Team Name: Mocking-JAY

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IDEA:

Using BCI (Brain Computer Interface) to avail motory actions in the lower limbs of paralysed people.

ABSTRACT

The failure of the neurons in the lower limbs of a paralysed person's body to successfully transmit signals from the brain to the muscles imposes restrictions on movement in a paralysed person. In this submission we are trying to put forth an idea with which the paralysed person can be facilitated to 'walk' by providing the exoskeletal support controlled by neural network enabled system trained to classify the brain signals sensed by an EEG(Electroencephalogram) to drive the exoskeleton. Although the technology is available, it's not being implemented. We have put forth this idea to exploit the technology to convert it into a usable product in a plausible way.

INTRODUCTION

BCI (Brain Computer Interface) is a multidisciplinary technology. It has emerged as a revolutionary approach to sense and understand neurological responses to a stimuli. BCI can be seen as a way in which we can control machines with our thoughts. For instance, a paralysed person can think of walking but he cannot. Through BCI we can harness the thought in the form of electrical signals to drive the exoskeleton which could help him walk.

BCI has 3 parts- Sensor, Decoder and an Actuator. The sensor is an electroencephalogram which harnesses the electrical signals generated in the cortex through the scalp . The decoder is a block where the harnessed signals are processed and it further generates instructions for controlling the actuator system which drives the exoskeleton.

MOTIVATION

This idea was inspired by looking at the raw statistics of a number of paralysed people. Every 1 in 200 people in India and 1 in 50 people in the world are paralysed and it is depressing to know that there's no cure to permanent paralysis. Although mobility aids including manual and electric wheelchairs and scooters facilitate their locomotion to some extent, they cannot provide the locomotive flexibility that the normal legs can offer.

