Emg Based Prosthesis Hand For Physically Challenged

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ABSTRACT-Prosthesis is basically artificial device which replaces a part or organ of body. A myoelectric prosthesis arm as name suggest, is a prosthesis arm which uses myoelectric (EMG) signals for control. This is possible due to the fact that the neuromuscular system of amputees remains intact even after amputation. The residual signals are made use of and it is sufficient enough to control the movement of the arm after suitable processing. Actuators such as motors are used replace the role which muscles play by providing force for movement of the arm. . But non-invasive is often preferred, because it is directly placed above the skin surface without inserting the electrode into patient body This thesis topic covers a broad range of engineering disciplines. The root of the system is an innovative mechanical design for a 3D printed prosthetic arm. Modern day electronic actuators and circuitry animate the device and allow for sophisticated control schemes. It is hoped that this work will be of value to a diverse audience.

Keywords-electromyography, online, prosthetics, ABS, Robotics, Degree of freedom.

I. INTRODUCTION:

It could be most valuable possession to any human being is their body. Replacing a missing human limb, especially a hand, is a challenging task which makes one truly appreciate the complexity of the human body. For centuries innovators have been trying to replace lost limbs with manmade devices. Several prosthetic devices have been discovered from ancient civilisations around the world demonstrating the ongoing progress of prosthetic technology.A myoelectric control system is one in which operation of the output apparatus is controlled by the electric potentials which accompany the contraction of one or more muscles. The advantages of myoelectric control over other control methods In a myoelectric control system, this electric control signal is derived directly from the action of the controlling muscle. The human finger in total has 4 degrees of freedom. Three of these are the rotations of each joint (DIP, PIP, MCP) which combine to control flexion and extension of the finger.

II. BLOCK DIAGRAM

To create a useful myoelectric prosthesis it is necessary to have a well-designed mechanical system.

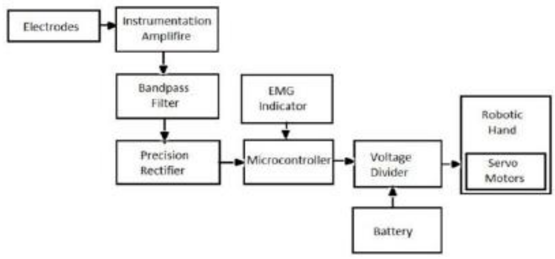

Fig.1 Block diagram of EMG Based Prosthesis hand.

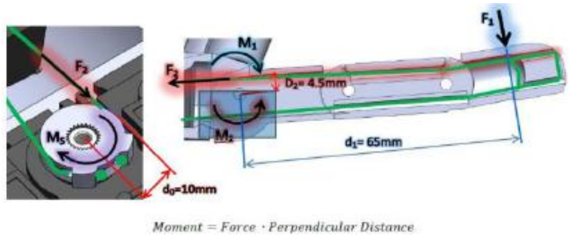

Fig.2 Forces acting on finger

In this case the tendon creates a moment about each joint in the finger. The moment about the knuckle joint will be the greatest since it is the furthest away from the applied force. Therefore it is the turning force at the knuckle that limits the load we can lift at the tip of the finger. At the point where the maximum lift-able load is applied the moments M1 and M2 will balance out. To begin our calculations we must determine the tensile force in the tendon. The stall torque (maximum turning force) of the MG996R Servos is 10kg-cm (1 N/m).

$$\tau_{servo} d = F_2$$

$$F_2 = 1(N/m) \cdot 10mm$$

$$F_2 = 10N \ (tension\ in\ the\ tendon)$$

$$F_1 D_1 = F_2 D_2$$

$$F_1 = \frac{10(N) \cdot 4.5(mm)}{65(mm)} = 0.70 \text{ N}$$

$$Mass_1 \approx 70g$$

III. FINGER ACTUATION SPEED

The MG996R servo has an operating speed of 0.15sec/60O. A full wrist rotation from a palm up to a palm down position (180O) therefore takes (0.15/60)*180 = 0.45s.

$$\frac{0.15s}{60^{o}} \cdot 180^{o} = 0.45s$$

It has been measured that a tendon must move about 2cm to move the finger from fully extended to fully flexed. Using the arc length formula

$$length = \frac{n^{o}}{360^{o}} \; x \; 2\pi r$$

IV. CONTROL FLOW

Flowchart shows the overall process of our project. EMG sensor sense muscle movement and convert it into the analog signals. Bandpass filter reject the undesired frequency band. EMG signal frequency range is 20Hz – 300Hz. It calculate absolute value of EMG signal.

Precision rectifier rectify the signal above and below the 0.7V. Controller defines fixed threshold voltage for hand close and open according to threshold if received signal voltage greater than threshold voltage then hand will open and otherwise close action.

