THE POWER OF
INDEPENDENT STUDIES

Four students take an independent study under Professor Shalom Ruben and discuss their experiences

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Background

CU professor Shalom Ruben, who has a doctorate in Mechanical Engineering, instructed an independent study course in the Spring of 2017 that allowed four seniors in various engineering fields to direct their own projects. This study gave students the unique opportunity to bring their own creative ideas to life.

Each student was told to choose a project complimentary to their personal interests, something engaging and relevant to their lives and also challenging. Ruben wanted the students to push themselves by entering into unknown fields, doing independent research to find relevant information for their projects, and ultimately, learning how to teach themselves.

Throughout the semester, Ruben repeatedly stressed the importance, not just of understanding how something works, but of comprehending the code and the mechanics underneath the shell. In one case, this meant a student had to learn how to manipulate a drone's series of commands to expand its abilities and alter its purpose. For another student, this meant crafting his own computer numerical control (CNC) stage, a software where one can program a machine to create/do whatever is inputted by the user.
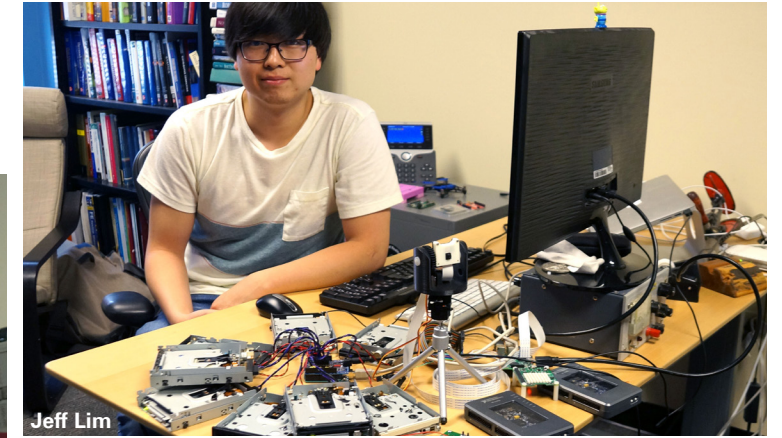
While the projects had few restrictions and thus presented many opportunities, they also brought students face to face with several difficulties. Ruben noted that the solutions to arising conflicts weren't
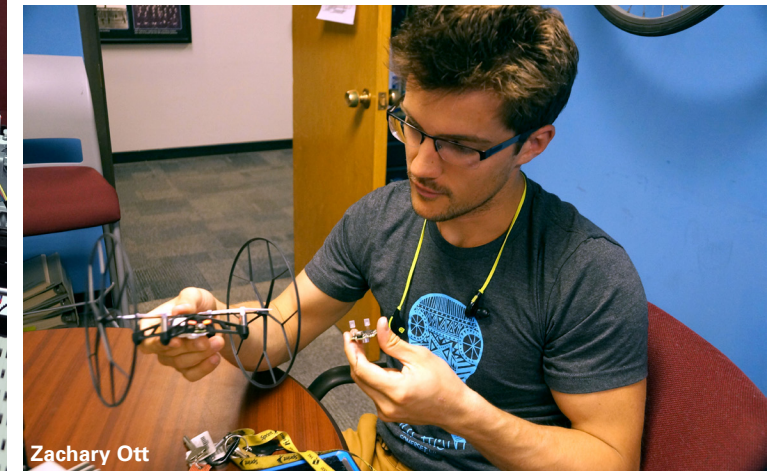

