DESIGN AND PERFORMANCE TESTING OF A ROBOTIC COTTON HARVESTING END-EFFECTOR

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Abstract

Cotton is harvested mechanically once at the end of the growing season. Since there is just one harvest pass the plants are typically defoliated when about 60% of the cotton bolls are open. The early opened bolls expose their fiber to weather for weeks, degrading fiber quality. Furthermore, cotton harvesters compact the soil, in turn reducing hydraulic conductivity in the wheel tracks and thus reducing yield. Small robotic harvesting machines can potentially harvests multiple times during the growing season and pick the seed cotton soon after the boll opens, preserving fiber quality. Such small machines would be much less likely to compact the soil. In this research, a prototype robotic cotton harvester was designed and tested. A three-finger, moving pinned belt, underactuated end-effector was built and attached to a 3 degrees of freedom (DOF) manipulator. A vision sensor based on a ZED-2 stereo camera and the YOLOv4 artificial-intelligence based algorithm was used to detect cotton bolls. An NVIDIA Jetson TX2 GPU-based computer and an Arduino microcontroller controlled the robotic manipulator and end-effector. After initial picking of a particular boll, the vision sensor looked for remaining seed cotton in the boll, and if any remained the robot directed the end-effector to complete the picking of seed cotton at those locations.