ECE 492 - Computer Engineering Design Project

EMG Controlled Car

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Overview

The goal of this project was to create an RC car that was controlled using two EMGs. The EMGs measure the electrical activity in the muscles and send the signals to the Altera DE0 Nano FPGA board. The board processes the signals and determines what command the user wants to send to the car. Transistors are activated by the board to send the commands to the transmitter and then on to the car. One EMG is responsible for the forward and reverse signals and the other EMG is responsible for the left and right signals.

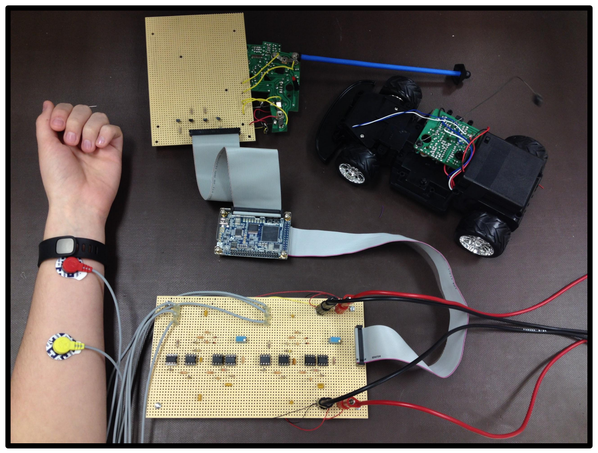

Fig. 1 Hardware Components

Transmitter

- Reverse engineered existing transmitter to interface with the DE0 Nano.
- NPN transistors used to create switches that turn on when signals are sent from the DE0 Nano.
- When a transistor is turned on, the transmitter sends a signal to the car which corresponds to the forward, reverse, left and right commands.

Electromyography (EMG)

- Electrical activity from the skeletal muscles measured using a differential amplifier.
- The signal is inverted and sent through a high pass filter.
- The signal is rectified then sent through a low pass filter
- Finally the signal is inverted and amplified once again.
- The signal is a positive DC value large enough for the DE0 Nano.

Signal Classification

- Data is continuously collected on the rising edge of the signal until the signal gets to its maximum value or it surpasses the forward threshold value.
- Once the falling edge of the signal is found, the data is compared with the predefined threshold values.
- Once the specific gesture has been captured, no further processing is required. More samples are collected to ensure that samples do not fall below the stop threshold value

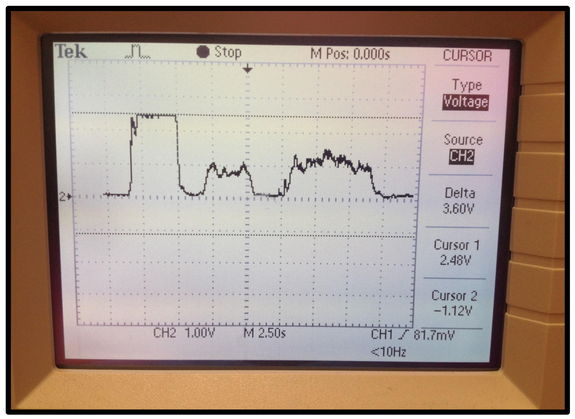

Fig. 2 EMG Output

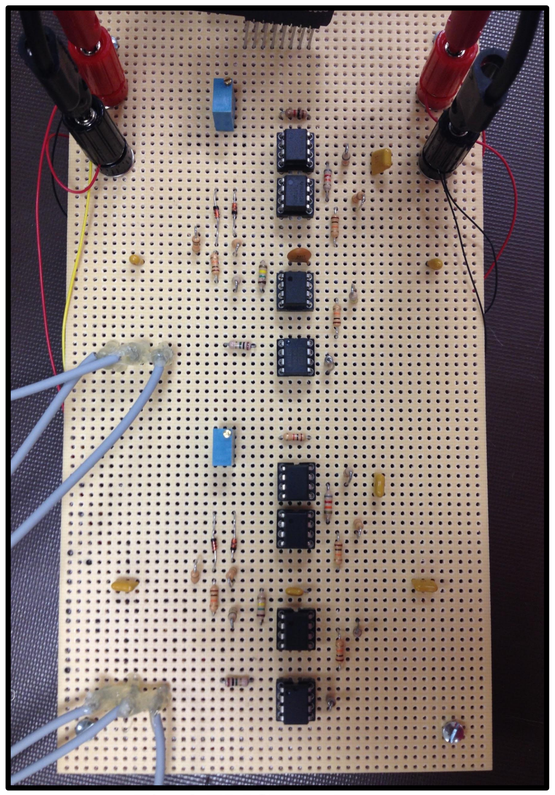

Fig. 3 EMG Hardware

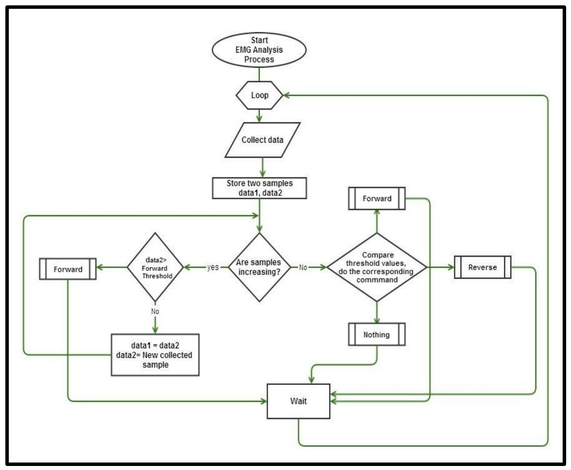

Fig. 4 Signal Classification Algorithm

Conclusion

Electromyography has great potential for human-machine interfacing. There is ongoing research on classifying EMG signals in order to build better prosthetics. The user would have to flex one muscle and their hand would close instead of having to use a cable system where they have to extend their arm to close the hand.

Some companies such as Thalmic Labs are using EMGs as a novel way to interact with computers. Not only can it make using computers easier to use for the most people but it can really benefit people with disabilities that make it difficult to use the traditional mouse and keyboard.

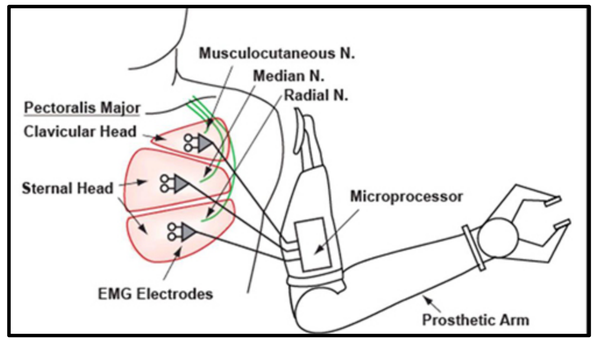

Fig. 5 Prosthetic arm using EMG

Resources:

http://en.wikipedia.org/wiki/Electromyography

http://www.instructables.com/id/Muscle-EMG-Sensor-for-a-Microcontroller/?ALLSTEPS

http://www.rehab.research.va.gov/jour/11/486/page643.html

https://www.thalmic.com/en/myo/

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