A Multi-Joint Geometer-Like Spatial Wall-Climbing Robot With Vacuum Suction Used in Assisting High Altitude Tasks and Terrain Prospection

Sheng, Jiarong (School: Shanghai Pinghe Bilingual School)

Wall-climbing robots play an important role building and terrain prospection. They can replace human in prospecting dangerous environments and help improve the efficiency of high-altitude tasks. Therefore, this project designs a spatial wall climbing robot adjustable multi-vacuum sucker. First, the project designs a wall climbing robot with 4 vertical degrees of freedom (DOF) and 1 horizontal DOF, achieved through 5 steering engines. The suction cup is connected with an air pump to achieve the vacuum effect. Laser ranging modules and pressure sensors are installed to determine the position and state of the sucker unit and determine whether the robot successfully attached to the wall respectively. Three- dimensional blueprints of the robot's design are constructed through SolidWorks to simulate its gaits. The electronic design of the robot is controlled by Arduino, which connects with magnetic valves, laser ranging modules, pressure sensors, the steering engine commissioning board, and the power supply. The robot's different gaits of squirming, flipping, and rotating are achieved through constructing the geometric relationship between the positions of the five steering engines. This also helps design the robot's self-adjusting program. Through experiments, the wall climbing robot with a body length of 40 centimeters and a weight of 300 grams can successfully perform the gaits of obstacle crossing and wall transitioning between different angles under a vacuum degree of -80 kilopascal and a torque of 1.95Nm. The robot can effectively self-adjust the rotation angle of its steering engines to achieve the best vacuum suction state.