JELLIBOT: Underwater Clean-Up Robot

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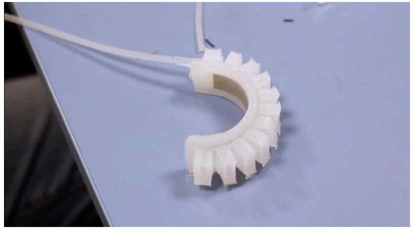
Problem

There is an estimated 11 million tons of plastic on the ocean floor[1]. Our project aims to tackle this by reaching the pockets of trash that are hard to reach by other cleanup efforts.

[1]"Ocean floor a 'reservoir' of plastic pollution," *ScienceDaily*, Apr. 4, 2024. [Online]. Available: https://www.sciencedaily.com/releases/2024/04/240404190801.htm

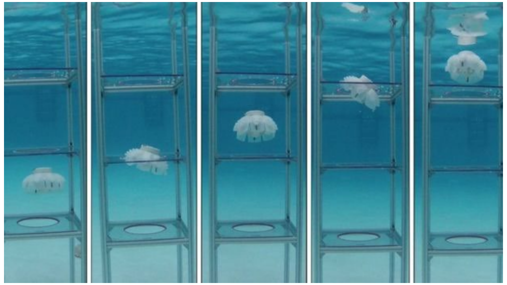
Approach

Drawing inspiration from jellyfish movement, we are using FDM printers to create bending linear actuators. The flexible bending actuators will use a pneumatic network to actuate them simultaneously.



(Anticipated) Results

Bending actuators will create thrust by rapidly closing and slowly expanding, as well as act as a gripper to pick up plastic.



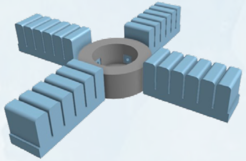
Impact

We aim to reduce water pollution by extracting visible plastic waste using swarm cleaner robots. This would minimize need for manual labor in small-scale water cleanup efforts by using cost-effective FDM printing.

Project Journey

Initial Research

- Researched underwater robots
- Inspired by soft jellyfish robot from FSU and wanted to make one using FDM printing [2]

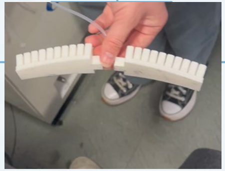


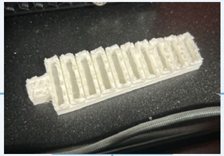
Iteration 1

- 4 bending actuators attached to disc
- Tried code to make the actuator inflate fast and deflate slow

Iteration 2

- Added more chambers and tapered design to get more bending
- Tested gripper capabilities



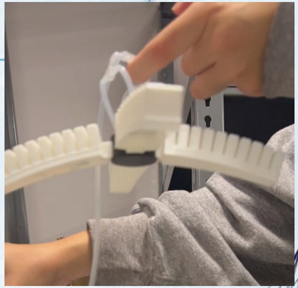


Print Failures

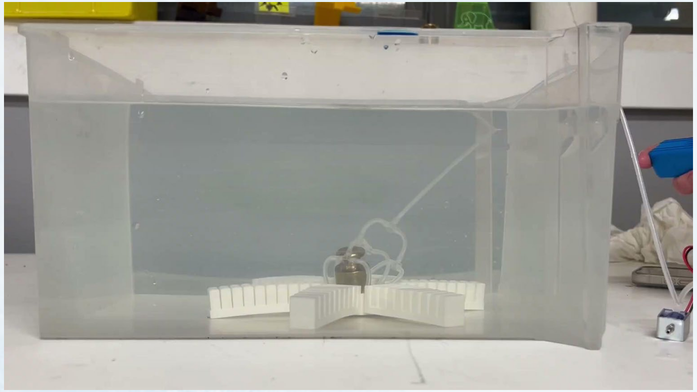
- Experienced a lot of print problems like layer separation and stringing
- Remedied issues by removing nearby printer to stop vibrations

