ABSTRACT

Solar energy is one of the most promising renewable energy sources in Indonesia due to the abundant availability of sunlight throughout the year. However, the efficiency of solar panels can decrease as a result of dust and dirt accumulation, making regular cleaning essential. Manual cleaning methods have several drawbacks, such as the risk of accidents, potential panel damage, and limited accessibility. This research designs and develops a prototype of a solar panel cleaning robot based on a line follower system, operated on a rooftop installation with a flat surface.

The system employs a TCRT5000 sensor for path navigation and an ultrasonic sensor to support efficient water usage, controlled by fuzzy logic that provides stable responses to path deviations. Test results show that the TCRT5000 sensor can accurately distinguish between light and dark surfaces, while calibration of the ultrasonic sensor improves measurement accuracy to above 98%.

The implementation of the robot resulted in an average increase of 6.23% in the solar panel output current after cleaning. This study demonstrates that a line follower-based solar panel cleaning robot can significantly improve panel performance and serve as an efficient automated maintenance solution.

Keywords: *solar energy, solar panel, energy efficiency, cleaning robot, line follower, fuzzy logic*