DESIGN AND IMPLEMENTATION OF A BIONIC LIMB

A PROJECT SYNOPSIS

SUBMITTED BY

ASEEM MISHRA (T150953004)

SAMIKSHA KAMBLE(T150953058)

ADITYA SANGLE(T150953059)

UNDER THE GUIDANCE OF

Prof. HARSHALI MANE

SUBJECT: EMPLOYABILITY SKILLS AND MINI PROJECTS (ESMP)

TE (ELECTRONICS AND TELECOMMUNICATION)

INNOVATION & LEADERSHIP

www.isquareit.edu.in

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

HOPE FOUNDATION's

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY,

HINJAWADI, PUNE(MH)-411057

SAVITRIBAI PHULE PUNE UNIVERSITY

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Project Details

Problem Statement

The aim of this project is to create a prototype of a hand which can be placed on the forearm of the body. This hand would achieve the basic movements of grabbing an object in two different ways:

[1]Impingement, with the index, middle Finger and thumb. For smaller objects and more precision.

[2] Enclosure, with the whole fingers. For standard objects. To developed a prosthetic arm which is low in cost, and restricted in the movement.

The proposed system can be controlled by signals from a set of muscles in the body (i.e., EMG signals) and will have a functional elbow and hand with independent functionality. More over the arm will be lightweight and strong enough for daily activities.

Introduction

Prosthetic is an artificial device that replaces a missing body part, which may be lost through trauma, disease, (or) congenital conditions. When a person becomes a limb amputee, he or she is faced with staggering emotional and financial lifestyle changes. The amputee requires a prosthetic devices and services which become a life-long event. Prosthesis is an artificial extension that replaces a missing body part such as an upper or lower body extremity. It is part of the field of biomechatronics, the science of fusing mechanical devices with human muscle, Brain, skeleton, and nervous systems to assist or enhance motor control lost by trauma, disease, or defect. An artificial limb is a type of prosthesis that replaces a missing extremity, such as arms or legs. The type of artificial limb used is determined largely by the extent of an amputation or loss and location of the missing extremity. Artificial limbs may be needed for a variety of many types of Prosthesis Reasons, including disease, accidents, and congenital defects. There are four main types of artificial limbs. These include the transtibial, transfemoral, transradial, and transhumeral prostheses. From many papers on biomedical and mechatronics it is studied and analyzed the grip force distribution for different prosthetic hands designs and the human hand fulfilling a functional task is taken and the design approach of the prosthetic hand and it's mainly focused on increasing the functionality, cosmetic and controllability of the prosthetic hand. 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. The values from the above papers are taken into consideration.

Objective

- The main objective is to design and develop a reliable low - cost prosthetic arm control circuit.
- A control system circuit using Arduino will be proposed.
- A Simulation of the proposed system will be run.
- Performance evaluation of the proposed system will be carried out.

Outcome

1.We will be able to achieve the prototype of bionic limb.

2.The amputee will be able to perform various movements and physical manipulation of good using his artificial limb.

3.The improvement or optimization of the kind of technology used in creating a bionic limb.

Abstract

This project deals with the design and development of Bionic Limb for amputated person. The design of the system is based on a simple, flexible and optimal control strategy that enables the person to use the device as normal arm. The hand system has independent commands to move the limb up and down precisely. Implementation of the mechanical hardware design of the human hand is based on connected double re volute joint mechanism. The tendon system of the double re-volute joint mechanism and feedback network provides the hand with the ability to confirm to object topology and therefore providing the advantage of using a simple control algorithm. The model should be fabricated with Servo motors and force sensors for fingers actuation. The entire setup is mounted on to the shoulder of the amputated person. Inputs for the motors can be generated through EEG signals generated from touch sensor, which enables the user to grasp the objects. This thesis explores the boundaries of one of the most advanced multi material 3D printers today. By doing so, inspiring others to create more natural looking and less power consuming prosthetic.

