Engineering a Robot Arm with Computer Vision and Simulated Grabbing for Manipulation of Objects

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Over 1.7 million people in the United States alone are currently living with limb loss. Estimates show that 185,000 amputations are performed each year, with that number expected to double in 2050. Previous innovations in upper limb prosthetics lack the functionality to cost anticipated. Costs range from $5,000 to $120 million for an upper limb prosthesis. This project used a new hand and arm design, along with an object detection neural network to allow for greater complexity for manipulating objects and a revolutionary way to identify and grab specific objects. To test this goal, a new design for the hand and arm was modeled. The design was a blend of biological inspiration with mechanical simplification. Controlling the hand was a C# game environment with a virtual model present. A single shot multibox detector neural network was joined to the game environment using a text file. The detected object class from the neural network triggered an animation of the hand pattern designed for that class. The animation was then run when the a digital button was pressed. A combination of the neural network, simulation software, and a new design provided grabbing accuracy results of 86% and precision movement results of 90%. The hand was able to grip up to 6kg for each phalange, meaning roughly a 14kg grip per finger or 56kg for the hand. For the holding test, each finger was able to hold the minimum of 4kg (estimated maximum is 20kg). This means a holding grip strength of 80kg could be achieved.The results collected indicate that the efficacy and ease of use when grabbing objects with my method and design superseded what's on the current market today for upper limb prosthetics for not only functionality but cost as well.

Awards Won:
Third Award of $1,000
International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention