SPACE SHOTS

High School Students Use Digital Manufacturing to Build Flying Camera for NASA

"The ability of Dimension 3D Printers to quickly and inexpensively produce parts that are strong enough for use in real applications opens up a world of opportunities for schools."

— Mike Bennett,
Cypress Woods High School

Cypress Woods High School students test ROV in weightless environment.

The High Schools United with NASA to Create Hardware (HUNCH) project provides students with the opportunity to design and build products for potential use in space missions. Its goal is to provide work experiences that inspire high school, career technology and engineering academy students to pursue careers in science and engineering.

As part of this project, NASA asked the students of Cypress Woods High School to design and build a remotely operated vehicle (ROV) that carries a camera and can maneuver around the International Space Station (ISS) under the direction of ground control. The ROV is needed because nearly all of the time of the crew of the ISS is occupied with a myriad of other tasks. Ground controllers need to be able to monitor experiments, check parameters on displays and gauges, verify switch settings, and perform other similar tasks without taking up the valuable time of the crew.

NASA engineers visited the school and presented the design requirements for the ROV such as size constraints, safety concerns, and avoiding interference with existing wireless equipment. Under the guidance of Mike Bennett, technology teacher for Cypress Woods High School, the students began by brainstorming different design concepts. Then they broke up into teams to research different aspects of the design such as propulsion systems, cameras, control systems, batteries, etc. Based on the results of their research, the students developed their initial concept design, first with hand sketches and later as detailed design in their CAD system.

"In the past, the tooling costs involved in conventional manufacturing methods such as injection molding would have made it impractical for the students to build a real version of their design," Bennett said. "Fortunately, our school system had invested in Dimension 1200es 3D Printers for all of our drafting classes. So we were already familiar with the ability of FDM to build functional prototypes and end use parts with the mechanical properties needed to stand up to tough applications in space or on Earth." Fused Deposition Modeling (FDM) technology is an additive manufacturing process that builds plastic parts layer by layer, using data from CAD files.

Teaching Systems, Inc. is the reseller that worked with Cypress Woods High School. "I recommended the Dimension printer because it's dust-free and quiet so it can run in the classroom as opposed to competing products which would have required a special room," said Owen Savage, CEO of Teaching Systems, Inc.

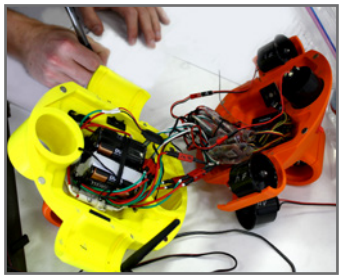
The student's ROV design features six FDM components including the bottom and top shell and four motor covers. The ROV is powered by six ducted fans providing two different directions of pitch, roll and yaw motion. The camera transmits audio and video on the 900 MHz spectrum. A radio control system designed for use with model helicopters was used.

The use of FDM technology made it possible to quickly improve the functionality of the design. For example, in the original design the motors would only fit one way in the housing. "After looking at the prototypes, we decided that it would be nice to be able to install the motor in either direction so we added a channel and a lip on the opposite side and printed out new shells," Bennett said.

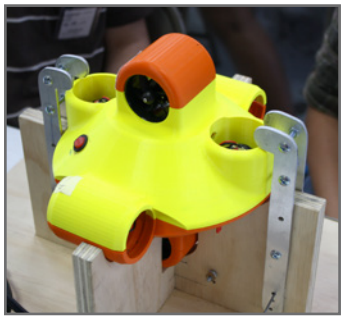
The students flew their design in a specially modified Boeing 727 operated by Zero G Corporation, which flies parabolic arcs to produce weightless periods of 20 to 25 seconds. They tested the maneuverability and controllability of the ROV as well as its ability to capture and transmit images. Based on these tests, students are planning to use more powerful motors and add gyro stabilizers to improve controllability in the next generation design.

"The ability of Dimension to quickly and inexpensively produce parts that are strong enough for use in real applications opens up a world of opportunities for schools such as ours," Bennett concluded. "We are now waiting for NASA to approve our proposed design improvements and test the next generation ROV on the zero gravity plane. After that we are hoping that the ROV will be selected for launch to the ISS."

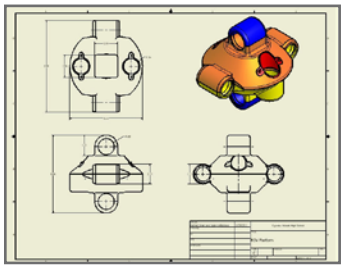
Cypress Woods High School students testing ROV in a NASA zero gravity plane.



Top shell (yellow) and bottom shell (orange) are both FDM parts.



Platform holds ROV in position when not being used.



Students created ROV design in CAD system.

Stratasys | www.stratasys.com | info@stratasys.com

7665 Commerce Way
Eden Prairie, MN 55344
+1 888 480 3548 (US Toll Free)
+1 952 937 3000 (Intl)
+1 952 937 0070 (Fax)

2 Holtzman St.,
Science Park, PO Box 2496
Rehovot 76124, Israel
+972 74 745-4000
+972 74 745-5000 (Fax)

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