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Prosthetic Arm with Microcontroller

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***Abstract*—A prosthetic hand can be designed to replicate the normal functions of the human hand by obtaining electro potential muscle signals associated with finger movements. A low-cost myoelectric robotic arm is described in this paper. The goal of the developed device is to be used as an electromyogram (EMG) signal-controlled low-cost prosthesis. As the key controller, the Arduino Development Board is used. Theoretical findings have shown that without dropping the item the automated hand should be able to perform gripping and clasping operations.**

Keyword: Prosthetic, Arduino, EMG

INTRODUCTION

Prostheses are tools which are used to restore and supplant lost appendages. People who unfortunately lose their limbs require a prosthetic limb in place of it which helps them carry out daily life activities.

In 2001, India had a population around 1,028,610,328, out of which around 21,906,769 people are specially abled and out of this, 6,105,477 people are suffering from movement disabilities. While developed nations show a smaller statistic of amputees, the developing nations comprise a total of 2.4 million arm amputees. The cable-driven actuation structure will agape and lock hand prosthetic extensions that may be claw-like tools that allow objects or latex-gloved devices to provide strong grasp strength and visual control that have a more pragmatic appearance at the cost of control. Usually, body-powered mechanisms are very robust and flexible and provide intuitive control of the prosthetic system through cable tensioning, as well as force feedback.

Quite possibly, the benefit of creating anthropomorphic robotic hands comes from the hope that motorized prosthetic hands will be used to regain vanished hand ability.

PRINCIPLE

The ElectroMyoGraphy signals are released when the muscles are flexed. The automated hand employs these signals from the flexor muscle and the extensor muscle. The muscle sensor module needs to be placed around the said muscles; one MyoWare muscle sensor is applied for receiving EMG signals.

We will carry on a trial of the muscle sensors with the accompanying two uncomplicated tasks: hand shutting and hand opening.
The automated robotic hand can use the natural signals of the extensor as well as flexor muscles to its benefit.

