

# PAUSE AND PLAY

## Students' 3D-Printed Multicolor Ukulele Impresses

*"We had a unique opportunity to take advantage of what the 3D printer could do. So we incorporated a 3D, color version of the RIT tiger."*

— Betsy Khol, RIT student

*Students paused the 3D Printer during its build to incorporate three colors into their working 3D printed ukulele.*

Around the Rochester Institute of Technology (RIT) campus, professor Denis Cormier's reputation has earned his rapid prototyping course a wait list. Industrial, mechanical and manufacturing engineering students line up in hopes that they will be included in the discussion of 3D-printing technologies.

With all the buzz 3D printing has earned recently, students are increasingly aware of it, and they want to understand what is possible and how they can use the technology. Joe Noble, a mechanical engineering undergraduate, said, "I knew that 3D printers existed, but I didn't have a lot of knowledge about them."

Cormier changes that. "Because of this course, we now have the exposure to advanced and innovative techniques that we could use in the future," said Jeet S. Mehta, a graduate student pursuing a master's of science in mechanical engineering.

In one quarter, Cormier introduces students to the processes, materials, capabilities and limitations of a broad range of 3D-printing technologies. He concludes with a description of what is on the horizon. Betsy Khol, an undergraduate in the industrial engineering program, said, "At the end of the quarter, the course was all about where we could take 3D printing and where the technology was going, which was really exciting."

The course challenges students to put their new-found knowledge into practice. "Our assignment was to design, build and play a musical instrument," said Noble. He and teammates Mehta and Khol created a ukulele and built it on a Dimension 3D Printer. "The ukulele was a practical decision; we could tune it."

But that simple idea morphed into something more. "We had a unique opportunity to take advantage of what the 3D printer could do. So we incorporated a 3D, color version of the RIT tiger," said Khol.

Although they had options for automated color 3D printing, the team devised a series of interventions to make its Dimension 3D Printer build a multicolored instrument. According to Mehta, "The key reason for selecting the Dimension machine for printing our part was the plastic material that it uses. Since we had to play the instrument, the strength and integrity of the part was very important."

With one small prompt from Cormier, the team got creative. “When Dr. Cormier informed us that we could pause a build and swap material cartridges to change colors, that’s when everything came together. Now we could print the ukulele in one go without having to assemble different pieces,” said Mehta.

According to Noble, the process was quite easy. “We designed the tiger face to have an even number of layers for each color. In the Catalyst setup program, we oriented the ukulele with the tiger facing down. Then all we had to do is insert pauses between the layers where there was a color change.”

At the Dimension printer, the team waited 20 minutes for the first color to complete then swapped material cartridges and repeated that for the remaining colors. After that, they left for the day and had a 3D printed ukulele waiting for them when they returned to class. After soaking the ukulele to remove support structures, the team attached the mounting pegs, added strings and tuned it for their big debut.

The final test was a humble, eight-note rendition of “Jingle Bells.” For their work and innovation, Cormier gave them an A. He said, “When fellow students and guests heard Joe playing the team’s 3D-printed ukulele, there were plenty of grins and ‘cool’ comments throughout the auditorium.”

According to Noble, “It was one of my favorite classes that I’ve taken at RIT. I now have a whole other dimension to the possibilities of prototyping. It is a very intriguing field. If I ended up working in it — in the actual development of the processes — I’d be stoked.”



CAD rendering.



Joe Noble, Betsy Khol and Jeet S. Mehta incorporated the RIT tiger into their instrument, with its open mouth forming the sound hole.



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