



A Helping Hand

3D PRINTING OPENS THE DOOR FOR BIONIC ARMS FOR CHILDREN
IN NEED FOR UNDER \$350

“The opportunity to engineer hope for families and give children the tools to chase their dreams is incredible.”

– Albert Manero, Ph.D. student in Mechanical Engineering, University of Central Florida

CASE STUDY



Six-year-old Alex Pring tries out his new 3D printed arm, created in part by a Dimension 3D Printer.

3D printing's ability to transform lives through its medical applications has taken another leap forward.

Alex Pring, a six-year-old boy from Groveland, Florida, was born without his lower right arm. As traditional medical solutions cost up to \$40,000 and are challenging to adapt to the child's growth, his mother Alyson Pring searched for help online. After trying options from non-profit medical groups and home-built solutions she found online, she discovered the Enabling the Future Network¹, which uses 3D printing to provide children with replacement prosthetic hands.

Through Enabling the Future, she met Albert Manero, a Ph.D. student in mechanical engineering at the University of Central Florida. Manero put together a team including UCF students, graduates and other volunteers with the goal of designing highly functional replacement limbs at a much lower cost for Alex and other children with limb deficiency.

After Alex put on his new arm, he learned within a few minutes how to pick up objects by flexing and relaxing his bicep. Then came his first hug with his mother with both arms. “The look on Alex’s face brought the room to tears,” Manero said.

Building a New Arm

The team worked in its spare time, designing a simple and inexpensive solution. The team used the university’s Dimension® Elite™ 3D Printer to bring its design to life from the sketches to prototype. The printer allowed Manero’s team to rapidly try new designs, and the high resolution of the machine, coupled with the strength of ABS*plus*™ material, gave the functionality the team had hoped for. “3D printing made it possible to build prototypes of new design iterations overnight, helping us design and build the arm in only eight weeks,” Manero shared.

Inside of the prototype’s arm shell, an electromyography sensor and microcontroller work to allow Alex to open and close the printed hand with only the flexing of his biceps muscle. When Alex flexes his biceps, the control system reads the bio-electrical impulses and activates a servo motor that operates Kevlar cords strung through the fingers to close the hand. Velcro strapping secures Alex’s arm into a socket with a diabetic sock. Alex can move his arm while minimizing skin abrasions and allowing his skin to breathe well in the hot Florida sun.

To help Alex learn to adapt to using the arm, the team used a neoprene shoulder brace to help distribute the weight across Alex’s torso. The arm itself weighs in at approximately one pound, and as Alex continues to get stronger the heavy feeling will disappear.

The total cost of the materials and printing of the arm was only \$350 for the team’s first prototype, which was given to the family at no cost. The arm can be updated as Alex grows by printing a new hand for approximately \$20, or a new forearm for \$40. The other parts of the arm, such as the servo motor and cords, were inexpensive off-the-shelf components purchased from online suppliers.

Future Plans

The team has posted the plans for the arm and is working to build arms for additional children around the world. On the morning before Thanksgiving, the team drove through the night to Lynchburg, Virginia, to deliver an arm to seven-year-old Madelyn Rebsamen. Her new arm design was inspired and painted to match her love of the movie “Tangled.”



The 3D printed replacement limb is strapped to a neoprene shoulder brace to distribute the arm’s weight across Alex’s torso.



Albert Manero of the University of Central Florida directed the team that created Alex Pring’s new 3D printed limb replacement.



Alex works with Manero and his team to test his new replacement limb.

Manero's team has transitioned into a non-profit Limbitless Solutions² and it is working with teams from universities and institutions around the world to help children in need. The team's work now continues to increase the functionality and reduce the cost to enable open access to children across the United States and beyond. Yet even with requests coming in from more than 20 countries, the team was able to hide one new Christmas gift under Alex Pring's tree on Christmas morning – a new arm inspired by “Transformers,” Alex's favorite toy.

¹Enablingthefuture.org
²Limbitless-Solutions.org



Seven-year-old Madelyn Rebsamen also received a replacement limb through the Enabling the Future Network.



Alex examines the University of Central Florida's Dimension 3D Printer, which helped create his new replacement limb.



Alex received a new Transformers-themed replacement limb as a Christmas present.

How does 3D printing compare with traditional medical solutions for UCF?

METHOD	COST
FDM technology	\$350
Traditional medical solutions	\$40,000
Savings	\$39,650

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