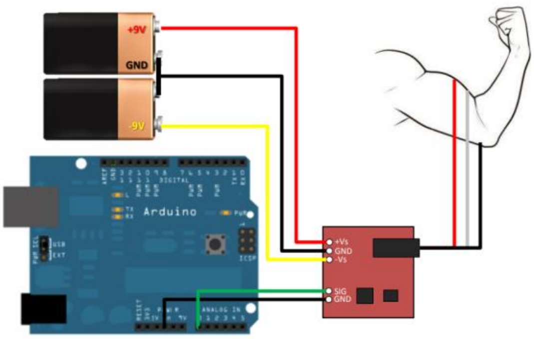

Fig.1 Basic Connection

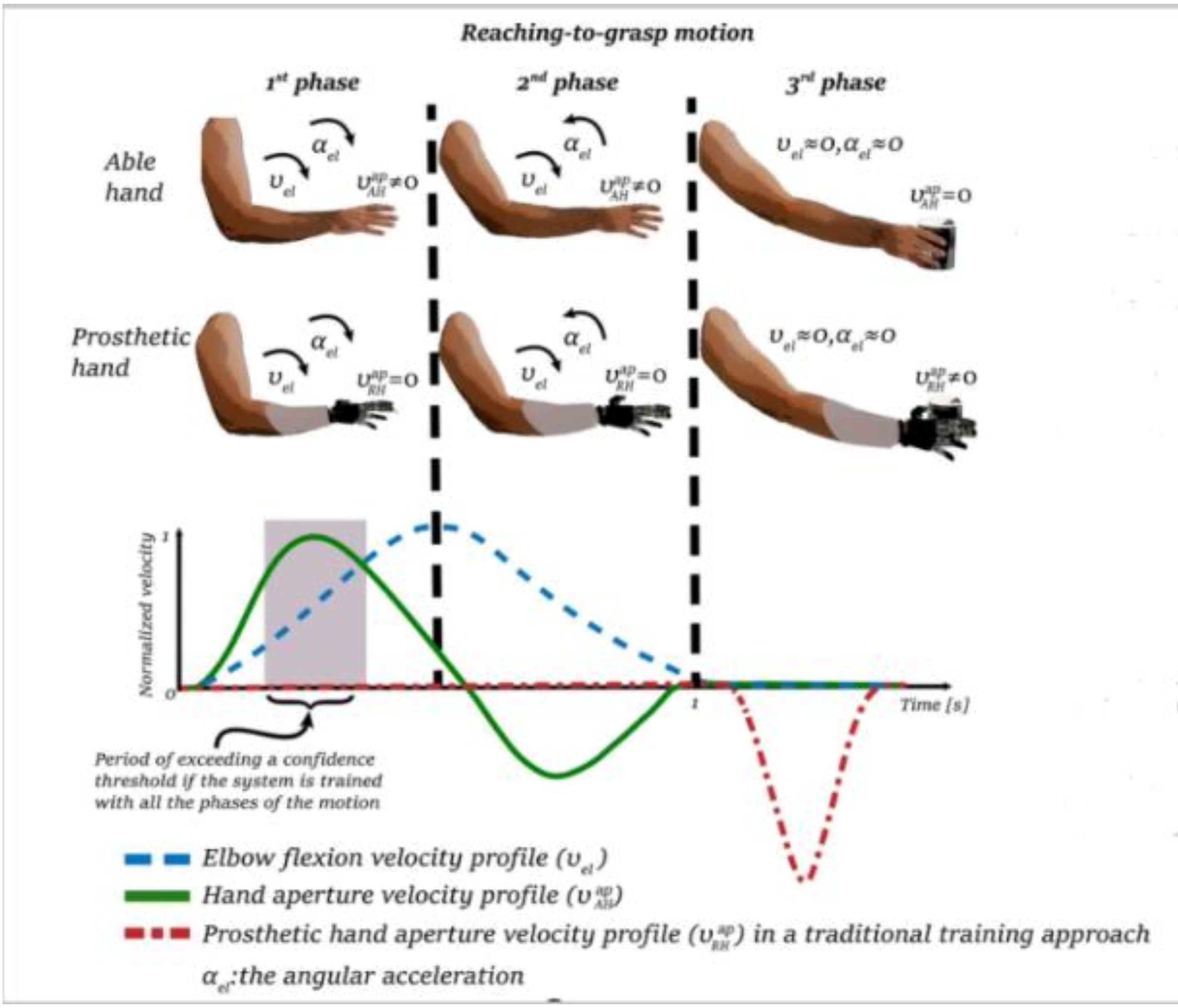

Fig.3 Muscle sensor

RELEVANT THEORY

The movement of actin against myosin to produce contraction is used by all forms of muscles. Contraction is induced in the muscle tissue by electrical signals generated by the nerves, in particular by motor nerves; we try to catch these electrical impulses by electrodes in the muscle sensor and use them to monitor our built protheses.

A vast number of research studies on prosthetic limbs are available. This thesis involves the recognition and application of EMG signals on a bionic arm from the human arm, the pattern and the progress of the prosthetic limb that is regulated by the signals from muscles close to the human shoulder. Myoelectric is one of the most widely used methods of the several techniques for manipulating prostheses, since myoelectric prosthesis users may use the signals.

Against the amount of prosthesis studies available, however, most of the works have ignored one issue: the cost. In design, production and distribution, the cost issue has a major role which can lead to considerably less sensitivity to the prosthesis.

WORKING

Figure 3 displays the summary flow-chart of our system. The flow of the mechanism commences from the site where EMG signals are produced i.e the human arm.The muscle movements that provide the definition of how tightly the muscle is being flexed. With the help of electrode patch, the MyoWare muscle sensors present in the muscle, Sense the EMG signals, which are then transmitted towards the principle transmitter. For the chief head controller of the robotic hand ,we will use an Arduino production board. The chief controller pushes compact servo motors after receiving the signals, as per the EMG signals. In the robotic paw, these small servo motors are placed.It often executes hand closing motion after the human user removes their hand. In comparison, as the user extends open their palm, the robotic Servo Motors Controller Arduino palm performs the opening process. This is how the hand's grasping actions will be performed.

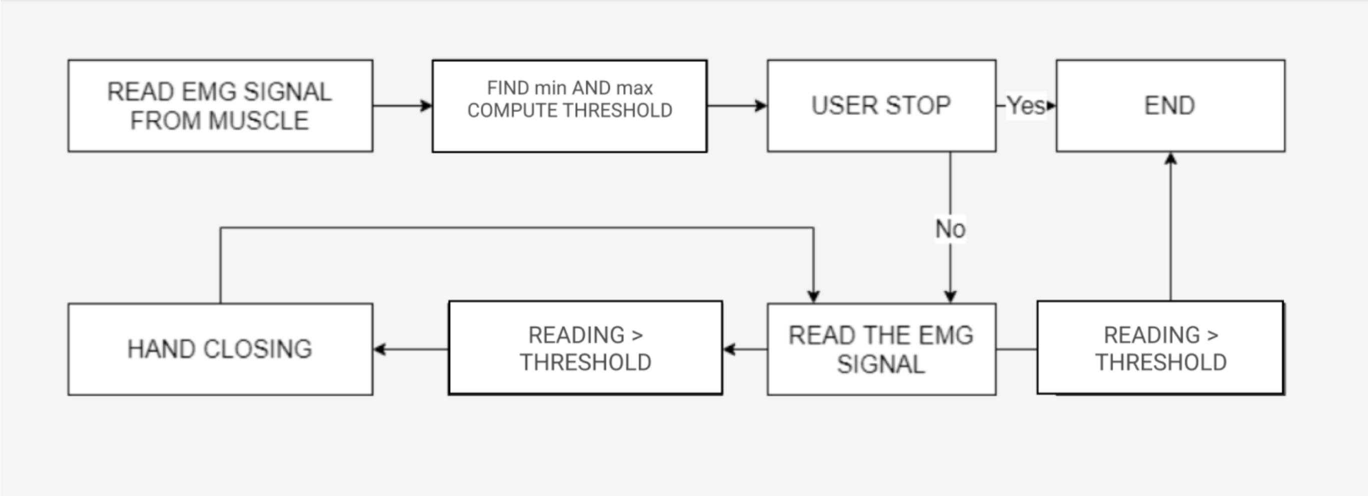

Fig.3 Overview Block Diagram

COMPONENTS

Servo Motor:

There are three major servo motors used in the entirety of the robotic arm, one for the base movements and two on the side of the base plate to transmit the movement through the various links to the arm in a precise manner. The servo motor will also be attached to the base plate, to keep it fixed and avoid vibrations during the actual functioning of the arm.

