Autonomous Robotic harvester Prototype (Garden-Bot)

Mechanics of Robotic Manipulators Graduate Research Project

Problem Statement & Goal:

- This report introduces a new type of robot prototype (Garden-Bot) that autonomously harvests red peppers in protected environments. The robotic manipulator that was chosen is a lightweight 6-DOF arm that will fit on a mobile platform. The kinematics of the robotic arm are presented using variables of the link lengths. (Garden-Bot proposes vision-based automation done through an RGB-D camera that is mounted on top of the end effector or the robotic arm. Garden-Bot acquires multiple images of the red pepper through this camera and uses it to build a complete 3D model through different techniques. To grasp and cut the red pepper, two actuators (suction cup & thermal cutter) combined into a decoupling mechanism are used. Garden-Bot starts by gathering data through its camera. Then a series of steps occur to process the data and convert it into more meaningful input. Once the input is processed, this one is used to guide the robotic arm to its target. Finally, grasping and cutting operations take place. The cost of building Garden-bot is predicted to go to about $28,900 and it is estimated to take about 5 months for a group of engineers to build it. A set of performance metrics are proposed in this paper to test the true performance of this prototype.

Concepts learned while working in this project:

- **rigid-body motions**, forward and inverse **kinematics**, differential kinematics**, forward and inverse dynamics of robotic manipulators**, **motion planning**, and **control** theories
- **Assign frames of reference** to mathematically describe the locations of individual joints and end-effectors of the robot.
- Understand the relationships between **kinematic design, configuration space, and workspace.**
- Describe the **dynamic motions of a robotic manipulator** and apply analytical and/or numerical methods to **solve the equations of motion**.
- **Apply linear control laws** for controlling a robotic manipulator with a single or multiple degrees of freedom.