Design of Robotic Arm for Automated Apple Peeling Machine

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Abstract:

Automation plays a vital role in increasing productivity and reducing human effort in an industry. Especially in food processing industries where hygiene is very important, robots are preferred in place of human involvement. The project aims to replace manual loading of an apple into apple peeling machine through a robotic arm. At present, manual loading of an apple into apple peeling machine takes around 6 seconds. This process is completely automated by inclusion of a robotic arm and a gripper to improve production efficiency.

Literature survey is carried out to understand bio-mechanical properties of an apple and to find maximum gripping force for an apple without damaging it. Based on the maximum gripping force, a novel gripper is designed through numerical calculations. The design is modelled and analysed for contact forces between the link and apple in ADAMS software. Kinematic synthesis is carried out using the co-ordinates of the apple peeling machine to arrive at link lengths of the robotic arm. Links are modelled in modelling software and joint forces, torque are obtained in ADAMS. Static and transient analysis of each link is carried out in ANSYS software using these joint forces.

A novel and cost effective end effector design for gripping irregular objects is achieved. Simulation results of the gripper shows that the maximum contact force between apple and link is 9 N which is below the penetration force of 12.74 N for "Golden Delicious" apple. Analysis result of each link shows that the developed stresses are well within the acceptable limit under static and dynamic conditions. The loading time of an apple into apple peeling machine is achieved in 4.5 seconds.

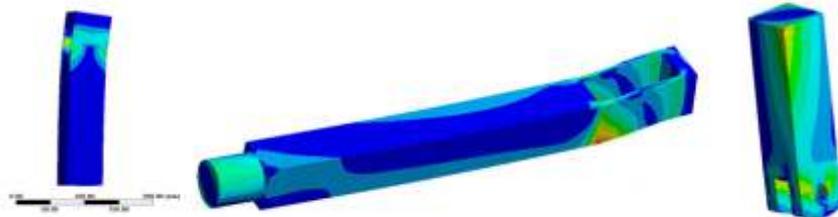**Experimental setup for vibration testing**

Path traced by robotic arm
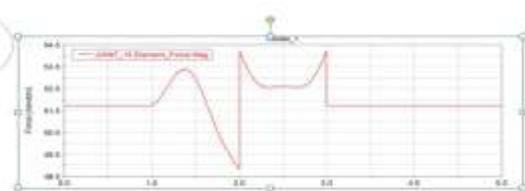
Variation in joint forces

Physical model of gripper

Analysis of individual links