Prosthetic Robot Hand

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***Abstract*:- Current prosthetic hands have limited functionality and are cost prohibitive. A design of a cost effective anthropomorphic prosthetic hand was created. The novel design incorporates five individually actuated fingers in addition to powered thumb roll articulation, which is unseen in commercial products. Fingertip grip force is displayed via LEDs for feedback control. The hand contains a battery and micro-controller. Multiple options for signal input and control algorithms are presented. A prototype will serve as a platform for future programming efforts.**

Keywords—Functionality, articulation, micro controller, algorithms

INTRODUCTION

The objective of the work of an bio mechatronics to develop an artificial hand which can be used for functional substitution of the natural hand (prosthetics) and for humanoid robot applications. The artificial hand is designed for replicating sensory-motor capabilities of human hand.

Commercially Available prosthetic devicrs, such as otto bock sensor hand, as well as multifunctional hand designs are far from providing the grasping capabilities of the human hand.

BIO MECHATRONIC DESIGN

The main requirements to be considered since the very beginning of a artificial hand design are the following: natural appearance, controllability, noiselessness, lightness and low energy consumption.

These requirements can be fulfilled by implementing an integrated design approach aimed at embedding different functions (mechanism, actuation, sensing and control) within a housing closely replicating the shape, size and appearance of the human hand.

This approach can be syntheaized by the term:”biomechatronic” design.

INDEX/MIDDLE FINGER DESIGN

The four prototypes have been designed by reproducing, as closely as possible, the size and kinematics of a human finger.

They consist of three phalanxes and of palm housing, which is the part of the palm needed to house the proximal actuator.

THUMB DESIGN

A thumb has been designed in order to complete the hand prototype and to perform grasping tasks with thumb opposition. The thumb has been designed by simply removing the distalphalanx from the index/middle finger.

MAIN PARTS

Once the finger motion assembly was chosen, the next step was to choose how to power that finger joint. Electric servo motors are by far the simplest and best option for this application.

Hydraulic and 21 pneumatic components would introduce tremendous packaging and safety issues, as well as unusual control problems. servo motors are widely available in multiple sizes and power options, with a variety of COTS electronic speed controllers.

The first thing to be evaluated in this system was to look at the approximate size consumed by a simple transmission and motor setup to see if it would roughly fit into the form factor of a human hand or not.

ARDUINO UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.

The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts..

SERVO MOTOR

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor.

It is just made up of simple motor which run through servo mechanism.

Operating Speed: 0.51sec of 180 degrees (4.8V no load)
0.39sec of 180 degrees (6V no load)

Stall Torque: 13 kg-cm at 4.8V.
15 kg-cm at 6V.

Gear Type: All Metal Gears.

Bearings: Dual

MUSCLE SENSOR

Muscle Sensor is Advancer Technologies measures, filters,rectifies, and amplifies the electrical activity of a muscle andproduces an analog output signal that can easily be read by a microcontroller, enabling novel, muscle-controlled interfaces ofthe projects.

USER CONTROL INPUT

The biggest question people ask about prosthetic hands is, "So, how is it controlled?" This project was focused on the feasibility of a mechanical system, with room for many options on the controls side. There is no one control method that is required for this prosthetic hand design. After listening to the experts speak at the 2012 Neuroprosthetics Symposium at WPI1 , it was made clear that the best control systems would have two characteristics described by Gerwin Schalk in his talk, "Advanced Neural Prosthetics: Prospects and Challenges"; they should be completely non-invasive, and they should be easy to learn to use or adjust. Connecting to nerves through surgery would be an expensive and stressful process, and surgery should always be avoided if possible due to risk of complications and recovery. The best control systems need to be easy to adjust because otherwise a user would have to visit a prosthetist which will cost them additional time, money, and frustration. Any sensors which have to be specifically tailored to a given individual should be avoided if possible.

TOE OPERATED SWITCHES

The DEKA Luke Arm is actually controlled through "toe operated" switches. This information is not publicly documented or described, but it was confirmed by speakers at the Neuroprosthetics Symposium. They are controlling an entire arm, seemingly without too much difficulty in the various demonstration videos found in the media. The idea of toe operated switches is very intriguing because of its simplicity. A user could have two very small switches, one worn inside of each shoe, which contains a small button cell battery and miniature wireless transmitter. Each switch could just have a pair of force sensitive resistors, one below the big toe, and one above the big toe. This would provide for at least two "actions" per foot, "up" and "down". Additionally, because the buttons would be analog, a hard push could easily be differentiated from a light tap. There may not be super linear precise control, but there would at least be some variation. The biggest benefit for this system would be that it would not need to be tuned much depending on what muscle or electrical signals could be used on an amputees remaining limb. For the prosthetic hand, this would allow for two main input channels. One channel would change what grip mode the hand is currently in. The other channel would control an action function while in that mode. That would be the entire system. A user may use their left toe and cycle through the grip modes until they are in the precision pinch mode, then, using their right toe, they would be simply moving the index finger in and out slowly and in a controlled fashion. These actions would be imperceptible to a bystander, because only small movements of the toes should be required. In order to make the mode selections easier for the user, a series of LEDs in a bar graph would display the current mode, 1-6 for example. A system of this nature would not be perfect, but it could work well for most daily tasks. Ideally there would be a small button located on the hand that could be easily actuated to put the hand into a sleeping mode so unwanted signals are not received when someone is walking or actively using their feet for example.

CONCLUSION

A complete mechanical design of a prosthetic hand was developed in a short time frame. It was proven to have increased functionality over currently available products. The use of a novel compound thumb gearbox allowed for powered articulated thumb roll actuation. The carefully thought out use of universal components allowed for a tight packaging of the complete system while keeping costs to a minimum. The ease of manufacturing of the components for one hand was proven by having outside companies actually produce the parts needed. It is clear that there are going to soon be many more prosthetic hand options as more companies decide to enter the market and produce competitive hands. A lasting test platform has been developed which will make programming and algorithm development have real functional tests. With the commonly available hobby and remote control industry components developed today, there is less need to seek out the absolute top of the line precision industrial components. In a large company there is a standard way of designing and creating new systems, and that mostly involves using the highest level of components possible because the designers are not directly paying for the research and development, nor do that care much about the final cost of a high end item. When an individual designs a new system, not working for a company, they are able to challenge traditional design and manufacturing methods to produce an equivalent product more quickly and easily.

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