Project Category

Example- Instrumentation and Control Systems, Electronic Communication Systems, Biomedical Electronics, Power Electronics,Audio , Video Systems, Embedded Systems,Mechatronic Systems etc.

Proposed system

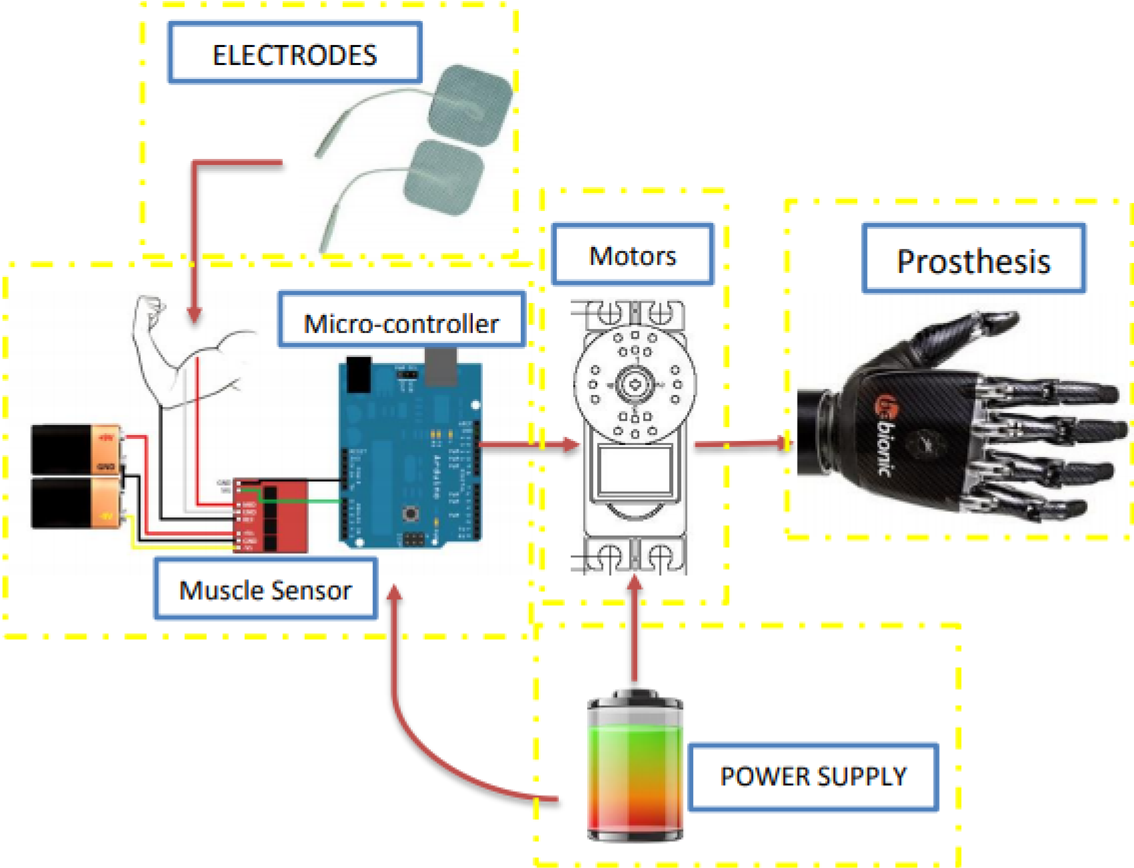

Figure 1: Block diagram

A bionic arm works by picking up signals from a user's muscles. When a user puts on their bionic arm and flexes muscles in their residual limb just below their elbow; special sensors detect tiny naturally generated electric signals, and convert these into intuitive and proportional bionic hand movement. The bionic hand is controlled by tensing the same muscles which are used to open and close a biological hand. Most Bionic Arm users are able to control their bionic hand within just ten minutes, whereas some require a little more rehabilitation to strengthen their muscle sites.

