2016

Light Exoskeleton Gear (L.E.G.)

Andy Myers

Ali Al Matouq

Kelsey DeJesus-Banos

Jessica Vidmark

Light Exoskeleton Gear (L.E.G.)

Andy Myers, Ali Al Matouq, Kelsey DeJesus-Banos, Jessica Vidmark

Faculty Advisor: Dr. Kenneth Gibbs, Dept of Electrical and Computer Engineering, Florida Institute of Technology

Abstract

The L.E.G. combines the inherent mechanical support of a knee brace with extra assistance provided in a similar way as a robotic leg. Surface Electromyography (SEMG) sensors are connected to the user's leg to assess in what direction the brace should assist the user. In addition to providing assistive and resistive features for the user's physical benefit, there is an option for the user to send the voltage data of the L.E.G. to a computer via Bluetooth and display the results in a VI executable.

SEMG Signal Acquisition

SEMG signals are low voltage, capacitively coupled signal measurements that capture some very small amount of muscle energy.

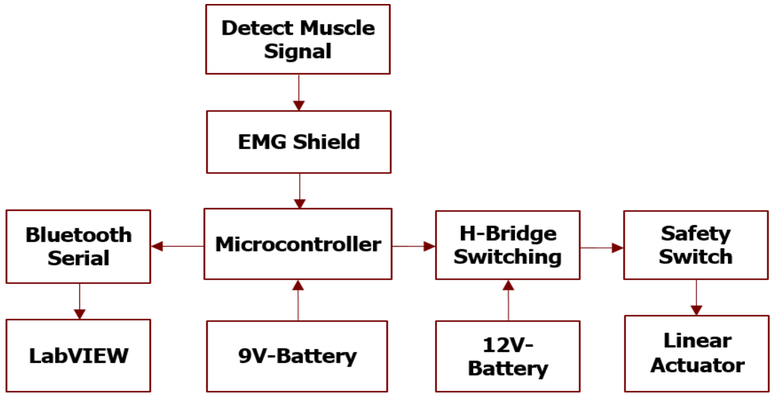
Procedure for capturing signals:

- Changes in surface voltage are captured using noninvasive electrical patches placed on the user
- The voltage signals are sent through SEMG chips for amplification
- The amplified signals are sent to the Arduino for decision making and are then passed, using a Bluetooth chip, to a LabVIEW executable for visual representation of the muscle signals

Data Analysis & Transmission (Assistive Mode)

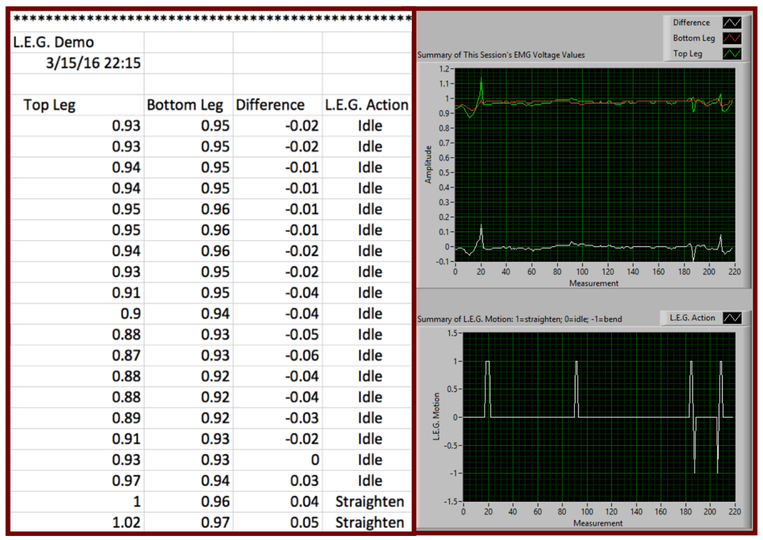
- SEMG signals are transferred to the Arduino for determining the intended direction of leg motion
- The L.E.G. bends, extends, or remains idle such that it moves in the direction of intended motion
- Voltage readings are sent via Bluetooth to the user interface

Block Diagram



LabVIEW User Interface

- Displays graphs of SEMG voltage readings and motion of L.E.G.
- Saves data to a user log for future reference



