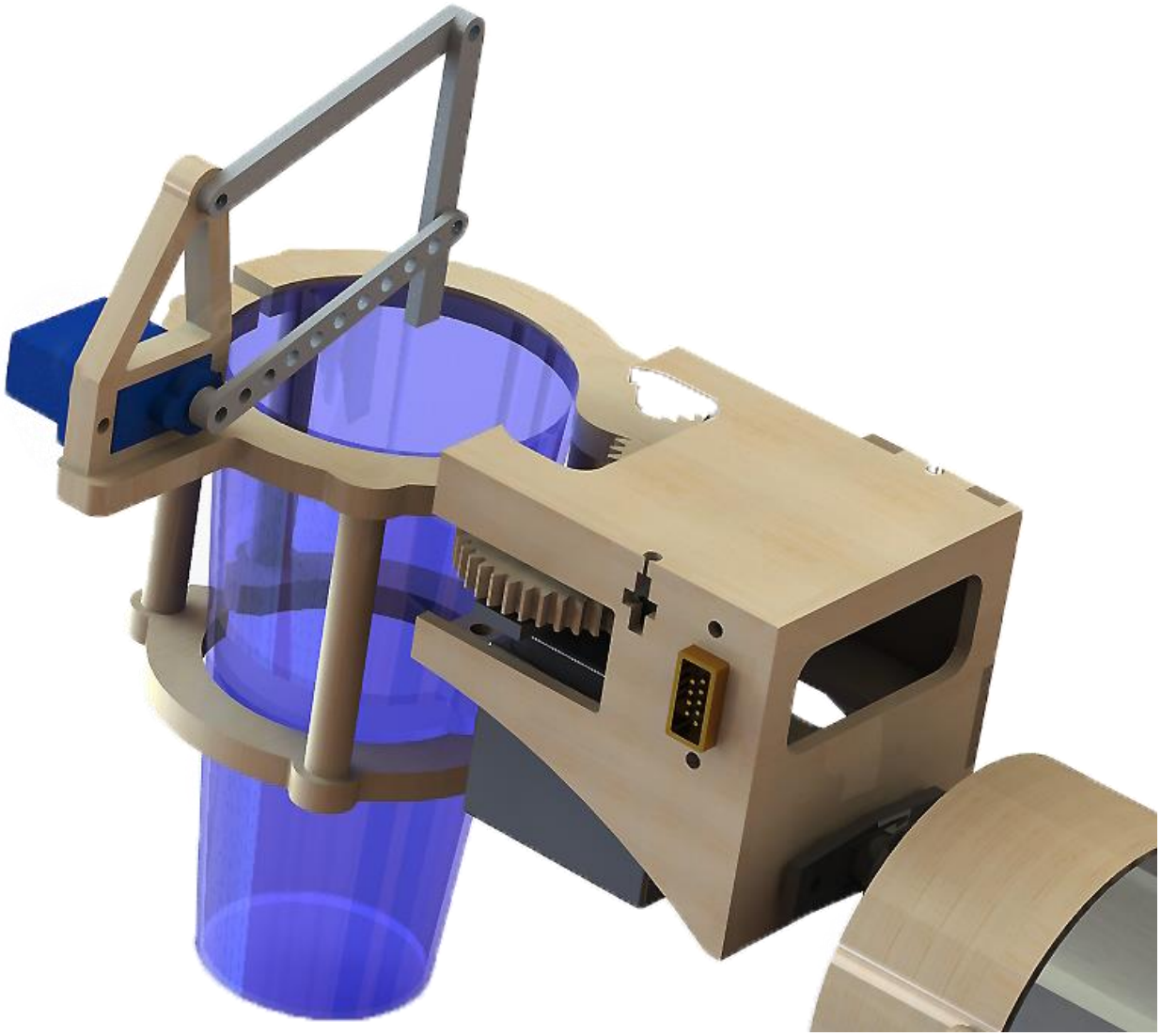


Middlesex University London

Mechatronics Project 1

Plastic cup handling project

Team Blink | PDE2440 Robotics and Mechatronics | 2016/2017

https://www.youtube.com/watch?v=QOW2QM0xkpE&feature=youtu.be

1 TASK DESCRIPTION

Design, build and test an end effector for the UR5 robot that will be used to grasp and pick up a transparent plastic cup filled with water and empty this water into another glass.

- The end effector is not permitted to spill the water or break the feeble cup.
- The end effector must have the ability to detect the presence of water in the transparent plastic cup.
- The rig must work reliably before it is attached to the UR5 arm.
- The system must indicate the presence of water using red and green LEDs, (water not detected, water detected respectively).
- The end effector must be implemented using LabVIEW and NI ELVIS or myRIO.
- The end effector must have at least one (appropriate) component 3D printed.

