CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Maitreyee R. Joshi

Project Number

S0911

Project Title

TouchProsthetics: Bringing Tactile Sensations to Upper-Extremity Prosthetics Using Haptic Devices

Abstract

Objectives/Goals

The goal of this engineering project is to improve the usability of upper-extremity prosthetics for amputees by creating a tactile feedback device that would allow them to feel intuitive tactile sensations, such as contact and pressure, through the prosthetic arm.

Methods/Materials

The major components of this tactile feedback system are fingertip sensors, an embedded control system, and haptic tactors; more specifically, force-sensing resistors for used for sensors, DC motors are used for haptic tactors, and a Buffer IC and a Arduino Uno Microcontroller Board are used for the embedded control system. According to the amount of force detected in the force-sensing resistors, different amounts of voltage are sent through the circuit. In accordance to the amount of input voltage, the DC motor rotates at a particular speed. The faster the DC motor rotates, the more torque it creates and thus the greater amount of force it pushes with.

Results

To determine the accuracy of tactile feedback device, the amount of force placed on the force-sensing resistors on the end effectors of the prosthetic arm was compared to the amount of force that was outputted by the DC motors. The graphs of the resistance and voltage outputted over time from the circuit containing the force-sensing resistors and the power source were used to calculate the approximate amount of force placed upon the end effectors of the prosthetic arm; this was compared to force outputted from the DC motors, calculated by measuring the approximate number of rotations of the motor and then calculating torque and force it created. By examining the graphs of input force and output force, it is evident that the tactile feedback device is quite successful in recreating the approximate amount of force that is being applied at the sensors.

Conclusions/Discussion

By examining the amount of force outputted by the motors in relation to the amount of force placed upon the end effectors of the prosthetic arm, it is evident that the method of using several haptic devices to correspond to the sensors was extremely successful. Consequently, this engineered device has demonstrated that, by placing sensors on the end-effectors of the prosthetic arm and motors on the nerves of amputees, a sense of force can be recreated. Using this same method, other senses of tactile sensation, such as temperature, vibrations, and shear force, can be recreated as well.

Summary Statement

This tactile feedback device brings tactile sensations to upper-extremity prosthetics for amputees, allowing them to feel sensory information through their prosthetics as if it were coming from a real body extremity.

Help Received

Family friend provided soldering material and gave advice on the different types of materials available on the market to build the device