Design of Jellyfish-Inspired Robot for Corals Ecosystem Protection and Restoration

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Coral reefs, hosting over 25% of all marine species on less than 1% of the ocean floor, are bleaching and dying due to the increased thermal variations caused by climate change. Among the survivors are "super corals" that have acclimatized resilience against such stressors. To prevent coral bleaching and speed up the evolutionary processes of "super corals," I have developed a bioinspired robotic jellyfish, which can facilitate the process of collection and dissemination of "super corals" gametes and the deployment of larval settlement substrates. The robot mimics the gentle movement of jellyfish, aiming to cause minimal ecological disruption. This study presents three iterations of the robotic prototype: The first iteration employs a servo-actuated system that coils in and out the string to release and contract the wings; the subsequent models adopt a direct motor linkage to the wings for propulsion. Compared to servo systems, motor actuation offers greater stability and controllability because it’s challenging to control the speed of servos. Furthermore, I have evaluated various construction materials for the robotic fins, comparing rigid 3D-printed components and flexible PVC membranes. By designing a bend constraint on the fins, motion counteraction observed in the first-version experimental trials was minimized. This increased the moving efficiency of the robot. Additionally, I have included operational functions in the design, allowing the robot to collect buoyant gametes and dispense larval substrates with its vertical and rotational capabilities. Looking forward, I plan to integrate a camera system and implement algorithmic gamete detection to further automate the robot.