ABSTRACT

The cleanliness of solar panel surfaces plays a crucial role in ensuring optimal solar energy absorption. The accumulation of dust and dirt, especially on floating solar panel systems, can significantly reduce power output. This research focuses on the design and development of an autonomous cleaning robot that utilizes an odometry method based on rotary encoders to achieve accurate navigation and movement control.

The robot is equipped with an ultrasonic sensor-based safety mechanism that functions as a smart braking system, preventing the robot from falling off when approaching the panel's edge. Its control system coordinates three main actuators: a brush motor, a water pump with a spray nozzle, and wheel drive motors. Rotary encoder data are used as the primary reference for distance and direction estimation, while ultrasonic sensors serve as complementary safety features in navigation.

Experimental testing demonstrated that the robot was able to execute the cleaning process according to the predetermined navigation scenario and effectively detect workspace boundaries. The developed system shows promising potential for application in floating solar panel maintenance, contributing to the preservation of panel performance and the extension of operational lifespan.

Keywords: Floating solar panels, cleaning robot, rotary encoder, odometry, ultrasonic sensor, actuator.