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Board 135: Undergraduate Projects/Research in a Liberal Arts College

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UNDERGRADUATE RESEARCH IN A LIBERAL ARTS COLLEGE

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INTRODUCTION

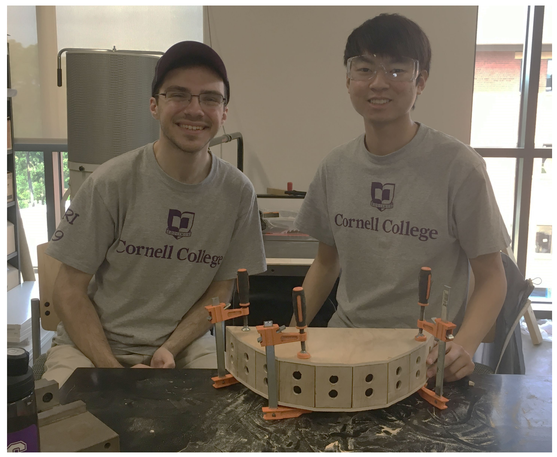
- Cornell College is a liberal arts college with an emphasis on teaching.
- The faculty members are asked to offer summer research projects to undergraduate students.
- The Cornell Summer Research Institute, CSRI, lasts eight weeks, and the students perform hands-on research and present their findings in multiple occasions.
- Three summer projects so far.

SUMMER RESEARCH INSTITUTE

- Main goal: hands-on research experience for undergraduate students.
- Other activities:
  - A TED-like talk presented by faculty members,
  - Workshop on applying for graduate studies,
  - Workshop on different fellowships,
  - Workshop on research ethics,
  - Workshop on improving the resume, and job interviews skills.
- Multiple presentations by students:
  - Week one: the students explain their projects and the main goals in an informal kick-off picnic.
  - Midterm presentation: an e-posters to explain their progress
  - Final presentation: the last week. It includes results, discussions, and possible future work. The students talk about the challenges they encountered and what they would do differently if they had a chance to redo the project.
  - The annual Cornell Symposium: another chance for the students to share their research with the larger college community.
- The students receive Ingenuity In Action credit as a part of new core curriculum under Research category.

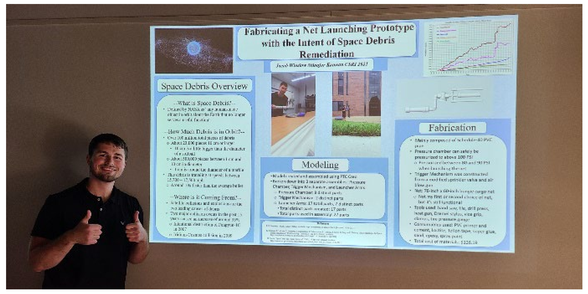
FIRST PROJECT, GESTURE-CONTROLED PIANO

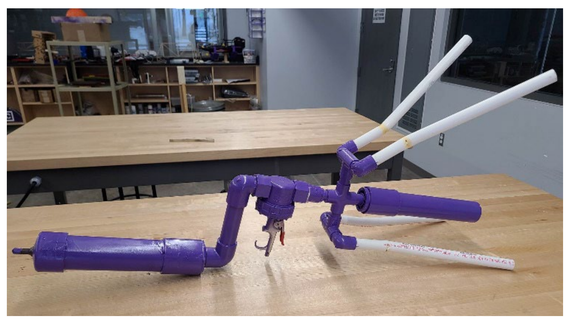
- A gesture-controlled piano allowing for eight functioning octaves, volume control, chords, dynamics, and various instrument voicings.
- The idea: from an open-source project by Andy Grove.
- Added features: a display to show the instrument being played and a unique arched design.
- Students learned about different ways of human-computer interactions.
- Hardware and Software: ultrasonic sensors, Raspberry Pi, Python, and Fluidsynth.
- Interdisciplinary research: liberal arts education, such as music and design, and engineering education, such as engineering design, programming, and electrical engineering.
- The project result was presented at ASEE 2020 virtual conference in the student paper section.



SECOND PROJECT, SPACE DEBRIS

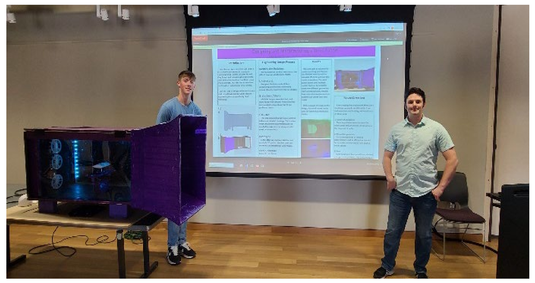
- NASA defines space debris as “any human-made object in orbit about the Earth that no longer serves a useful function.”
- Satellite collisions and explosions are the two leading causes of debris.
- Inspired by the net-launcher idea, the student designed and built a net launcher that used compressed air to eject the net.
- Model created and assembled using PTC Creo.
- This project brought the subject of space debris to the attention of the college’s community.

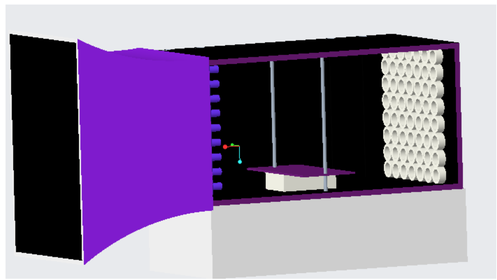




THIRD PROJECT, WIND TUNNEL

- A small wind tunnel to visualize the fluid motion and possibly to measure lift and drag forces.
- The students used knowledge and technical skills in fluid mechanics, engineering design and manufacturing classes.
- The hope was for the wind tunnel to be usable for the fluid mechanics class, but some of the not-very-wise design choices prevented it from being a reliable machine.
- One of the students decided to spend some time to fix the design's shortcomings.





CONCLUSION

- The Summer Research Institute has served undergrad engineering students in many ways.
- Working closely with a faculty member on a research project.
- Projects: often defined in collaboration between the faculty and the students.
- Building a community for eight weeks with other students participating in the program. They participate in many activities.
- Educational outcomes include teamwork, engineering ethics, communications, inquiry and reasoning.