Fig.5 SG90 Servo

Controller:

A servo control, a sequence of repeating pulses of variable duration, may be obtained by transmitting a servo signal, where the positioning to be accomplished by the servo is determined either by the duration of the pulse. Like, servo motor shaft action, the controller translates the optical command signal into the analogue parameter.
Using the controller, we can monitor the number of servos at a time and upload the program regarding their movements synchronize the action of the servo for -operation of any servo in any series and synchronise the actuation of four servos sequentially in a loop programmed with the aid of the controller.

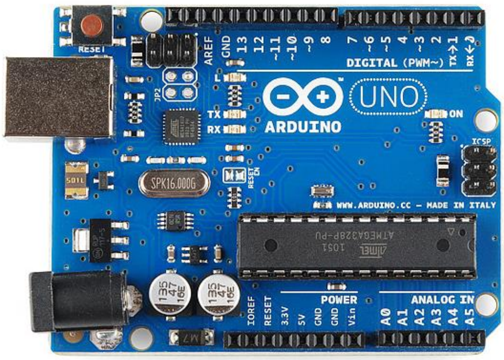

Fig. 4 Arduino

DC Power Source:

The electrical battery is made up of two or more electromagnetic cells. These cells convert the chemical energy into the electrical energy. Zinc-carbon batteries (a common dry cell battery) use dry Leclanche cells with a minimal voltage of 1.5 V, the same as alkaline batteries. They both use a zinc-manganese dioxide combination.

Fig. 6 Lithium Battery

Muscle Sensor:

EMG Muscle Sensor Module V3.0 filters and rectifies electrical activity of a muscle with the aid of cables and electrodes and outputs 0-Vs Volts based on the amount of activity in the muscle chosen, where Vs is the voltage of the power source.

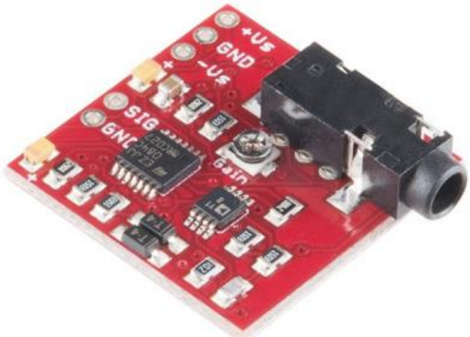

Fig.7 Muscle Sensor Module

Voltage Regulator:

In electronic circuits, voltage regulators are very common. For a varied input voltage, they produce a constant output voltage. In our case, the 7805 IC is an iconic IC regulator that is most often used in projects. Two meanings are suggested by the name 7805, "78" means it is a positive voltage regulator, and "05" means it provides 5V as output. So a +5V output voltage will be given by our 7805.
This IC will have an output current of up to 1.5A. However, for projects that use more electricity, the IC suffers from heavy heat loss, so a heat sink is suggested. For instance, if 12V is the input voltage and 1A is consumed, then (12-5) * 1 = 7W. These seven watts are dissipated as gas.

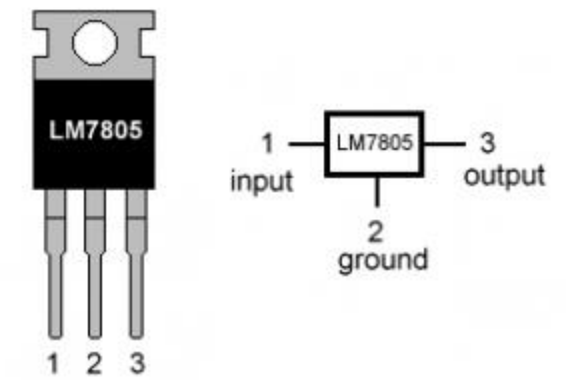

Fig.8 LM7805 Voltage Regulator

CONCLUSION

Arduino is the chief controller. Muscles that are responsible for decreasing on the two sides of joints between the bones 'flexor muscles', muscles responsible for increasing the angle henceforth 'extensor muscles' found in the human forelimb receive EMG signals. In terms of closing and opening of the hand, with respect to the signals, it would carry out a basic act.

Objects in the tests will be picked and clutched with some slipping from the prosthetic arm with the appropriate force. Future work involves hand interface enhancements and applications of deep learning approaches.

APPLICATION AND SCOPE

The main feature of this project is its simplicity and the cost efficiency. We believe with some better design of the robotic hand, we will also be able to perform better actions and with an additional number of sensors we may be able to replicate further actions involving natural hand-like movement of fingers.

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