Project Beowulf

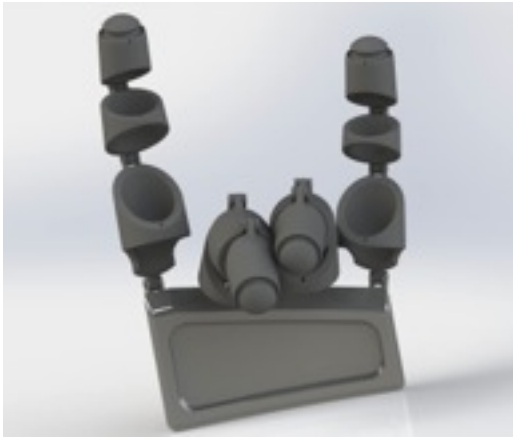
UW BioMechatronics Club, Fall 2015

An Introduction:

Project Beowulf is the BioMechatronics Club's first attempt at a fully functioning proof of concept design project in the field of biomechanics. The product is to be an exoskeletal tendoned glove intended at helping individuals who are in need of assisted grip. It is intended for use by the elderly and disabled, however stretch goals such as military application are being kept in mind throughout development. Beowulf is comprised of a 3D-printed exoskeleton, nylon tendons, force sensitive resistors (FSRs) and EMG sensors, a motor, and a passive tightening mechanism. The 3D-printed exoskeleton surrounds the fingers and simulates joints, providing a structure to actuate along. The nylon tendons extend from the fingertips to the forearm to connect the exoskeleton to the motor which controls all of the active movement in the device. The motor will actuate upon signal from a processing unit which will take data from both the FSRs and EMG sensors to determine when to power the motor, and finally a small coiled spring will be used to ensure that the tendons remain sufficiently taught at all times.

The Design:

The finger design was completed early by the team and was first modelled as shown below by Taran Ravindran. The design has since been edited significantly and now includes joints on the sides of the fingers to promote proper bending as well as a stopping mechanism to prevent the joints from turning backwards. This section of the design is relatively mature and will not require much more work. Some future goals include looking into using the MME Clinic's resin printer to print a soft interior to the hard ABS exoskeleton to make it more comfortable for the end user.



Some additional work will need to be done to evaluate need for and design parts which support the knuckles and palm.

The tendons are a relatively simple part of the design; they will be made of nylon fishing wire or a slightly more durable alternative and they will wrap the tips of the fingers and connect them to the actuator.

The sensors and processor will be the most engaging section for those interested in software dev, digital signal processing, and the like. We will use data from force sensitive resistors inside the glove to determine the force exerted by the user and we will cross-reference this with EMG data from the user's forearm to determine when to actuate the grip assist with hopefully no false positive and very few false negative readings. We have already bought and tried out the FSRs and they are ready and available to be experimented with. The EMG data will likely be read by our Myo armbands (donated from Thalmic Labs) but we are actively looking into other possible units to use for this task. Finally the processor will be an on-arm microprocessor such as a Raspberry Pi, Arduino, or Intel Edison however any should be functional for our requirements.

The actuation is interesting since it involves both active and passive components. We feel as though the best design is to have a passive part such as a coiled spring or elastic to keep the tendons taught and to have a very strong active component which will apply sufficient force over a very small distance once the hand has been placed on the object it is gripping. This design is especially effective since it minimizes the physical work that needs to be done by the device to effectively zero while allowing the user to grip in any shape capable by their human hand.

Areas of Work:

Almost any work that is available to be done on Beowulf is highly encouraged for new members to experiment with. Members should feel free to talk to executives and each other about ideas regarding design and implementation. Documentation and SolidWorks files can be made available to any individual in the group and active members will be given partial access to the various physical resources that the club has in their possession.

Love, The Biotron Exec Team