Development of Efficient Underwater Robot Based on Quadruped Structure of Sea Turtles and Fish Fin Hydrodynamics

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Marine debris pollution and pipeline leaks pose significant threats to our fragile marine ecosystems, presenting hazards that are neither safe nor effective to address through manual labor. This study introduces a novel underwater robot, inspired by the multi-legged structure of sea turtles and the fin propulsion dynamics of fish, designed to offer an efficient and unobtrusive solution to these pressing engineering challenges. The robot features a cylindrical sealed capsule as its core, with a quadrupedal structure that allows it to navigate underwater and traverse the seabed, which ensures versatility in performing various tasks. A peristaltic pump facilitates buoyancy control, allowing the robot to adjust its depth by altering its weight. Remote operation is achieved through the Blinker APP via Wi-Fi, enabling accessibility and ease of control. This project endeavors to enhance the robot's propulsive efficiency by investigating the impact of fin shapes on velocity, utilizing both numerical simulation and empirical testing. Through the optimization of fin design, along with streamlined modifications to the leg linkage structure and adjustments to the robot's center of gravity, a marked improvement in swimming speed was achieved, increasing from 0.0357 m/s to 0.133 m/s. Further iterations focused on refining the mechanical arm's control algorithm for precise maneuverability and improving the robot's agility around underwater pipelines through enhancements in its turning radius and speed. The experiments have proven that these advancements facilitate the robot's application in underwater garbage removal and pipeline inspection, offering considerable practical value in addressing critical environmental and infrastructural issues.

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