EMG controlled Animatronics Hand

Tam Phuong
Faculty Advisor: Philip T. McCreanor, Ph.D.
Mercer University - School of Engineering, Macon, GA

Abstract

Human-robot control interfaces have received increased attention within the past decades. There is a strong necessity for simple schematics for controlling a robotic hand due to the introduction of robots in everyday life. Nowadays, they are used in providing services to people with special needs (i.e. the elderly, people with disabilities, or people with impairments).
The ability to reach and grasp objects in an everyday-life environment seems simple for humans, but it is complicated from an engineering point-of-view to replicate. Humans rely on complex coordination of the musculoskeletal system in the upper limbs for reaching and grasping objects.
In this research, an animatronic hand will be made and controlled by two methods. The first method will have the robotic hand trigger by a flex sensor mounted on top of a glove. The second method will use an EMG to pick out muscle signals in the forearm. An Arduino board will read the changes in voltage from the EMG and trigger the servos to move an amount proportional to the changes. The servos will pull the strings replicating how the tendons allow the fingers to move.

Introduction

EMGs been investigated extensively as a means of controlling prosthetic devices. Research shows that amputees and partially-paralyzed individuals have intact muscles that are still able to generate electric signals. The EMG has the ability to detect changes in electrical potential from muscle cells. This makes the EMG extremely useful in controlling artificial motor functionality.

Flex Sensor Controlling Animatronics Hand

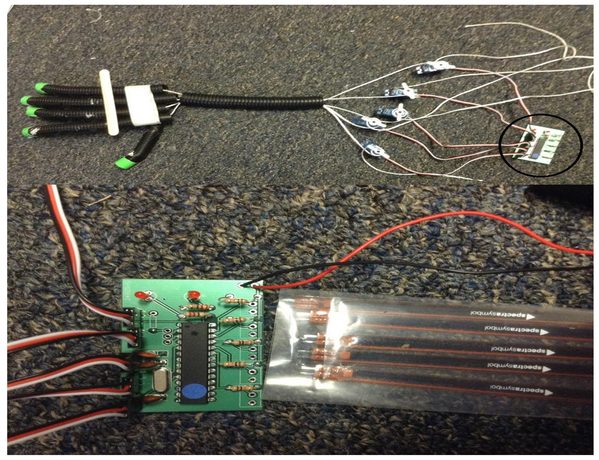


Figure 1: Animatronic Hand With Flex Sensor

Flex sensors are sensors that detects changes in resistance based on the physical bend of the sensor. They convert the amount of bend into electrical resistance. In other words, the more the sensor are bent, the larger the resistance value becomes. The microcontroller picks up on the change in resistance and triggers the servos. The servos acts similar to tendons by pulling on the string which allows the fingers to move.

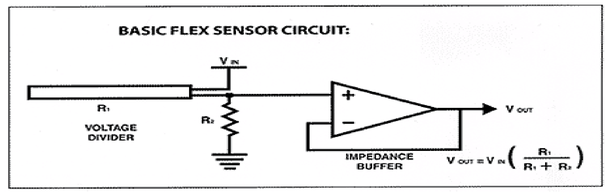
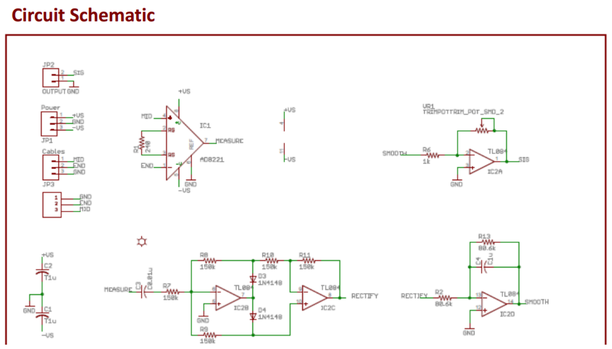


Figure 2: Basic Flex Sensor Circuit provided by Gundanium

EMG Sensor



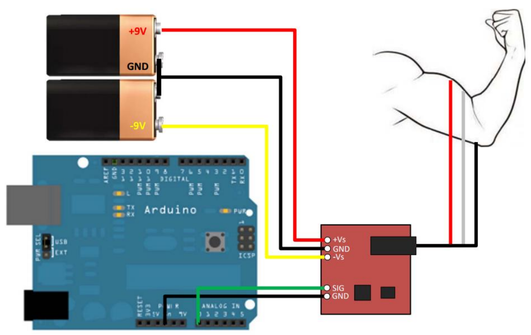


Figure 3: EMG Circuit Schematics Provided By karlssonrobotics

EMG is used to recorded the electrical activity produced by skeletal muscles. In this research, the EMG is used to detect the electrical potential generated by the muscle cells when those cell are electrically or neurologically activated. The signals is then used by the Arduino. The Arduino will used the signal to trigger the servos which will move the animatronic fingers. EMG provides many important and useful applications, but it has many limitations that must be understood, considered, and eventually removed so that it does not affects the muscle signal.

Future Work

The extra step would be to program the Arduino to pick out the EMG signal and trigger the servos. This would allow an user to be able to control the animatronics hand by flexing the user biceps or other muscles.

In future studies, it would be beneficial to create a 3-D print of the hand to simulate an actual human hand. By doing, this would open up more option. For example, by adding an Arduino voice recognition shield to receive verbal commands and then make corresponding motions with the hand. The advantage of voice control would be the fact that it does not require muscles and is more flexible to different physical conditions.

References

Gundanium, . "DIY Muscle Sensor / EMG Circuit for a Microcontroller." . N.p.. Web. 9 Apr 2014. <http://www.instructables.com/id/Muscle-EMG-Sensor-for-a-Microcontroller/>.

"Muscle Sensor v3." . N.p.. Web. 9 Apr 2014. <http://dlnmh9ip6v2uc.cloudfront.net/datasheets/Sensors/Biometric/Muscle Sensor v3 Users Manual(1).pdf>.

L. Eriksson , F. Sebelius and C. Balkenius "Neural control of a virtual prosthesis", *ICANN*, 1998

P. Shenoy , K. J. Miller , B. Crawford and R. N. Rao "Online electromyographic control of a robotic prosthesis", *IEEE Trans. Biomed. Eng.*, vol. 55, no. 3, pp.1128 -1135 2008

Acknowledgements

This work was supported by the Engineering Honors Program at Mercer University. I would like to thank Dr. Philip T. McCreanor, Director of the Engineering Honors Program, for his guidance in pursuing and documenting this project. I would also like to thank Dr. O'brien for sharing his technical contributions and Mr. Jeremy Barker for letting me use his laboratory .