Bio limb for Amputees

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Abstract : This study has been undertaken to help partially amputed people to gain better psychological outlook in life. Most of the EEG and EMG prosthetic hands have several shortcomings such as low intensity, high cost and blocked them from practical realization. The present proposal proposes a novel method of providing a user friendly and cost effective device for partially amputed people. The program of the device was done by using an Arduino microcontroller. This novel device can help a partially amputed person to lead a normal life in society and gain his self-esteem. The cost of the device is three times low as compared to the marketed device which has less option and heavy weight. This cost effective device was designed with limited number of sensors and motors in order to achieve its compactness and it would also produce more number of hand movements much similar to the original hand.

Index Terms **- Biomimetic limb, Arduino microcontroller, servo motors, flexes sensors, cost effective**

I. INTRODUCTION

The research on prosthetic hands has developed rapidly in recent years to meet the demands of those who have lost their limbs. Although electroencephalography (EEG) and electromyography (EMG) is used in many research fields, these signals only give a coarse view of neural activity and muscle activity of human body [1]. Amputation is the removal of a limb by trauma, medical illness, or surgery. There are many reasons an amputation may be necessary. The proposed project aims to design a biomimetic limb for partially amputed people. which would make a difference to the victim and also boost his self-esteem and confidence. The aim of the project is to design a cost effective biomimetic device using limited number of sensors and motors. Attaining more effectiveness with less number of sensors is a major issue.it is also important to have a detailed study on operations and functions of amputed part.

In the current scenario signals are acquired from the forearm. These signals do not give accurate results for movement of individual fingers [1]. EEG and EMG sensors are used which are slippery, cause irritation on skin and which do not provide effective results [1,5]. Usage of minimum number of motors limits the grasping action [2]. The proposed proposal checks the effectiveness of each and every finger independently and provides more accurate output. The flex sensors help to mimic the functions of hand and it does not cause any pain or insecurity to the amputee. Pressure sensors were designed at the tip of each finger that provided similar sensing as that of original hand[3].The major drawback of pressure sensors is, when it comes in contact with the object the force misinterpreted by the sensor. When each finger of the hand was designed based on the coupling linkage principle and actuated by a DC motor individually the prosthetic hand was noisy due to multiple number of gear stages and did not maintain a dynamic relationship between force and position [4].

II. RESEARCH METHODOLOGY

The methodology involves collection of different types of acrylic pieces were collected to design the artificial hand. The artificial hand was made in such a way that it appears similar to original hand. Designing the hand glove with flex sensors was a prototype hand with servo motors. Comparison and compilation of the working movement of the prototype based on hand glove was carried out by providing the standardised power supply to Arduino. The Arduino was programmed and tested with respect to flex sensors.

2.1 Materials and Methods

In the current scenario signals are acquired from the arm are much more comfortable and compatible. Electromagnetic sensors were placed in different positions for capturing the anatomical position in real time [Allen et al. 2003]. The present work used the flex sensors on the glove for capturing the anatomical position of the fingers in real time. The flex sensors were used for bending the fingers and maintain its resistance.

2.1.1 Sensory System

The Flex Sensor' or 'Bend Sensor' converts the change in bend into electrical resistance and the bend is directly proportional to its resistance value. The Flex sensor was procured from amazon.com and it is based on resistive Carbon elements. As a variable printed resistor, the flex sensor achieves great form-factor on a thin flexible substrate and gives the range of resistance from 30 K Ohms to 125 K Ohms. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius

and the radius is inversely proportional to resistance value. The sensor is printed with a polymer ink that has given the resistance of about 30k Ohms when the sensor is straight.

2.1.2 Arduino microcontroller

Arduino microcontroller type "ATmega328" has an operating voltage of 5V. It has fourteen digital input output pins of which six provide Pulse Width Modulation output. Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. "Uno" which means one in Italian was chosen to mark the release of Arduino Software (IDE) 1.0 which included the Uno board and version 1.0 of Arduino Software. A standard programming language compiler and a boot loader is present in the Arduino that executes the programs given to the microcontroller. The hardware consists of a simple open source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM.

2.1.3 Servo motor

The servo motor is normally a simple DC motor which is used for controlling specific angular rotation with the help of additional servomechanism like a typical closed loop feedback control system. It is very tiny in size and weighs around 9grams with high output power. The working of a servo motor is much similar to the DC motor but it is smaller in size than the DC motor. Servo motors are available in power ratings from fraction of few watts up to few 100 watts. These motors have high torque capabilities.

2.1.4 Prosthetic Hand

The Prosthetic Hand was designed using human hand's anthropomorphic characters such as the appearance, power, weight, the grasp functionality etc. The shape of palm and fingers and their positions are similar to that of human hand. The ultimate goal of the design was to develop a five-fingered hand that is lighter and cost effective, with built-in actuation mechanism.

Figure1: Prosthetic Finger

III. RESULTS AND DISCUSSION

The proposed system was developed and tested for various degrees of freedom. Since the artificial hand consists of more number of joints, we are able to obtain better flexibility and good degrees of freedom. In the current scenario the patient has to remove his limb due to any accidental issues. Because of removal of limb or parts of limb the patient loses his moral strength as well as feels inferior and inconvenient in his day to day life. The proposed proposal has come up with better effectiveness and grasping ability of the artificial hand.

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