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Hand gripper design as an application of EMG measurement

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ABSTRACT

The medical, rehabilitation and bio-mimetic technology demand human actuated devices which can support in the daily life activities such as functional assistance or functional substitution of human organs. These devices can be used in the form of prosthetic, skeletal and artificial muscles devices. Such devices are costly which is not affordable to every consumer so to overcome these we have designed a hand gripper which uses the electromyography (EMG) signals to control this device.

Keywords*— EMG Sensor, Hand gripper, Servo motor, ATMEGA328, 9V battery, Electrodes*

1. INTRODUCTION

This project captures the myoelectric signals in the forearm and uses them to control a hand gripper [1]. In prosthetic hands, active bending is restricted to two or three joints, which are actuated by single motor drive acting simultaneously on the metacarpophalangeal (MP) joints of the thumb, of the index and of the middle finger, while other joints can bend only passively. On the other hand, robotic hands have achieved high-level performance in grasping and manipulation.

2. RELATED WORK

EMG sensing can be done using a sensor band and electrodes. Here we are using electrodes as the sensor band leads to high cost.

The red sensor is the high sensor, meant to find the high part of the voltage difference, with the green being the low voltage sensor, and the yellow sensor on the elbow is the reference node, or ground node [1]. With this setup, we were able to get a stable and repeatable useable signal that we had control over.

3. METHODOLOGY

3.1 Working

The inputs of this system are the myoelectric signals from the forearm; the outputs are the movements of the hand. The system currently uses multiple 9V batteries to power the microcontroller and the servos. The locations of the signal sensors differ for each customer but stay in the same location without the customer moving them once they are set. The sensor picks up the signals from the user's arm. This sensor sends the signals to the microcontroller and the microcontroller interprets the signals it receives. The microcontroller itself does not have the current driving capabilities to move the robotic hand alone. This requires a driving circuit in order for the signals from the microcontroller to drive the servos and moving parts in the robotic hand. Finally, the robotic hand mimics the motions of a human hand based on the input signal. This entire circuit runs off 9V batteries, meaning several 9V are required to source enough current to drive all the parts for an extended period of time [1].

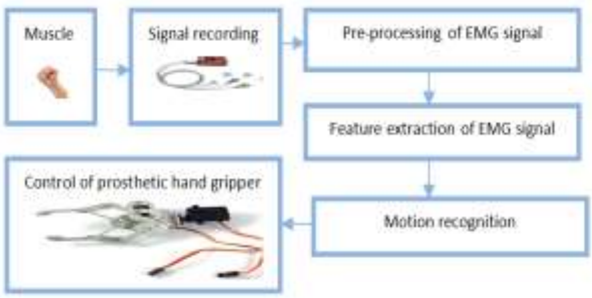

Fig. 1: Block diagram [2]

3.2 Hardware Specifications

3.2.1 EMG Sensor

The Electromyogram (EMG) Sensor allows the user to measure the electrical activity of muscles. It can be used as a control signal for prosthetic devices. This sensor will measure the filtered and rectified electrical activity of the muscle. [4]

Fig. 2: EMG Sensor

3.2.2 Hand Gripper

Ability to be used with 2 servo motors for gripper open/close and wrist rotate. Can grip and lift up to 200 gm of the load in form of small objects. Maximum opening 3.5cm. [3]

3.2.3 Servo motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. [5]

Fig. 3: Servo motor

3.2.4 Arduino (ATmega328)

The ATmega328 provides following features: The Atmel picoPower ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs close to 1MIPS per MHz this empowers system designed to optimize the device for power consumption versus processing speed.

Fig. 4: Arduino (ATmega328)

3.2.5 9V Battery

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in the rechargeable form in nickel-cadmium, nickel-metal hydride, and lithium-ion. Mercury-oxide batteries of this format.

Fig. 5: 9V Battery

3.2.6 Electrodes

Electrodes are very easy to handle, enabling you to very quickly set-up an EMG measurement using the pre-gelled disposable electrodes. The disposable electrodes have a measurement surface of about 12mm. [6]

Fig. 6: Electrodes

4. CONCLUSIONS

The Gripper was able to execute a variety of grips in response to detecting these objects. The Gripper was successfully designed to fit within the size restraints of the average adult male hand. The system functions were verified to the best of our abilities. If the recommendations we made for future improvements were implemented this device would be able to bring a highly functional and easy to use for thousands of people.

5. REFERENCES

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