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# Stroke Rehabilitation via Electroencephalogram Sensors and an Articulated Robot

**Authors :** Winncy Du, Jeremy Nguyen, Harpinder Dhillon, Reinardus Justin Halim, Clayton Haske, Trent Hughes, Marissa Ortiz, Rozy Saini

**Abstract :** Stroke often causes death or cerebro-vascular (CV) brain damage. Most patients with CV brain damage lost their motor control on their limbs. This paper focuses on developing a reliable, safe, and non-invasive EEG-based robot-assistant stroke rehabilitation system to help stroke survivors to rapidly restore their motor control functions for their limbs. An electroencephalogram (EEG) recording device (EPOC Headset) and was used to detect a patient's brain activities. The EEG signals were then processed, classified, and interpreted to the motion intentions, and then converted to a series of robot motion commands. A six-axis articulated robot (AdeptSix 300) was employed to provide the intended motions based on these commends. To ensure the EEG device, the computer, and the robot can communicate to each other, an Arduino microcontroller is used to physically execute the programming codes to a series output pins' status (HIGH or LOW). Then these "hardware" commends were sent to a 24 V relay to trigger the robot's motion. A lookup table for various motion intensions and the associated EEG signal patterns were created (through training) and installed in the microcontroller. Thus, the motion intention can be direct determined by comparing the EEG patterns obtaibed from the patient with the look-up table's EEG patterns; and the corresponding motion commends are sent to the robot to provide the intended motion without going through feature extraction and interpretation each time (a time-consuming process). For safety sake, an extender was designed and attached to the robot's end effector to ensure the patient is beyond the robot's workspace. The gripper is also designed to hold the patient's limb. The test results of this rehabilitation system show that it can accurately interpret the patient's motion intension and move the patient's arm to the intended position.

**Keywords :** brain waves, EEG sensor, motion control, robot-assistant stroke rehabilitation
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