1.1 SURVEY OF A SOLUTION IN RELATION TO THIS PROJECT

1.1.1 Gripper Design

There are several end effector designs, used in the industry to firmly grasp cups and similar objects alike. Most of these designs use actuators powered by compressed gases, hydraulics, and electricity as these are readily available in the industry.

In this project, we have decided to use electricity as our power source, as this is readily available and easy to implement. This section would briefly survey effectors that grip externally and are viable for use with electric actuators. These actuators have been limited to servos and motors.

Most of our inspiration came from VEX's robotics gripper. Its comes standard with the VEX's Clawbot Mobile Robot/Gripper Kit. VEX's robotics gripper has parallel jaws that grip objects externally, and both jaws are driven by a servo attached to one the jaws. It is a well-designed gripper as it even has sprung jaws to prevent back drive of the motor.

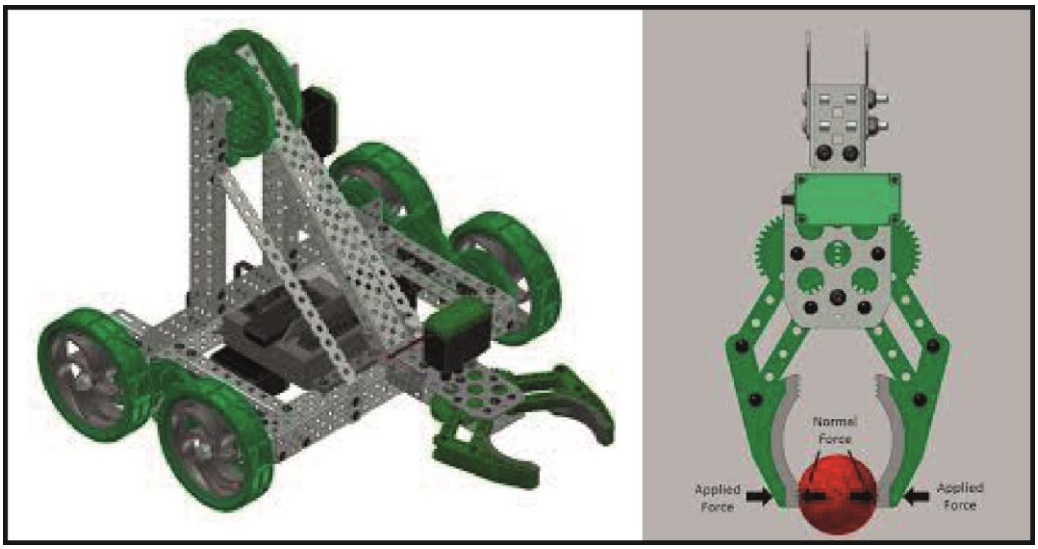


Figure 1

This formed the basis of our design, but a few modifications had to be made. VEX's grippers were designed to grip objects of varying shapes and sizes. However, this was not required as the object in this project is a particular cup with known dimensions. Also, the use of parallel jaws made VEX's grippers slightly heavy. This was a potential problem because we required a second degree of freedom to empty the cup, therefore having a light front weight was mandatory.

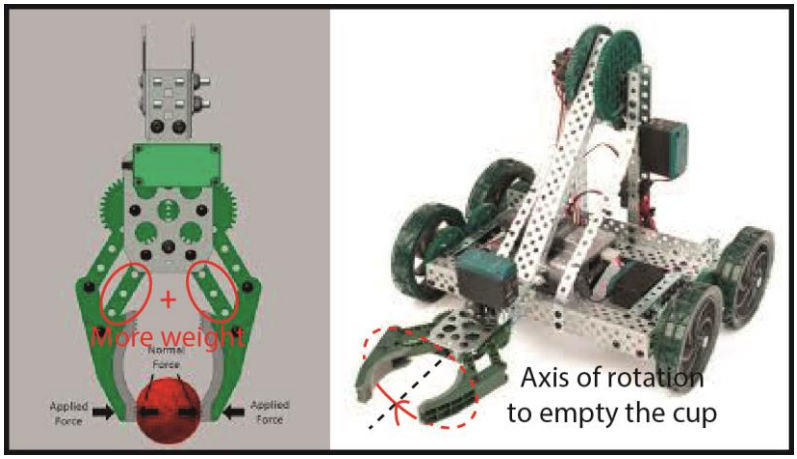


Figure 2

We decided to trade the parallel jaws for radial ones. The radial jaw design is used mainly in the robotics industry. Radial jaws are very easy to implement and are often lighter than parallel jaws as there are fewer parts. Unlike parallel jaws, radial jaws have to be carefully modelled to avoid the object grabbing area when the jaws are opened or closed.

