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Prosthetic Human Hand Using EMG And ARDUINO Micro Controller

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Abstract— Prosthetic hands can partly replace functions of the missing hand, such as grasping and holding an object. Here the prosthetic hands are developed aiming at replicating the appearance and performance of the natural human hand and to obtain a complete functional substitution for the natural human hand. The artificial hand should be felt by the user as part of their body and it should provide the user the same functions of the natural human hand.The possible design shape is analyzed and embedded with electronic subsystem like sensors: EMG (Electromyograph), the actuation is provided by the servo motor.The kinematics, controllability, force distribution and torque required of the prosthetic hand are compared with the natural human hand and the maximum values are taken in to consideration. The brain of this prosthetic hand is an Arduino Uno microcontroller in addition to that EMG sensors and probes that are interfaced with the board, placed in the human hand and the whole setup is made up of polymer which is suitable and reliable for the fabrication purpose. As the EMG sensors are placed in the hand of the user is useful for the monitoring and grasping the nerve movement. The changes in the nerve movement with respect to the thoughts are grasped using the sensors and transmitted to the microcontroller which makes the hand to move accordingly.The programming is compiled through Arduino software, which is an open-source platform and the simulation of interfacing of components is done by using Proteus 8 Professional software.
Keywords-

Keywords— EMG (Electromyograph), Phalanges, Electrodes

I. INTRODUCTION

In medicine, a prosthetics is an artificial device that replaces a missing body part, which may be lost through trauma, disease, or congenital conditions. Prosthetic amputee rehabilitation is primarily coordinated by a prosthetist and an inter-disciplinary team of health care professionals including psychiatrists, surgeons, physical therapists, and occupational therapists.A person's prosthesis should be designed and assembled according to the patient's appearance and functional needs. For instance, a patient may need a trans radial prosthesis, but need to choose between an aesthetic functional device, a myoelectric device, a body-powered device, or an activity specific device. The patient's future goals and economical capabilities may help them choose between one or more devices. From[1]study andanalyze of the grip force distribution for different prosthetic hand designs and the human hand fulfilling a functional task is taken and from[2]design approach of the prosthetic hand and it's mainly focused on increasing the functionality, cosmetic and controllability of the prosthetic hand. The values from the above papers are taken in to consideration

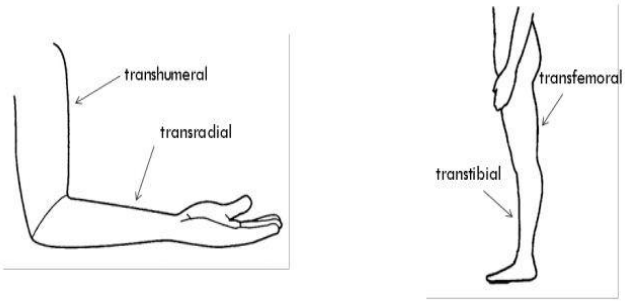

Fig 1 Types of Prothesis

II. PROPOSED METHODOLOGY

Arduino is open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world.

The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers.

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on the Processing project,which includes support for the C and C++ programming languages.

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Electromyography (EMG) is the study of muscle function through analysis of the electrical signals emanated during muscular contractions. Electromyography is often used by many clinicians and researchers. Many times even experienced electromyographers fail to provide enough information and detail on the protocols, recording equipment and procedures used to allow other researchers to consistently replicate their studies.

Electromyography is measuring the electrical signal associated with the activation of the muscle. This may be voluntary or involuntary muscle contraction. The EMG

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activity of voluntary muscle contractions is related to tension. The functional unit of the muscle contraction is a motor unit, which is comprised of a single alpha motor neuron and all the fibres it enervates. This muscle fibre contracts when the action potentials (impulse) of the motor nerve which supplies it reaches a depolarization threshold.

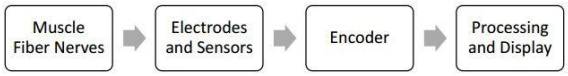

Fig 2 EMG process

Another widely accepted method of placing the electrodes or surface electrodes is to use the motor point. As with placing the electrodes over the belly of the muscle, there are numerous publications that give the general motor point locations as a starting location, then you can find the exact position by using the motor point finder. Another specific issue that must be addressed is the inter-electrode distance.

