

Development of a mobile seed-sowing robot for precision agriculture

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In traditional agriculture, when planting small seeds (e.g., carrot, onion), scattering seeds across mounded beds and removing seedlings that are too close together is the common practice. This practice is inefficient and leads to seed wastage, uneven crop growth and increased labour costs. In this work, a robot capable of sowing individual carrot seeds with typical dimensions <3 mm was developed. The width and the height of the robot can be adjusted to match the dimensions of the mounding bed using telescoping tubes in the chassis. The robot can place seeds in up to ten columns. The user can select the number of columns and the distance between the rows using push buttons. The height of the mounded bed is measured by an ultrasonic sensor and seed sowing stops when the mound bed can no longer be detected. The mobility system of the robot has a two-track layout. Each track has one drive wheel and three idler wheels. The tracks are driven by 12 V DC motors, and torsion springs are incorporated as suspension components to stabilize the robot. The robot utilizes differential steering and a joystick is used to apply course corrections. The seed handling mechanism has two pneumatic nozzles and a movable linear array of ten slots. Each nozzle is actuated by a servo motor and the suction force is generated by a diaphragm pump (HY-4000). The linear array is actuated by a stepper motor (NEMA 17). Once the nozzles pick up individual seeds from a seed container, the movable array aligns its slots with the nozzles enabling the seeds to be placed in the designated slots. The seeds placed in the slots move through flexible tubes and get placed on the mounded bed. Under laboratory conditions, the average seed dispensing time was measured to be approximately 5 s and the accuracy of the robot was measured to be within 2 cm when traversing rows. These results require further validation through field tests.

Keywords: *Automated seed sowing, Precision agriculture, Agricultural automation*