Prosthesis-An era for physically challenged people

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ABSTRACT:

These days the major difficulties are faced by lame and handicapped people. Prosthesis gives a new life to these people by providing them with the gifts that a normal human being possess. This paper deals with implementing prosthesis with highest speed by uses by motors and CNTs taking care of the weight of the materials used in prosthesis.

KEY WORDS:

Prosthesis- artificial device that replaces a missing body part, DC- brushed micro motor- motor with reliably good speed

INTRODUCTION

Since the beginning of time humans have felt the need to replace lost limbs for cosmetic, functional and psycho-spiritual reasons. Prosthetic limbs helps to give people back their independence and challenge stereotypes of disability. Prosthetic limbs are incredibly valuable to the amputees because a prosthesis can help restore some of the capabilities lost with the amputed limb.

What is a Prosthesis?

A prosthesis refer to an artificial replacement for any missing body part like fingers, toes, ears, eyes, noses and limbs as well. About 9000 products of prosthesis has been developed. Some of them are artificial pacemaker, hip and knee replacement, intraocular lenses, cardiac stents, bones, corneas and human tissues.

Modern Prosthetic Limbs:

Modern prosthetic limb replaces peg legs and mobility aiding sticks with power suits and robot arms. The prosthetic limb was once a static, inflexible mockery for the lost one but today, the incredible technology in the science of prosthetics makes them elegant examples of new technology and design that are awe inspiring. Electronic technologies make today's advanced prosthetics more controllable, even capable of automatically adapting their function such as walking, running, etc.

Components of a prosthetic limb:

- Pylon
- Socket
- Suspension system
- Foam cover
- Foot

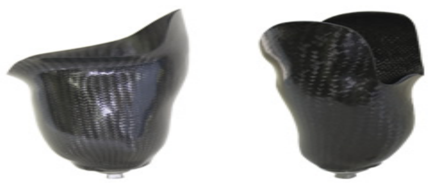
Pylon :

The pylon is the internal structure that makes the skeleton of a prosthetic limb. It gives the structural support and has traditionally been formed of metal rods. Later the heavier metal rods are replaced by light weight metals such as aluminium and titanium alloys. More recently carbon fibre composites are used for its lighter weight and strength. The pylons are sometimes covered by a foam-like material which can be shaped to match the recipient's dimension, shape including his/her skin tone. It also gives the prosthetic limbs a more lifelike appearance. The socket is usually made from polypropylene.

The socket:

The prosthetic socket joins the residual limb to the prosthesis or artificial part with a liner interface that gives a cushion and comfortable fit to the recipient. It forms the second skin that lies between the movable muscle tissue and the hard core of the socket. It reduces friction and pressure points of the residual limb for protection. In order to do so, the prosthetic socket is custom-made for each patient according to the shape and condition of the residual limb and the respective mobility grade.

The socket is a portion of prosthetic device that interface the artificial part with the patient's limb stump or residual limb. Because the socket transmits force from the prosthetic limbs to the body, it must be meticulously fitted to the residual limb to ensure that it does not cause irritation or damage to the skin or underlying tissues. A soft liner is typically situated within the interior of the socket and the patient also wear a layer of one or more prosthetic socks to achieve a more comfy fit.



The suspension system:

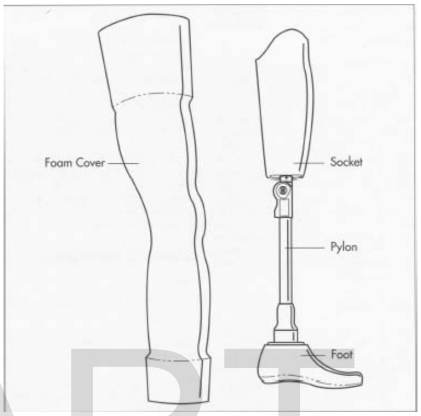
The suspension system is what keeps the prosthetic limbs attached to the body. The suspension mechanism can come in several different forms such as straps, belts or sleeves which are used to attach the prosthetic device.

