Inspection 360: A Novel Spin-Climbing Robot Design Targeting at Performing Maintenance Tasks for Cable-stayed Bridges

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Cable-stayed bridges are becoming increasingly popular worldwide. Inspection and maintenance of the cables are vital to ensure safety. However, in many places of the world, such tasks are conducted manually by workers climbing high in baskets, which is dangerous. Existing robot tools available are complex and expensive, hence limited affordability. This project prototyped a novel robot design which features a spin-climbing movement pattern, aiming at a simpler structure and lower cost, for the purpose of fitting wider deployment scenarios and reducing human risks. The robot consists of three driving wheels and six omnidirectional wheels, which support it to travel on cables with a unique spinning mode. This mode reduces the need of installing multiple cameras, sensors, or maintenance tools, because the robot can rotate by itself and provide 360° views without any dead angle. It also features a lead-screw structure and thus adapts to cables with varying diameters from 12 centimeters to 16 centimeters. Its flexible aluminum structure enables it to climb smoothly by overcoming small bulges on cables. In lab tests, the robot was proven to be capable of carrying inspection tools of up to 10 kilograms. The normal force distribution was also analyzed in various experiments on simulated cables. The conclusion is hence drawn that the spin-climbing mechanism has its unique advantage and future adaptability. Equipped with wireless control and a Wi-Fi camera, bridge maintenance crew can now control this robot prototype and perform visual inspections wirelessly by observing the real-time video streams on mobile devices.

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