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DESIGN, FABRICATION AND EVALUATION OF A MOBILE ROBOT FOR GREENHOUSE SPRAYING

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ABSTRACT Chemical application of nutrients and pesticides is one of the most important and dangerous processes in agricultural production. By using robots, it is possible to reduce human exposure to pesticide application risk. The aim of this research was the automatic spraying of plants in greenhouses. Therefore, a three-wheel differential steering mobile robot was designed and built to act as a greenhouse sprayer. Power was transmitted from two DC motors to two driver wheels through a gearbox and shaft system. Six ultrasonic sensors were used to produce guidance signals for the robot. A proportional controller was developed and installed for controlling the left and right motors, which navigate the robot through the aisle ways using range information provided by ultrasonic sensors. After design and fabrication, performance of the robot was evaluated using the developed controller inside a real greenhouse with 98 cm aisle widths and concrete floors along a U-shaped path at three speeds. Also the spraying, central station, safety and obstacle detection units of the robot were evaluated. Tests results showed that the average of RMSE of the robot position were 4.93, 5.34 and 6.51 cm at speeds of 15, 25 and 35 cm/sec respectively. By increasing the speed, RMSE of the robot position increased. Also turning radius and turning space of the robot at the end of aisles increased by increasing the speed. The performance of central station, safety and obstacle detection units of the robot were acceptable. The accuracy of spraying unit in "spraying" was 99.47 % and in "not-spaying" was 99.92 % that are acceptable for greenhouse applications.

Keywords: Mobile robot, Ultrasonic sensor, Proportional control, Greenhouse, Spraying