Problem Statement
• Develop an innovative 3D printable prosthetic arm solution which is strong and life-like in appearance and function. The device should meet all FDA standards and be designed for commercialization.

Principles and Practices
• QIDI Tech FDM printers used to print parts by designed in SolidWorks.
• The forearm and hand cover created using 3D scans.
• Polylactic acid (PLA) chosen for material properties, cost, printability, and compatibility with human skin.
• 3D printing allowed complex contoured shapes to be manufactured quickly and inexpensively. Life-like curvature made possible using 3D scans.
• Emphasis on consumers – industry and client surveys were used to develop requirements and determine necessary functions.
• Software designed minimally to use little storage, freeing up space for sensory data.
• Used commonly available, affordable electronic and non-printed components to reduce costs.

Design
• Solution designed to address all customer concerns found through the client survey: comfortable and ease of use while still mimicking the motion of a hand.
• Integrates novel mechanical and sensory features with the best affordable systems currently on the market at a low overall cost of about $1,500.

Mechanics
• DC lead screw motors used as low-cost, durable linear actuators; dual shaft worm-driven gearbox for wrist control; servo and cable system for thumb control.
• Locking mechanism connects forearm to sleeve. Sleeve was chosen to use embedded myoelectric sensors and strength.
• Full range of motion and 50 lb weight limit achieved in using motor-driven four bar linkages in fingers.

Software
• Controlled by Arduino Mega and motor shields.
• Customized supervised-to-unsupervised machine learning algorithms allow the arm to learn gestures after a brief calibration.

Electronics
• Force-sensitive resistors in fingers used for touch sensing.
• Myoelectric sensors in sleeve read muscle tensions as user input.
• Thermoelectric devices to cool the sleeve, improving comfortability.
• Temperature sensors in fingers used to determine dangerously hot or cold objects.

Testing and Results
• In order to test, an artificial residual limb was constructed to test the cooling system inspired by customer feedback.

Future Improvements
• Stronger materials used for weak points (possible multi-material design).
• Single circuit board with increased memory.
• Improve battery life.
• Artificial skin covering.
• Increase sensory capabilities.
• Multiple/customized appearance options.
• Standardized, scalable CAD files for manufacturability.
• Reduce sound.
• Four-way wrist motion.

Acknowledgements
PriMA would like to thank all advisors and supporters to this project. Special thanks to our advisors, Jennifer Schlegel, the Kern Entrepreneurial Engineering Network, Project Based Learning, and the National Science Foundation, Grant CBET-1403345.