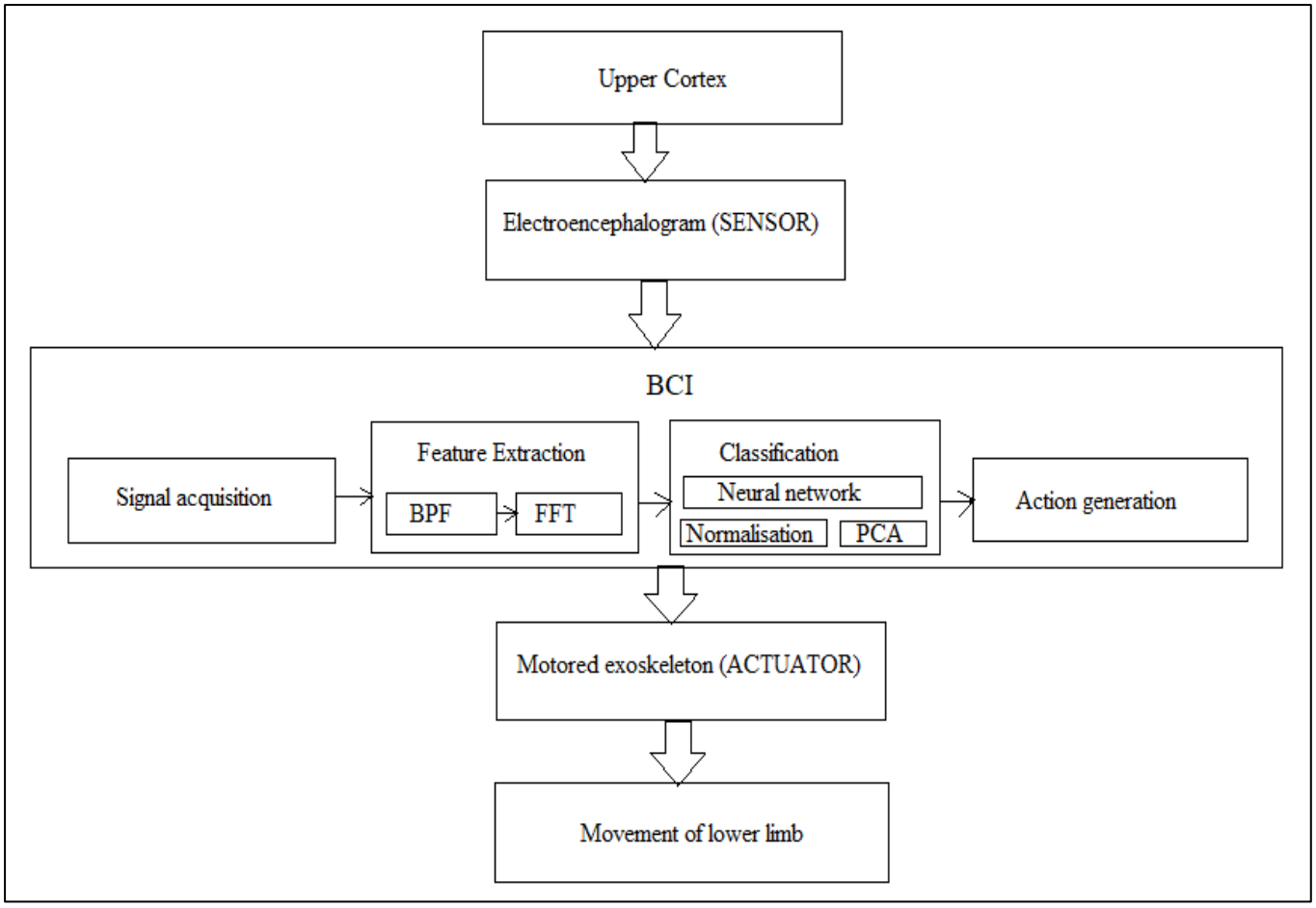
METHODOLOGY

A person can be trained to learn motor skills even without actually having to do anything by a process called motory imaging. Motory imaging is basically imagining an action to learn motory skills. Thinking of moving limbs or appendages produce distinctive lateralised pattern on the primary, sensory and motor cortex.

The acquired brain signals can be broadly associated to five main actions-

1. Delta – Associated with deep sleep (1-3 Hz)
2. Theta – Associated with shallow sleep (4-7 Hz)
3. Alpha – Associated with reflexed state (8-13 Hz)
4. Beta – Associated with wakefulness (14-30 Hz)
5. Gamma – Associated with excited states like walking, running, etc. (13-45 Hz)

Thinking about these states produce certain types of signals. When we use sensorimotor rhythms (standard brain waves formed by synchronising brain activities) with motory imaging, there occur changes in certain energy bands due to event related synchronisation and desynchronization. This concept can be used to associate person's imagination to a specific movement.



BLOCK DIAGRAM

We use EEG to read the signals from the brain. These signals appear in the form of varying frequency and amplitude. This is fed to the BCI block. In the BCI block after the signal acquisition, we extract the required features and classify the waves. This is done by passing the waves through a BPF (Band Pass Filter) whose output would give us the frequency of waves which are associated primarily to locomotion. We generate the spectrum of brain waves using FFT (Fast Fourier Transform). We normalise the spectrum of waves into machine understandable scale. These are passed through neural network where principle component analysis takes place. The result of the classification would be used to generate an action. An action is a sequence of instructions which is fed to the motorised exoskeleton. This exoskeleton helps in the movement of limbs.

SOCIAL IMPACT

The people suffering from lower limb paralysis are almost bedridden. They are dependent on others to lead their lives. Through this product, we can help them gain confidence and give them a second chance to live their life independently.

MARKET SURVEY

The classical method of treatment for temporary paralysis involves rehabilitation and training of lower limbs. But this method does not show 100% success rate in some patients and there is

no treatment for permanent paralysis. Using this product, we can treat the patients more effectively at substantially comparable price. Although mobility aids which include manual and electric wheelchairs could facilitate their locomotion to some extent, they cannot provide the locomotive flexibility that the normal legs can offer. This product is designed for all class of people and it is a kind of reform in the society as it helps the paralysed people to lead their lives independently.