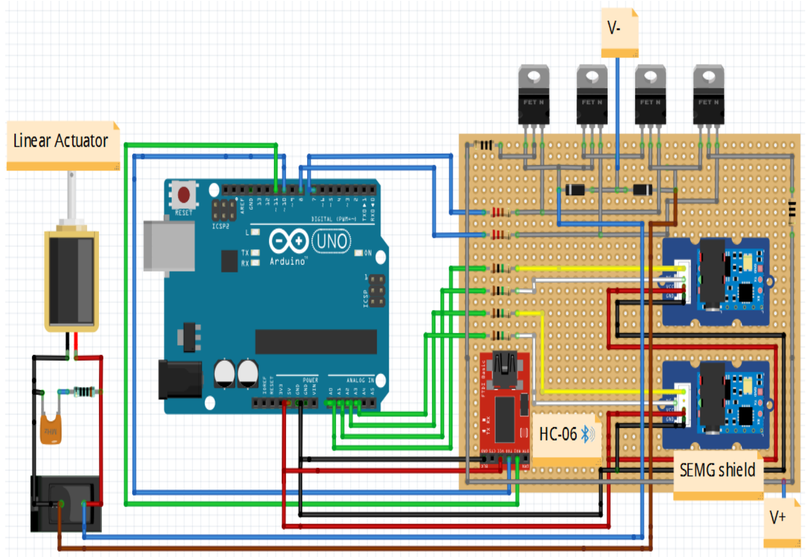
L.E.G. Demo
3/15/16 22:15

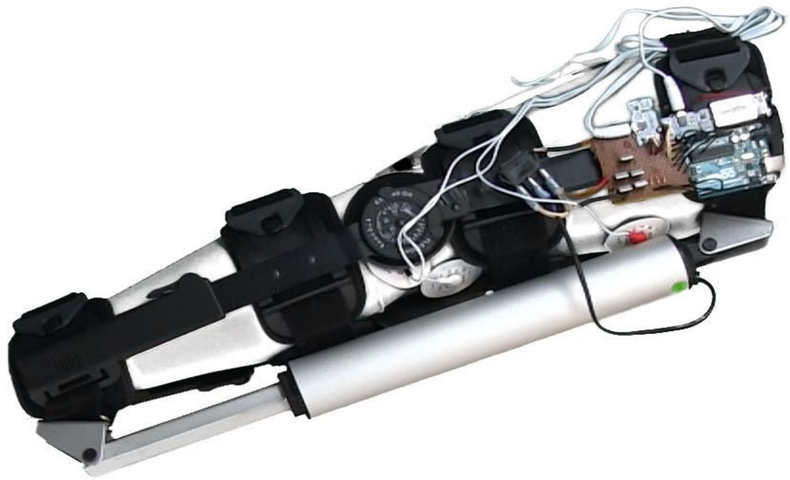
Top Leg	Bottom Leg	Difference	L.E.G. Action
0.93	0.95	-0.02	Idle
0.93	0.95	-0.02	Idle
0.94	0.95	-0.01	Idle
0.94	0.95	-0.01	Idle
0.95	0.96	-0.01	Idle
0.95	0.96	-0.01	Idle
0.94	0.96	-0.02	Idle
0.93	0.95	-0.02	Idle
0.91	0.95	-0.04	Idle
0.9	0.94	-0.04	Idle
0.88	0.93	-0.05	Idle
0.87	0.93	-0.06	Idle
0.88	0.92	-0.04	Idle
0.88	0.92	-0.04	Idle
0.89	0.92	-0.03	Idle
0.91	0.93	-0.02	Idle
0.93	0.93	0	Idle
0.97	0.94	0.03	Idle
1	0.96	0.04	Straighten
1.02	0.97	0.05	Straighten

Data Analysis & Transmission (Resistive Mode)

- SEMG signals are transferred to the Arduino for determining the intended direction of leg motion
- The L.E.G. bends, extends, or remains idle such that it opposes the direction of intended motion
- Voltage readings are sent via Bluetooth to the user interface

Circuit Schematic





Conclusion

- Additional components including heat sinks, Zener diodes, and an RC snub were added to protect the circuit from thermal damage and voltage spikes
- The L.E.G. has a near-real-time response to EMG signals and is able to respond using both assistive and resistive modes
- In the future a phone app could be created both for data transfer from the L.E.G. to LabVIEW over distance and for manual operation of the L.E.G.

NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology