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Prosthetic hand for the brain-computer interface system

Abstract

The objective of the study is to develop a prosthetic hand for the usage of Brain-computer Interface (BCI) system. In the proposed BCI system the prosthetic hand was introduced as an external device controlled by the system. This hand is required to perform four essential tasks of the human hand: cylindrical grasp, key pinch, pulp to pulp pinch and tripod pinch. The hand was inspired by the perfection and complexity of the human hand. This hand consists of palm and 5 fingers with a total of 16 degrees of freedom (DOF). The phalanges of each finger was modeled as three link open chain joined at the metacarpal joint (MCP), proximal joint (PIP) and distal joint (DIP). Phalanx was made from two identical parallel aluminum plates and connected to the other segment using a bolted spacer acting as hinge joint. The Length of each segment was made such that it will form an equiangular motion path during trajectory. Each joint is actuated by its individual actuator. Two mechanisms were proposed in this study. The first mechanism is the tendon drive; used terelyne string to pull each segment to flexion. The second mechanism is a spring return; a stored resistive force in torsion spring will kick the segment to its initial position. The hand was equipped with potentiometers and force sensors for control purposes. The prototype of the prosthetic hand was tested with BCI system, in order to meet its initial objective and additional tests were carried out to evaluate its performance. An experiment to test the performance of the prosthetic hand was carried out successfully. Strength of each tendon was measured using a proof ring method and motion images were captured using video camera and analyzed using Peak Motus 7 Motion Analysis software.

Keywords — Prosthetic hand, Brain-computer Interface (BCI)