Foam cover:

The pylon is usually covered by a foam like material to give the shape of the limb which resembles exact limb of the recipient by taking proper measurements.

The Foot:

The feet are made from urethane foam with a wooden inner keel construction. Other materials commonly used are plastics such as polyethylene, polypropylene, acrylics, and polyurethane. Prosthetic socks are made from a number of soft yet strong fabrics. Earlier socks were made of **wool,** as are some modern ones, which can also be made of cotton or various synthetic materials.



PROPOSED MODEL:

The prosthetics commonly used these days is myoelectric prosthetics. The myoelectric prosthetics use a DC motor that is usually run by a battery, in order to control the movement of the limb and the fingers. This kind of prosthetics use electric sensors that get the data from the movement of muscles. It can provide high speed and strength to the limbs. The myoelectric prosthetics also suffer from its own disadvantage of giving higher amount of weight to the artificial limb. The weight generated is due to the motor and the battery used. This makes the user uncomfortable.

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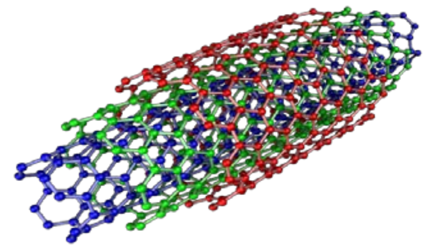
A reliable change can be bought in the components used in the process of prosthetics. The prosthetics contain the usage of the following parameter.

- Preparation of Pylon:

The pylon is the basic element of the prosthetics. It is the skeleton or the internal frame of the limb. The pylon used commonly these days is made of Titanium steel pin. Since the pylon acts as the internal frame it must have good strength, it must be weightless and easy to be handled by the patient. In recent trends, lighter carbon – fiber composites have been used to make pylon.

- Proposed material for the preparation of pylon:

For getting the structure with good tensile strength and high durability the carbon nanotubes (CNTs) implementation is bought up in this paper.Carbon nanotubes are allotropes of carbon that are usually cylindrical in shape. With the development in carbon nanotubes, an implementation of grapheme carbon nanotube can provide relatively high strength. The fundamental advantage of an integrated grapheme-CNT structure is the surface area, three dimensional frame networks of CNTs couple with the high edge density of grapheme. Graphene edges provide significantly higher charge density.



The CNTs possess high strength and are very minute in diameter (of nano and micro range). Preferably multi walled nanotubes implementation can be surrounded by Titanium Steel pin to increase the strength incredibly.

Properties of CNTs:

- Carbon nanotubes are the strongest and stiffest materials yet discovered in terms of tensile strength. A multi-walled carbon nanotube can have tensile strength up to 63 gigapascals (GPa).
- It is durable and non-corrosive.

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- Standard single-walled carbon nanotubes can withstand a pressure up to 24 GPa without deformation.

- **Foam:**

The pylon is generally surrounded by foam that usually is in the color of the skin and gives a good physical appearance to the artificial limb. In order to get a good shape of the limb, a foam made of Polyurethane is used.

- **Socket:**

The socket is the portion of the prosthetic device that interfaces with the patient's limb stump or residual limb. Because the socket transmits forces from the prosthetic limb to the patient's body, it must be meticulously fitted to the residual limb to ensure that it doesn't cause irritation or damage to the skin or underlying tissues.

- **Suspension System:**

The suspension system is what keeps the prosthetic limb attached to the body. The suspension mechanism can come in several different forms. For example, in the case of a harness system, straps, belts or sleeves are used to attach the prosthetic device.

Components:

The working process of the prosthetics with the structure given above can be done by using Biomechatronic Components. These include:

- **Biosensors:**

Biosensors detect the user's "intentions." Depending upon the impairment and type of device, this information can come from the user's nervous and/or muscle system. In simple words, the response of the brain and the shrinking of the muscle part from where the artificial limb is attached are recognized by this sensor. The biosensor relates this information to a controller located either externally or inside the device itself, in the case of a prosthetic. Biosensors may be wires that detect electrical activity such as galvanic detectors (which detect an electric current produced by chemical means) on the skin, needle electrodes implanted in muscle, and/or solid-state electrode arrays with nerves growing through them.