Unlike the classical Neurological EMG, where an artificial muscleresponse due to external electrical stimulation is analysed in static conditions, the focus of Kinesiological EMG can be described as the study of the voluntary neuromuscular activation of muscles within postural tasks, functional movements, work conditions.

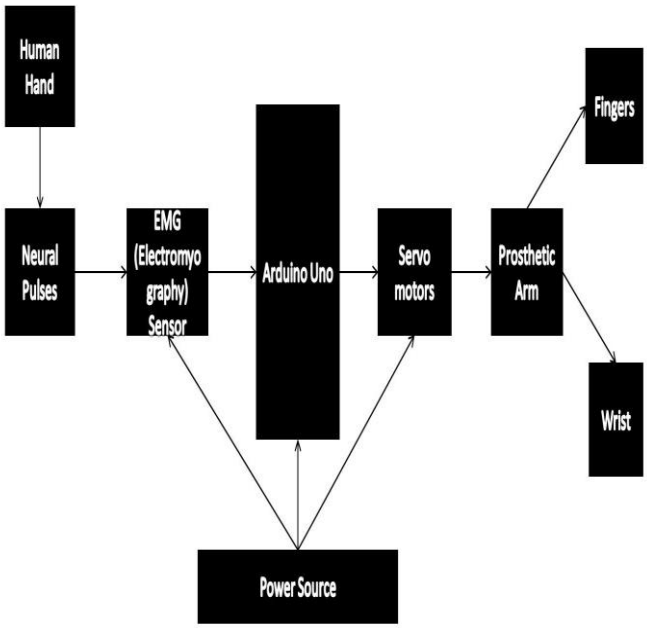

Fig 3 Proposed Block Diagram

A. Proteus

Proteus 8 is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. You can simulate your programming of microcontroller in Proteus 8 Simulation Software.

Proteus is a Virtual System Modelling and circuit simulation application. The suite combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs. Proteus also has the ability to simulate the interaction between software running on a microcontroller and any analog or digital electronics connected to it.

B. Electrodes Placing

A hand is a prehensile, multi-fingered extremity located at the end of the arm or forelimb of primates such as humans. A few other vertebrates such as the koala (which has two opposable thumbs on each "hand" and fingerprints remarkably similar to human fingerprints) are often described as having either "hands" or "paws" on their front limbs.

Fingers are some of the densest areas of nerve endings on the body, are the richest source of tactile feedback, and have the greatest positioning capability of the body; thus the sense of touch is intimately associated with hands. Like other paired organs (eyes, feet, legs), each hand is dominantly controlled by the opposing brain hemisphere, so that handedness, or the preferred hand choice for single-handed activities such as writing with a pencil, reflects individual brain functioning.

Fig 4 Human hand Anatomy

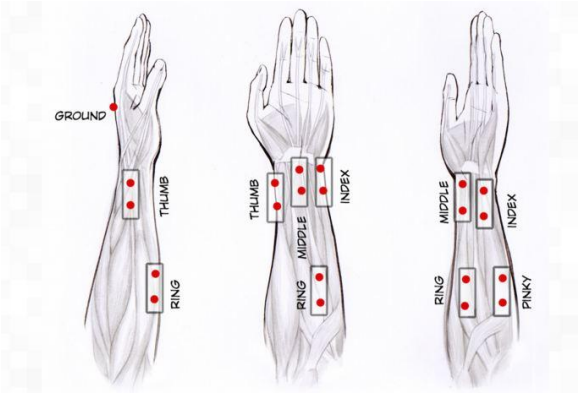

Fig 5Position for Placing Electrodes

C. Servomotor

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. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

III. CONCLUSION

From the different types of prosthetics arms used, the method I proposed is easy to be constructed and user friendly. Thus by implementing this idea many people could use it in an effective way. The design and simulation for the prosthetic hand was completed in this paper, and the further development of the prosthetic hand will be developed from the analysis of the result which have been obtained from this paper.

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