acts as a bridge between the microcontroller and motors.

**Power Supply:**
Power supply is needed for any electronic device to work. Power supply supplies voltage to various parts of the circuit and hence the need for it.

**Applications:**
- It helps the paralyzed person to walk as a normal person
- Cost effective
- Light weight

**Results:**
Conclusion and future work:
- Due to high cost of existing rehabilitation options, 85% of the paralysis patients are not able to get treatment for their conditions.
- The main objective of our project is to give these patients a relatively inexpensive, yet affective to help them with their recoveries.
The work can be further extended wherein more advanced technology can be incorporated like smart phones, eye contacts instead of switches and joystick, and can be used for other parts of body parts like hands and so on.