The biosensors receive the signal from the brain and the muscle detects it in the correct manner and sends its response back to the brain.

- **Controller:**

The controller is interfaces the user's nerve or muscle system and the device. It relays and/or interprets intention commands from the user to the actuators of the device . It also relays and/or interprets feedback information from the mechanical and biosensors to the user. The controller also monitors and controls the movements of the biomechatronic device.

- **Mechanical sensor:**

Mechanical sensors measure information about the device (such as limb position, applied force and load) and relate to the biosensor and/or the controller. These are mechanical devices such as force meters and accelerometers.

- **Amplifier:** (introduced in the model)

The signals obtained from the biosensors are not sufficient to be detected by the mechanical sensor. In order to overcome this drawback, an amplifier to increase the gain of the electrical signal is provided. The amplifier is basically designed using Integrated Chips (IC). Since the ICs are very small in size, the placing of the amplifier prepared using them won't be a sign of difficulty.

- **Actuator:**

The actuator is an artificial muscle that produces force or movement. The actuator can be a motor that aids or replaces the user's native muscle depending upon whether the device is orthotic or prosthetic.

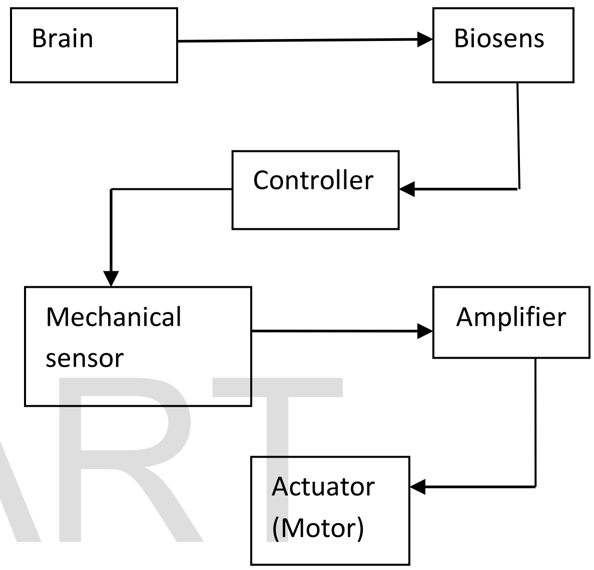
- **MOTOR: (introduced in the model-micro motor)**

The controller acts as a medium between the biosensor and the mechanical sensor. The electrical signals after amplification are carried to the actuators (motor) using wires. The Dc motor basically used is brushed motor having a need of 27 rpm. A Dc-brushed micro motor can act as the best source of speed.

Features of micro motor:

1. It gives high speed.
2. Easy to clean.
3. Small in size and easy to fit.

General Working:



The intentions of the brain with respect to the movement of the limb are recognized by the biosensor. The movement of the muscle (shrinking and expanding) at the point where the artificial limb is attached also helps the biosensors to sense the needed movement. After receiving the pulse from the brain and processing it, the biosensor sends the response detection signal back to the brain.

The controller controls the signals and acts as an interface between the biosensor and the mechanical sensor.

The mechanical sensors relates the position of the limb giving the details about how it has to be moved with respect to the signals obtained by the biosensors.

The electrical output obtained is relatively very low to run a motor. Thus, a convenient amplifier made up of IC to give small size is used in order to increase the gain at the output.

This electrical energy is fed to the motor (brushed micro motor). The micro motor rotates in an average speed and this helps the patient to move the artificial limb.

Advantages:

- With the usage of CNTs the strength of the pylon is increased.
- This kind of prosthetics contains less weight.
- It is easy to clean and looks natural.
- It does not involve a tedious process of operation or manual operation.

Conclusion:

Thus prosthesis with CNTs and micormotors can give reliably fast working and comfortably prosthesis and help in advancement in the field of medicals too.

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