The goal of this project is to create a robotic hand that mimics the motion of the human operator. This robotic hand will rely on mechanisms similar to those of the human body in order to move.

In the human hand, flexor tendons are responsible for finger motion, with attachments at each phalanx responsible for bending at the three finger joints. These tendons undergo flexion and extension via the contraction and relaxation of muscles.

This project mimics muscle contractions and their corresponding tendon movements in order to model human motion on a robotic hand. In this experiment, muscle contractions were simulated through the motion of high-voltage servo motors. Fishing-line "tendons" attached to the phalanges would move in response to servo motion to induce finger flexion and extension.

Initially, 9 g servos were used to flex the fingers from their neutral position. However, these motors proved too weak to overcome the elastic force of the rubber bands. The servos were replaced with larger, stronger 20 Kg servos. While they have performed better, the new servos have problems with instability an inconsistency from electromagnetic interference.

This CAD model aimed to mimic some of the natural constraints to motion that are present in the human finger.

To mimic human motion, the base of the thumb must be able to rotate orthogonally to the plane of the palm. This is achieved by using two helical gears with 45° pitch angles. One gear is placed within the palm and controlled by a belt connected to an external servo. The second gear is integrated into the base of the thumb.

While the flex sensor model allows for the user to wear an intuitive sensor glove, there was great difficulty integrating the flex sensors into the design without damaging the relatively expensive devices. To avoid this issue, user movement can be sensed using an Arduino-base electromyogram. In this system, muscle contractions will be directly translated to robotic hand movement, serving as a pseudo-prosthetic.

The robotic hand project is funded by the University of California, Los Angeles, Bioengineering Department. The fingers and palm of the hand were three-dimensionally printed using resources provided by the UCLA Boelter Makerspace. The robotic hand team would also like to acknowledge Design Team Project Managers Smiti Narayanan, Ryan Tsang, and Willie Wu for their guidance and assistance with this project.

References

