Tactile Feedback system of a Robotic Gripper

Ileana Laguna and Dajah Massey

Abstract
Surgical robots would not be properly functional without the use of haptic and tactile feedback. The purpose of tactile feedback is to transmit the conditions and pressure the robot is conducting on any given object to the robotic gripper operator. This enables the robotic gripper operator to have a sense how firmly the gripper is holding an object.

Method
The procedure required to create and test actuators and sensors on a robotic gripper. Following a manual, we were able to assemble the robotic arm, then we connected it to the control system. The control system was then connected to the computer compatible with software named RIOS SSC-32, which allowed us to control the robot.

Next we attached the sensors that measure up to 25 pounds to the gripper of the robotic arm. We then rewired the sensor so that it can easily connect and reach the circuit and tested if it worked using a voltmeter.

The control system is the circuit board that transforms resistance of the sensors to voltage that would operate the valves of the pneumatic system.

The valves control the amount of air that goes through the tubes connected to the actuators. The valves turn on and off according to the voltage, which allows the actuators to inflate at different levels.

Results
In the end, the silicon balloon actuators glued on each other and inflated properly. Once connected to the air source the balloon actuators worked accurately. We controlled the robotic gripper’s sensors and managed to inflate the actuators in different measurements.

Introduction
Pneumatic balloon actuators provide a sense of tactile feedback to an operator through the help of sensors that transmit pressure. The operator manipulates the robotic gripper by inputting data into the computer that is connected to the control system of the gripper. In return the gripper’s attached sensors transmit back the amount of pressure that it’s implementing on the object. Therefore the more the robot gripper squeezes, the more the operator will feel the pressure and therefore the balloon actuators will inflate. This process is called the closed feedback process in which the operator feeds data into the computer and the robot responds to the instructions.

Objective
To construct and modify a robotic arm by attaching sensors to the gripper that corresponds to pneumatic balloon actuators on the test subject's fingertips. This provides the test subjects with haptic feedback.

Discussion
The activation of the entire system enabled the pneumatic balloon actuators to replicate the pressure felt by the robot gripper. The balloon actuators corresponded with the pressure and inflated according to it in three different levels.

Conclusion
Majority of the test subjects were able to distinguish the three different levels of the actuators from zero, one, and two being the highest. One of them however was not able to distinguish the different levels properly possibly because operators error in unstable pressure on the sensor. Also the test subject's lack of knowledge of the system.

Tactile feedback can be integrated to the robotic gripper therefore the operator can feel what the gripper is touching. This is beneficial because this can possibly prevent over grasping or under grasping of objects surrounding the robot.

Acknowledgements
Thanks to the UCLA CEED Office, Dr. Warren Grundfest, CASIT and our mentor Ji Son who patiently guided us through all aspects of this research.