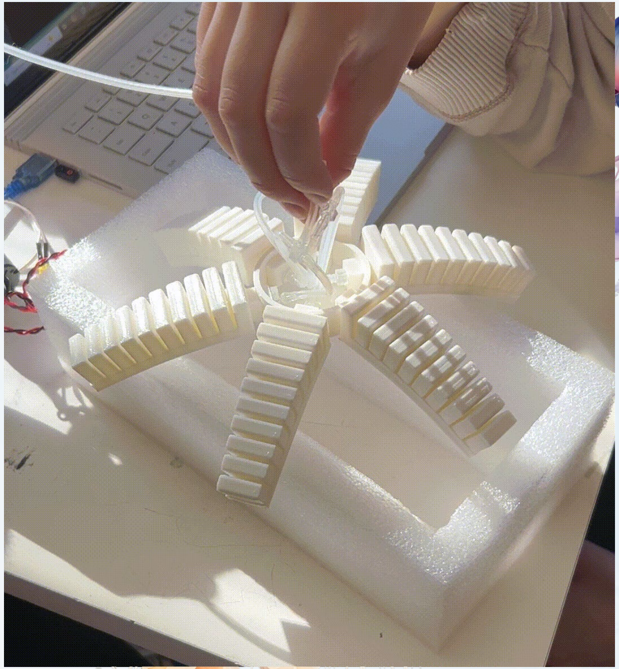
Iteration 3

- Tested actuators together using compressor
- Added additional actuators
- Added a valve for better control



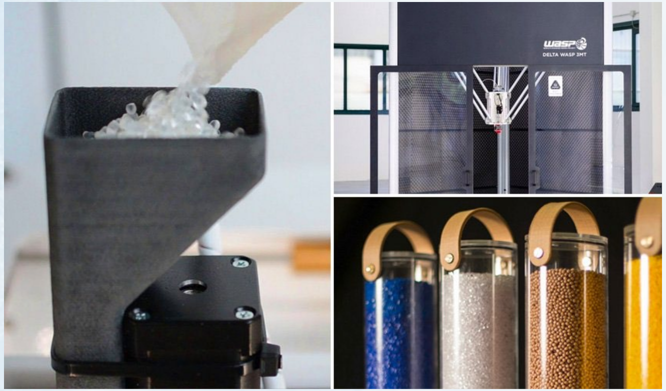
Video of Final Demo



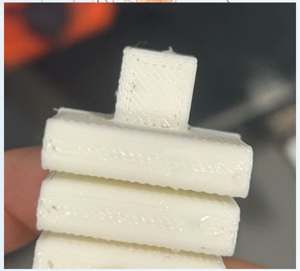


Next Steps

- We found that the TPU actuated too slowly to create enough thrust to propel the jellyfish and that the jellyfish's movement was mainly caused by its buoyancy
- Our next steps would be to…
  - Use pellet printing to lower actuation time and pressure to create more thrust
  - Actuate with water instead of air so the Jellibot does not float to the top when actuated
- Add sensing and directionality for full ocean monitoring and plastic removal capabilities

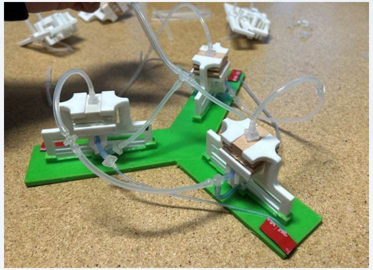


Biggest Takeaways



Troubleshooting 3D Prints

- Learned about isolating print parameters to achieve airtight prints with TPU



Capabilities of Soft Robots

- Introduced us to flexible robots, sensorized filaments, and fluidic logic

Design Process

- Managed deadlines, iterated on our ideas, and worked as a team

Thanks!

Special thanks to Professor Nemitz, Cem, Savita, and Yijia!

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References

[1]"Ocean floor a 'reservoir' of plastic pollution," *ScienceDaily*, Apr. 4, 2024. [Online]. Available: https://www.sciencedaily.com/releases/2024/04/240404190801.htm

[2] J. Frame, *Self-contained soft robotic jellyfish with water-filled bending actuators and positional feedback control*, Florida Atlantic University, 2016.