The technology fitted inside the bionic arm is known scientifically as electromyography, and the special sensors are electromyographical, or EMG, electrodes. Myoelectric bionic arms are plug and play, meaning users can take their bionic arm on and off. The bionic Arm has an adjustable dynamic socket for maximum comfort. No surgery is required The implementation of 3D printing and computer numerical control (CNC) machining in biology is a relatively new and exciting field of study.

Robotic limbs and prosthesis are mainly constructed with bolt joints, motors and actuators, components you will not normally find in the human body. Every new product is lighter and better, and effort is made to make robotics more realistic looking. Most bionic limbs have built-in computers that detect the muscle signals. Some bionic limbs require sensors to be implanted into the remaining muscles of the limb. This type of bionic limb is much more advanced and can allow users to control the limb with their minds.

This type of prosthetic limb gives users maximum control and adapts to how quickly or slowly the muscles tense. When the muscles are tensed more gently, the bionic limb will respond slower. When muscles are tensed quickly, the limb will react faster.

Requirement of resources and limitation

The manufacturing requir some basic concepts and platforms for manufacturing the product. Basic requirement of 3D manufacturing process is to develop a software based digital model of product. To develop a digital model of we can utilize a different CAD software(i.e. Pro-E, Creo, SolidWorks, CATIA, Blender etc.)

To manufacture the prosthetic hand with use of the additive manufacturing/3D printer we have to set some parameter for printing. To set that parameter i.e. bed temperature, nozzle temperature, alignment of object, coordinates of the object, layer thickness etc. different software are used.

One of the software used for this application is ‘CURA’. After setting all parameter in software, we just input that software generated file to 3D printer. 3D printer will read the file and manufacture the object according to given dimension and parameter.

Impact Analysis

Social:

Positive Impacts:

- Limb Movement
- Perform Various Activities
- Physical Manipulation of things
- Active Participation In social Activities

Negative Impacts:

- May Experience Severe pain
- Extra weight of limb
- Uneasiness

Future scope and Further enhancement

Automation, Continuous improvements of the program and the signal reading. Improve the design to achieve more natural and real shape.

For centuries prosthetics have been limited to basic attachments replacing missing limbs or extremities, but in the last 20 years, artificial limbs have moved forward at an electric pace.

Today's technologies incorporate more advanced ranges of movement and, with the advent of neuroprosthetics, researchers have brought about the rise of sophisticated brain-controlled prosthetic limbs. These are combined with electrode arrays – placed in the brain, nerves or muscles – to decode the messages between the brain and the limb that control movement, allowing users' brains to power basic movement in, say, a prosthetic arm.

As University of Chicago (UChicago) associate professor and neuroprosthetics researcher Dr Sliman Bensmaia notes, brain-controlled prosthetics have become a vibrant field of research.

"The idea is to put electrodes in [the motor cortex] so when [a tetraplegic patient] tries to move their arm, or imagines moving their arm, there is a characteristic pattern of activation in this motor part of the brain," he says. "We can take the signals from this part of the brain and infer what the patient or the subject wanted to do, and then you make the robotic arm do that. There's a cottage industry of developing different ways of doing that, and they're all slight variants of one another."

Neuroprosthetics have unlocked advances that amputees and paralysed patients previously wouldn't have dreamed of, but as with any rapidly emerging area of research, there's still a long way to go before the field meets its full potential. One of the major limiting factors for the dexterity of neuroprosthetics relates to a sense that most humans take for granted: touch.

Conclusion

- The prosthetic hand through additive manufacturing process is the ultimate solution for a cost effective prosthetic hand.
- Increase in quality accuracy of the model is achieved.
- a unique combination of medical science and computer aid designing and manufacturing

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Table 1: PROJECT PLANNING: (Timing Analysis)

Parameters	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**	**Week 9**	**Week 10**	**Week 11**	**Week 12**	**Week 13**
Formation of group													
Identification of problem statement													
Literature survey													
Objectives and outcomes													
Proposed system (methodology)													
Simulation/ Bread board testing)													
PCB designing and manufacturing													

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Testing and verification													
Report writing													
Final presentation/ demo													
(color the cells selected for the task/parameter to be perform)													