Ryan Mettlen
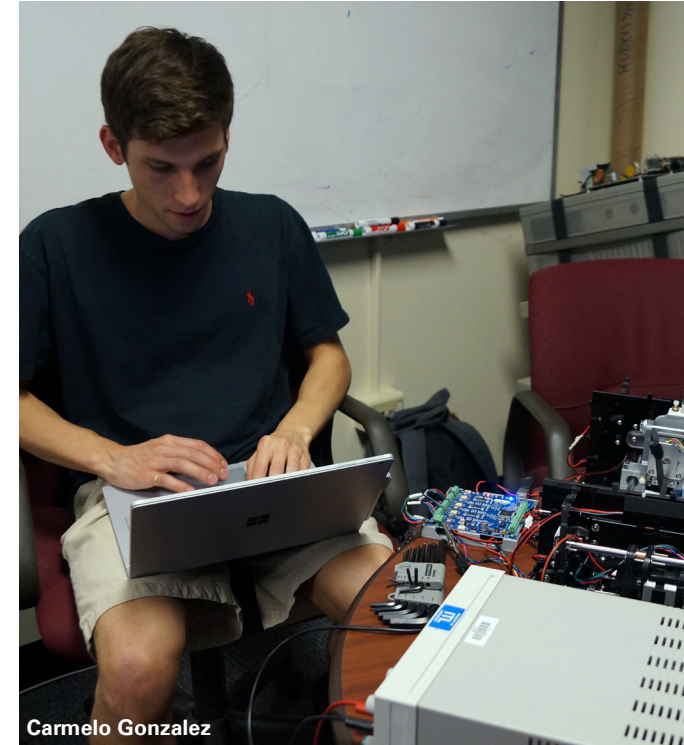
Shalom Ruben

always to be found in the textbook or on the homework website; rather, they had to be found by the independent and creative pursuits of the students. Ruben's core intention for the class was to encourage precisely this kind of problem-solving.

Jeff Lim

Lim's project manipulated old floppy disks to play music based on the frequency each one makes when it moves.

"For this independent study, you really have to be on your own, read everything on your own, learn on your own and move forward within your project on your own," Lim said. "The hand-holding days are gone."

Lim's motivation to start this project stemmed from his passion for music. He has an ear for the different notes and wanted to combine his talents for both music and engineering. His greatest obstacle was making the floppy disks move.

Zachary Ott

Ott's project involved a parrot drone with a camera and the ability to detect direction of motion. Ott hoped to learn about the code underneath the drone so that he could get a base code for future projects and avoid a lot of debugging work.

As a bonus, he taught aspects of the code to peers pursuing their independent study under Ruben to help them avoid hitting a wall. One of his personal challenges involved researching the drone and finding existing papers about the code.

"None of the mechanical engineering courses applied to me. This independent study allowed me to do something in regards of what I wanted to do," Ott said. "For normal classes, the answers are out there. But with this, you have to create the answers...I had to find forums online discussing issues on the
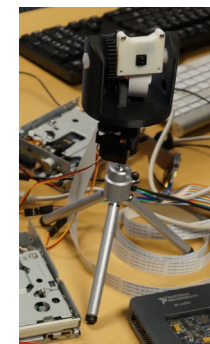

Carmelo Gonzalez

Zachary Ott

Jeff Lim

drone. I had to figure out things myself. It is a lot of real world experience."

Ryan Mettlen

Mettlen's goal was to gain a deeper understanding of computer vision, a field dealing with how computers learn from digital images and videos. He did this by developing a system that could detect motion and even read numbers.

"This independent study forces you to self-motivate," Mettlen said. "The work world is not like school, so this independent study helps students learn and get used to the real world."

His project utilized servos, 3D-printed housings and an Arduino Raspberry Pi board. During Mettlen's study, Ruben gave Mettlen multiple readings to assist him in his endeavors. Mettlen then was prompted to explain the content


back to Ruben to ensure he understood the material correctly.

Carmelo Gonzalez

Gonzalez's project involved building a CNC stage, which is a machine that has a 3D printer-like stage and a mobile point. He showed off its capabilities by attaching a pen, which can move in all directions of a 2-D plane, to the mobile point and giving the machine directions about what to draw or write. It performed almost perfectly. According to Gonzalez, the project's most difficult aspect was figuring out how to
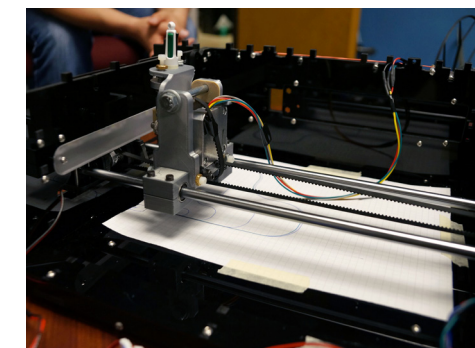
program the machine so that it could correctly write whatever the user input.

Ruben's students clearly benefited from the class, but so did he. One of his main motives for teaching the class was to experience the one-one-one teaching format, which is not his usual format; Ruben often teaches classes that exceed 100 students.

"Through the independent study project, the students teach me and it's very rewarding," Ruben said.

For students to get an Independent study class approved in the engineering school, the proposal must be reviewed by graduate advisors and a graduate committee.

The submission must provide a description of the project, and specify the class' duration and premise, learning objectives, reference materials and final deliverables. Students wishing to participate must also demonstrate academic achievement and find a faculty member, like Ruben, who will supervise them throughout the course of their work.