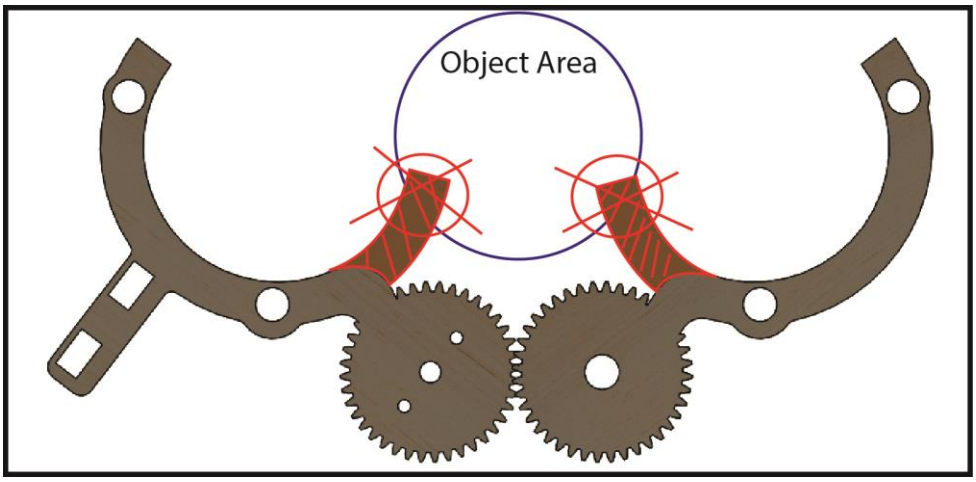


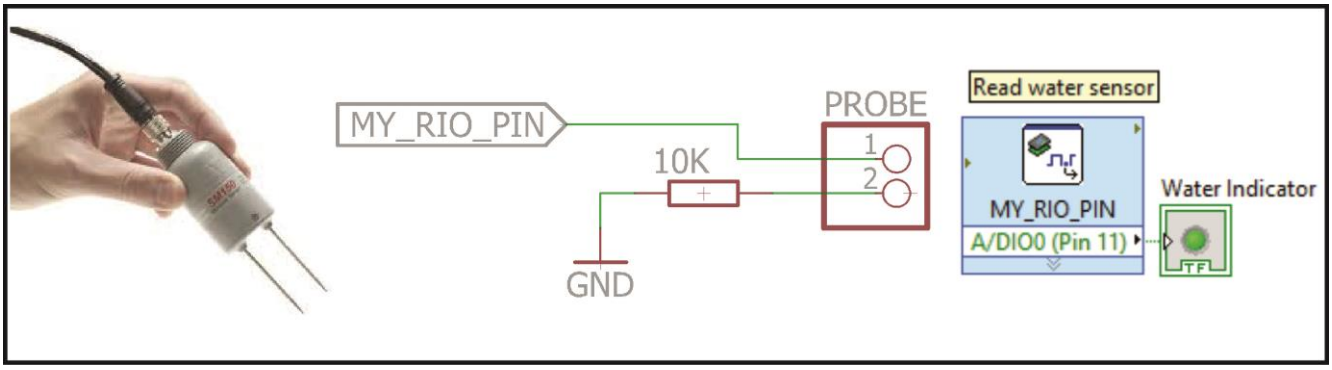
Figure 3

We also decided not to implement the sprung back drive prevention system as in VEX's gripper because our servo would directly control the position of the Jaws and would be steady enough to hold the cup even on power down.

1.1.2 Water Sensor

Water sensors are used all over the technical, medical and plumbing industry. Due to water's unique properties such as its density and conductivity, there are various methods of detecting its presence. Among these the most commonly found in the industry are mainly derivatives of contact sensors (such as water probes, and mechanical/electrical float switches), and or contactless sensors such as ultrasonic range finders, and thermal scanners.

In this project, we decided to use the least ambiguous of the many solutions available for detecting the presence of water (water probes). Water probes are very easy to implement and interface with NI myRIO. They would work reliably in this project.



1.2 PROJECT EVOLUTION

1.2.1 Nov 2016

- We met to set our objectives, to ensure that the all the requirements are met.

1.2.2 11 Nov 2016

- Designed CAD model of the plastic cup in Solidworks.

1.2.3 13 Nov 2016

- Designed the wireframe sketch of the overall design.
- Decided the optimum position for the water sensor.

1.2.4 14 Nov 2016

- Design the overall project schematics and program flow.
- Tested the water probes.

1.2.5 21 Nov 2016

- Designed CAD model of Servos in Solidworks.
- Planned the overall gripper design, considering both aesthetics, and functionality.

1.2.6 21 Dec 2016

- Redesigned the parallel arms for the water probes.
- Designed the external connectors (Used D-type plugs).
- Soldered and assembled power regulation board.

1.2.7 22 Dec 2016

- Redesigned the haul for the jaws.
- Redesigned the body roll attachment points.

1.2.8 23 Jan 2017

- Finished the main program
- Test the gripper with the UR5

1.2.9 03 Feb 2017

- Live Demo.
- Project End.