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Multifunctional Gripper

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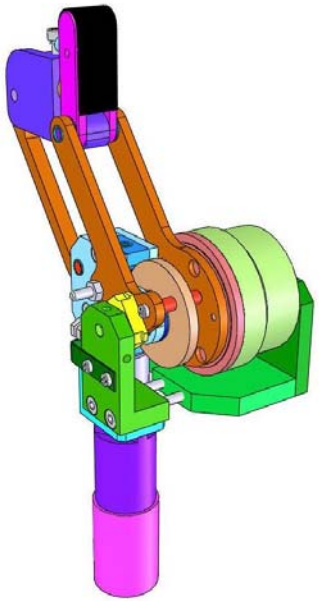

Figure 1: Finger of the Gripper

Introduction: The goal of our diploma thesis was to design a multifunctional gripper for robot applications. A gripper, or in other words, the hand of a robot is used to enable robots to interact with the environment. However, a multifunctional gripper is able to handle different kinds of work pieces of various shapes, dimensions, weights, etc. The advantage of using such a gripper is to substitute several dedicated grippers which are just employed for respective work pieces. This robot gripper was subdivided into two assemblies, namely the finger and the palm. **Finger:** During the period of planning the design of the finger, we decided to develop a gripper with three fingers. Each finger has two degrees of freedom, featuring two links which can move separately. With this flexibility the finger is able to perform various types of grasps whereas a parallel grasp (second links are moving parallel to each other) is the most common one. Nevertheless, it is also possible to perform also enveloping grasps as well as fingertip grasps. However, a robot nowadays delivers high performances what causes high accelerations up to 20 m/s^2 (2 g). The results of such high accelerations are the enormous forces and moments. Hence, the actuators of the gripper

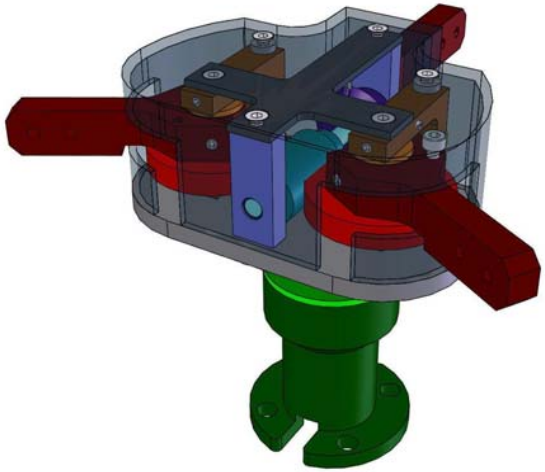

Figure 2: Palm of the Gripper

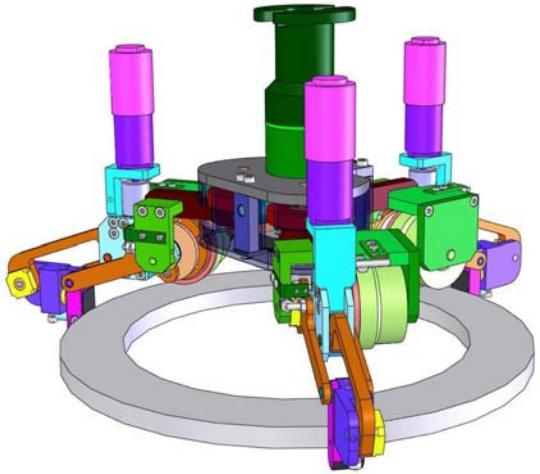

Figure 3: Multifunctional Gripper

must be able to resist to the big moments even if they are holding a work piece of a certain weight. However, with the aid of a worm gear and a strong motor, these fingers are able to guarantee a secure parallel grasp of a work piece of up to 2 kilograms. To control the whole system of the fingers, each one of them provides several different sensors as force and position sensors. Finally, also several micro switches are included which define the end stops of the links.

Palm: Besides the fingers, the functionalities of the palm are to increase the flexibility of the gripper as well as providing the junctions for the fingers and the robot. Basically, three “arms” are needed to attach the fingers onto the palm. One of them is fixed to the frame whereas the other two are able to perform a symmetrical rotation at an angle of 90° each. This pivoting mechanism increases the versatility of the whole gripper and has been made possible by a particular layout of different gear wheels. Additionally, this layout has got another useful mechanical property since it provides a self-locking mechanism. The advantage of that mechanism is, however, to relieve the DC motor of needing additional torque. To control the angle of the arms an incremental encoder is attached to the motor. Additionally, a micro switch is installed to define the end stop of the arms.

Multifunctional Gripper: Finally, combining the three fingers with the palm a versatile and dexterous gripper has been designed. Providing totally 7 degrees of freedom, the gripper is able to grasp a rich variety of different shapes of work pieces which can have a diameter of 4 up to 240 millimeters. The maximum load the gripper can hold is between 2 and 8 kilograms, depending on the robot accelerations. Adding up the weights of the fingers and the palm, the Multifunctional Gripper reaches a total weight of about 2 kilograms.