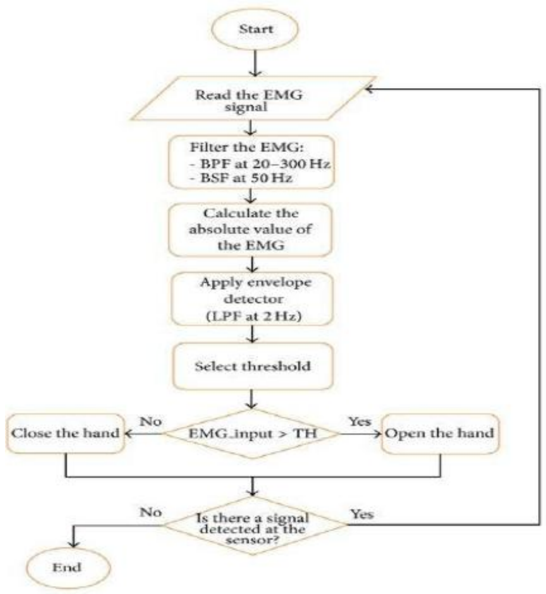

Fig.3 Control Flow

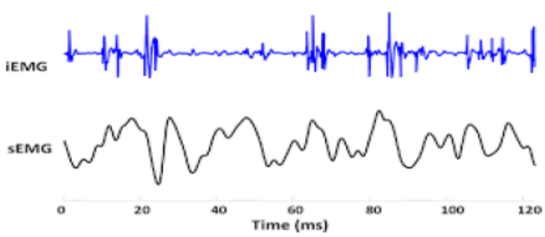

Fig.4 EMG Signal

Electromyography sensing Myoelectric signals are electrical pulses within the body produced by contracting muscles. Surface electrodes on the user's skin can detect these small signals and in the case of prosthetics be used to control the device. The problem with surface EMG techniques is that there is a lot of cross talk between muscle signals. Because muscles groups, especially in the arm, are physically close together, it is difficult to distinguish exactly which muscle is generating the measured signal via the surface electrodes. One way of alleviating this problem is through target muscle reinnervation (TMR). TMR is a surgical procedure which takes residual nerve endings from an amputation site and spreads them across an alternative intact muscle group. Because the nerves and corresponding muscle contractions are now spread over a larger area it is easier to decipher individual signals.

V. RESULTS

This system is designed& programed, manufactured, and tested. A virtual simulation has been done with its approximate results. to simulate the motion of motors according to signals from muscles, identifying the best position to take the signal from as well as using it in the of powered prosthetic offers great comfort to the patient.

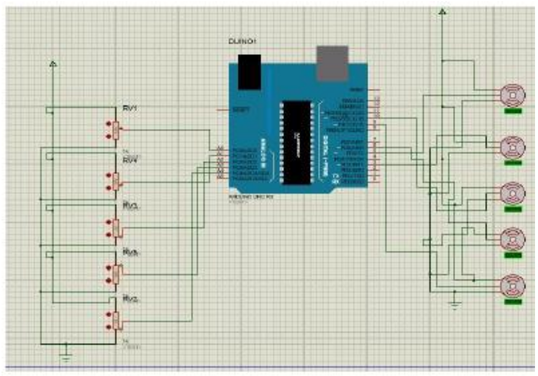

Fig.5 Simulation Result

Printed circuit consist of conductive circuit applied to one or both the sides of an insulating base , depending on that it is called either single sided or double sided PCB. The performance of an electronic circuit depends upon the layout a design of the PCB. They are used to route the electrical current and signals through copper tracks which are finally bounded to an insulating base.

Fig.7 PCB Design

VI. CONCLUSION

The academic goals of this thesis were initially uncertain and certainly change throughout the course of the year. The initial aim was to develop a low cost 3D printed myoelectric prosthetic arm. The goals and expectations for this thesis have been achieved and it is hoped that the presented body of work allows for several new thesis topics to be researched in the future. the EMG signals from the muscles sensors operates hand according to program of controller unit.

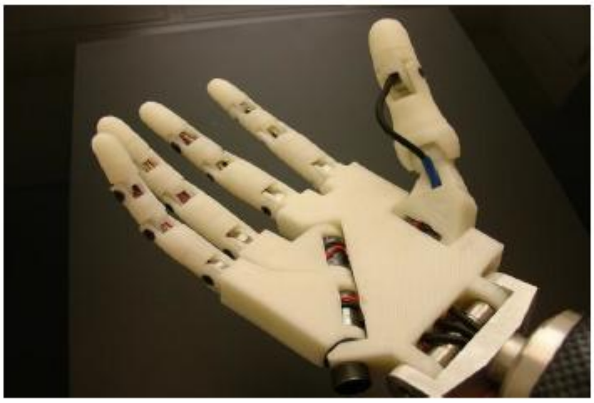

Fig.8 Open Hand

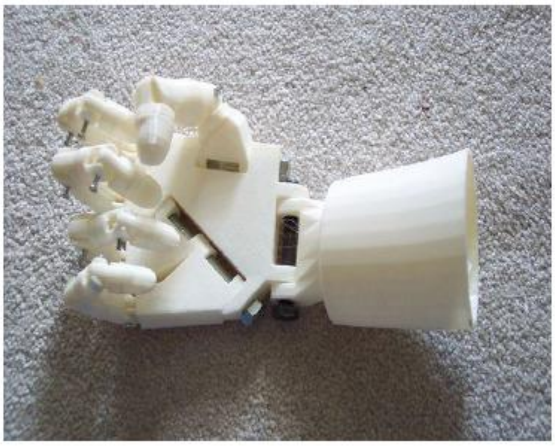

Fig.8 Close Hand

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